





# HPLC Columns for Bio LC

## Contents

• YMC-Pack ODS-A .....	164-167
• YMC-Pack ODS-AQ.....	164-167
• YMC-Pack C8 (Octyl) .....	164-167
• YMC-Pack C4 (Butyl) .....	164-167
• YMCbasic .....	164-167
• YMC-Pack Protein-RP .....	168-169
• YMC-Pack Diol .....	170-171
• YMC-Pack Polyamine II .....	172-173
 • YMC-BioPro QA / SP .....	174-175
 • YMC-BioPro QA-F / SP-F .....	176-177
• Ordering Information .....	178-185
• Glass Columns ECO series.....	186-187
• Ordering Information .....	188-191
• Glass Columns ECO <sup>PLUS</sup> series .....	192-193
• Ordering Information .....	194-197

## Introduction

### HPLC Columns for Biochromatography

The application of HPLC to biological separations is an exciting and rapidly growing field. It is only in the last 10-15 years, with the development of high purity silica and methods to eliminate active silanol residues, that reversed phase HPLC has been accepted as applicable to the separation of peptides and proteins, nucleic acids and related compounds, both analytically and on a preparative scale. Previously denaturation of the biomolecule and/or low recoveries had prevented work in this field. The columns used are related to standard HPLC columns, but either have wider pore diameters to cater for the larger molecules or specific chemistries to allow eluents specific to biomolecular chemistry, such as TFA, to be used.

# Bioseparation Columns



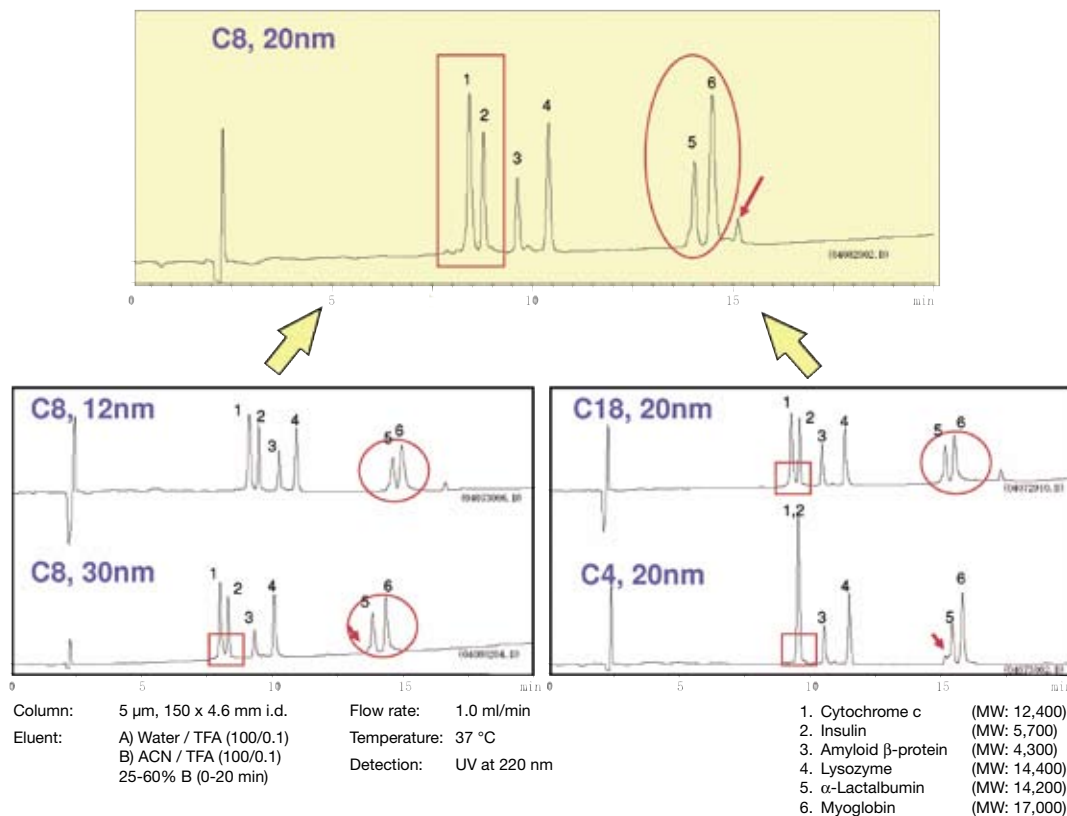
- **YMC-Pack ODS-A: C18 with wide pore size for separation of peptides and proteins**
- **YMC-Pack ODS-AQ: "hydrophilic" C18**
- **C8 with wide pore size for separation of relatively highly hydrophobic compounds**
- **C4 with wide pore size for different selectivity from C18**



	ODS-A	ODS-AQ	C8	YMCbasic	C4
Particle size / $\mu\text{m}$	3; 5	3; 5	3; 5	3; 5	3; 5
Pore size / nm	12; 20; 30	12; 20	12; 20; 30	proprietary	12; 20; 30
Surface area / $\text{m}^2\text{g}^{-1}$	330; 175; 100	330; 175	330; 175; 100	proprietary	330; 175; 100
Carbon content / %	17; 12; 7	14; 10	10; 7; 4	7	7; 5; 3
pH range	2.0 - 7.5	2.0 - 7.5	2.0 - 7.5	2.0 - 7.0	2.0 - 7.5

## Separation of peptides and proteins on columns with different pore sizes and functional groups\*

For peptides and proteins with molecular weight of 4,300 to 17,000, separation characteristics are compared using columns with different pore size and functional group. In accordance with the table above, the suitable column is C8, 20 nm for groups of compounds with a molecular weight within this range. If either pore size or functional group of the packing material is not optimised, peak broadening and poor resolution are observed. By using the most suitable column (C8, 20 nm) for the target compound, sharp peak shapes and outstanding separation are achieved.

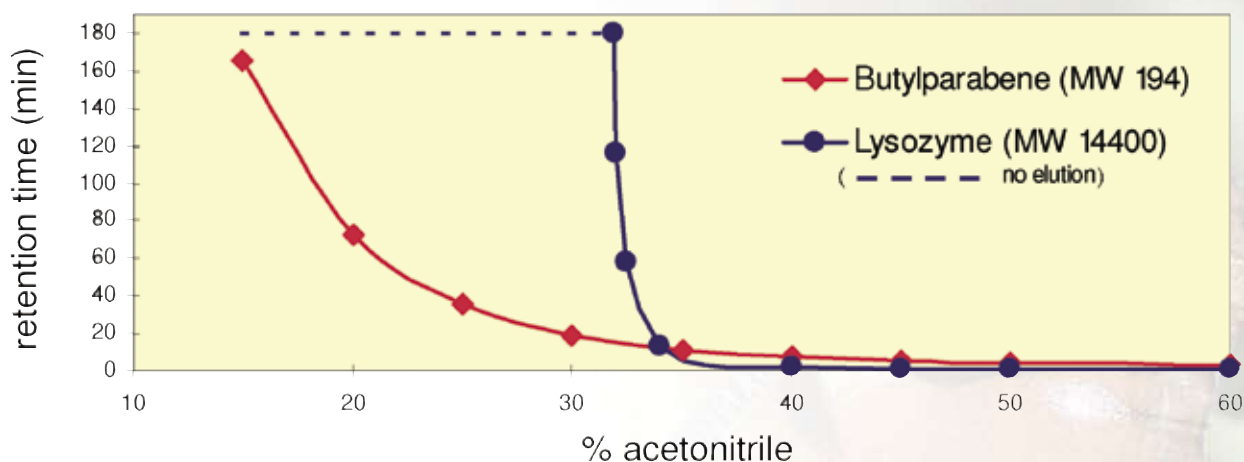


# Bioseparation Columns

## How to select a reversed-phase column for bioseparation\*

By monitoring the dependency between the retention time of analytes and the percentage of organic solvent being used, an interesting different behaviour between small organic molecules and proteins is revealed.

Small organic molecules like butylparabene are retained/eluted by a distribution mechanism as shown in the linear relationship between retention time and percentage of organic modifier. This is in sharp contrast to the retention behaviour of peptides and proteins, e.g. lysozyme. These are retained/eluted by an adsorption-desorption (on-off) mechanism and as a result the pore size has to be carefully considered.



## Column Selection Tool\*

MW		C18	C8	C4
	12 nm	⊙	○	△
	20 nm	○	⊙	○
	30 nm	△	○	⊙

⊙ : excellent, ○ : good, △ : moderate

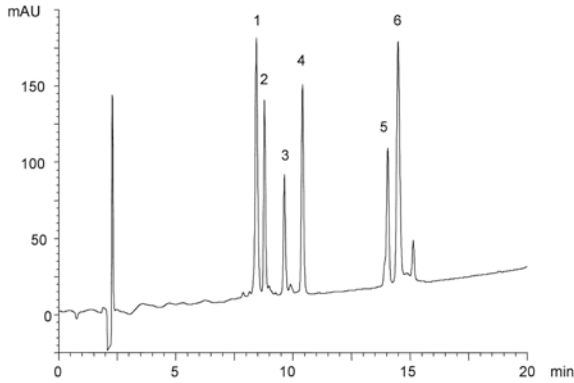
As shown in the table (left), the C18 column with 12 nm pore size is suitable for small peptides up to a MW 5000. The best efficiency for large peptides or small proteins can be obtained by employing a C8 phase characterised by a 20 nm pore size. Furthermore, most of the proteins are eluted effectively by a C4 column with 30 nm.

Whilst, the separation may be influenced also by the hydrophobicity of the peptide/protein and the nature of the column's bonded phase. Therefore, for initial method development, it might be useful, in the first instance, to follow the arrow shown in the table for method optimisation.

# Bioseparation Columns

## Peptides and Proteins

- |                                       |           |
|---------------------------------------|-----------|
| 1. Cytochrome c (Horse heart)         | MW 12,400 |
| 2. Insulin (Bovine pancreas)          | MW 5,733  |
| 3. Amyloid $\beta$ -protein (1-40)    | MW 4,330  |
| 4. Lysozyme (Chicken egg white)       | MW 14,300 |
| 5. $\alpha$ -Lactalbumin (Human milk) | MW 14,100 |
| 6. Myoglobin (Horse skeletal muscle)  | MW 17,000 |

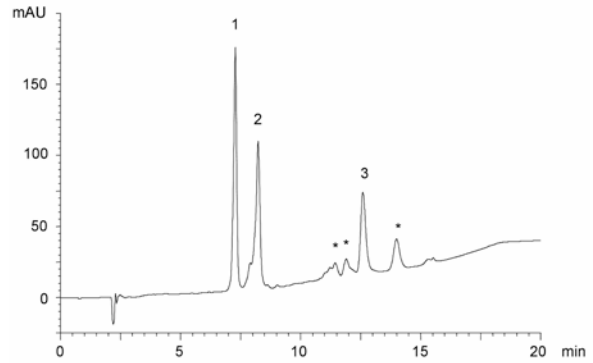


Column: YMC-Pack C8 (5  $\mu$ m, 20 nm) 150 x 4.6 mm i.d.  
 Eluent: A) water / TFA (100/0.1)  
 B) acetonitrile / TFA (100/0.1)  
 25-60% B (0-20 min)  
 Flow rate: 1.0 ml/min  
 Temperature: 37  $^{\circ}$ C  
 Detection: UV at 220 nm  
 Injection: 10  $\mu$ l (0.1 ~ 0.2 mg/ml)

## Proteins

- |                                   |           |
|-----------------------------------|-----------|
| 1. BSA                            | MW 66,000 |
| 2. Conalbumin (Chicken egg white) | MW 77,000 |
| 3. Lipoxidase (Soybean)           | MW 96,000 |

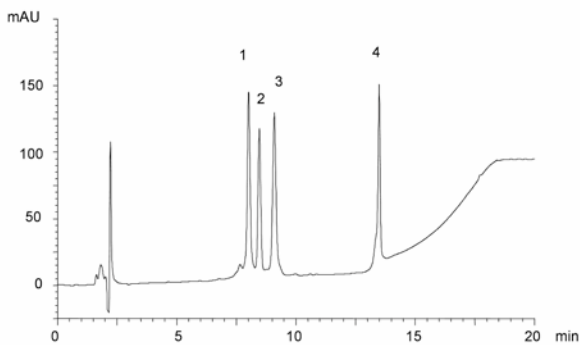
\* Impurities in commercial lipoxidase



Column: YMC-Pack C4 (5  $\mu$ m, 30 nm) 150 x 4.6 mm i.d.  
 Eluent: A) water / TFA (100/0.1)  
 B) acetonitrile / 2-propanol / TFA (50/50/0.1)  
 30-75% B (0-15 min), 75% B (15-20 min)  
 Flow rate: 1.0 ml/min  
 Temperature: 37  $^{\circ}$ C  
 Detection: UV at 220 nm  
 Injection: 10  $\mu$ l (0.25 ~ 1.0 mg/ml)

## Proteins

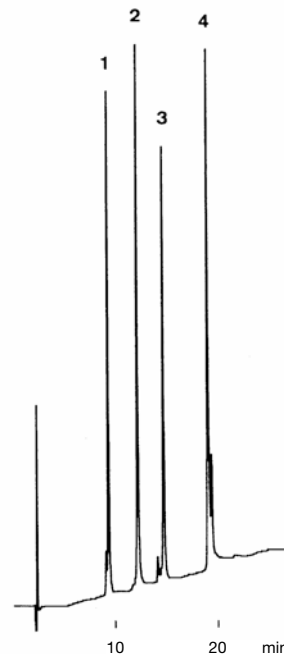
- |   |           |
|---|-----------|
| 1. $\beta$ -Lactoglobulin B (Bovine milk)         | MW 18,300 |
| 2. $\beta$ -Lactoglobulin A (Bovine milk)         | MW 18,400 |
| 3. $\alpha$ -Chymotrypsinogen A (Bovine pancreas) | MW 18,300 |
| 4. Ovalbumin                                      | MW 45,000 |



