Introduction

We are pleased to present the 12th YMC General Catalog.
Since its formation in 1980, YMC CO., LTD. has been working in the rapidly changing field of chemistry. Over this time, the rate of discovery of new materials and technologies for improving the quality of life have been occurring at rates never dreamed of by past generations. Additionally, chemistry disciplines are becoming increasingly cross-linked with each other as well as with related technologies, and these discoveries generate an even greater impact on the expansion of all chemical and biological fields.
YMC CO., LTD. believes that progress in chemistry is infinite and has focused its resources in the field of High Performance Liquid Chromatography, a key technology that contributes to the discovery, analysis, and purification of important chemical substances. Substances that are discovered, analyzed, and/or purified using YMC products frequently contribute to the improved health and well being of humans and animals. For example, YMC is extremely proud of the important contribution that our company makes in the area of diabetes care. Compounds used in the treatment of diabetes are often analyzed and/or purified using YMC products developed and manufactured by our company.
YMC's intellectual assets and the know-how cultivated by many years of experience with High Performance Liquid Chromatography have been combined with complementing technology platforms so that we can continue our challenge of pushing limits in precision, detection, discovery, and production. The following pages in this catalogue represent the fruits of our company's effort towards helping YMC fulfill its mission of helping our customers succeed in sustaining and improving the quality of life for the present and future generations.

山村隆治

Ryuji Yamamura
CEO

YMC

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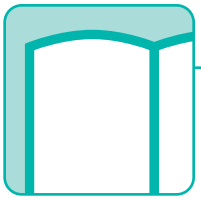
Please read this section before ordering



Checking a catalog item

Check your desired product in the ordering information section on each page.

Ordering Information

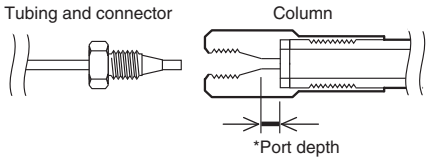
YMC-Pack *Pro* C18

Phase dimension	Column I.D. (mm)	Column length (mm) 50	75	100	150
120 Å 5 µm	2.0	AS12S05-0502WT	AS12S05-L502WT	AS12S05-1002WT	AS12S05-1502WT
	3.0	AS12S05-0503WT	AS12S05-L503WT	AS12S05-1003WT	AS12S05-1503WT
	4.6	AS12S05-0546WT	AS12S05-L546WT	AS12S05-1046WT	AS12S05-1546WT
	6.0	—	—	—	AS12S05-1506WT

Packing material type | **Pore size** | **Column size** | **Product number**

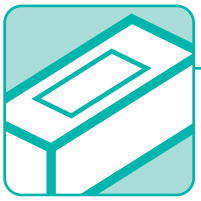
S: Spherical packing material
I: Irregular packing material

Consideration of connector and column fittings



The end of the product number	*Port depth	Style of endfitting
PT / PTH	2 mm	Parker style (UPLC compatible)
WT / WX / WTG / WP	3 mm	Waters (W) style

UPLC is a registered trademark of Waters Corporation



Checking the product label

Check these items on the label of your product before re-ordering.

Purchasing products

YMC CO., LTD. products are available all over the world. Our products are available through local distributors. For distributors all over the world, visit our web site:

URL http://www.ymc-group.com

United States | Canada | Mexico | Central America | South America

YMC America, Inc.

941 Marcon Blvd., Suite 201 Allentown, PA 18109, U.S.A.
TEL: +1-610-266-8650 FAX: +1-610-266-8652
E-Mail: info@ymcamerica.com | URL: http://www.ymcamerica.com/

Europe | Middle East | Africa | Former U.S.S.R.

YMC Europe GmbH

Schöttmannshof 19 D-46539 Dinslaken Germany
TEL: +49-2064-4270 FAX: +49-2064-427222
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TEL: +65-9023-7617
E-Mail: sales@ymc.sg | URL: http://www.ymc.sg

Featured Products

CHIRAL ART

- HPLC column/packing material with polysaccharide derivatives chiral selector
- Applicable to various chiral compounds
- Excellent resolution/durability
- Extremely low initial cost on analysis and purification

YMC-BioPro

- Ion exchange columns ideal for analysis of proteins, peptides, and nucleic acids
- Newly developed hydrophilic polymer beads with low nonspecific adsorption
- Non-porous type for increasing resolution and throughput
- Porous type for higher binding capacity and recovery

BioPro SmartSep/BioPro Ion Exchange Media

- BioPro SmartSep ion exchange media for high-throughput purification of biopharmaceuticals
- BioPro ion exchange media for purification of biopharmaceuticals, proteins and nucleotides
- High productivity on purification
- Available in Screening Kit for media selection and method development

YMC-Triart

- Effective for method screening with various chemistries
- Great chemical durability provided by hybrid particles
- Superior peak shapes for a wide range of compounds and in various conditions
- UHPLC compatible column with operating pressure up to 100 MPa packed with 1.9 µm particle
- Available in highly-durable semi-preparative column

Meteoric Core

- Ultra fast analysis and excellent resolution
- Excellent peak shape on basic and coordination compounds
- Wide usable pH range
- Low column bleeding and ideal for LC/MS

Bulk packing material based on organic/inorganic hybrid

- For lab-scale to production-scale purification
- Excellent durability and long lifetime
- Compatible with alkaline CIP
- Outstanding cost-effectiveness

Preparative Systems

BioStream

- Suitable for downstream processing for biopharmaceutical manufacturing
- Compliance with cGMP

Multiple Preparative HPLC LC-Forte/R

- Preparative device designed for both high-/low- pressure chromatography
- Ideal for purification in the crude stage through to the final stage
- Compact design but equipped with multiple functions such as recycling function, automatic programming function, etc.

Preparative HPLC Devices K-Prep series

- Strong support for preparative purifications provided by fully-automatic operation by PC
- Custom-made device available upon request
- Compliance with IQ/OQ validation and CSV

DAD/DAU series

- Suitable for high purification in various fields such as pharmaceuticals, fine chemicals and functional foods
- Cost-effective self-packing dyanamic axial compression columns
- Superior column performance, durability and reproducibility provided by usage at constant pressure

Flow Reactor

KeyChem®-Integral

- Heterogeneous reaction in single system

YSP-series syringe pump

- High-performance and cost-effective syringe pumps

YMC Columns

	Product Name		USP CLASS No.	Pore size (Å)	Particle size (µm)	C%	Silanol treatment	Usable pH range	Page	
									Analytical column	Preparative column
Reversed-phase	ODS									
	YMC-Triart	C18	L1	120	1.9, 3, 5	20	Yes	1.0~12.0	59~61	116~120
		C18 ExRS		80	1.9, 3, 5	25			62	
	Meteoric Core	C18		80	2.7	7		1.5~10.0	72~75	–
		C18 BIO		160	2.7	5				
	Pro series	*Pro* C18		120	2, 3, 5	16		2.0~8.0	83, 84	116~121
		Hydrosphere C18		120	2, 3, 5	12			83, 85	
		Pro C18 RS		80	3, 5	22		1.0~10.0	86	
	YMC-Pack ODS series	ODS-A		120	3, 5	17		2.0~7.5	87	116~121
				200	5	12				
				300	3, 5	7				
		ODS-AM		120	3, 5	17			87	121
		ODS-AQ		120	3, 5	14			88	116~121
				200	5	10				
		ODS-AL		120	5	17	No		88	121
	J'sphere ODS series	ODS-H80		80	4	22	Yes	1.0~9.0	89	121
		ODS-M80		80	4	14		2.0~7.5		
		ODS-L80		80	4	9				
	YMC-Pack PolymerC18			–	6, 10	–	–	2.0~13.0	89	–
	Other than ODS									
	YMC-Triart	C8	L7	120	1.9, 3, 5	17	Yes	1.0~12.0	63	116~120
		Phenyl	L11	120	1.9, 3, 5	17		1.0~10.0	64	
		PFP	L43	120	1.9, 3, 5	15	No	1.0~8.0	65	
	Meteoric Core C8		L7	80	2.7	5	Yes	1.5~9.0	72~75	–
	Pro series	*Pro* C8	L7	120	3, 5	10		2.0~7.5	96	122
		Pro C4	L26	120	3, 5	7				
	YMC-Pack series	C_8	L7	120	3, 5	10			97	122
				200	5	7				
				300	5	4				
		C_4	L26	120	3, 5	7			97	122
				200	5	5				
				300	5	3				
		TMS	L13	120	3, 5	4			98	122
		Ph	L11	120	3, 5	9			98	122
		CN	L10	120	3, 5	7			99	122
				300	5	3				
		PROTEIN-RP	L26	200	5	4	–	1.5~7.5	99	123
	YMCbasic		L7	200	3, 5	7	Yes	2.0~7.5	100	–
	YMC Carotenoid		L62	–	3, 5	–	–	2.0~7.5	100	123

	Product Name		USP CLASS No.	Pore size (Å)	Particle size (μm)	C%	Silanol treatment	Usable pH range	Page	
									Analytical column	Preparative column
Normal-phase	YMC-Triart Diol-HILIC		L20	120	1.9, 3, 5	12	–	2.0~10.0	66	–
	YMC-Pack series	SIL	L3	120	3, 5	–	–	2.0~7.5	104	123
		SIL-06		60	5					
		Diol-NP	L20	60	5				104	123
				120	5					
		CN	L10	120	5				105	122
		PVA-Sil	L24	120	5			2.0~9.5	105	–
		Polyamine Ⅱ	–	120	5			2.0~7.5	106, 107	123
		NH_2	L8	120	5				108	123
		PA-G	–	120	5			4.0~7.5	108	–
Ion exchange	YMC-BioPro series	QA	–	porous	5	–	–	2.0~12.0	37	–
		SP		porous	5					
		QA-F		non-porous	3, 5				38, 39	–
		SP-F		non-porous	3, 5					
SEC Silica-based	YMC-Pack series	Diol-60	L20 L33 L59	60	5	–	–	5.0~7.5	45, 46	47
		Diol-120		120	5					
		Diol-200		200	5					
		Diol-300		300	5					
SEC Polymer-based	YMC-GPC		–	50	10	–	–	–	–	124, 125
				100	10					
				500	10					
				1000	10					
				MIX	10					
Chiral separation	CHIRAL ART	Amylose-C	L51	–	3, 5	–	–	–	26~29	26~29
		Cellulose-C	L40	–	3, 5					
		Amylose-SA	–	–	3, 5			2.0~9.0		
		Cellulose-SB		–	3, 5					
		Cellulose-SC		–	3, 5					
	YMC CHIRAL series	NEA (R), (S)	–	300	5	–	–	2.0~6.5	30	–
		α-CD BR		120	5			3.5~6.5	31	–
		β-CD BR		120	5					
		γ-CD BR		120	5					