Column: YMC-Pack C4 (5  $\mu$ m, 30 nm) 150 x 4.6 mm i.d.  
 Eluent: A) water / TFA (100/0.1)  
 B) acetonitrile / TFA (100/0.1)  
 40-50% B (0-10 min), 50-90% B (10-15 min), 90% B (15-20 min)  
 Flow rate: 1.0 ml/min  
 Temperature: 37  $^{\circ}$ C  
 Detection: UV at 220 nm  
 Injection: 10  $\mu$ l (0.2 ~ 0.3 mg/ml)

## Proteins

- |                   |
|-------------------|
| 1. Ribonuclease A |
| 2. Cytochrome c   |
| 3. Lysozyme       |
| 4. Myoglobin      |

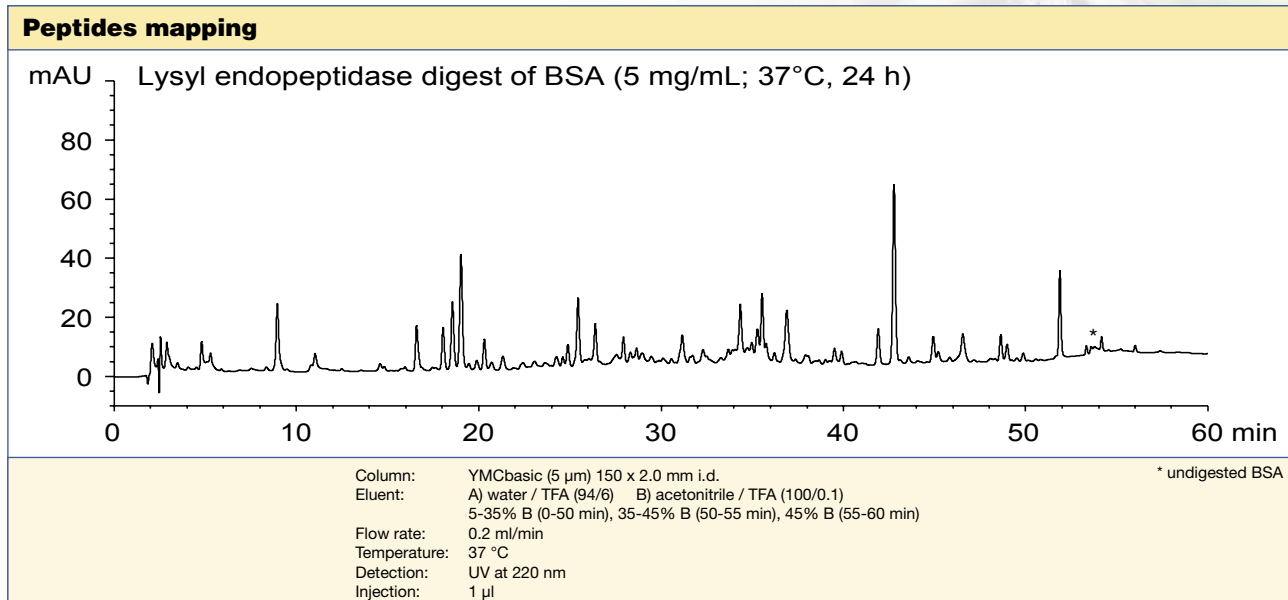
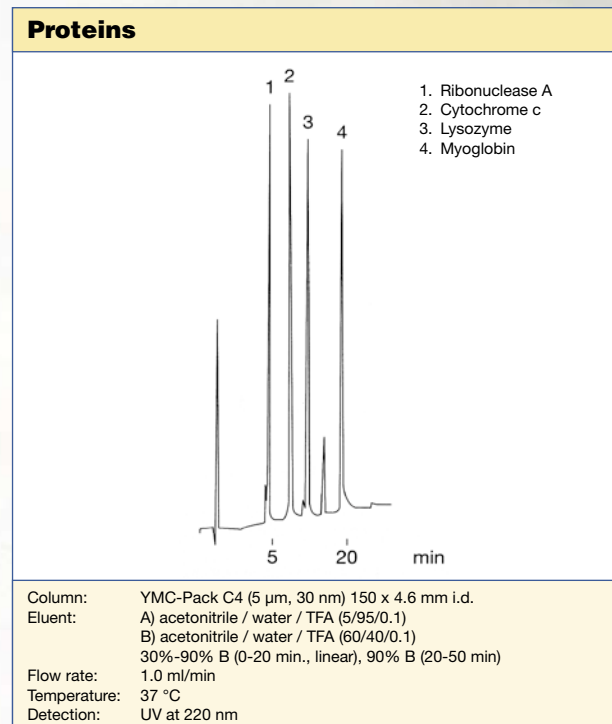
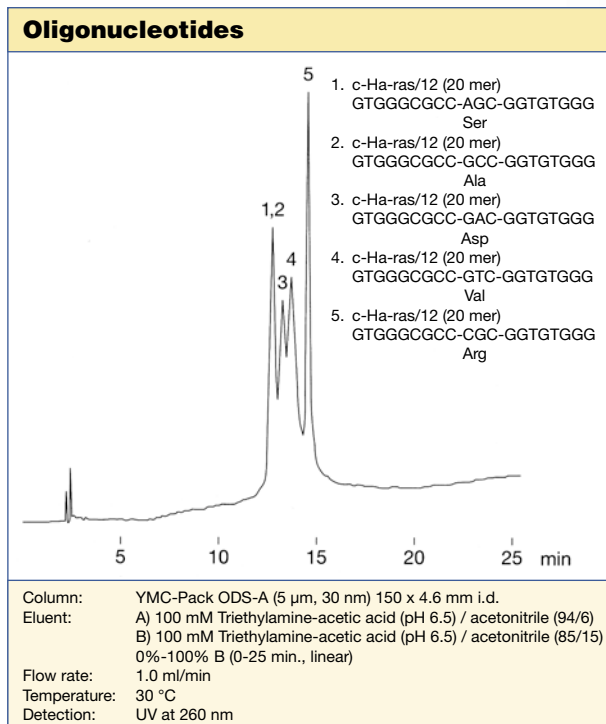


Column: YMC-Pack ODS-A (5  $\mu$ m, 30 nm) 150 x 4.6 mm i.d.  
 Eluent: A) acetonitrile / water / TFA (5/95/0.1)  
 B) acetonitrile / water / TFA (60/40/0.1)  
 30-90% B (0-20 min, linear), 90% B (20-25 min)  
 Flow rate: 1.0 ml/min  
 Temperature: 37  $^{\circ}$ C  
 Detection: UV at 220 nm, 0.32 AUFS  
 Injection: 16  $\mu$ l (0.16 ~ 0.33 mg/ml)

# Bioseparation Columns

## Applications

YMC's wide-pore columns are reversed phase columns available with 20 nm or 30 nm pore size. A choice of bonded phase chemistries from C18, C8, and C4 are also available, enabling the analyst to choose the most appropriate pore size and stationary phase.



## Column care

YMC Bioseparation columns are stable towards hydrolysis between pH 2.0 - 7.5. Remove acids and buffer salts before storage. Clogged inlet frits often can be cleaned by changing the flow direction.

When biopolymers, including proteins and sugars, adsorb to the column, it is usually difficult to wash out the macromolecules with organic solvents. When a sample containing macromolecules is analysed, it is preferable to conduct pre-treatment and/or use a guard column. For detailed information please refer to the "Column Care and Use Instructions", which are shipped with each analytical column.

# YMC-Pack Protein-RP



- wide pore, short alkyl chain for RP separation of peptides and proteins
- excellent selectivity and recovery for proteins or peptides
- improved durability in acidic buffers containing TFA



YMC-Pack Protein-RP	Specification
Particle size / $\mu\text{m}$	5
Pore size / nm	proprietary
Carbon content / %	4
Recommended pH range	1.5 - 7.5

## General

YMC-Pack Protein-RP is a wide pore, butyl reversed-phase column specifically designed for the separation of high molecular proteins and peptides. YMC-Pack Protein-RP is designed to overcome the major limitations of short chain reversed phase columns used for biomolecular analysis.

## Properties

### High Mass Recovery

The high purity of the silica support and the complete bonding coverage of the Protein-RP phase results in very high sample recoveries. This is an important consideration when choosing a column for biochemical analysis. Typical recoveries for common peptides and proteins are listed in the table.

### High Chemical Stability

YMC-Pack Protein-RP has been designed to overcome one major limitation of short chain reversed phase columns used for bio-molecular analysis.

In such columns aqueous acidic eluents, such as 0.1% TFA, often lead to a loss of retention and resolution. YMC-Pack Protein-RP utilises a proprietary bonding and endcapping process to produce a phase which is resistant to typical eluents used for the analysis of proteins and peptides.

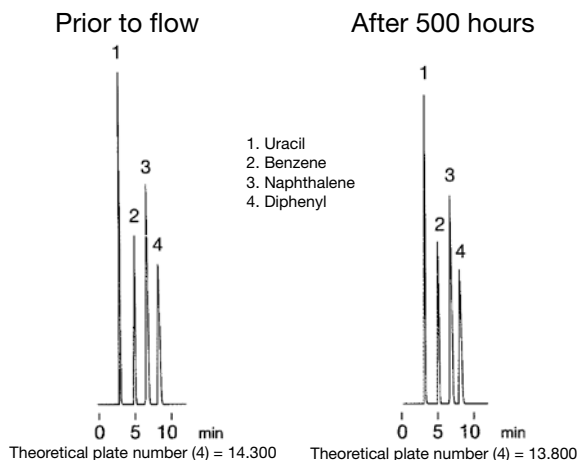
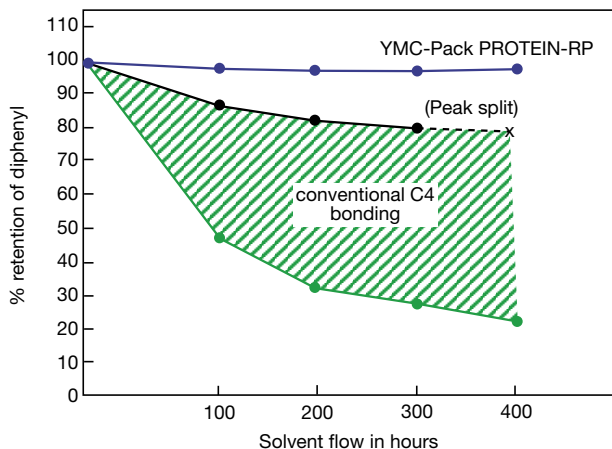
The graph on the next page illustrates the superior durability of YMC-Pack Protein-RP. There is no loss in retention over the course of 500 hours of continuous elution 0.1% TFA. In contrast, the retention of diphenyl on C4 columns from other manufacturers is seen to decrease with time. This is caused by acidic hydrolysis of butyl groups from the silica support.

Sample	Recovery (%)			
	YMC-Pack Protein-RP	conventional C4		
Ribonuclease A	93	95	—	86
Cytochrome c	94	89	—	95
Lysozyme	98	93	—	76
Myoglobin	97	85	—	93
BSA	94	92	—	86
Ovalbumin	90	73	—	88
Transferrin	94	98	—	88
Insulin (bovine)	97	73	—	92
Insulin B chain	82	76	—	70
$\alpha$ -Mating factor	93	82	—	81
Leu-Enkephalin	92	84	—	91
Gly-Gly-Gly-Gly	95	86	—	70



# YMC-Pack Protein-RP

## Improved durability when used with TFA solution



**Flow conditions**  
 Eluent: water / TFA (100/0.1)  
 Flow rate: 1.0 ml/min  
 Temperature: ambient

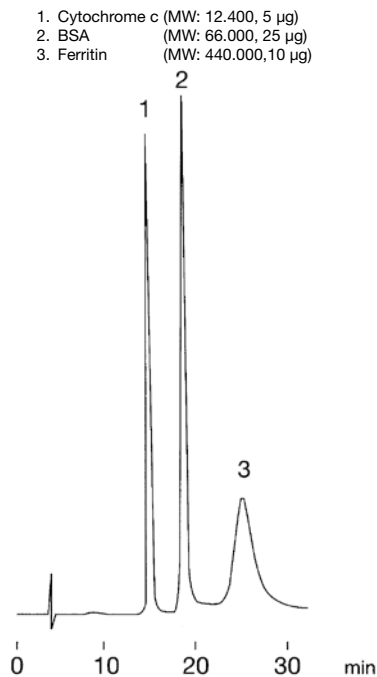
**Measurement conditions**  
 Column: YMC-Pack Protein-RP (5 µm) 250 x 4.6 mm i.d.  
 Eluent: acetonitrile / water (40/60)  
 Flow rate: 1.0 ml/min  
 Temperature: 30° C  
 Detection: UV at 254 nm, 0.32 AUFS

Source: Courtesy of YMC Co., Ltd.

## Applications

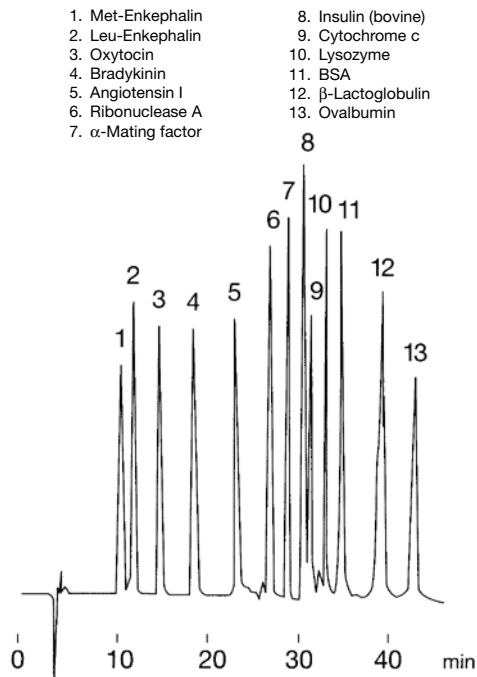
The selectivity of YMC-Pack Protein-RP is different from that seen with conventional wide pore butyl phases and it is specifically suited for the protein analysis. In the applications below it effectively separates both low molecular weight compounds and high molecular weight proteins, with equally good peak shapes being obtained.

### Proteins



Column: YMC-Pack Protein-RP (5 µm) 250 x 4.6 mm i.d.  
 Eluent: A) water / TFA (100/0.1)  
 B) acetonitrile / TFA (100/0.1)  
 30%-90% B (0-45 min., linear)  
 Flow rate: 1.0 ml/min  
 Temperature: ambient  
 Detection: UV at 280 nm, 0.04 AUFS

### Proteins and peptides



Column: YMC-Pack Protein-RP (5 µm) 250 x 4.6 mm i.d.  
 Eluent: A) water / TFA (100/0.1)  
 B) acetonitrile / TFA (100/0.1)  
 10%-90% B (0-60 min., linear)  
 Flow rate: 1.0 ml/min  
 Temperature: ambient  
 Detection: UV at 220 nm, 0.32 AUFS

# YMC-Pack Diol



- utilises silica gel base with high pressure resistance
- for molecular weight determination of proteins, peptides and sugars
- minimal secondary interaction
- low-cost gel filtration column
- high mechanical stability

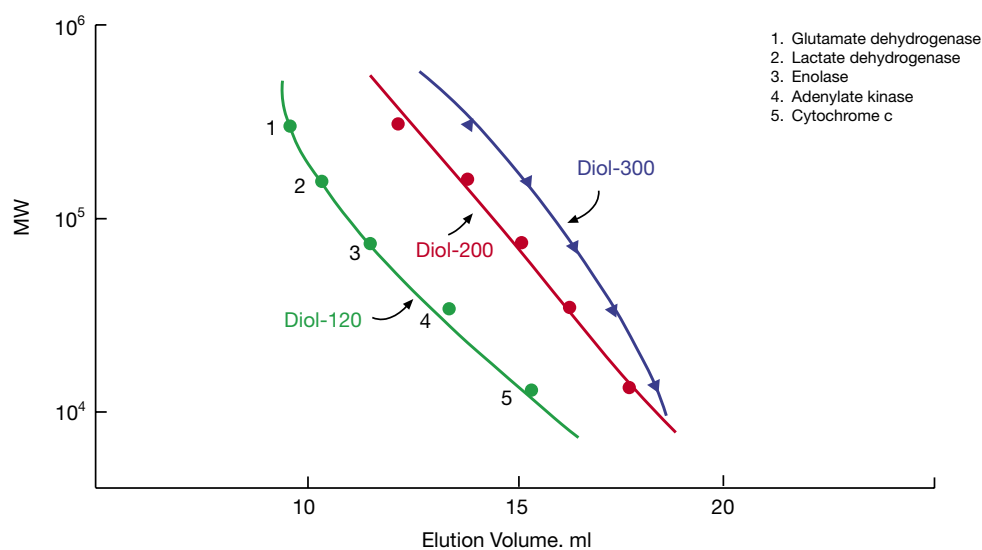


YMC-Pack Diol	Specification			
Pore size / nm	6	12	20	30
Particle size / $\mu\text{m}$	5	5	5	5
Surface area / $\text{m}^2\text{g}^{-1}$	650	330	175	100
Recommended pH range	5.0 - 7.5	5.0 - 7.5	5.0 - 7.5	5.0 - 7.5

## General

The silica based YMC-Pack Diol is a rugged and efficient size exclusion material (GPC). It is generally used for the separation of biomolecules and pharmaceuticals. As the non-specific adsorption sites have been eliminated it exhibits better performance characteristics for size separations than underivatized silica. YMC-Pack Diol is available in four porosities: 6, 12, 20 and 30 nm. Diol-6 is most suitable for the separation of peptides or oligosaccharides with molecular weights of 10,000 or less, whereas Diol-12, -20 and -30 (either used individually or in combination) are suitable for separations of proteins and other water-soluble compounds with molecular weights of 10,000 to several hundred thousands.

### Proteins and peptides\*

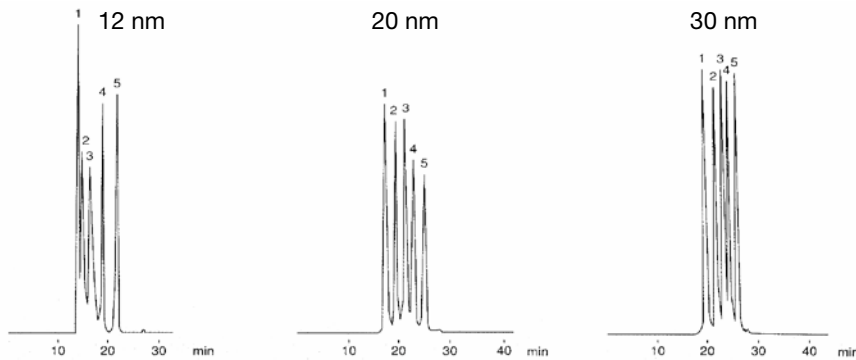


Column: YMC-Pack Diol, 500 x 8.0 mm i.d.  
 Eluent: 0.1M  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 7.0) containing 0.2M NaCl  
 Flow rate: 0.7 ml/min  
 Temperature: ambient  
 Detection: UV at 280 nm



# YMC-Pack Diol

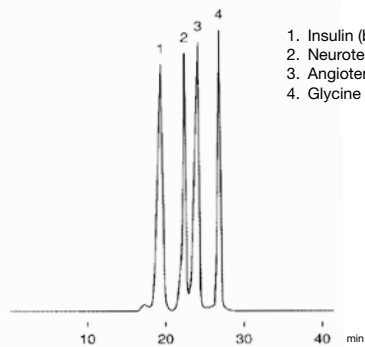
## For separation of proteins with molecular weights from 10,000 to several hundred thousands\*



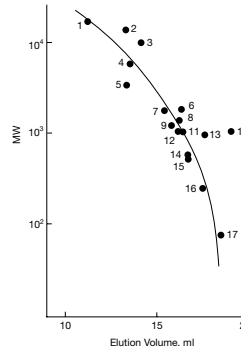
1. Glutamate dehydrogenase (MW: 290,000)
2. Lactate dehydrogenase (MW: 142,000)
3. Enolase (MW: 67,000)
4. Adenylate kinase (MW: 32,000)
5. Cytochrome c (MW: 12,400)

Column: YMC-Pack Diol, 500 x 8.0 mm i.d.  
 Eluent: 0.1 M  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 7) containing 0.2 M NaCl  
 Flow rate: 0.7 ml/min  
 Temperature: ambient  
 Detection: UV at 280 nm

## For separation of peptides with molecular weights of 10,000 or less\*



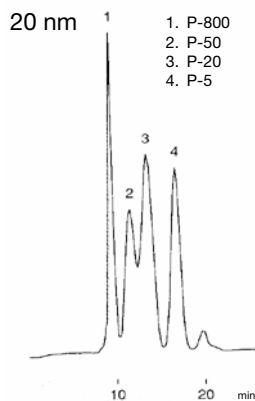
1. Insulin (bovine)
2. Neurotensin
3. Angiotensin-II
4. Glycine



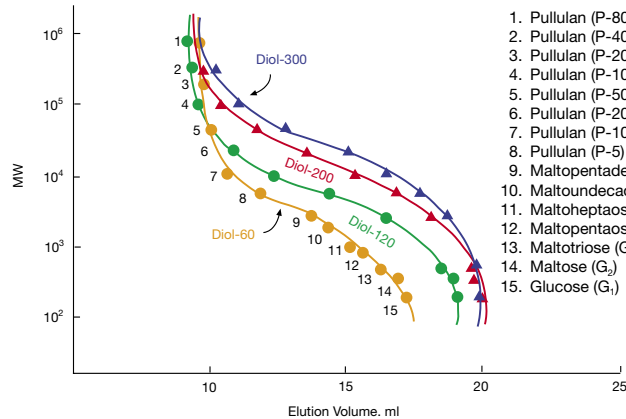
1. Myoglobin (MW: 17,000)
2. Ribonuclease A (MW: 13,700)
3. Cytochrome c (MW: 12,400)
4. Insulin (bovine) (MW: 5,700)
5. Insulin B chain (MW: 3,496)
6.  $\alpha$ -Mating factor (MW: 1,684)
7. Neurotensin (MW: 1,672)
8. Angiotensin-I (MW: 1,296)
9. CCK-octapeptide (MW: 1,143)
10. Bradykinin (MW: 1,060)
11. Angiotensin-II (MW: 1,040)
12. Oxytocin (MW: 1,007)
13. Angiotensin-III (MW: 931)
14. Met-enkephalin (MW: 573)
15. Leu-enkephalin (MW: 555)
16. Tetraglycine (MW: 246)
17. Glycine (MW: 75)

Column: YMC-Pack Diol (6 nm) 500 x 8.0 mm i.d.  
 Eluent: 0.1 M  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 7) containing 0.2 M NaCl / acetonitrile (70/30)  
 Flow rate: 0.7 ml/min  
 Temperature: ambient  
 Detection: UV at 215 nm

## For molecular weight determination of carbohydrates\*



1. P-800 (MW: 853,000)
2. P-50 (MW: 48,000)
3. P-20 (MW: 23,700)
4. P-5 (MW: 5,800)



1. Pullulan (P-800) (MW: 853,000)
2. Pullulan (P-400) (MW: 380,000)
3. Pullulan (P-200) (MW: 186,000)
4. Pullulan (P-100) (MW: 100,000)
5. Pullulan (P-50) (MW: 48,000)
6. Pullulan (P-20) (MW: 23,700)
7. Pullulan (P-10) (MW: 12,200)
8. Pullulan (P-5) (MW: 5,800)
9. Maltopentadecaose ( $G_{15}$ ) (MW: 2,448)
10. Maltoundecaose ( $G_{11}$ ) (MW: 1,800)
11. Maltoheptaose ( $G_7$ ) (MW: 1,152)
12. Maltopentaose ( $G_5$ ) (MW: 852)
13. Maltotriose ( $G_3$ ) (MW: 504)
14. Maltose ( $G_2$ ) (MW: 342)
15. Glucose ( $G_1$ ) (MW: 180)

Column: YMC-Pack Diol (20 nm) 500 x 8.0 mm i.d.  
 Eluent: water  
 Flow rate: 1.0 ml/min  
 Temperature: ambient  
 Detection: RI

\* Source: Courtesy of YMC Co., Ltd.

# YMC-Pack Polyamine II



- amino phase with polymeric surface
- exclusively 2° and 3° amino groups
- stable towards hydrolysis and oxidation
- high recovery
- excellent life-time
- saccharides and derivatives
- nucleotides
- tocopherols
- for normal or reversed phase separations



YMC-Pack Polyamine II	Specification
Pore size / nm	12
Particle size / $\mu\text{m}$	5
Surface area / $\text{m}^2\text{g}^{-1}$	n/a
Carbon content / %	n/a
Recommended pH range	2.0 - 9.0

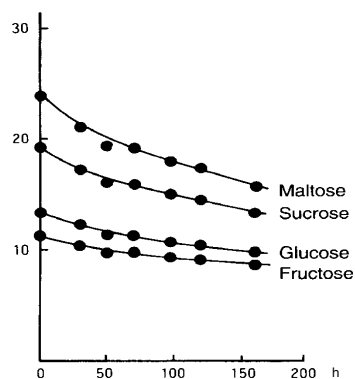
## General

The chromatographic separation and the reliable quantitation of carbohydrates is extremely important in many areas of biomolecular science. For these particular applications, YMC provides YMC-Pack Polyamine II, a polymeric amino phase.

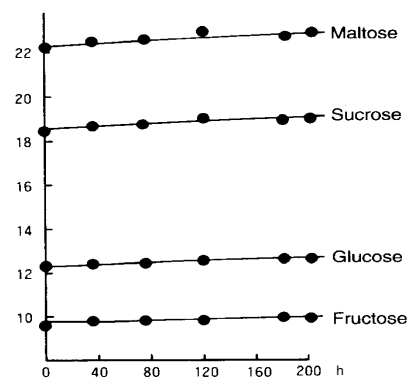
## Properties

YMC-Pack Polyamine II is based on ultrapure YMC silica as a support material. The functionality of the stationary phase is achieved by a covalently bonded polymer layer containing secondary (2°) and tertiary (3°) amino groups. The 2° and 3° amino groups of YMC-Pack Polyamine II are only weakly nucleophilic, exhibiting a significantly reduced reactivity towards carbonyl compounds. Therefore, unlike conventional amino phases with primary n-propylamino ligands, YMC-Pack Polyamine II does not form Schiff' bases or other stable condensation products. In addition, the 2° and 3° amino groups of the polymer layer are to a large extent resistant to oxidation and hydrolysis (as shown in the figure below).

### Stability of amino type packings



a) conventional amino phase



b) YMC-Pack Polyamine II

Source: Courtesy of YMC Co., Ltd.