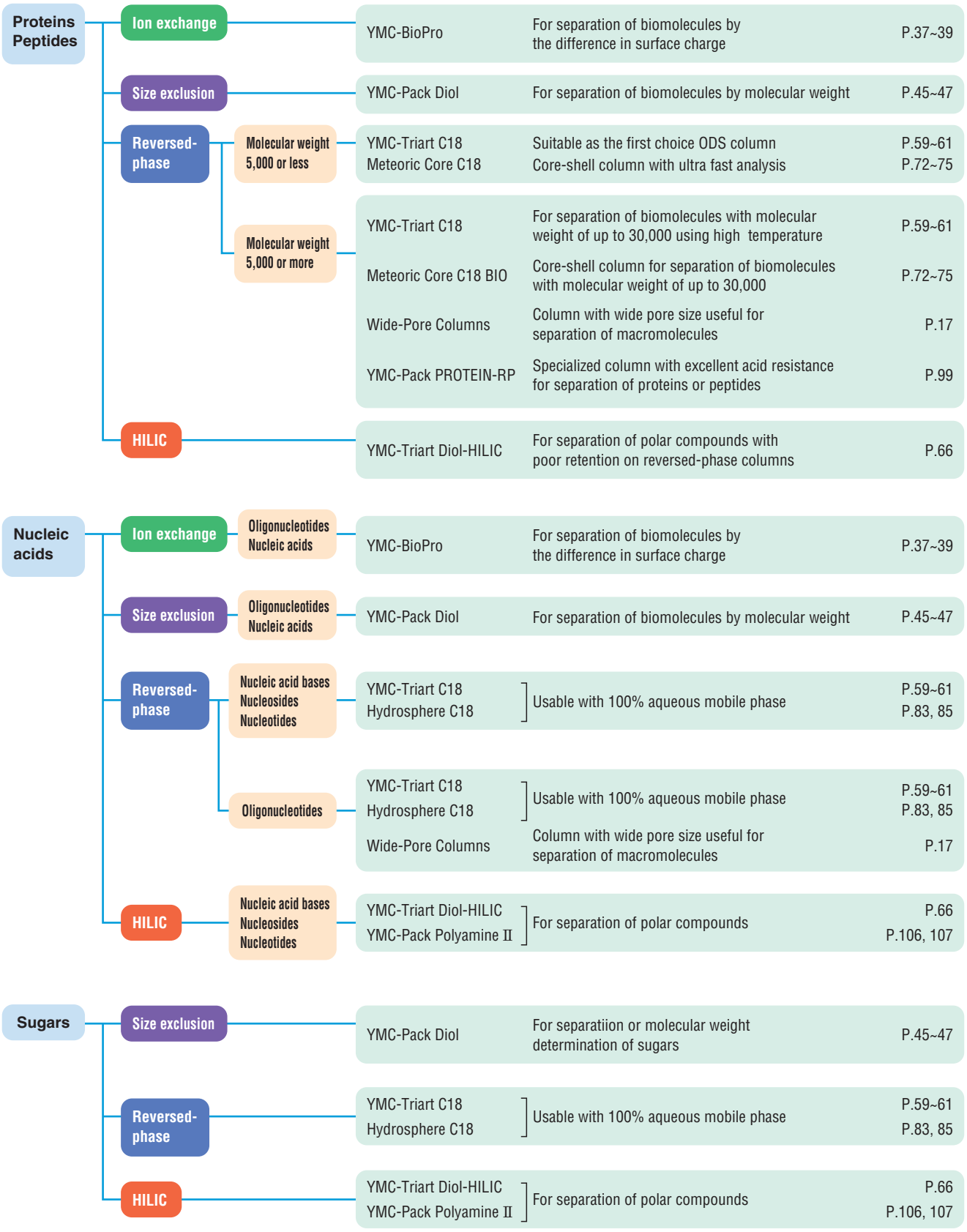
01

Column Selection Guide

USP

USP CLASS No.	USP Description	Functional group	YMC product	page
L1	Octadecyl silane chemically bonded to porous or nonporous silica or ceramic microparticles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	C18	YMC-Triart C18	59~61
			YMC-Triart C18 ExRS	62
			Meteoric Core C18	72~75
			Meteoric Core C18 BIO	
			YMC-UltraHT *Pro* C18	83
			YMC-UltraHT Hydrosphere C18	83
			YMC-Pack *Pro* C18	84
			Hydrosphere C18	85
			YMC-Pack *Pro* C18 RS	86
			YMC-Pack ODS-A	87
			YMC-Pack ODS-AM	87
			YMC-Pack ODS-AQ	88
			YMC-Pack ODS-AL	88
			J'sphere ODS-H80	89
			J'sphere ODS-M80	
			J'sphere ODS-L80	
L3	Porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	Silica	YMC-Pack SIL	104
			YMC-Pack SIL-06	
L7	Octylsilane chemically bonded to totally porous or superficially porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	C8	YMC-Triart C8	63
			Meteoric Core C8	72~75
			YMC-Pack *Pro* C8	96
			YMC-Pack C_8	97
			YMCbasic	100
L8	An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 1.5 to 10 µm in diameter.	NH_2	YMC-Pack NH_2	108
L10	Nitrile groups chemically bonded to porous silica particles, 1.5 to 10 µm in diameter.	CN	YMC-Pack CN	99
L11	Phenyl groups chemically bonded to porous silica particles, 1.5 to 10 µm in diameter.	Phenyl	YMC-Triart Phenyl	64
			YMC-Pack Ph	98
L13	Trimethylsilane chemically bonded to porous silica particles, 3 to 10 µm in diameter.	C1	YMC-Pack TMS	98
L20	Dihydroxypropane groups chemically bonded to porous silica or hybrid particles, 1.5 to 10 µm in diameter.	Diol	YMC-Triart Diol-HILIC	66
			YMC-Pack Diol-NP	104
			YMC-Pack Diol-60	45, 46
			YMC-Pack Diol-120	
			YMC-Pack Diol-200	
			YMC-Pack Diol-300	
L24	Polyvinylalcohol chemically bonded to porous silica particle, 5 µm in diameter.	Polyvinylalcohol	YMC-Pack PVA-Sil	105
L26	Butyl silane chemically bonded to totally porous silica particles, 1.5 to 10 µm in diameter.	C4	YMC-Pack *Pro* C4	96
			YMC-Pack C_4	97
			YMC-Pack PROTEIN-RP	99
L27	Porous silica particles, 30 to 50 µm in diameter.	Silica	YMC-Pack SIL-HG	130, 135
L33	Packing having the capacity to separate dextrans by molecular size over a range of 4,000 to 500,000 Da. It is spherical, silica-based, and processed to provide pH stability.	Diol	YMC-Pack Diol-60	45, 46
			YMC-Pack Diol-120	
			YMC-Pack Diol-200	
			YMC-Pack Diol-300	
L40	Cellulose tris-3,5-dimethylphenylcarbamate coated porous silica particles, 5 to 20 µm in diameter.	Cellulose tris-3,5-dimethylphenylcarbamate	CHIRAL ART Cellulose-C	26~29
L43	Pentafluorophenyl groups chemically bonded to silica particles by a propyl spacer, 1.5 to 10 µm in diameter.	PFP	YMC-Triart PFP	65
L51	Amylose tris-3,5-dimethylphenylcarbamate-coated, porous, spherical, silica partilces, 5 to 10 µm in diameter.	Amylose tris-3,5-dimethylphenylcarbamate	CHIRAL ART Amylose-C	26~29
L59	Packing for the size-exclusion separation of proteins (separation by molecular weight) over the range of 5 to 7,000 kDa. The packing is a spherical 1.5-to 10-µm, silica or hybrid packing with a hydrophilic coating.	Diol	YMC-Pack Diol-60	45, 46
			YMC-Pack Diol-120	
			YMC-Pack Diol-200	
			YMC-Pack Diol-300	
L62	C30 silane bonded phase on a fully porous spherical silica, 3 to 15 µm in diameter.	C30	YMC Carotenoid	100

Column selection guide (Biochromatography)

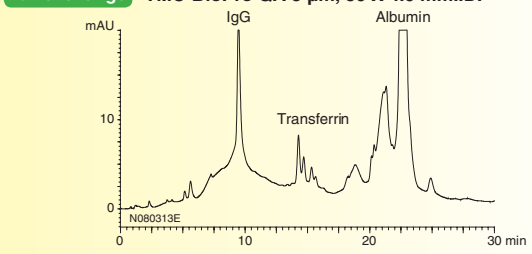


Comparison of separation mode

Separation of proteins by different mode

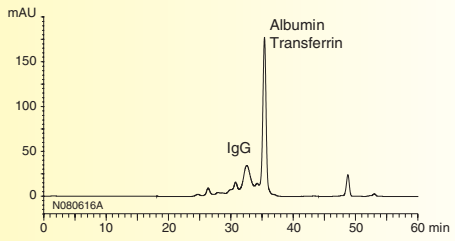
Human serum

Ion exchange **YMC-BioPro QA 5 µm, 50 X 4.6 mmI.D.**



Eluent	: A) 20 mM Tris-HCl (pH 8.6) B) 20 mM Tris-HCl (pH 8.6) containing 0.5 M NaCl 0-30%B (0-15 min), 30-100%B (15-30 min)
Flow rate	: 0.5 mL/min
Temperature	: 25°C
Detection	: UV at 280 nm
Injection	: 20 µL (100 µL/mL)

Size exclusion **YMC-Pack Diol-300 + Diol-200 5 µm, 300 X 8.0 mmI.D. X 2**

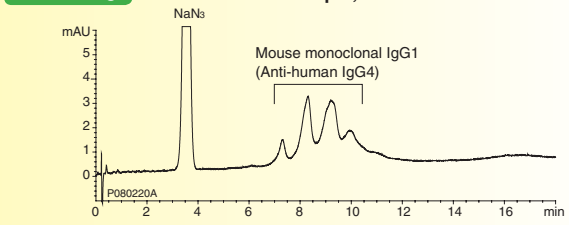


Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0) containing 0.2 M NaCl
Flow rate	: 0.5 mL/min
Temperature	: ambient (25°C)
Detection	: UV at 280 nm
Injection	: 20 µL (100 µL/mL)

Proteins in human serum are separated by the difference in the surface charge on ion exchange chromatography (IEC) and by the difference in the molecular weight on size exclusion chromatography (SEC).