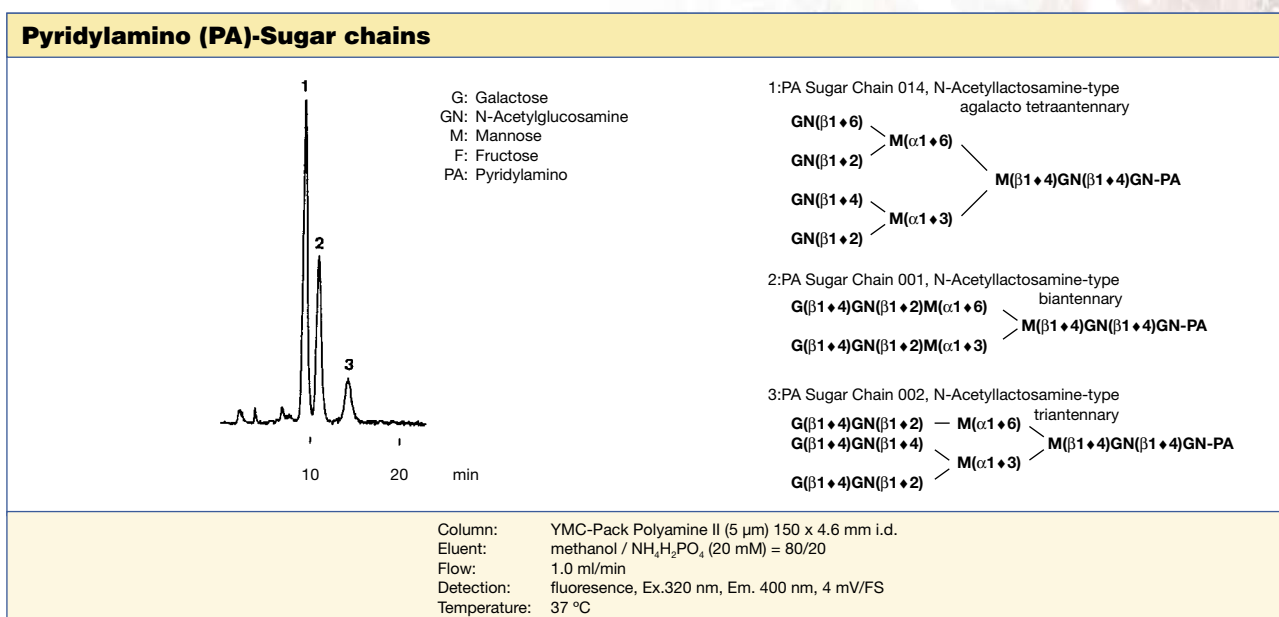
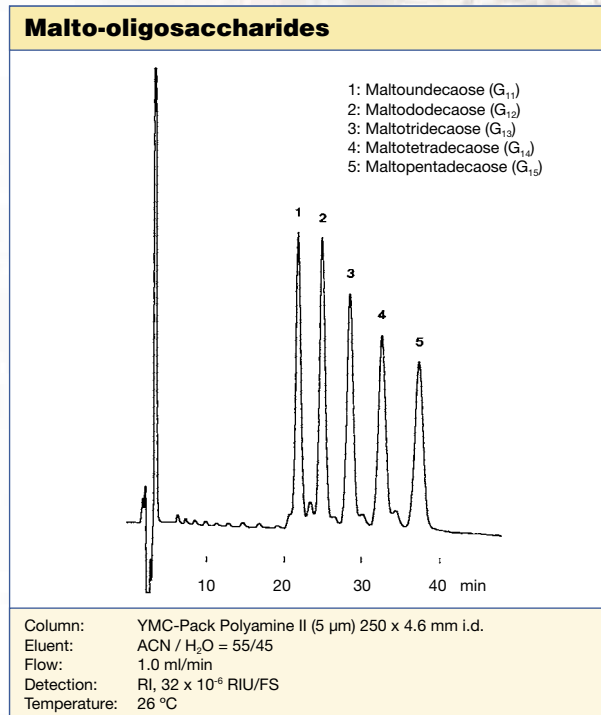
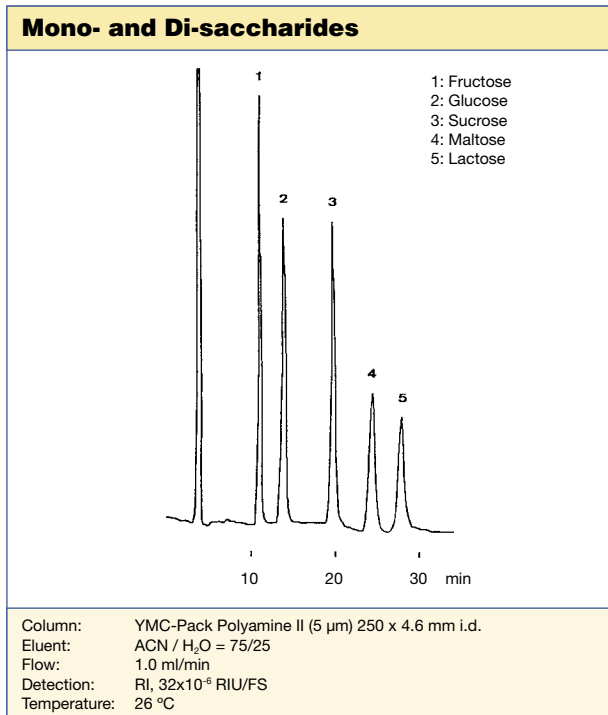


# YMC-Pack Polyamine II

The low reactivity of the 2° and 3° amino groups preserves the long-term retention characteristics and selectivity of YMC-Pack Polyamine II. Compared to conventional amino phases, one of their most outstanding benefits is the significantly prolonged lifetime. As the silica matrix is completely polymer coated, even the short-term use of basic eluents up to pH 10.5 is possible. Reducing sugars are often adsorbed irreversibly to conventional amino phases. This causes problems in recovery and quantitation. With YMC-Pack Polyamine II columns however, the adsorption of reducing sugars plays only a minor role. As a result a high recovery of these compounds can be obtained which is beneficial for accurate and reliable quantitation. For the separation of saccharides, YMC-Pack Polyamine II columns are typically used with water/acetonitrile eluents, with water as the stronger eluent. With the exception of chlorinated hydrocarbons, YMC-Pack Polyamine II columns can be used with every other organic eluent in normal phase or HILIC mode.

YMC-Pack Polyamine II columns are a powerful tool for the analysis of small carbohydrates and complex carbohydrate chains from glycoproteins.

## Applications



# YMC-BioPro QA/SP



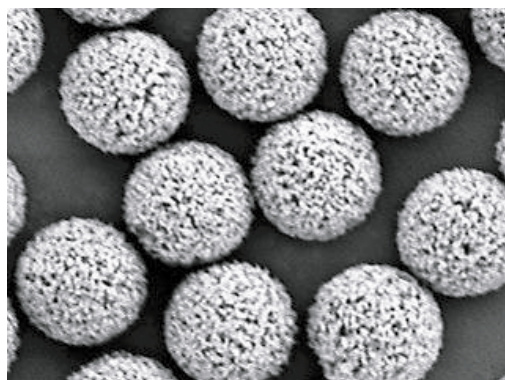
- newly developed porous hydrophilic polymer with low nonspecific adsorption
- excellent binding capacity and recovery of biomolecules
- very high resolution



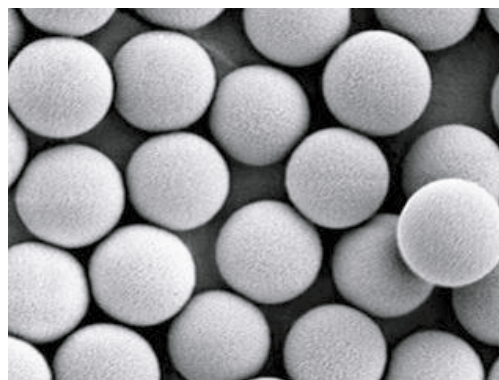
YMC-BioPro Series	YMC-BioPro QA	YMC-BioPro SP
Matrix	hydrophilic polymer bead	hydrophilic polymer bead
Pore size / nm	100	100
Particle size / $\mu\text{m}$	5	5
Charged group	$-\text{CH}_2\text{N}^+(\text{CH}_3)_3$	$-\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$
Counter ion	$\text{Cl}^-$	$\text{Na}^+$
Ion-exchange capacity	0.075-0.100 meq/ml-resin	0.070-0.095 meq/ml-resin
Dynamic binding capacity	110-150 mg-BSA/ml-resin	70-100 mg-human IgG/ml-resin
Available pH range	2.0 - 12.0	2.0 - 12.0

## General

YMC-BioPro series ion exchange columns are available in QA and SP chemistries and are based on 5 micron porous (QA or SP columns) or nonporous (QA-F and SP-F columns) hydrophilic polymer beads. The porous materials offer excellent binding capacity with unusually high efficiency, and low operating pressure when packed in 50 x 4.6 mm columns. The nonporous particles offer high efficiency, exceptional resolution, and low operating pressures in 30 x 4.6 mm and 100 x 4.6 mm columns.



Porous polymer beads



Nonporous polymer beads

# YMC-BioPro QA/SP

## High binding capacity and high recovery

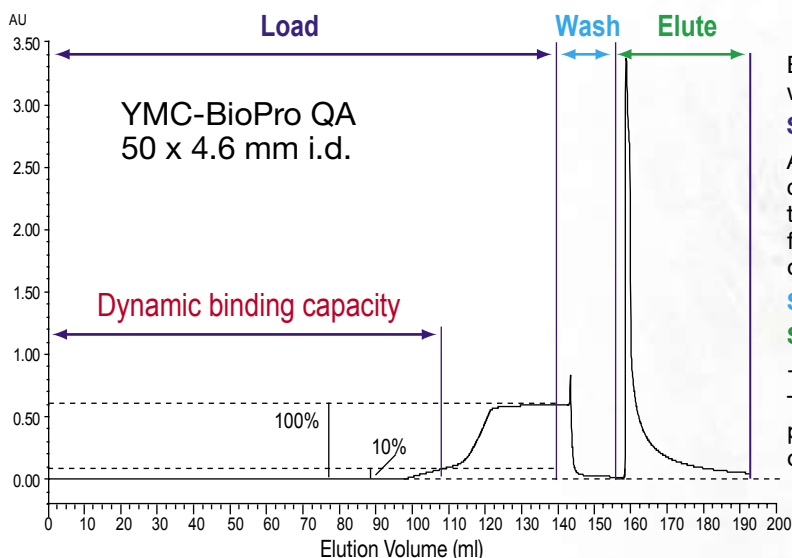
The porous type of YMC-BioPro shows great absorption capacity and excellent recovery, making it is useful for semi-preparative separations of proteins and antibodies

## Comparison of dynamic binding capacity (DBC) for BSA

	Dynamic binding capacity (mg/ml-gel, 10% breakthrough)	Eluted amount (mg/ml-gel)	Recovery* (%)
YMC-BioPro QA	126	120	95
Mono Q	100	35	35
BioAssist Q	73	58	79

\* Recovery: (Eluted amount/Dynamic binding capacity) x 100

Compared with conventional porous polymer anion-exchange columns, YMC-BioPro QA gives higher DBC and recovery rates. This indicates that YMC-BioPro has a much lower nonspecific adsorption compared to conventional columns.



Before the determination, equilibrate the column with equilibration buffer.

### Step 1: Load

A protein solution of known concentration is continuously loaded at the desired flow rate and the absorbance of the eluate is monitored until full saturation is achieved (100% UV absorbance of the pure sample solutions).

### Step 2: Wash

### Step 3: Elute

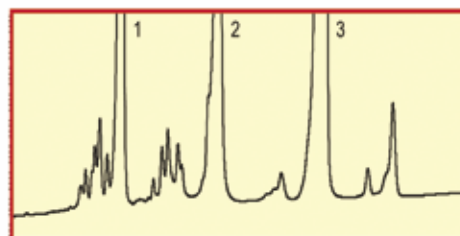
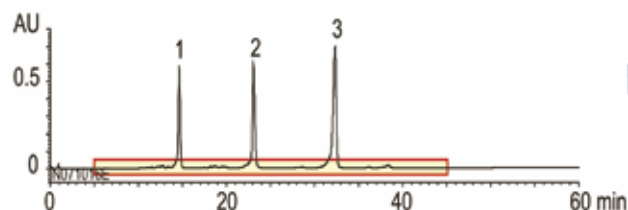
- Determination of DBC

The volume of protein solution that has been applied upto a specific breakthrough point (usually 5 or 10%) is a measure of the DBC of the medium.

## Superior resolution

### Standard protein separation on YMC-BioPro SP\*

YMC-BioPro SP  
5  $\mu$ m, 50 x 4.6 mm i.d.



Eluent: A) 20 mM  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 6.8)  
B) 20 mM  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 6.8) containing 0.5M NaCl  
Flow rate: 0.5 ml/min (4.6 mm i.d. column)  
0.59 ml/min (5.0 mm i.d. column)  
Temperature: 25 °C  
Detection: UV at 220 nm  
Injection: 20  $\mu$ l (4.6 mm i.d. column)  
23.6  $\mu$ l (5.0 mm i.d. column)

1. Cytochrome c (0.5 mg/ml)  
2. Ribonuclease A (0.5 mg/ml)  
3. Lysozyme (0.5 mg/ml)

\* By courtesy YMC Co., Ltd.