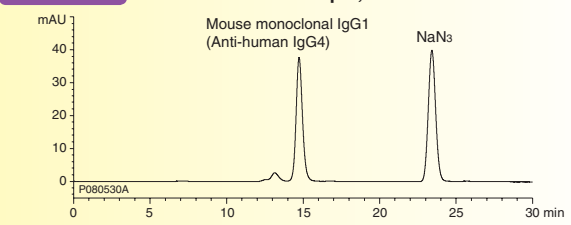
Mouse monoclonal IgG1 anti-human IgG4 (Purified by DEAE chromatography, containing NaN_3)

Ion exchange **YMC-BioPro QA-F 5 µm, 30 X 4.6 mmI.D.**



Eluent	: A) 20 mM Tris-HCl (pH 8.1) B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl 10-25%B (0-18 min)
Flow rate	: 1.0 mL/min
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 10 µL (0.1 mg/mL)

Size exclusion **YMC-Pack Diol-200 5 µm, 300 X 4.6 mmI.D.**

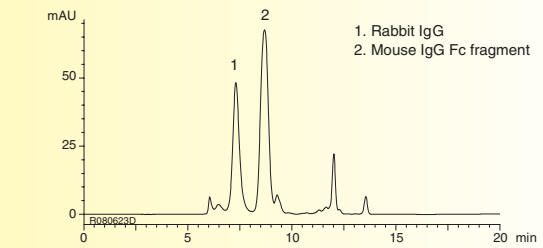


Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0)
Flow rate	: 0.17 mL/min
Temperature	: ambient (25°C)
Detection	: UV at 220 nm
Injection	: 10 µL (0.05 mg/mL)

Mouse monoclonal antibody against human IgG4 is analyzed on ion exchange chromatography (IEC) and size exclusion chromatography (SEC). Several peaks possibly derived from isoform of antibody are observed in ion exchange mode, while a single peak is detected in size exclusion mode.

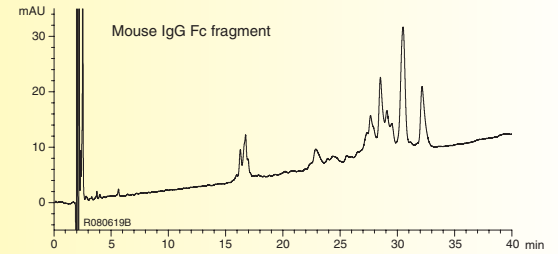
Mouse IgG Fc fragment (Prepared from normal serum)

Size exclusion **YMC-Pack Diol-200 5 µm, 300 X 8.0 mmI.D.**



Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 6.9) containing 0.2 M NaCl
Flow rate	: 1.0 mL/min
Temperature	: ambient (27°C)
Detection	: UV at 220 nm
Injection	: 5 µL (0.5 mg/mL)

Reversed-phase **YMC-Pack C_4 (300 Å) 5 µm, 150 X 4.6 mmI.D.**



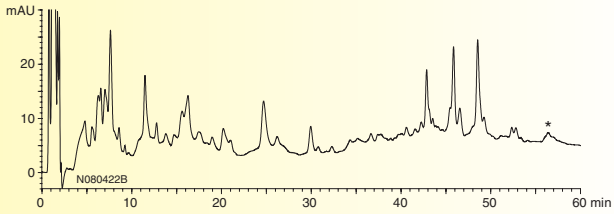
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 25-45%B (0-40 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm
Injection	: 5 µL (1.0 mg/mL)

Size exclusion chromatography (SEC) is useful for separation of substances which have distinct differences in molecular weight, like between IgG and its fragments. On the other hand, reversed-phase chromatography (RPC) is suitable for a precise analysis of peptides and proteins with a molecular weight of less than 100 kDa such as IgG Fc fragment.

Separation of proteins by different mode

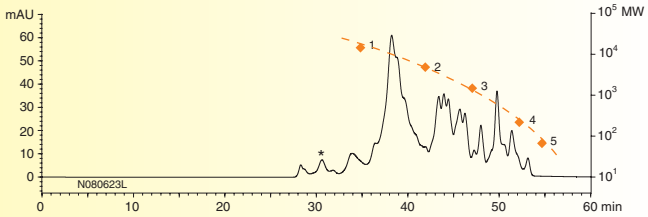
Tryptic digests of BSA

Ion exchange **YMC-BioPro QA 5 µm, 50 X 4.6 mmI.D.**



Eluent	: A) 20 mM Tris-HCl (pH 8.6) B) 20 mM Tris-HCl (pH 8.6) containing 0.5 M NaCl 0-15%B (0-30 min), 15-60%B (30-60 min)
Flow rate	: 0.5 mL/min
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 20 µL

Size exclusion **YMC-Pack Diol-120 + Diol-60 5 µm, 500 X 8.0 mmI.D. X 2**

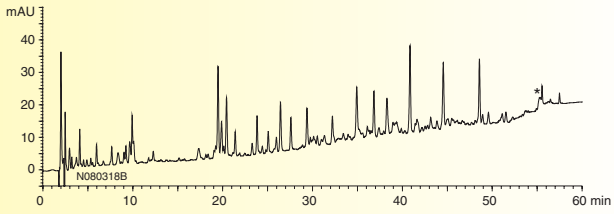


Calibration curve of peptides and proteins

1. Myoglobin	(MW 17,000)
2. Insulin (Bovine)	(MW 5,700)
3. Neurotensin	(MW 1,672)
4. Tetraglycine	(MW 246)
5. Glycine	(MW 75)

Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0) containing 0.2 M NaCl/acetonitrile (70/30)
Flow rate	: 0.7 mL/min
Temperature	: ambient (25°C)
Detection	: UV at 220 nm
Injection	: 5 µL

Reversed-phase **YMCbasic 5 µm, 150 X 2.0 mmI.D.**



* undigested BSA

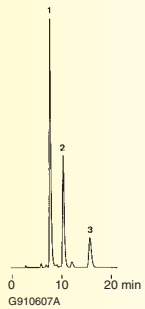
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 5-35%B (0-50 min), 35-45%B (50-55 min), 45%B (55-60 min)
Flow rate	: 0.2 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm
Injection	: 1 µL

These chromatograms show separation of tryptic digests of BSA (MW: 66,000) in ion exchange chromatography (IEC), size exclusion chromatography (SEC) and reversed-phase chromatography (RPC). The molecular weight of the digests is estimated to be approximately from 100 to 20,000 by SEC chromatogram. IEC and RPC chromatograms show many peaks of fragments which are separated by the difference in structure, charge and hydrophobicity.

Separation of sugar chains by different mode

Pyridylamino (PA) -Sugar chains

Reversed-phase **YMC-Pack ODS-A (120 Å) 5 µm, 150 X 4.6 mmI.D.**



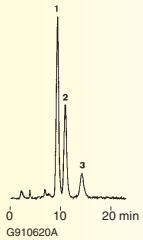
1.PA-Sugar Chain 014

2.PA-Sugar Chain 001

3.PA-Sugar Chain 002

Eluent	: methanol/20 mM $NH_4H_2PO_4$ (5/95)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: FLS at Ex. 320 nm, Em. 400 nm
Injection	: 2 µL (3.3 pmol/mL)
Sample	: PA-Sugar Chain Series, manufactured by TAKARA BIO INC.

Normal-phase **YMC-Pack Polyamine II 5 µm, 150 X 4.6 mmI.D.**



Eluent	: methanol/20 mM $NH_4H_2PO_4$ (80/20)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: FLS at Ex. 320 nm, Em. 400 nm
Injection	: 3 µL (3.3 pmol/mL)
Sample	: PA-Sugar Chain Series, manufactured by TAKARA BIO INC.

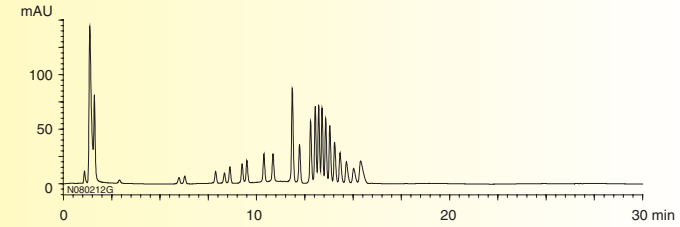
Pyridylamino (PA) sugar chains are often analyzed for structural determination of sugar chain in glycoproteins and glycolipids. Separations of PA sugar chains in reversed-phase (RP) mode and normal-phase (NP) mode are shown. Two dimensional HPLC combining two different modes, such as RP mode and NP mode, is useful tool for structural determination of sugar chain.

Comparison of separation mode

Separation of nucleic acids by different mode

DNA fragments 1 Kb DNA ladder (75 - 12,216 bp)

Ion exchange **YMC-BioPro QA-F 5 µm, 100 X 4.6 mmI.D.**

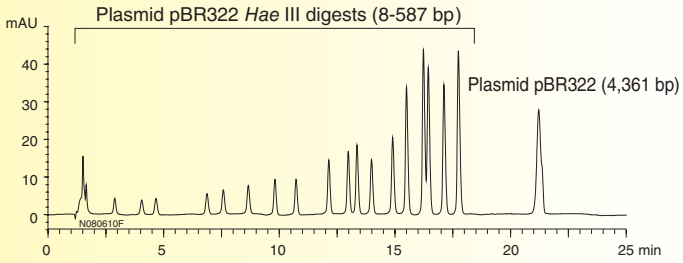


Eluent	: A) 20 mM Tris-HCl (pH 8.1) containing 0.7 M NaCl B) 20 mM Tris-HCl (pH 8.1) containing 1.0 M NaCl 0-100%B (0-30 min)
Flow rate	: 0.5 mL/min
Temperature	: 25°C
Detection	: UV at 260 nm
Injection	: 20 µL

DNA fragments are analyzed with YMC-BioPro QA-F ion exchange column. 100 mm length column of YMC-BioPro QA-F is ideal for high-resolution analysis of nucleic acids.