# YMC-BioPro QA-F/SP-F



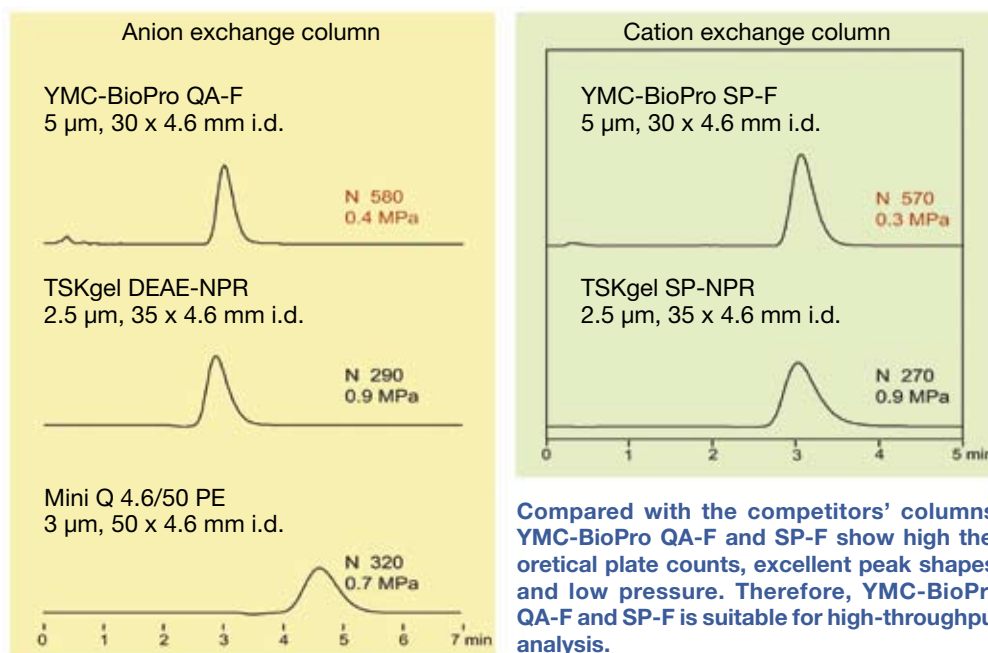
- newly developed nonporous hydrophilic polymer with low nonspecific adsorption
- excellent binding capacity and recovery of biomolecules
- very high resolution



YMC-BioPro Series	YMC-BioPro QA-F	YMC-BioPro SP-F
Matrix	hydrophilic polymer bead	hydrophilic polymer bead
Pore size / nm	nonporous	nonporous
Particle size / $\mu\text{m}$	5	5
Charged group	$-\text{CH}_2\text{N}^+(\text{CH}_3)_3$	$-\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$
Counter ion	$\text{Cl}^-$	$\text{Na}^+$
Ion-exchange capacity	0.075-0.110 meq/ml-resin	0.230-0.290 meq/ml-resin
Dynamic binding capacity	12-20 mg-BSA/ml-resin	10-18 mg-human IgG/ml-resin
Available pH range	2.0 - 12.0	2.0 - 12.0

## High efficiency with a lower column pressure

### Comparison of column efficiency on non-porous polymer based columns\*



Eluent: 20 mM Tris-HCl (pH 8.1) (for anion exchange columns)  
20 mM  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 6.8) (for cation exchange columns)

Flow rate: 0.12 ml/min

Temperature: 25 °C

Detection: UV at 220 nm

Injection: 20  $\mu\text{l}$

Sample: Formamide (2  $\mu\text{l}/\text{ml}$ )

# YMC-BioPro QA-F/SP-F

**High throughput analysis of proteins\***

**YMC-BioPro SP-F**  
5  $\mu$ m, 30 x 4.6 mm i.d.  
4.8-5.2 MPa

N(1)	7100
N(2)	12100
N(3)	17600
Rs(1,2)	7.60
Rs(2,3)	6.38

**TSKgel SP-NPR**  
2.5  $\mu$ m, 35 x 4.6 mm i.d.  
11.9-12.1 MPa

N(1)	4400
N(2)	2600
N(3)	11400
Rs(1,2)	4.50
Rs(2,3)	4.50

**YMC-BioPro SP-F can separate the proteins sharply without the peak-tailing observed in the chromatography of competitor's SP-NPR. Furthermore, despite having a larger particle size, the theoretical plate number of YMC-BioPro SP-F is higher.**

Eluent: A) 20 mM  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 6.8)  
B) 20 mM  $\text{KH}_2\text{PO}_4$ - $\text{K}_2\text{HPO}_4$  (pH 6.8) containing 0.5M NaCl  
Gradient: YMC-Bio SP-F 0-100% B (0-4 min)  
TSKgel SP-NPR 0-100% B (0-4.67 min)  
Flow rate: 1.5 ml/min  
Temperature: 25  $^\circ\text{C}$   
Detection: UV at 220 nm  
Injection: 20  $\mu$ l  
Sample: 1. Ribonuclease A (0.1 mg/ml)  
2. Cytochrome c (0.1 mg/ml)  
3. Lysozyme (0.1 mg/ml)

**Long column for high resolution analysis\***

**YMC-BioPro QA-F**

100 x 4.6 mm I.D.  
N 3060  
1.2 MPa

30 x 4.6 mm I.D.  
N 580  
0.4 MPa  
**x 5**

**The theoretical plate count for the 100 mm column is about 5 times higher than 30 mm column, making it very useful for high-resolution analyses.**

Eluent: 20 mM Tris-HCl (pH 8.1)  
Flow rate: 0.12 ml/min  
Temperature: 25  $^\circ\text{C}$   
Detection: UV at 220 nm  
Injection: 20  $\mu$ l  
Sample: Formamide (2  $\mu$ l/ml)

**Application - Nucleotides -\***

a) 0.5-1.0 M NaCl (0-25 min)  
Slope 0.02 M/min

b) 0.5-1.0 M NaCl (0-50 min)  
Slope 0.01 M/min  
**Gradient time X 2**  
**Gradient slope X 1/2**

c) 0.7-1.0 M NaCl (0-30 min)  
Slope 0.01 M/min  
**0.2 M increase in initial NaCl**  
**Same gradient slope**

Column: YMC-BioPro QA-F, 5  $\mu$ m, 100 x 4.6 mm i.d.  
Eluent: A) 20 mM Tris HCl (pH 8.1) containing 0.5M NaCl  
B) 20 mM Tris HCl (pH 8.1) containing 1.0M NaCl  
Flow rate: 0.5 ml/min  
Temperature: 25  $^\circ\text{C}$   
Detection: UV at 260 nm  
Injection: 20  $\mu$ l  
Sample: 1 Kb DNA Ladder (0.25 mg/ml)

**Elution of DNA fragments is optimised on 100 mm columns. The sensitivity is improved by reducing the gradient to half. In addition, the analysis time can be shortened by increasing the buffer concentration, while maintaining excellent resolution.**

\* By courtesy YMC Co., Ltd.

# Ordering Information



## YMC-Pack ODS-A, 12 nm, 3 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AA12S030302QT	AA12S030502QT	AA12S031002QT	AA12S031502QT	AA12S032502QT	AA12S030102
3.0	AA12S030303QT	AA12S030503QT	AA12S031003QT	AA12S031503QT	AA12S032503QT	AA12S030103
4.0	AA12S030304QT	AA12S030504QT	AA12S031004QT	AA12S031504QT	AA12S032504QT	AA12S030104
4.6	AA12S030346WT	AA12S030546WT	AA12S031046WT	AA12S031546WT	AA12S032546WT	AA12S030104



For other dimensions please refer to page 185

## YMC-Pack ODS-A, 20 nm, 3 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AA20S030302QT	AA20S030502QT	AA20S031002QT	AA20S031502QT	AA20S032502QT	AA20S030102
3.0	AA20S030303QT	AA20S030503QT	AA20S031003QT	AA20S031503QT	AA20S032503QT	AA20S030103
4.0	AA20S030304QT	AA20S030504QT	AA20S031004QT	AA20S031504QT	AA20S032504QT	AA20S030104
4.6	AA20S030346WT	AA20S030546WT	AA20S031046WT	AA20S031546WT	AA20S032546WT	AA20S030104



For other dimensions please refer to page 185

## YMC-Pack ODS-A, 12 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AA12S050302QT	AA12S050502QT	AA12S051002QT	AA12S051502QT	AA12S052502QT	AA12S050102
3.0	AA12S050303QT	AA12S050503QT	AA12S051003QT	AA12S051503QT	AA12S052503QT	AA12S050103
4.0	AA12S050304QT	AA12S050504QT	AA12S051004QT	AA12S051504QT	AA12S052504QT	AA12S050104
4.6	AA12S050346WT	AA12S050546WT	AA12S051046WT	AA12S051546WT	AA12S052546WT	AA12S050104



For other dimensions please refer to page 185

## YMC-Pack ODS-A, 20 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AA20S050302QT	AA20S050502QT	AA20S051002QT	AA20S051502QT	AA20S052502QT	AA20S050102
3.0	AA20S050303QT	AA20S050503QT	AA20S051003QT	AA20S051503QT	AA20S052503QT	AA20S050103
4.0	AA20S050304QT	AA20S050504QT	AA20S051004QT	AA20S051504QT	AA20S052504QT	AA20S050104
4.6	AA20S050346WT	AA20S050546WT	AA20S051046WT	AA20S051546WT	AA20S052546WT	AA20S050104



For other dimensions please refer to page 185

## YMC-Pack ODS-A, 30 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AA30S050302QT	AA30S050502QT	AA30S051002QT	AA30S051502QT	AA30S052502QT	AA30S050102
3.0	AA30S050303QT	AA30S050503QT	AA30S051003QT	AA30S051503QT	AA30S052503QT	AA30S050103
4.0	AA30S050304QT	AA30S050504QT	AA30S051004QT	AA30S051504QT	AA30S052504QT	AA30S050104
4.6	AA30S050346WT	AA30S050546WT	AA30S051046WT	AA30S051546WT	AA30S052546WT	AA30S050104



For other dimensions please refer to page 185

# Ordering Information

## YMC-Pack ODS-AQ, 12 nm, 3 µm

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AQ12S030302QT	AQ12S030502QT	AQ12S031002QT	AQ12S031502QT	AQ12S032502QT	AQ12S030102
3.0	AQ12S030303QT	AQ12S030503QT	AQ12S031003QT	AQ12S031503QT	AQ12S032503QT	AQ12S030103
4.0	AQ12S030304QT	AQ12S030504QT	AQ12S031004QT	AQ12S031504QT	AQ12S032504QT	AQ12S030104
4.6	AQ12S030346WT	AQ12S030546WT	AQ12S031046WT	AQ12S031546WT	AQ12S032546WT	AQ12S030104

For other dimensions please refer to page 185



## YMC-Pack ODS-AQ, 20 nm, 3 µm

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AQ20S030302QT	AQ20S030502QT	AQ20S031002QT	AQ20S031502QT	AQ20S032502QT	AQ20S030102
3.0	AQ20S030303QT	AQ20S030503QT	AQ20S031003QT	AQ20S031503QT	AQ20S032503QT	AQ20S030103
4.0	AQ20S030304QT	AQ20S030504QT	AQ20S031004QT	AQ20S031504QT	AQ20S032504QT	AQ20S030104
4.6	AQ20S030346WT	AQ20S030546WT	AQ20S031046WT	AQ20S031546WT	AQ20S032546WT	AQ20S030104

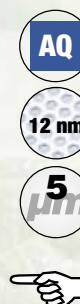
For other dimensions please refer to page 185



## YMC-Pack ODS-AQ, 12 nm, 5 µm

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AQ12S050302QT	AQ12S050502QT	AQ12S051002QT	AQ12S051502QT	AQ12S052502QT	AQ12S050102
3.0	AQ12S050303QT	AQ12S050503QT	AQ12S051003QT	AQ12S051503QT	AQ12S052503QT	AQ12S050103
4.0	AQ12S050304QT	AQ12S050504QT	AQ12S051004QT	AQ12S051504QT	AQ12S052504QT	AQ12S050104
4.6	AQ12S050346WT	AQ12S050546WT	AQ12S051046WT	AQ12S051546WT	AQ12S052546WT	AQ12S050104

For other dimensions please refer to page 185



## YMC-Pack ODS-AQ, 20 nm, 5 µm

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	AQ20S050302QT	AQ20S050502QT	AQ20S051002QT	AQ20S051502QT	AQ20S052502QT	AQ20S050102
3.0	AQ20S050303QT	AQ20S050503QT	AQ20S051003QT	AQ20S051503QT	AQ20S052503QT	AQ20S050103
4.0	AQ20S050304QT	AQ20S050504QT	AQ20S051004QT	AQ20S051504QT	AQ20S052504QT	AQ20S050104
4.6	AQ20S050346WT	AQ20S050546WT	AQ20S051046WT	AQ20S051546WT	AQ20S052546WT	AQ20S050104

For other dimensions please refer to page 185



**Note:** For your first order on guard cartridges, please add one guard cartridge holder per system to your order list: integral guard cartridge holder for columns with 2.1-4.0 mm i.d. **XPGCS-Q1** or universal guard cartridge holder for columns with 4.6 mm i.d. **XPGCH-Q1**. The holder can continuously be re-used and, thus it is not required for repeat orders.