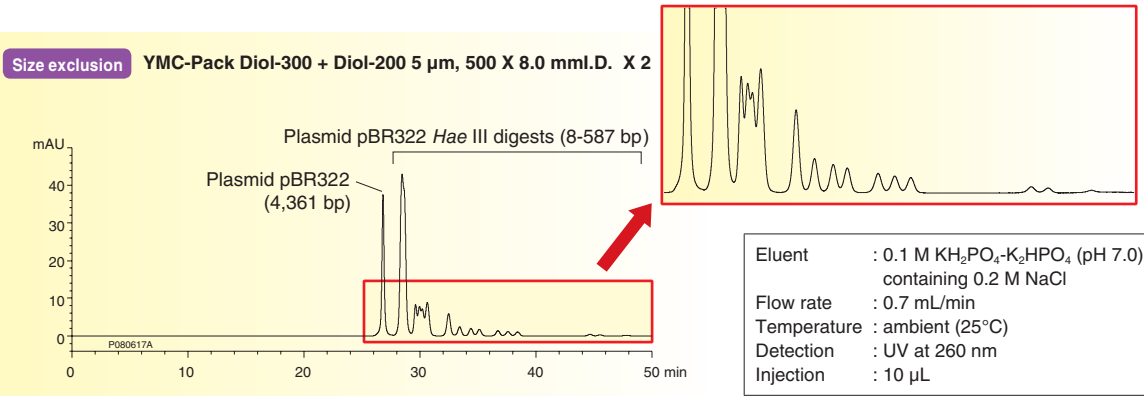
Plasmid pBR322 restriction fragments

Ion exchange **YMC-BioPro QA-F 5 µm, 100 X 4.6 mmI.D.**



Eluent	: A) 20 mM Tris-HCl (pH 8.1) B) 20 mM Tris-HCl (pH 8.1) containing 1.0 M NaCl 70-85%B (0-20 min), 85%B (20-25 min)
Flow rate	: 0.5 mL/min
Temperature	: 35°C
Detection	: UV at 260 nm
Injection	: 10 µL

Size exclusion **YMC-Pack Diol-300 + Diol-200 5 µm, 500 X 8.0 mmI.D. X 2**



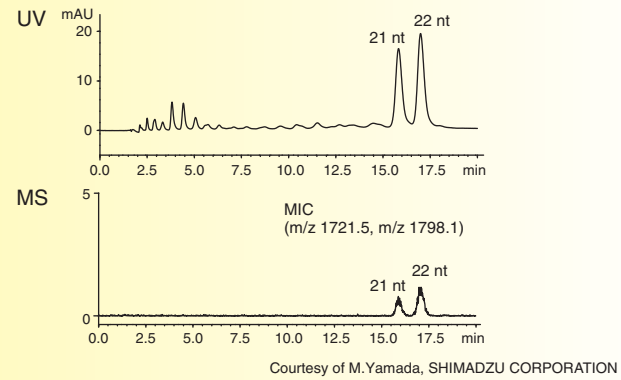
Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0) containing 0.2 M NaCl
Flow rate	: 0.7 mL/min
Temperature	: ambient (25°C)
Detection	: UV at 260 nm
Injection	: 10 µL

The separation of plasmid pBR322 restriction fragments (8-857 bp) is compared between in ion exchange mode and size exclusion mode. Ion exchange chromatography (IEC) is applicable to identification of each fragment requiring high resolution and size exclusion chromatography (SEC) is usable for characterization of molecular weight distribution.

Oligonucleotide (mi RNA)

YMC-Triart C18 3 µm, 150 X 2.0 mmI.D.

5'-pUGG AGU GUG ACA AUG GUG UUG-3' (21 nt, MW 6890.1)
5'-pUGG AGU GUG ACA AUG GUG UUG U-3' (22 nt, MW 7196.3)



Courtesy of M.Yamada, SHIMADZU CORPORATION

Eluent	: A) 10 mM DBAA* (pH 7.5) B) 10 mM DBAA* (pH 7.5)/acetonitrile (50/50) 62-72%B (0-20 min)
Flow rate	: 0.2 mL/min
Temperature	: 30°C
Detection	: UV at 260 nm and ESI-negative mode
Injection	: 4 µL (5 nmol/mL)
Instrument	: LC) Shimadzu Prominence MS) Shimadzu LCMS2020

* di-*n*-butylamine-acetic acid

This figure shows LC/MS analysis of oligonucleotides in reversed-phase mode. YMC-Triart C18 columns are useful for oligonucleotides and they can achieve excellent separation by one-nucleotide difference and sufficient intensity in UV and ESI-MS.

Reversed-phase separation of peptides and proteins

How to select reversed-phase columns

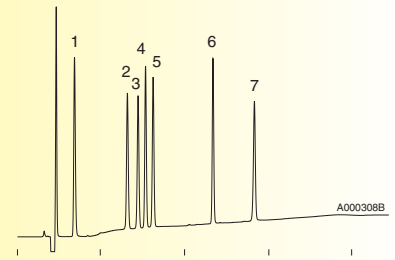
To separate proteins or peptides, it is important to select columns based on the molecular weight of the compounds to be separated. As shown in the table on the right, the C18 column with 120 Å pore size is generally suitable for small peptides up to MW 5,000. In the case of large peptides or small proteins up to MW 20,000, the C8 column with 200 Å pore size often gives the best column efficiency. Furthermore, most of proteins are eluted effectively by the C4 column with 300 Å. Separation may also be influenced by the hydrophobicity of the analyte and the type of the functional group as well as molecular weight. If the sufficient separation is not achieved with columns marked with a double circle, perform optimization as indicated by the arrows shown in the table. In addition to columns C18, C8, and C4 shown in the table, PROTEIN-RP and CN type columns with different selectivity are also useful.

Molecular weight of sample	Functional group / Pore size	C18	C8	C4
5,000 ↓ 20,000 ↓ 100,000	120 Å	◎	○	○
	200 Å	○	◎	○
	300 Å	○	○	◎

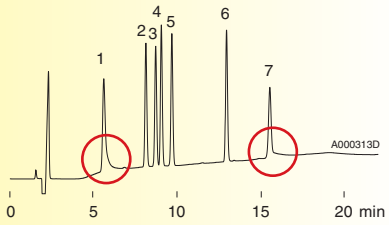
Separation of peptides (MW 574 - 3,465)

Excellent peak shapes for basic peptides

Hydrosphere C18 (120 Å) 5 µm, 150 X 4.6 mmI.D.



Brand E2 (100 Å) 5 µm, 150 X 4.6 mmI.D. (ODS column for hydrophilic compounds)



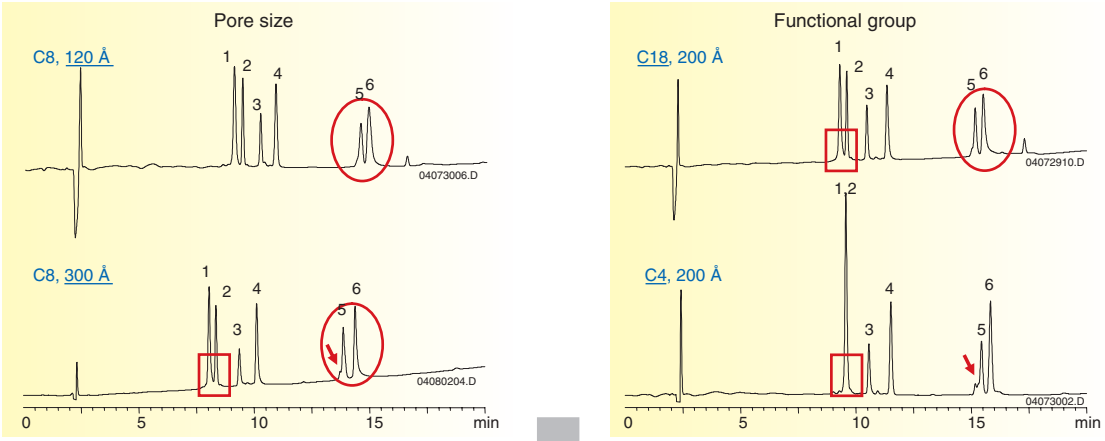
1. BAM-12P (MW 1,425)
2. [D-Ala^2,Met^5]-Enkephalinamide (MW 587)
3. α-Endorphin (MW 1,746)
4. Met-Enkephalin (MW 574)
5. [D-Ala^2,Met^5]-Enkephalin (MW 588)
6. γ-Endorphin (MW 1,899)
7. β-Endorphin (MW 3,465)

Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 20-40%B (0-15 min), 40%B (15-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

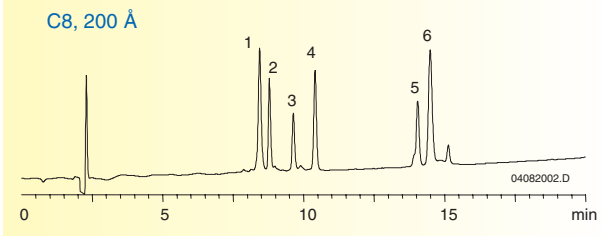
Generally, the conventional C18 column with 120 Å pore size is suitable for analysis of small peptides up to 5,000 in molecular weight. Especially Triart and Pro series ODS columns, which are processed with advanced endcapping technology, are ideal for separation of basic peptides. As shown in the above, Hydrosphere C18, a Pro series column, exhibits excellent separations and superior peak shapes of basic peptides (peak 1 and 7), in contrast to the commercial ODS column for hydrophilic compounds, Brand E2.

Separation of peptides and proteins (MW 4,300 - 17,000)

Comparison of separation on columns with different pore size and functional group



Optimized combination of pore size and functional group



1. Cytochrome *c* (MW 12,400)
2. Insulin (Bovine) (MW 5,700)
3. Amyloid β-protein (MW 4,300)
4. Lysozyme (MW 14,300)
5. α-Lactalbumin (MW 14,100)
6. Myoglobin (MW 17,000)

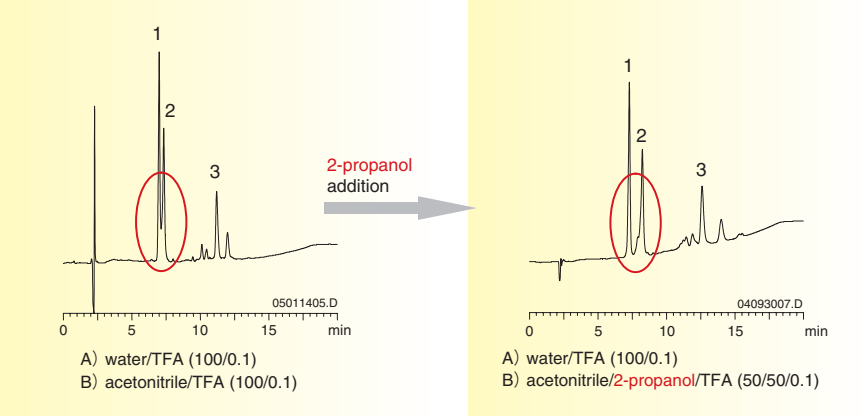
Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 25-60%B (0-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

For proteins and peptides 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, 200 Å for groups of compounds with a molecular weight within this range. If either pore size or functional group of the packing material is not optimized, peak broadening and poor resolution are observed. By using the most suitable column (C8, 200 Å) for the target compounds, sharp peak shapes and excellent separation are achieved.

Reversed-phase separation of peptides and proteins

Separation of proteins (MW 66,000 - 96,000)

Optimization of eluent conditions (C4, 300 Å)

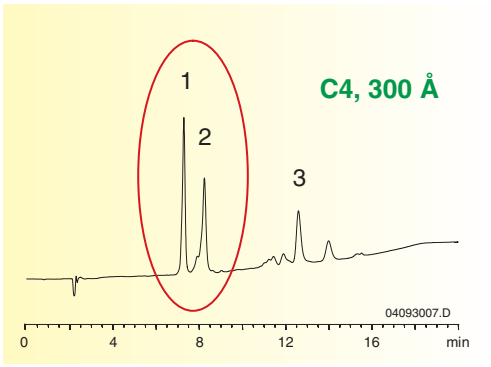


1. BSA (MW 66,000)
2. Conalbumin (MW 77,000)
3. Lipoxidase (MW 96,000)

Column	: YMC-Pack C_4 (5 µm, 300 Å) 150 X 4.6 mmI.D.
Gradient	: 30-75%B (0-15 min), 75%B (15-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

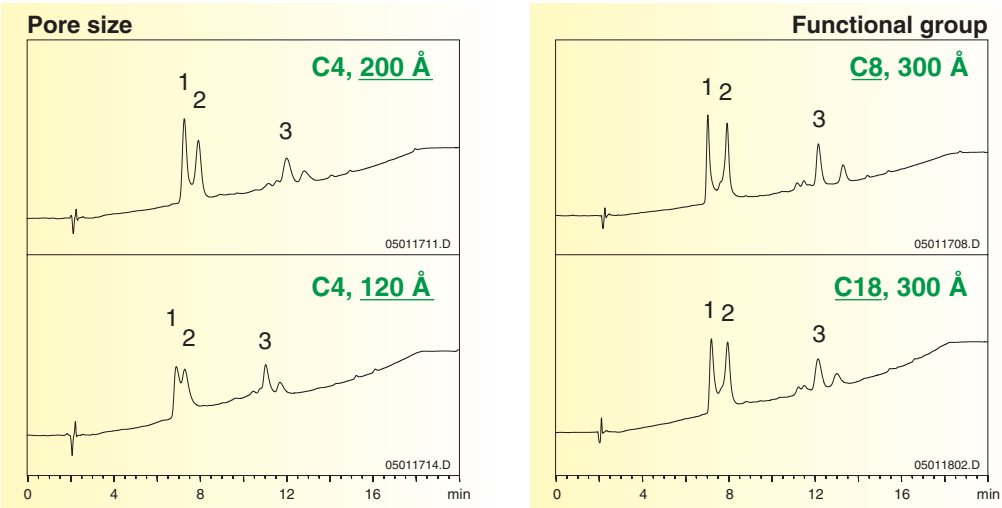
Gradient elution of water and acetonitrile containing TFA are often employed in an analysis of proteins and peptides. In some cases, addition of a "third solvent" is effective for change in selectivity and separation. The above example shows the resolution between highmolecular weight proteins (peak 1 and 2) is improved by adding 2-propanol into the standard mobile phase of acetonitrile/water/TFA.

Comparison of separation on columns with different pore size and functional group



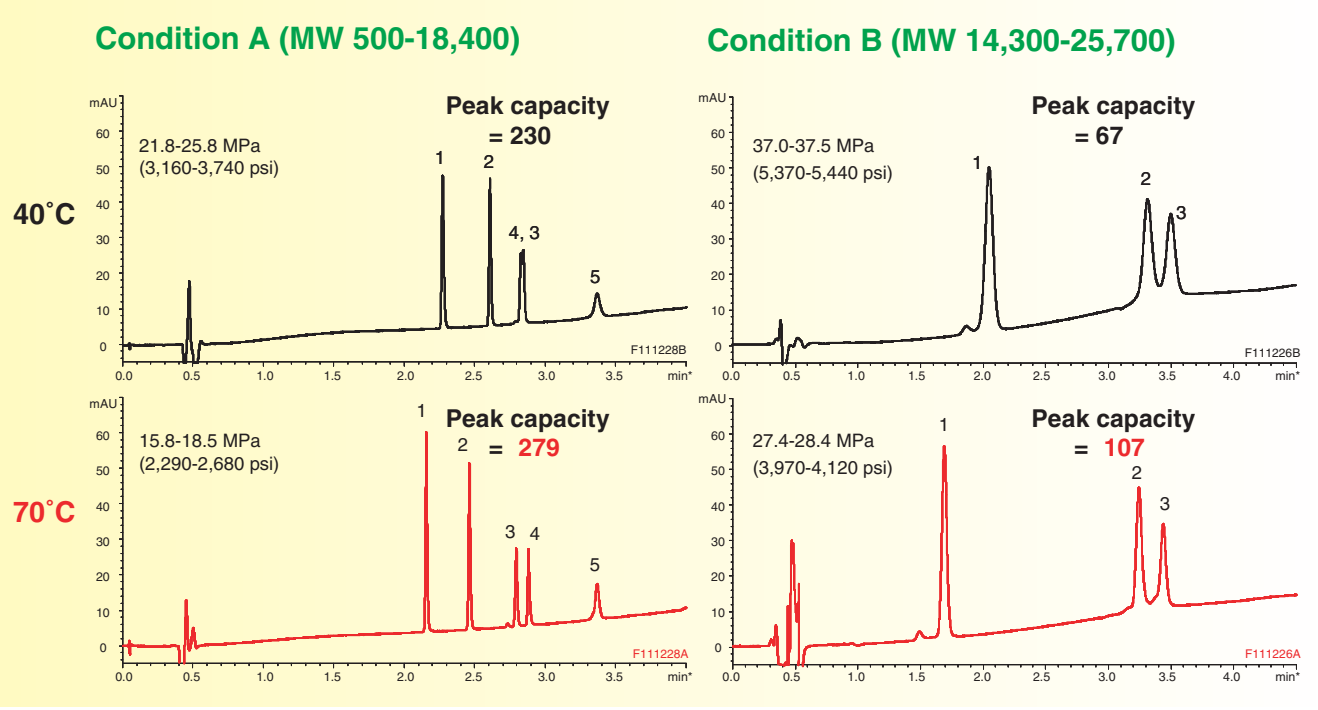
1. BSA (MW 66,000)
2. Conalbumin (MW 77,000)
3. Lipoxidase (MW 96,000)

Column	: 5 µm, 150 X 4.6 mmI.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°C
Detection	: UV at 220 nm



Separation characteristics of proteins with molecular weight of 66,000 to 96,000 are compared using columns with different pore size and functional group. The columns with smaller pore size, which have the same C4 functional groups, provide broader peak shapes and poor separations. In comparison among the 300 Å pore columns with different functional groups, the longer alkyl chain such as C18 and C8 results in poor resolution. It is important to choose optimal pore size and functional group depending on molecular weight of proteins for better peak shapes and resolutions. Proteins with molecular weight of 20,000 to 100,000 are separated effectively by the C4 column with 300 Å pore size.

Effect of column temperature on separation of peptides and proteins



Analytes	MW	Peak width ½ (min)	
		40°C	70°C
Condition A			
1. Oxytocin	1,007	0.017	0.014
2. Leu-Enkephalin	556	0.015	0.015
3. β-Endorphin	3,465		0.016
4. Insulin	5,733		0.015
5. β-Lactoglobulin A	18,400	0.043	0.030
Condition B			
1. Lysozyme	14,300	0.069	0.044
2. α-Chymotrypsinogen	25,700	0.080	0.049
3. β-Lactoglobulin A	18,400	0.080	0.048

Column	: YMC-Triart C18 (1.9 µm, 120 Å) , 50 X 2.0 mmI.D.
Eluent	: A) water/TFA (100/0.1)
	B) acetonitrile/TFA (100/0.1) - condition A
	B) acetonitrile/2-propanol/TFA (50/50/0.1) - condition B
Gradient	: 10-80%B (0-5 min) - condition A
	30-60%B (0-5 min) - condition B
Flow rate	: 0.4 mL/min
Detection	: UV at 220 nm
Injection	: 1 µL (50 µg/mL) - condition A
	1 µL (250 µg/mL) - condition B
System	: Agilent 1200SL

PC (peak capacity) = 1 + (gradient time/peak width*)
*peak width = $2W_{0.5h}$ average

The effect of temperature on separation of peptides and proteins with a variety of molecular weight (MW) is estimated. The separations at 40°C and 70°C are compared.
By increasing column temperature to 70°C, selectivity change is observed, and peaks become sharper. Thus, improved resolution especially for larger molecules is obtained. Generally, larger molecules diffuse very slowly compared to small molecules. An elevated temperature can improve efficiency and peak shape by lowering mobile phase viscosity and improving mass transfer.
Temperature is a simple and effective tool to increase resolution in separation of proteins and peptides.