# Ordering Information



## YMC-Pack C8, 12 nm, 3 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	OC12S030302QT	OC12S030502QT	OC12S031002QT	OC12S031502QT	OC12S032502QT	OC12S030102
3.0	OC12S030303QT	OC12S030503QT	OC12S031003QT	OC12S031503QT	OC12S032503QT	OC12S030103
4.0	OC12S030304QT	OC12S030504QT	OC12S031004QT	OC12S031504QT	OC12S032504QT	OC12S030104
4.6	OC12S030346WT	OC12S030546WT	OC12S031046WT	OC12S031546WT	OC12S032546WT	OC12S030104



For other dimensions please refer to page 185

## YMC-Pack C8, 20 nm, 3 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	OC20S030302QT	OC20S030502QT	OC20S031002QT	OC20S031502QT	OC20S032502QT	OC20S030102
3.0	OC20S030303QT	OC20S030503QT	OC20S031003QT	OC20S031503QT	OC20S032503QT	OC20S030103
4.0	OC20S030304QT	OC20S030504QT	OC20S031004QT	OC20S031504QT	OC20S032504QT	OC20S030104
4.6	OC20S030346WT	OC20S030546WT	OC20S031046WT	OC20S031546WT	OC20S032546WT	OC20S030104



For other dimensions please refer to page 185

## YMC-Pack C8, 12 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	OC12S050302QT	OC12S050502QT	OC12S051002QT	OC12S051502QT	OC12S052502QT	OC12S050102
3.0	OC12S050303QT	OC12S050503QT	OC12S051003QT	OC12S051503QT	OC12S052503QT	OC12S050103
4.0	OC12S050304QT	OC12S050504QT	OC12S051004QT	OC12S051504QT	OC12S052504QT	OC12S050104
4.6	OC12S050346WT	OC12S050546WT	OC12S051046WT	OC12S051546WT	OC12S052546WT	OC12S050104



For other dimensions please refer to page 185

## YMC-Pack C8, 20 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	OC20S050302QT	OC20S050502QT	OC20S051002QT	OC20S051502QT	OC20S052502QT	OC20S050102
3.0	OC20S050303QT	OC20S050503QT	OC20S051003QT	OC20S051503QT	OC20S052503QT	OC20S050103
4.0	OC20S050304QT	OC20S050504QT	OC20S051004QT	OC20S051504QT	OC20S052504QT	OC20S050104
4.6	OC20S050346WT	OC20S050546WT	OC20S051046WT	OC20S051546WT	OC20S052546WT	OC20S050104



For other dimensions please refer to page 185

## YMC-Pack C8, 30 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	OC30S050302QT	OC30S050502QT	OC30S051002QT	OC30S051502QT	OC30S052502QT	OC30S050102
3.0	OC30S050303QT	OC30S050503QT	OC30S051003QT	OC30S051503QT	OC30S052503QT	OC30S050103
4.0	OC30S050304QT	OC30S050504QT	OC30S051004QT	OC30S051504QT	OC30S052504QT	OC30S050104
4.6	OC30S050346WT	OC30S050546WT	OC30S051046WT	OC30S051546WT	OC30S052546WT	OC30S050104



For other dimensions please refer to page 185

# Ordering Information

## YMCbasic, 3 $\mu$ m

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BA99S030302QT	BA99S030502QT	BA99S031002QT	BA99S031502QT	BA99S032502QT	BA99S030102
3.0	BA99S030303QT	BA99S030503QT	BA99S031003QT	BA99S031503QT	BA99S032503QT	BA99S030103
4.0	BA99S030304QT	BA99S030504QT	BA99S031004QT	BA99S031504QT	BA99S032504QT	BA99S030104
4.6	BA99S030346WT	BA99S030546WT	BA99S031046WT	BA99S031546WT	BA99S032546WT	BA99S030104

For other dimensions please refer to page 185



## YMCbasic, 5 $\mu$ m

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BA99S050302QT	BA99S050502QT	BA99S051002QT	BA99S051502QT	BA99S052502QT	BA99S050102
3.0	BA99S050303QT	BA99S050503QT	BA99S051003QT	BA99S051503QT	BA99S052503QT	BA99S050103
4.0	BA99S050304QT	BA99S050504QT	BA99S051004QT	BA99S051504QT	BA99S052504QT	BA99S050104
4.6	BA99S050346WT	BA99S050546WT	BA99S051046WT	BA99S051546WT	BA99S052546WT	BA99S050104

For other dimensions please refer to page 185



# Ordering Information



## YMC-Pack C4, 12 nm, 3 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BU12S030302QT	BU12S030502QT	BU12S031002QT	BU12S031502QT	BU12S032502QT	BU12S030102
3.0	BU12S030303QT	BU12S030503QT	BU12S031003QT	BU12S031503QT	BU12S032503QT	BU12S030103
4.0	BU12S030304QT	BU12S030504QT	BU12S031004QT	BU12S031504QT	BU12S032504QT	BU12S030104
4.6	BU12S030346WT	BU12S030546WT	BU12S031046WT	BU12S031546WT	BU12S032546WT	BU12S030104



For other dimensions please refer to page 185

## YMC-Pack C4, 20 nm, 3 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BU20S030302QT	BU20S030502QT	BU20S031002QT	BU20S031502QT	BU20S032502QT	BU20S030102
3.0	BU20S030303QT	BU20S030503QT	BU20S031003QT	BU20S031503QT	BU20S032503QT	BU20S030103
4.0	BU20S030304QT	BU20S030504QT	BU20S031004QT	BU20S031504QT	BU20S032504QT	BU20S030104
4.6	BU20S030346WT	BU20S030546WT	BU20S031046WT	BU20S031546WT	BU20S032546WT	BU20S030104



For other dimensions please refer to page 185

## YMC-Pack C4, 12 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BU12S050302QT	BU12S050502QT	BU12S051002QT	BU12S051502QT	BU12S052502QT	BU12S050102
3.0	BU12S050303QT	BU12S050503QT	BU12S051003QT	BU12S051503QT	BU12S052503QT	BU12S050103
4.0	BU12S050304QT	BU12S050504QT	BU12S051004QT	BU12S051504QT	BU12S052504QT	BU12S050104
4.6	BU12S050346WT	BU12S050546WT	BU12S051046WT	BU12S051546WT	BU12S052546WT	BU12S050104



For other dimensions please refer to page 185

## YMC-Pack C4, 20 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BU20S050302QT	BU20S050502QT	BU20S051002QT	BU20S051502QT	BU20S052502QT	BU20S050102
3.0	BU20S050303QT	BU20S050503QT	BU20S051003QT	BU20S051503QT	BU20S052503QT	BU20S050103
4.0	BU20S050304QT	BU20S050504QT	BU20S051004QT	BU20S051504QT	BU20S052504QT	BU20S050104
4.6	BU20S050346WT	BU20S050546WT	BU20S051046WT	BU20S051546WT	BU20S052546WT	BU20S050104



For other dimensions please refer to page 185

## YMC-Pack C4, 30 nm, 5 $\mu$ m



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	BU30S050302QT	BU30S050502QT	BU30S051002QT	BU30S051502QT	BU30S052502QT	BU30S050102
3.0	BU30S050303QT	BU30S050503QT	BU30S051003QT	BU30S051503QT	BU30S052503QT	BU30S050103
4.0	BU30S050304QT	BU30S050504QT	BU30S051004QT	BU30S051504QT	BU30S052504QT	BU30S050104
4.6	BU30S050346WT	BU30S050546WT	BU30S051046WT	BU30S051546WT	BU30S052546WT	BU30S050104



For other dimensions please refer to page 185

# Ordering Information

## YMC-Pack Protein-RP, 5 $\mu$ m

Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	PR99S050302QT	PR99S050502QT	PR99S051002QT	PR99S051502QT	PR99S052502QT	PR99S050102
3.0	PR99S050303QT	PR99S050503QT	PR99S051003QT	PR99S051503QT	PR99S052503QT	PR99S050103
4.0	PR99S050304QT	PR99S050504QT	PR99S051004QT	PR99S051504QT	PR99S052504QT	PR99S050104
4.6	PR99S050346WT	PR99S050546WT	PR99S051046WT	PR99S051546WT	PR99S052546WT	PR99S050104

For other dimensions please refer to page 185



## YMC-Pack Diol, 6 nm, 5 $\mu$ m

Column i.d. (mm)	Column length (mm)			Guard cartridges with 10 mm length (pack of 5)
	250	300	500	
4.6	DL06S052546WT	DL06S053046WT	DL06S055046WT	DL06S050104
6.0	DL06S052506WT	DL06S053006WT	DL06S055006WT	—
8.0	DL06S052508WT	DL06S053008WT	DL06S055008WT	—
10.0	DL06S052510WT	DL06S053010WT	DL06S055010WT	—

For other dimensions please refer to page 185



## YMC-Pack Diol, 12 nm, 5 $\mu$ m

Column i.d. (mm)	Column length (mm)			Guard cartridges with 10 mm length (pack of 5)
	250	300	500	
4.6	DL12S052546WT	DL12S053046WT	DL12S055046WT	DL12S050104
6.0	DL12S052506WT	DL12S053006WT	DL12S055006WT	—
8.0	DL12S052508WT	DL12S053008WT	DL12S055008WT	—
10.0	DL12S052510WT	DL12S053010WT	DL12S055010WT	—

For other dimensions please refer to page 185



## YMC-Pack Diol, 20 nm, 5 $\mu$ m

Column i.d. (mm)	Column length (mm)			Guard cartridges with 10 mm length (pack of 5)
	250	300	500	
4.6	DL20S052546WT	DL20S053046WT	DL20S055046WT	DL20S050104
6.0	DL20S052506WT	DL20S053006WT	DL20S055006WT	—
8.0	DL20S052508WT	DL20S053008WT	DL20S055008WT	—
10.0	DL20S052510WT	DL20S053010WT	DL20S055010WT	—

For other dimensions please refer to page 185



## YMC-Pack Diol, 30 nm, 5 $\mu$ m

Column i.d. (mm)	Column length (mm)			Guard cartridges with 10 mm length (pack of 5)
	250	300	500	
4.6	DL30S052546WT	DL30S053046WT	DL30S055046WT	DL30S050104
6.0	DL30S052506WT	DL30S053006WT	DL30S055006WT	—
8.0	DL30S052508WT	DL30S053008WT	DL30S055008WT	—
10.0	DL30S052510WT	DL30S053010WT	DL30S055010WT	—

For other dimensions please refer to page 185



# Ordering Information



## YMC-Pack Polyamine II, 12 nm, 5 µm



Column i.d. (mm)	Column length (mm)					Guard cartridges with 10 mm length (pack of 5)
	33	50	100	150	250	
2.1	PB12S050302QT	PB12S050502QT	PB12S051002QT	PB12S051502QT	PB12S052502QT	PB12S050102
3.0	PB12S050303QT	PB12S050503QT	PB12S051003QT	PB12S051503QT	PB12S052503QT	PB12S050103
4.0	PB12S050304QT	PB12S050504QT	PB12S051004QT	PB12S051504QT	PB12S052504QT	PB12S050104
4.6	PB12S050346WT	PB12S050546WT	PB12S051046WT	PB12S051546WT	PB12S052546WT	PB12S050104



For other dimensions please refer to page 185

## YMC-BioPro Series



Column dimension (mm)	YMC-BioPro QA	YMC-BioPro SP	YMC-BioPro QA-F	YMC-BioPro SP-F
30 x 4.6	—	—	QF00S050346WP	SF00S050346WP
50 x 4.6	QAA0S050546WP	SPA0S050546WP	—	—
100 x 4.6	—	—	QF00S051046WP	SF00S051046WP

## Sure-Fit™ Connector

Since different column hardware manufacturers have introduced a variety of connecting port geometries over the years, the Sure-Fit™ Connector represents an ideal tool to avoid dead volumes or leakages, irrespective of the column brand, when connecting different columns to an HPLC system. YMC strongly recommends the use of the Sure-Fit™ Connector due to its internal spring tensioned mechanism, which automatically self-adjusts to any port depth while maintaining constant pressure on the capillary tubing. This guarantees a connection free from any dead volume. Column changeovers become easy, especially as no tools are required. The Sure-Fit™ Connector is fingertight to 6000 psi and is available in a range of capillary tubing i.d. and lengths.



Column i.d.* (mm)	Tubing i.d.* (mm)	Single end unit (incl. 20 mm stainless steel capillary)	Double end unit (incl. 20 mm stainless steel capillary)
1.0-3.0	0.13	SFS2005	SFD2005
3.0-4.6	0.18	SFS2007	SFD2007

\* Other versions available on request

# Ordering Information

The previous product listing represents commonly used standard column dimension. In order to identify any specific product version and order number, please see the example and the table below.

## Full listing of all chemistries and dimensions

Gel Code							Hardware Code						
Chemistry code		Pore size [nm]		Particle shape		Particle size [µm]		Length [mm]		Inner diameter [mm]		Column Type	
YMC30	CT	6	06	spherical	S	3	03	10	01	0.05	E5	Quick Seal Cartridge	QT
Pro C18	AS	8	08			4	04	20	02	0.075	E8		
Pro C18 RS	RS	12	12			5	05	33	03	0.1	F0	Waters type	WT
Hydrosphere C18	HS	20	20			6	06	50	05	0.2	G0		
ODS-A	AA	30	30					75	L5	0.3	H0		
ODS-AM	AM	100	A0			10	11	100	10	0.5	J0		
ODS-AQ	AQ	proprietary	99			15	16	125	R5	0.8	M0		
J'sphere ODS-H80	JH	non-porous	00			20	21	150	15	1.0	O1		
J'sphere ODS-M80	JM					50	50	250	25	2.1	O2		
J'sphere ODS-L80	JL					75	75			3.0	O3		
ODS-AL	AL							300	30	4.0	O4		
PAH	YP					63/210	A4						
PolymerC18	PC					150	A5	500	50	4.6	46		
Pro C8	OS							1000	A0	6.0	06		
C8 (Octyl)	OC									8.0	08		
YMCbasic	BA									10	10		
Ph (Phenyl)	PH									20	20		
Pro C4	BS									30	30		
C4 (Butyl)	BU												
Protein-RP	PR									50 (2000 psi)	52		
TMS (C1)	TM									70 (2000 psi)	72		
PVA-Sil	PV									100 (2000 psi)	A2		
Polyamine II	PB									150 (2000 psi)	B2		
NH <sub>2</sub> (Amino)	NH									200 (2000 psi)	C2		
CN (Cyano)	CN												
Diol	DL												
SIL (Silica)	SL												
BioPro-QA	QA												
BioPro-SP	SP												
BioPro-QA-F	QF												
BioPro-SP-F	SF												
Chiral NEA (R)	NR												
Chiral NEA (S)	NS												
Chiral CD BR α	DA												
Chiral CD BR β	DB												
Chiral CD BR γ	DG												
Chiral Prep CD ST	ST												
Chiral Prep CD PM	PM												

### Example

Choose your column and fill in the "Gel and Hardware Code" or detailed description (The part number consists of the "Gel Code" and the "Hardware Code").

YMC-Pack ODS-A	12 nm	spherical	3 µm	250 mm	1.0 mm	Quick Seal
<b>AA</b>	<b>12</b>	<b>S</b>	<b>03</b>	<b>25</b>	<b>01</b>	<b>QT</b>

Your column part number: **AA12S032501QT (Example)**

Please note that combinations of features cannot be selected at random, but only from the possible specifications for a chosen stationary phase. These can be determined from the individual product sections in this catalogue or from our homepage [www.ymc.de](http://www.ymc.de).

### For more details



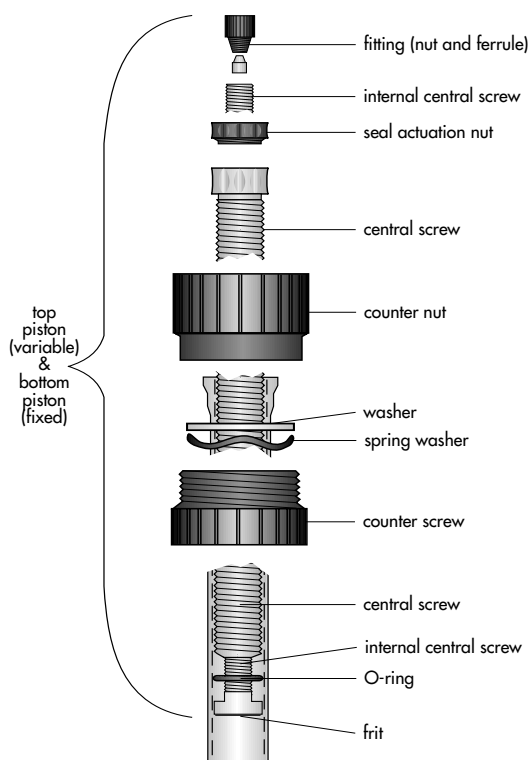
contact your local distributor or

YMC Europe GmbH, Schöttmannshof 19, D-46539 Dinslaken, Phone: +49 (0) 2064 / 427-0,

Fax +49 (0) 2064 / 427-222, e-mail: [info@ymc.de](mailto:info@ymc.de), homepage: [www.ymc.de](http://www.ymc.de)

# ECO Glass Columns

- **biocompatible**
- **solvent resistant version (optional)**
- **easy to use**
- **low temperature application**
- **2 adjustable length plungers supplied on request**
- **compatible with any LC system**
- **water-jacketed version available on request**



**ECO Column i.d. 10-50 mm**

## General

ECO columns are glass columns for almost all types of soft gel and low pressure (pressure limit 5 – 30 bar) liquid chromatography applications. With a choice of one or two adjustable length plungers, they are available in two forms: AB (aqueous buffer) for use with aqueous buffers and cold room applications and SR (solvent resistant) for all forms of normal and reversed phase chromatography.

ECO columns are produced by high-precision CNC manufacturing. They are competitively priced and equipped with a screw-lock system which makes it possible to open and seal the column simply and quickly. Each column passes a quality control pressure test. A water-jacketed option can be supplied on request.



*Eco column with water jacket*

## Versions available

Version	Temperature Range [°C]	Plunger	Seal	Frit
<b>ECO AB</b> (Aqueous Buffer)	4 - 40	POM	Viton® O-ring EPDM	Porous glass (i.d. 10 - 50 mm) Polyethylene (i.d. 70 - 80 mm)
<b>ECO SR</b> (Solvent Resistant)	16 - 40	PVDF	Kalrez® O-ring	Porous glass (i.d. 10 - 50 mm) Polyethylene (i.d. 70 - 80 mm)

# ECO Glass Columns

## Characteristics

Pressure limit:	5–30 bar (depending on diameter)	
Temperature range:	aqueous buffer version (AB): 4-40 °C solvent resistant version (SR): 16-40 °C	
Wetted parts:	borosilicate glass	
	aqueous buffer version (AB):	POM, sintered glass frit and Viton® seal (ID 10-50 mm) POM, polyethylene frit and EPDM seal (ID 70-80 mm)
	solvent resistant version (SR):	PVDF, sintered glass frit and Kalrez® seal (ID 10-50 mm) PVDF, stainless steel frit and Kalrez® seal (ID 70-80 mm)
Diameter:	10 mm, 15 mm, 25 mm, 50 mm, 70 mm, 80 mm	
Bed lengths:	120 mm, 200 mm, 450 mm, 750 mm, 1000 mm	
Height adjustment:	Adjustable plunger provides up to 120 mm bed height adjustment (2 adjustable plungers supplied on request).	
Connections:	The columns are supplied with different adaptors to allow direct connection to any LC-system.	

## Specifications

i.d. [mm]*	Pressure limit [bar]	Vario		Multivario	
		Bed length [mm]	Volume [ml]	Bed length [mm]	Volume [ml]
10	30	0-120	0-9.4	0-120	0-9.4
		80-200	6.3-16	0-200	0-16
		330-450	26-35	210-450	17-35
		630-750	50-59	510-750	40-59
		880-1000	69-79	760-1000	60-79
15	25	0-120	0-21	0-120	0-21
		80-200	14-35	0-200	0-35
		330-450	58-80	210-450	37-80
		630-750	111-133	510-750	90-133
		880-1000	156-177	760-1000	134-177
25	15	0-120	0-59	0-120	0-59
		80-200	39-98	0-200	0-98
		330-450	162-221	210-450	103-221
		630-750	309-368	510-750	250-368
		880-1000	432-491	760-1000	373-491
50	10	0-120	0-236	0-120	0-236
		80-200	157-393	0-200	0-393
		330-450	648-884	210-450	412-884
		630-750	1237-1473	510-750	1001-1473
		880-1000	1728-1964	760-1000	1492-1964
70	5	—	—	0-120	0-462
		—	—	0-200	0-770
		—	—	90-450	356-1732
		—	—	390-750	1501-2886
		—	—	640-1000	2463-3848
80	5	—	—	0-120	0-603
		—	—	0-200	0-1005
		—	—	90-450	452-2262
		—	—	390-750	1960-3770
		—	—	640-1000	3217-5026

\* Columns with inner diameter of 20 and 32 mm are available upon request

## Supplies

All columns: 1x frit removal tool / 2x plugs, PTFE (1/4"-28G) / 1x protective netted tubing

and for all diameters fitting tubing, nuts and ferrules:

i.d. 10–15 mm: 1x 1m FEP-tubing (0.8 x 1.6 mm) / 4x 1/4"-28G nut and ferrule (collapsible), for 1/16" tubing / 2x M6 nut and ferrule for 1/16" tubing / 2x 10-32 nut/ferrule for 1/16" tubing

i.d. 25–80 mm: 1x 1m FEP-tubing (1.6 or 2.4 x 3.2 mm) / 4x 1/4"-28G nut and ferrule (collapsible), for 1/8" tubing / 2x M6 nut and ferrule for 1/8" tubing

# Ordering guide for ECO columns

The part numbers for the columns contain information on the column type, inner diameter, column length, plunger type, frit porosity and seal (O-ring) material.

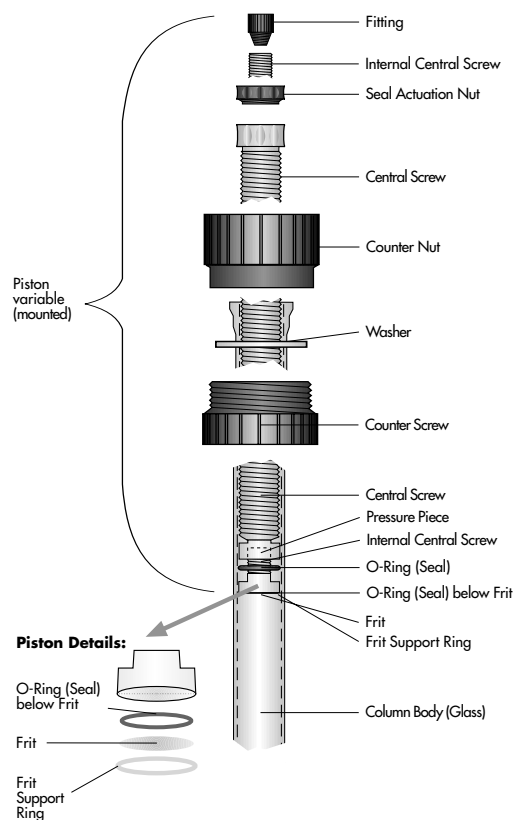
Inner diameter i.d. [mm]*	Pressure limit [bar]	Order code
10	30	ECO10/
15	25	ECO15/
25	15	ECO25/
50	10	ECO50/
70	5	ECO70/
80	5	ECO80/

\* Columns with inner diameter of 20 and 32 mm are available upon request

Column length [mm]	Order code
120	120
200	200
450	450
750	750
1000	999
Longer columns are available on request.	

No. of adjustable plungers	Order code
1 adjustable plunger (Vario)	V
2 adjustable plungers (Multi Vario)	M
up to 120 mm bed variability each	

Frit porosity [ $\mu\text{m}$ ]	Order code
10	0
16-40	3
40-100	4
Other frit porosities are available on request.	



**ECO Column ID 70-80mm**

Column version	Seal O-ring material	Order code
ECO AB (Aqueous Buffer)	Viton® / EPDM	V
ECO SR (Solvent Resistant)	Kalrez®	K

Option	Order code
Water-jacketed version*	-K
*(only in combination with Multi Vario plunger)	

# Ordering guide for ECO columns

## Examples

To order an ECO column in aqueous buffer version with an inner diameter of 15 mm, a column length of 120 mm, with 1 adjustable plunger and a frit porosity of 16-40  $\mu\text{m}$ , a Viton O-ring and without the water-jacket option, please use the corresponding part number ECO15/120V3V.

### Part Number: ECO15/120V3V

Example	ECO	15/	120	V	3	V
Column type	ECO					
Inner diameter		15/				
Column length			120			
Plunger type				V		
Frit porosity					3	
Seal O-ring material						V

To order a solvent resistant ECO column with an inner diameter of 10 mm, a column length of 120 mm, with 2 adjustable plungers and a frit porosity of 10  $\mu\text{m}$ , a Kalrez O-ring and with the water-jacket option, please use the corresponding part number ECO10/120M0K-K.

### Part Number: ECO10/120M0K-K

Example	ECO	10/	120	M	0	K	-K
Column type	ECO						
Inner diameter		10/					
Column length			120				
Plunger type				M			
Frit porosity					0		
Seal O-ring material						K	
Water-jacket option							-K

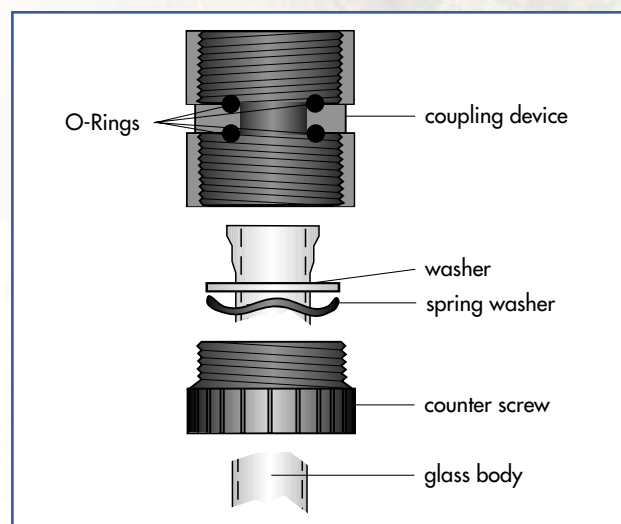
## Packing Adaptors

The ECO series packing adaptors consist of a column coupler and an empty glass body. These must be of the same diameter as the column to be packed and must be used as packing adaptors, not for extending the length of a column body. The length of the additional glass body used should be selected to allow:

- double the volume of slurry compared to the required packed bed volume if packing silica materials
- triple the volume of slurry for softer packing materials

The product manual supplied with each column contains detailed examples of dry packing and slurry packing techniques.