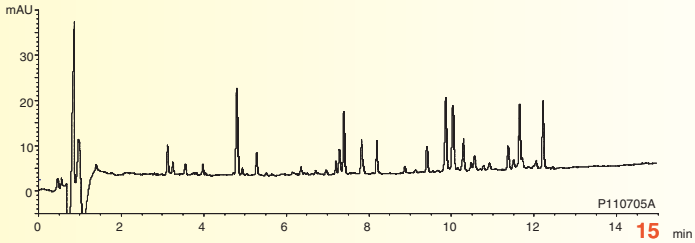
Reversed-phase separation of peptides and proteins

Improvement of resolution by increasing column temperature and coupling of 1.9 µm columns

40˚C

1.9 µm, 100 X 2.0 mmI.D.
15 min gradient
46.5-48.5 MPa (6,740-7,030 psi)

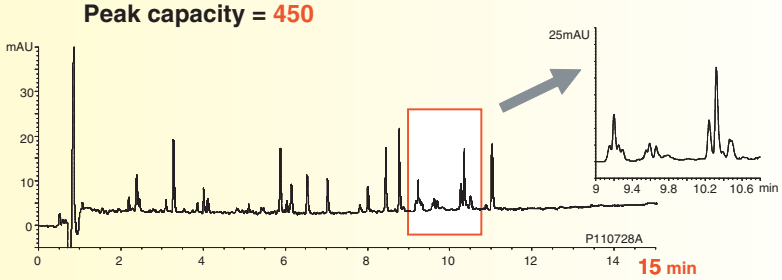
Peak capacity = 365



70˚C

1.9 µm, 100 X 2.0 mmI.D.
15 min gradient
27.6-28.6 MPa (4,000-4,150 psi)

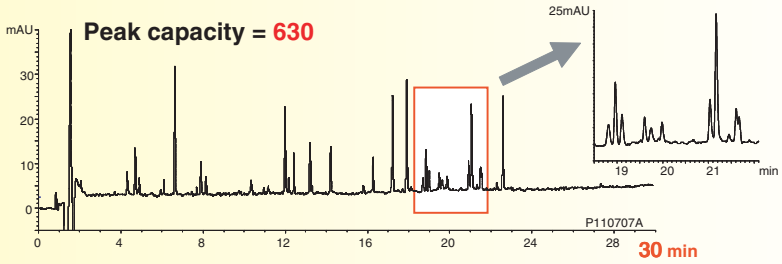
Peak capacity = 450



Coupling of two columns

Two coupled
1.9 µm, 100 X 2.0 mmI.D.
30 min gradient
58.1-61.6 MPa (8,430-8,930 psi)

Peak capacity = 630



Column	: YMC-Triart C18 (1.9 µm, 120 Å)
Eluent	: A) water/TFA (100/0.1)
	B) acetonitrile/TFA (100/0.08)
	5-40%B (0-15 min) for a single column
	5-40%B (0-30 min) for two coupled columns
Flow rate	: 0.4 mL/min
Detection	: UV at 220 nm
Injection	: 10 µL for a single column
	20 µL for two coupled columns
Sample	: Tryptic digest of Bovine Hemoglobin
System	: Agilent 1290

23% more peaks can be resolved by increasing the column temperature to 70°C in the separation of tryptic digest of Hemoglobin.
The outstanding efficiency obtained by a coupling of two 100 mm length of Triart 1.9 µm columns reduces co-elution peaks and allows the precise separation in an analysis of complicated samples, such as peptide mapping.

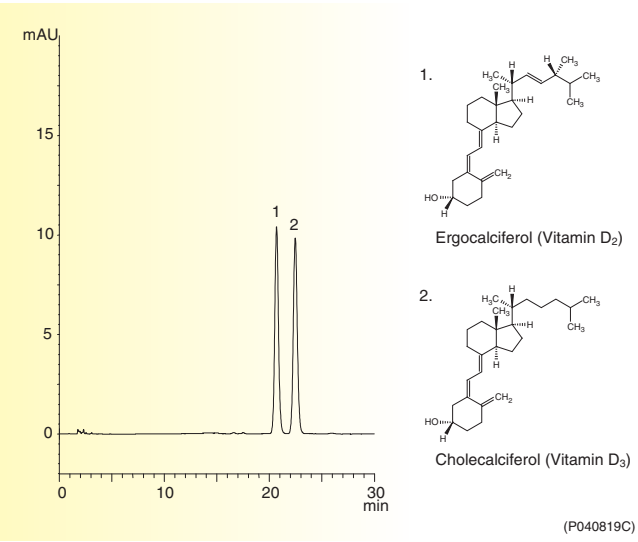
Column selection guide (Low molecular weight organic compounds)

Pharmaceutical products Agricultural chemicals Metabolites Food additives Natural products Others	Reversed-phase		YMC-Triart C18	Suitable as the first choice column for reversed-phase separation	P.59~61
			YMC-Triart (C18, C18 ExRS, C8, PFP, Phenyl)	Effective for method screening with 5 chemistries	P.59~65
	Normal-phase		YMC-Pack SIL, SIL-06	Standard normal-phase column	P.104
			YMC-Pack Diol-NP	Normal-phase column providing separation characteristics different from bare silica gel	P.104
	HILIC		YMC-Triart Diol-HILIC	For separation of polar compounds with poor retention on reversed-phase columns	P.66
Vitamins	Reversed-phase	Water-soluble vitamins	YMC-Triart C18	Usable with 100% aqueous mobile phase (For separation under a buffered or ion pairing mobile phase)	P.59~61
		Fat-soluble vitamins	YMC-Triart C18	Suitable as the first choice ODS column	P.59~61
			YMC-Pack ODS-AL	Non-endcapped ODS, suitable for separation of compounds with similar structure	P.88
			YMC Carotenoid (C30)	Separation behavior different from ODS	P.100
	HILIC	Water-soluble vitamins	YMC-Pack Polyamine II, NH_2	For separation of water-soluble vitamins such as vitamin C under HILIC mode	P.106~108
			YMC-Triart Diol-HILIC	For simultaneous separation of water-soluble vitamins	P.66
	Normal-phase	Fat-soluble vitamins	YMC-Pack SIL, SIL-06 YMC-Pack Polyamine II	For separation of fat-soluble vitamins such as tocopherol	P.104 P.106, 107
Organic acids Fatty acids	Reversed-phase		YMC-Triart C18	Usable with 100% aqueous mobile phase	P.59~61
	Normal-phase		YMC-Pack SIL, SIL-06	Standard normal-phase column	P.104
Phospholipids	Reversed-phase		YMC-Triart C18	For separation of molecular species	P.59~61
	Normal-phase		YMC-Pack SIL, SIL-06 YMC-Pack PVA-Sil YMC-Pack Diol-NP	For separation of phospholipid classes	P.104, 105
Amino acids	HILIC	Free amino acids	YMC-Triart Diol-HILIC	For simultaneous separation of amino acids under HILIC mode	P.66
	Reversed-phase	Free amino acids	YMC-Triart C18	Usable with 100% aqueous mobile phase	P.59~61
			Hydrosphere C18	For separation of hydrophobic amino acids	P.83, 85
		Labeled amino acids	YMC-Triart C18	Suitable as the first choice ODS column	P.59~61
Structural isomers	Reversed-phase		YMC-Triart C18 ExRS	High-density bonding for excellent ability to recognize planar structure	P.62
			YMC Carotenoid (C30)	For carotenoids separation	P.100
			YMC-Triart C8	For separations of isomers or structural analogs	P.63
			YMC-Triart PFP	For separations of polar compounds or isomers	P.65
			CHIRAL ART	For separations of isomers or structural analogs	P.26~29
	Normal-phase		YMC-Pack SIL, SIL-06	Standard normal-phase column	P.104
			CHIRAL ART	For separations of isomers or structural analogs	P.26~29
Optical isomers	Reversed-phase		CHIRAL ART YMC CHIRAL NEA	For separation of optical isomers	P.26~30
	Normal-phase		CHIRAL ART YMC CHIRAL NEA	For separation of optical isomers	P.26~30

Application 1 (Fat-soluble vitamins, Water-soluble vitamins)

Reversed-phase Vitamin D

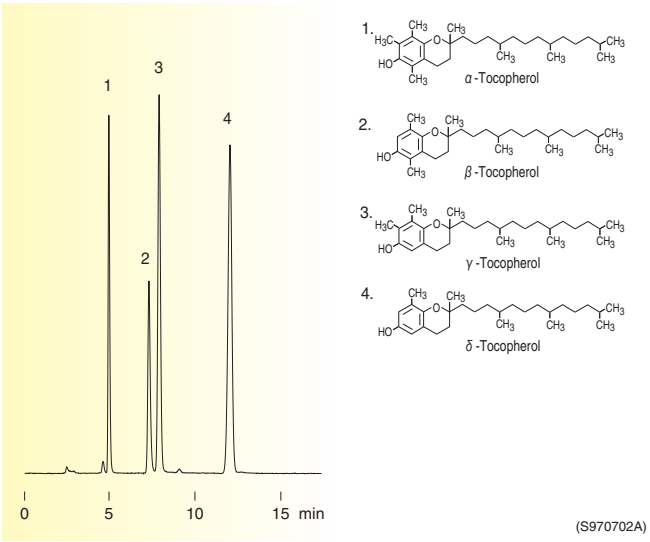
Separation of structurally similar compounds



Column	: YMC-Pack ODS-AL (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: acetonitrile/water (95/5)
Flow rate	: 1.0 mL/min
Temperature	: 40°C
Detection	: UV at 265 nm
Injection	: 10 µL (0.01 mg/mL)

Normal-phase Vitamin E (Tocopherols)

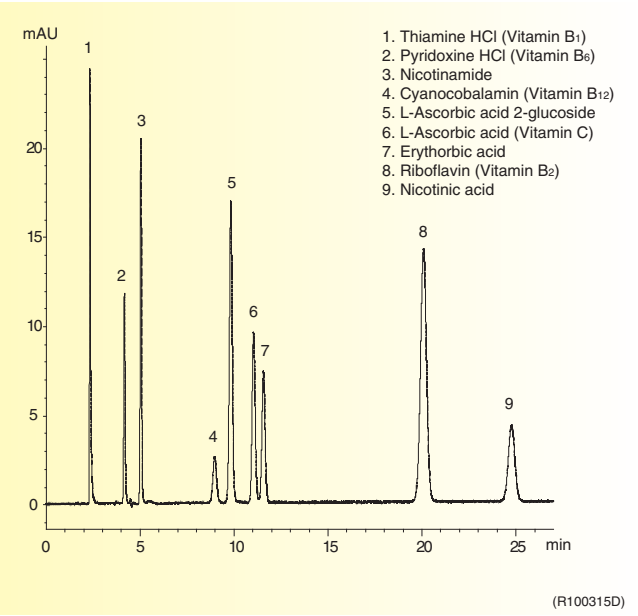
Separation of tocopherol homologues



Column	: YMC-Pack SIL (5 µm, 120 Å) 250 X 4.6 mm I.D.
Eluent	: *n*-hexane/2-propanol/acetic acid (1000/6/5)
Flow rate	: 1.4 mL/min
Temperature	: 35°C
Detection	: FLS at Ex 298 nm, Em 325 nm
Injection	: 20 µL (5~20 µg/mL)

Reversed-phase Water-soluble vitamins

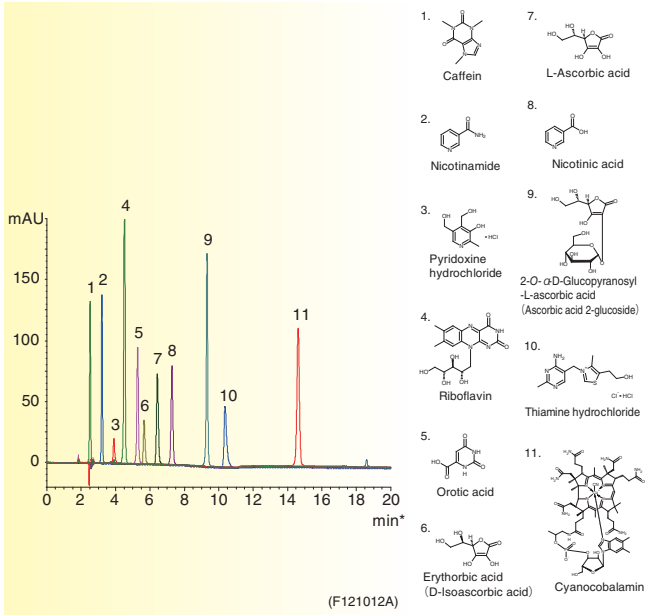
Simultaneous separation of water-soluble vitamins under ion pairing mobile phase



Column	: YMC-Triart C18 (5 µm, 120 Å) 250 X 4.6 mmI.D.
Eluent	: phosphate buffer*/acetonitrile (90/10) *Dissolve 1.4 g KH_2PO_4 in 800 mL water → add 26 mL 10% TBA·OH → adjust pH 5.2 by 20% H_3PO_4 → add water to make 1000 mL
Flow rate	: 0.8 mL/min
Temperature	: 40°C
Detection	: UV at 260 nm
Injection	: 10 µL (5 µg/mL)

HILIC Water-soluble vitamins

Simultaneous separation of water-soluble vitamins under HILIC mode

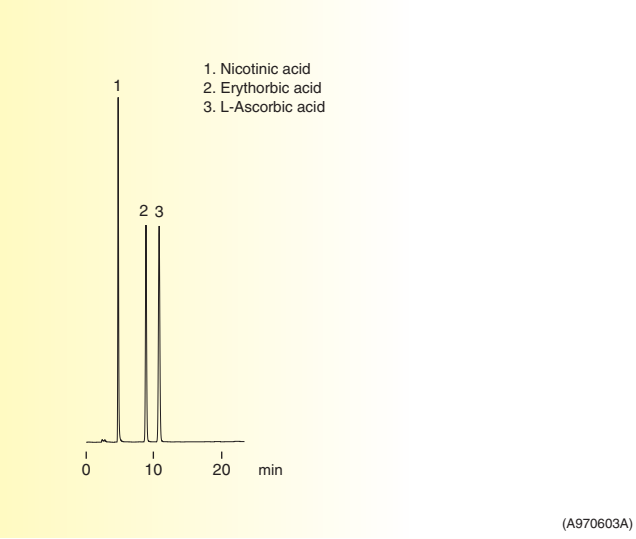


Column	: YMC-Triart Diol-HILIC (5 µm, 120 Å) 150 X 3.0 mmI.D.
Eluent	: A) acetonitrile/200 mM HCOOH-$HCOONH_4$ (pH 3.6)/water (90/5/5) B) acetonitrile/200 mM HCOOH-$HCOONH_4$ (pH 3.6)/water (50/5/45) 0-75%B (0-20 min)
Flow rate	: 0.425 mL/min
Temperature	: 40°C
Detection	: UV at 254 nm
Injection	: 4 µL (50 µg/mL)

Application 2 (Water-soluble vitamins, Organic acids, Amino acids)

HILIC Vitamin C (Ascorbic acid)

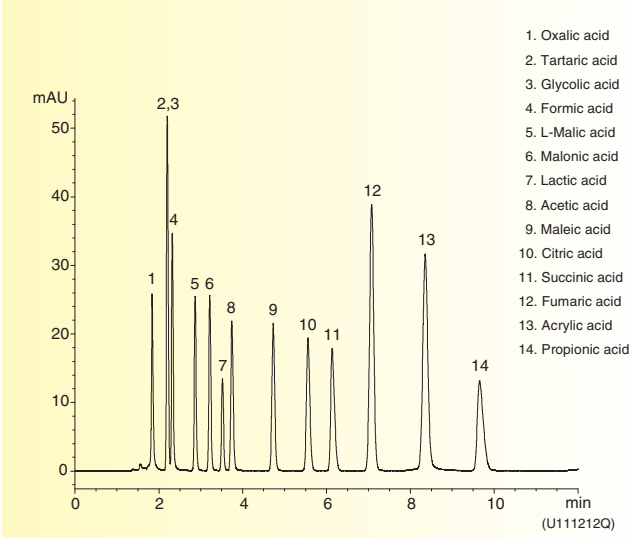
Separation of ascorbic acid under HILIC mode



Column	: YMC-Pack Polyamine Ⅱ 250 X 4.6 mmI.D.
Eluent	: acetonitrile/50 mM $NH_4H_2PO_4$ (70/30)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 250 nm, 0.16 AUFS
Injection	: 10 µL (0.05~0.1 mg/mL)

Reversed-phase Organic acids

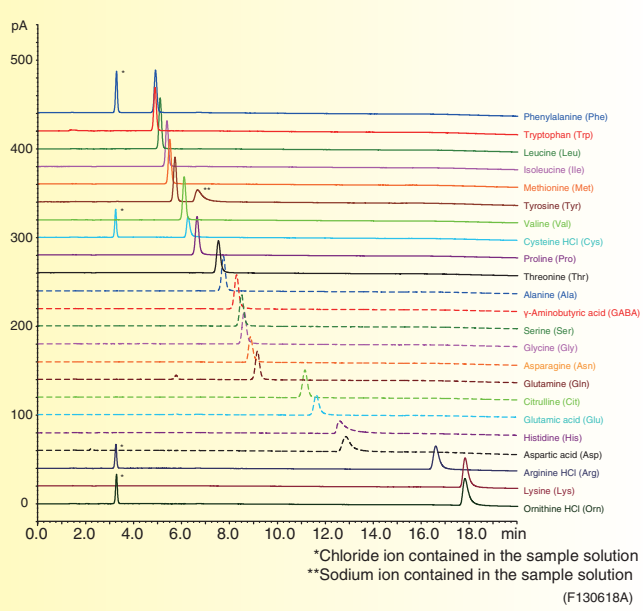
Simultaneous separation of organic acids under 100% aqueous mobile phase



Column	: YMC-Triart C18 (3 µm, 120 Å) 150 X 3.0 mmI.D.
Eluent	: 20 mM phosphoric acid
Flow rate	: 0.425 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm
Injection	: 2 µL (0.005~1.5 mg/mL)

HILIC Amino acids

Simultaneous separation of amino acids under HILIC mode

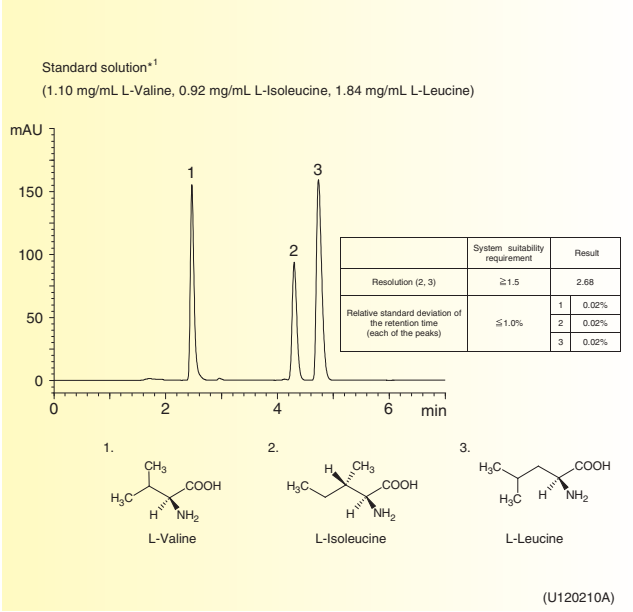


Column	: YMC-Triart Diol-HILIC (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: A) 100 mM HCOOH-$HCOONH_4$ (pH 3.6) B) acetonitrile 83-80%B (0-12 min), 80-68%B (12-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 40°C
Detection	: Corona® CAD® (Charged Aerosol Detector)
Injection	: 10 µL (0.1 mg/mL)

Corona and CAD are trademarks of Thermo Fisher Scientific.