For ordering information please see next page.



column coupler

# Ordering information for column coupler

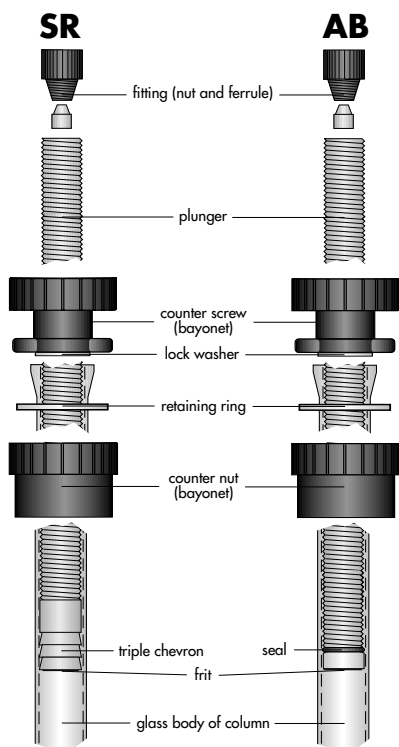
Inner Diameter*	Description	Length	Part Number
10	Column Coupler (no Glass Body) including Viton® O-Ring		ECO10KU/V
15	Column Coupler (no Glass Body) including Viton® O-Ring		ECO15KU/V
25	Column Coupler (no Glass Body) including Viton® O-Ring		ECO25KU/V
50	Column Coupler (no Glass Body) including Viton® O-Ring		ECO50KU/V
70	Column Coupler (no Glass Body) including EPDM O-Ring		ECO70KU/V
80	Column Coupler (no Glass Body) including EPDM O-Ring		ECO80KU/V
10	Glass Body for use with Column Coupler	120	ECO10/120
	Glass Body for use with Column Coupler	200	ECO10/200
	Glass Body for use with Column Coupler	450	ECO10/450
	Glass Body for use with Column Coupler	750	ECO10/750
	Glass Body for use with Column Coupler	1000	ECO10/999
15	Glass Body for use with Column Coupler	120	ECO15/120
	Glass Body for use with Column Coupler	200	ECO15/200
	Glass Body for use with Column Coupler	450	ECO15/450
	Glass Body for use with Column Coupler	750	ECO15/750
	Glass Body for use with Column Coupler	1000	ECO15/999
25	Glass Body for use with Column Coupler	120	ECO25/120
	Glass Body for use with Column Coupler	200	ECO25/200
	Glass Body for use with Column Coupler	450	ECO25/450
	Glass Body for use with Column Coupler	750	ECO25/750
	Glass Body for use with Column Coupler	1000	ECO25/999
50	Glass Body for use with Column Coupler	120	ECO50/120
	Glass Body for use with Column Coupler	200	ECO50/200
	Glass Body for use with Column Coupler	450	ECO50/450
	Glass Body for use with Column Coupler	750	ECO50/750
	Glass Body for use with Column Coupler	1000	ECO50/999
70	Glass Body for use with Column Coupler	120	ECO70/120
	Glass Body for use with Column Coupler	200	ECO70/200
	Glass Body for use with Column Coupler	450	ECO70/450
	Glass Body for use with Column Coupler	750	ECO70/750
	Glass Body for use with Column Coupler	1000	ECO70/999
80	Glass Body for use with Column Coupler	120	ECO80/120
	Glass Body for use with Column Coupler	200	ECO80/200
	Glass Body for use with Column Coupler	450	ECO80/450
	Glass Body for use with Column Coupler	750	ECO80/750
	Glass Body for use with Column Coupler	1000	ECO80/999

\* Column Couplers for columns with inner diameter of 20 and 32mm are available upon request



# ECO<sup>PLUS</sup> Glass Columns

- **biocompatible**
- **universal application**
- **solvent resistant version (optional)**
- **low temperature version available with polyethylene plunger and EPDM sealing ring (AB version)**
- **height adjustable plunger at both ends**
- **easy to use**
- **compatible with any LC system**



## General

ECO<sup>PLUS</sup> glass columns are multi-purpose columns for almost all types of liquid chromatography applications (pressure limit 30 – 80 bar). They are available in two forms; AB (aqueous buffer) for aqueous buffer and cold room applications and SR (solvent resistant) for normal and reversed phase chromatography.

Adjustable length plungers at both ends (as standard) and a totally inert triple chevron sealing system (SR versions) support the complete spectrum of applications from classical normal phase and reversed phase chromatography right through to biochromatography. The Quick-Lock connection (bayonet) system makes it possible to open and seal the column simply and quickly. ECO<sup>PLUS</sup> columns are produced by high-precision CNC manufacturing and each column passes a quality control pressure test.

## Versions available

Version	Temperature Range [°C]	Plunger	Seal	Frit
<b>ECO<sup>PLUS</sup> AB (Aqueous Buffer)</b>	4 - 40	Polyethylene	O-ring EPDM (ethylene polymer elastomer)	Column i.d. 5 - 50 mm: Polyethylene
<b>ECO<sup>PLUS</sup> SR (Solvent Resistant)</b>	16 - 40	PTFE	PTFE triple chevron Kalrez® O-ring version available on request	Column i.d. 5 - 15 mm: sintered glass Column i.d. 25 - 50 mm: stainless steel

# ECO<sup>PLUS</sup> Glass Columns

## Characteristics

Pressure limit:	30–80 bar (depending on diameter)
Temperature range:	aqueous buffer version (AB): 4–40 °C solvent resistant version (SR): 16–40 °C
Wetted parts:	borosilicate glass aqueous buffer version (AB): Polyethylene and EPDM solvent resistant version (SR): PTFE and sintered glass or stainless steel
Diameter:	5 mm, 10 mm, 15 mm, 25 mm, 35 mm, 50 mm
Bed lengths:	125 mm, 250 mm, 500 mm
Height adjustment:	Multi-variable plunger at each end, each providing over 60 mm bed height adjustment with Quick-Lock bayonet system (longer plunger option available offering 120 mm bed adjustment) per plunger.
Connections:	The columns are supplied with different adaptors to allow direct connection to any LC-system.

## Specifications

i.d. [mm]	Pressure limit [bar]	Short plungers		Long plungers	
		Bed length [mm]	Volume [ml]	Bed length [mm]	Volume [ml]
5	80	5-125	0.1-2.5	0-125	0-2.5
		130-250	2.6-4.9	10-250	0.2-4.9
		380-500	7.5-9.8	260-500	5.1-9.8
10	80	5-125	0.4-9.8	0-125	0-9.8
		130-250	1-20	10-250	0.8-20
		380-500	30-39	260-500	20.4-39
15	70	5-125	0.9-22	0-125	0-22
		130-250	23-44	10-250	1.8-44
		380-500	67-88	260-500	46-88
25	50	5-125	2.5-61	0-125	0-61
		130-250	64-123	10-250	4.9-123
		380-500	187-245	260-500	128-245
35	40	5-125	4.8-120	0-125	0-120
		130-250	125-241	10-250	9.6-241
		380-500	366-481	260-500	250-481
50	30	5-125	9.8-245	0-125	0-245
		130-250	255-491	10-250	19.6-491
		380-500	746-982	260-500	511-982

## Supplies

All columns:	1x frit removal tool / 2x plugs, PTFE (1/4"-28G) / 1x protective netted tubing
and for all diameters	fitting tubing, nuts and ferrules:
i.d. 5 mm:	1x 1 m tefzel tubing 1/16", mounted / 4x 1/4"-28G nut and ferrule (collapsible), for 1/16" tubing / 2x M6 nut and ferrule for 1/16" tubing / 2x 10-32 nut/ferrule for 1/16" tubing
i.d. 10–15 mm:	1x 1 m FEP-tubing (0.8 x 1.6 mm) / 4x 1/4"-28G nut and ferrule (collapsible), for 1/16" tubing / 2x M6 nut and ferrule for 1/16" tubing / 2x 10-32 nut/ferrule for 1/16" tubing
i.d. 25–50 mm:	1x 1 m FEP-tubing (1.6 x 3.2 mm) / 4x 1/4"-28G nut and ferrule (collapsible), for 1/8" tubing / 2x M6 nut and ferrule for 1/8" tubing

# Ordering guide for ECO<sup>PLUS</sup> columns

The part numbers for the columns contain information on the column type, inner diameter, column length, plunger type, frit material, frit porosity and column version (SR or AB).

Inner diameter i.d. [mm]	Pressure limit [bar]	Order code
5	80	TAC05/
10	80	TAC10/
15	70	TAC15/
25	50	TAC25/
35	40	TAC35/
50	30	TAC50/

Column length [mm]	Order code
125	125
250	250
500	500

Option*	Order code
2 Long plungers**	L
<p>* Standard version has 2 short plungers with 60 mm bed length adjustment each. Columns with 1 long and 1 short plunger are also available on request.  ** 2 Long plungers provide 120 mm bed length adjustment each.</p>	

Frit material	Order code
Polyethylene (AB version)	PE
Sintered glass (SR version with ID ≤ 15 mm)	G
Stainless steel (SR version with ID ≤ 25 mm)	S

Frit porosity [µm]	Order code
2	2
5 (only for polyethylene frits)	5
10	0
Other frit porosities are available on request.	

Column version	Order code
ECO <sup>PLUS</sup> AB (Aqueous Buffer)	AB-1
ECO <sup>PLUS</sup> SR (Solvent Resistant)	SR-1

# Ordering guide for ECO<sup>PLUS</sup> columns

## Example

To order a solvent resistant ECO<sup>PLUS</sup> column with an inner diameter of 50 mm, a column length of 500 mm, 2 long plungers and a stainless steel frit with a porosity of 2 µm please use the corresponding part number TAC50/500LS2-SR-1.

## Part Number: TAC50/500LS2-SR-1

Example	TAC	50/	500	L	S	2-	SR-1
Column type	TAC						
Inner diameter		50/					
Column length			500				
Plunger type				L			
Frit material					S		
Frit porosity						2-	
Version							SR-1

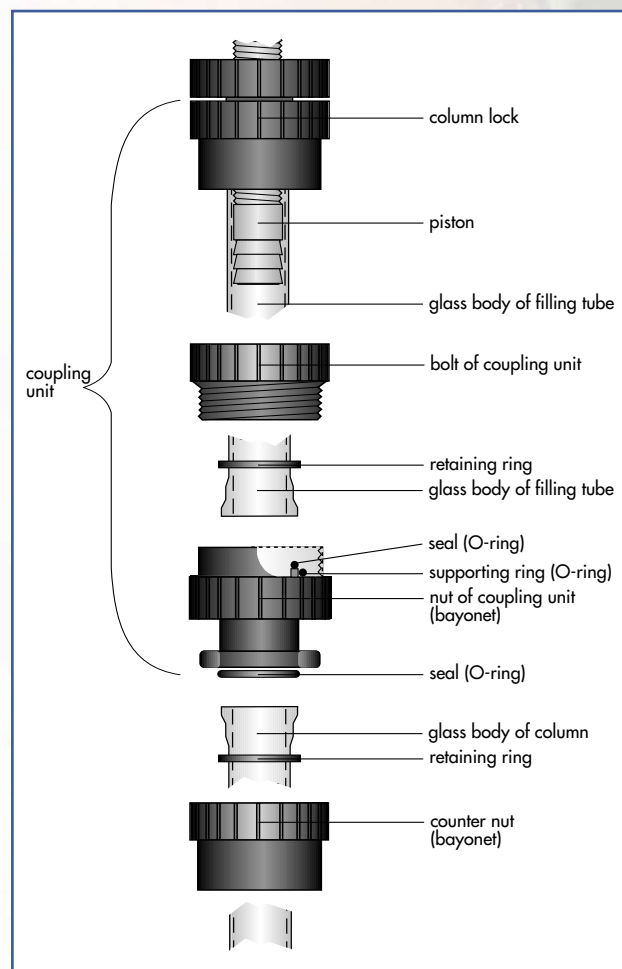
## Packing adaptors

The ECO<sup>PLUS</sup> series packing adaptors consist of a column coupler and an empty glass body. These must be of the same diameter as the column to be packed and must be used as packing adaptors, not for extending the length of a column body. The length of the additional glass body used should be selected to allow:

- double the volume of slurry compared to the required packed bed volume if packing silica materials
- triple the volume of slurry for softer packing materials

The product manual supplied with each column contains detailed examples of dry packing and slurry packing techniques.

For ordering information please see next page.



column coupler

# Ordering information for column coupler

Inner Diameter	Description	Length	Part Number
5	Column Coupler (no Glass Body) with 2 sets of O-rings for AB and SR Versions		TAC05KU-AS
10	Column Coupler (no Glass Body) with 2 sets of O-rings for AB and SR Versions		TAC10KU-AS
15	Column Coupler (no Glass Body) with 2 sets of O-rings for AB and SR Versions		TAC15KU-AS
25	Column Coupler (no Glass Body) with 2 sets of O-rings for AB and SR Versions		TAC25KU-AS
35	Column Coupler (no Glass Body) with 2 sets of O-rings for AB and SR Versions		TAC35KU-AS
50	Column Coupler (no Glass Body) with 2 sets of O-rings for AB and SR Versions		TAC50KU-AS
5	Glass Body for use with Column Coupler	125	TAC05/125
	Glass Body for use with Column Coupler	250	TAC05/250
	Glass Body for use with Column Coupler	500	TAC05/500
10	Glass Body for use with Column Coupler	125	TAC10/125
	Glass Body for use with Column Coupler	250	TAC10/250
	Glass Body for use with Column Coupler	500	TAC10/500
15	Glass Body for use with Column Coupler	125	TAC15/125
	Glass Body for use with Column Coupler	250	TAC15/250
	Glass Body for use with Column Coupler	500	TAC15/500
25	Glass Body for use with Column Coupler	125	TAC25/125
	Glass Body for use with Column Coupler	250	TAC25/250
	Glass Body for use with Column Coupler	500	TAC25/500
35	Glass Body for use with Column Coupler	125	TAC35/125
	Glass Body for use with Column Coupler	250	TAC35/250
	Glass Body for use with Column Coupler	500	TAC35/500
50	Glass Body for use with Column Coupler	125	TAC50/125
	Glass Body for use with Column Coupler	250	TAC50/250
	Glass Body for use with Column Coupler	500	TAC50/500

## Pilot- and process scale columns

For applications that require larger diameters we offer our pilot scale columns with inner diameters ranging from 60 to 600 mm in variable lengths.

(See pages 326-329)



# Questionnaire for Kronlab lab-scale glass columns

For help in selecting your column, for dimensions which are not standard, customized, and/or pilot scale columns in glass or steel or for a pre-packed column, please fill in and send back to:

**FAX-No. +49(0)2064/427-115**

- inner diameter (mm): \_\_\_\_\_
- min. bed length (mm): \_\_\_\_\_
- max. bed length (mm): \_\_\_\_\_
- bed volume (ml): \_\_\_\_\_
- max. pressure (bar): \_\_\_\_\_
- sealing: O-ring  PTFE triple chevron
- biocompatibility: yes  no
- frit material: PE  glass  stainless steel
- porosity (µm): \_\_\_\_\_
- O-ring material: EPDM  Kalrez®
- environment: cold storage room  room temperature
- solvents: \_\_\_\_\_
- packing material: \_\_\_\_\_
- quotation for packing device required: yes  no

Company/institute: \_\_\_\_\_

Name: \_\_\_\_\_

Department: \_\_\_\_\_

Street: \_\_\_\_\_

City: \_\_\_\_\_

Phone: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

Website: \_\_\_\_\_