Reversed-phase Amino acids

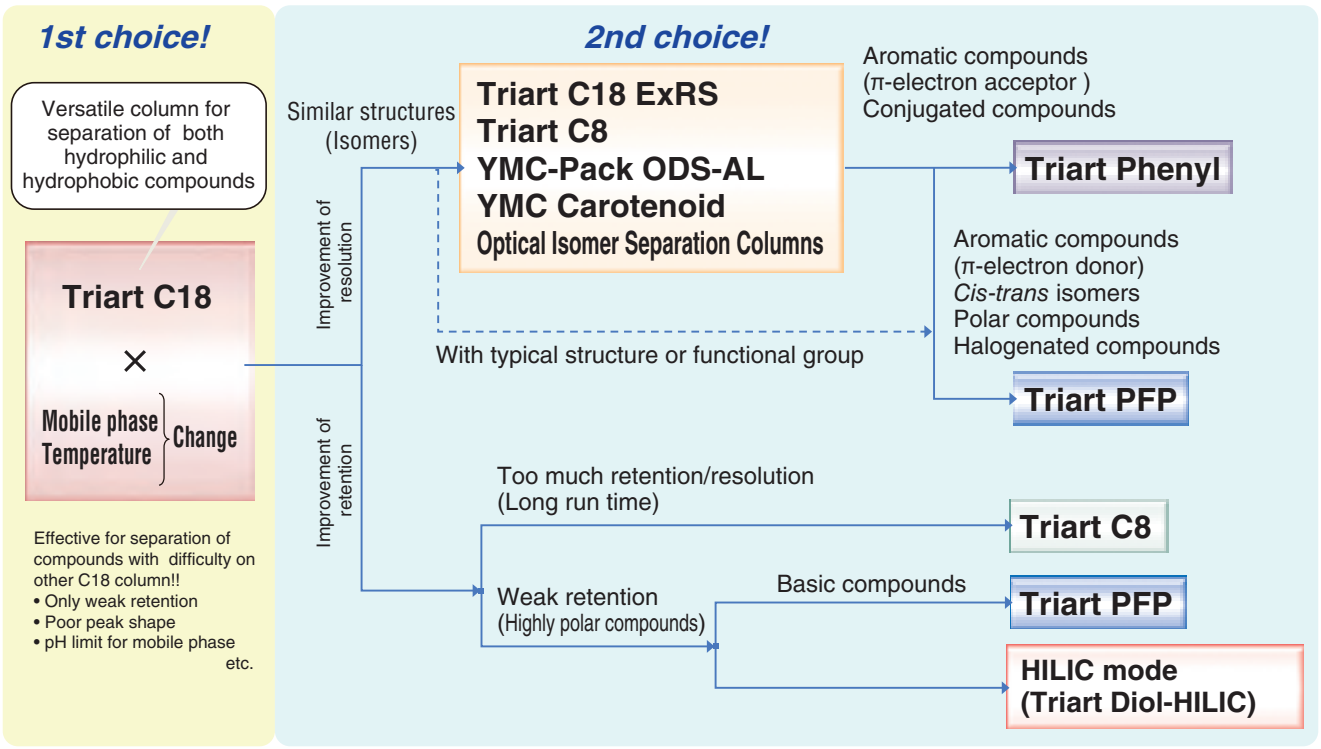
Separation of hydrophobic amino acids under highly aqueous mobile phase (JP method)



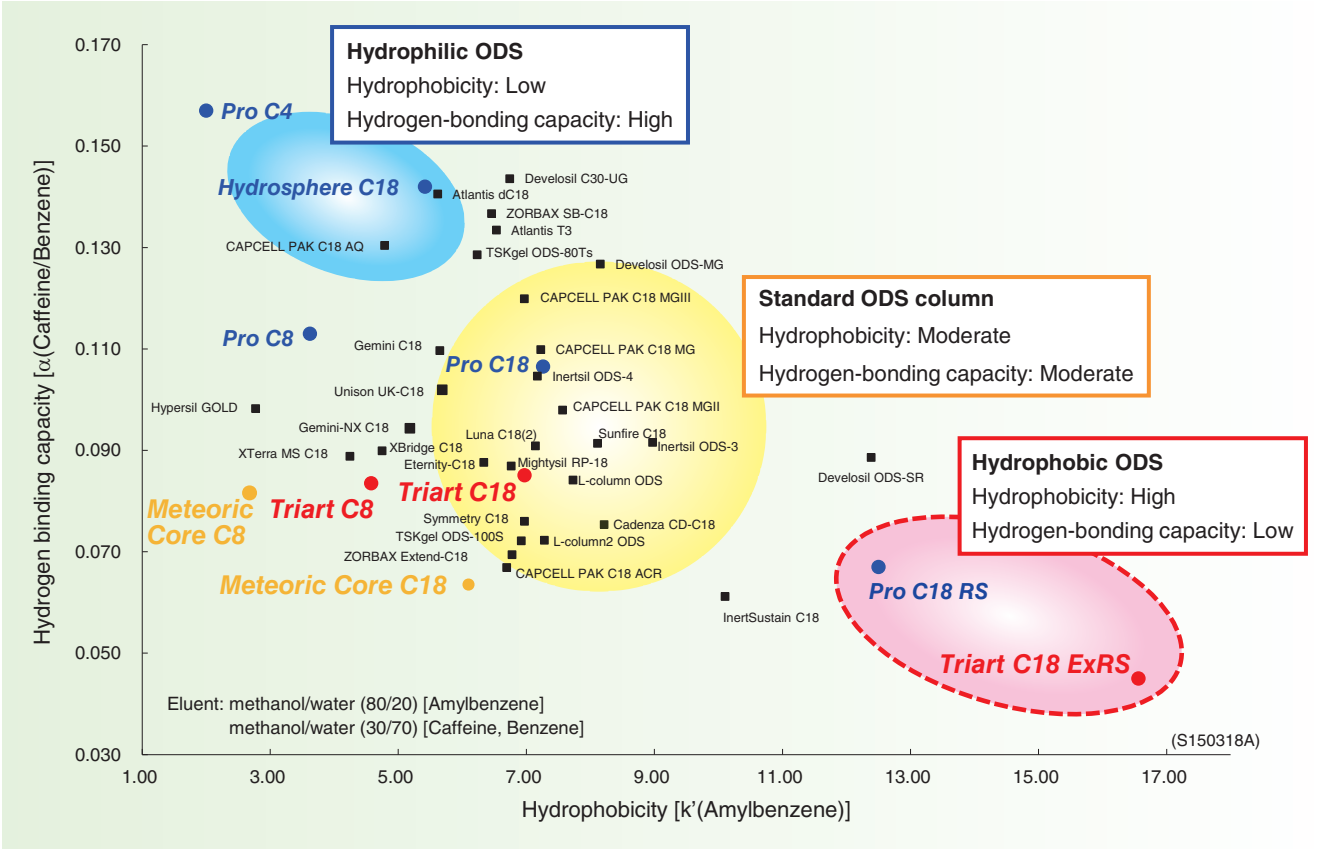
Column	: YMC-Triart C18 (3 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: phosphate buffer (pH 2.8)*2/acetonitrile (97/3) *2 *Dissolve 31.2 g of $NaH_2PO_4{\cdot}2H_2O$ in 1000 mL of water and adjust pH 2.8 with H_3PO_4*
Flow rate	: 0.9 mL/min *(adjust the flow rate so that the retention time of L-Valine is about 2.5 min)*
Temperature	: 40°C
Detection	: UV at 210 nm
Injection	: 20 µL
(The Japanese Pharmacopoeia 16th; Identification)	

*1 Standard solution was prepared from L-Valine, L-Isoleucine and L-Leucine supplied as a reagent for laboratory use.

Reversed-phase column selection guide



Comparison of hydrophobicity and hydrogen-bonding capacity of various columns



02

Optical Isomer Separation Columns and Packing Materials

Polysaccharide type

CHIRAL ART

- Applicable to various chiral compounds
- Excellent resolution/durability
- Extremely low initial cost on analysis and purification
- High durability column that is suitable for SFC

- Particl size: 3, 5, 10, 20 µm
- USP L40, L51

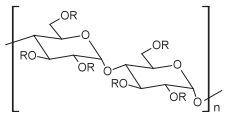
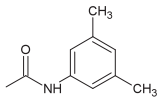
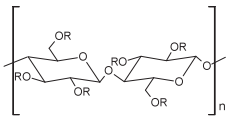
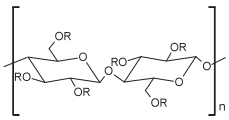
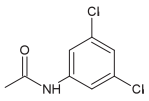
*See p.109, 110 for details of SFC column.

HPLC column / packing material with polysaccharide derivatives chiral selector

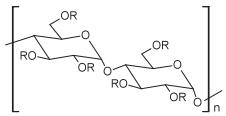
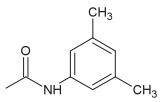
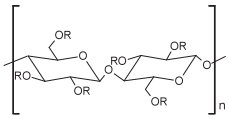
CHIRAL ART are HPLC column / packing materials coated/immobilized with polysaccharide derivatives chiral selector. CHIRAL ART Immobilized type can be used either in normal or reversed phase modes. CHRAL ART are suitable for separations of wide range of chiral compounds, cis-trans isomers and geometric isomers. Packing materials are available in large quantities (multi kg).

Specifications

Immobilized type

Column/Packing material		Particle size (µm)	Chiral selector		USP Classification
CHIRAL ART Amylose-SA		3 5 10 20	 Amylose tris(3,5-dimethylphenylcarbamate)	 R: 3,5-Dimethylphenylcarbamate	–
CHIRAL ART Cellulose-SB			 Cellulose tris(3,5-dimethylphenylcarbamate)		–
CHIRAL ART Cellulose-SC			 Cellulose tris(3,5-dichlorophenylcarbamate)	 R: 3,5-Dichlorophenylcarbamate	–
Usable mobile phase	Normal-phase	*n*-hexane, *n*-heptane, methanol, ethanol, 2-propanol, acetonitrile, ethyl acetate, tetrahydrofuran, chloroform, *t*-butyl methyl ether, etc.			
	Reversed-phase	acetonitrile, methanol, ethanol, 2-propanol, tetrahydrofuran, water, aqueous buffer, etc.			

Coated type

Column/Packing material	Particle size (µm)	Chiral selector		USP Classification
CHIRAL ART Amylose-C	3 5 10 20	 Amylose tris(3,5-dimethylphenylcarbamate)	 R: 3,5-Dimethylphenylcarbamate	L51
CHIRAL ART Cellulose-C		 Cellulose tris(3,5-dimethylphenylcarbamate)		L40
Usable mobile phase	*n*-hexane, *n*-heptane, ethanol, 2-propanol, acetonitrile, etc.			

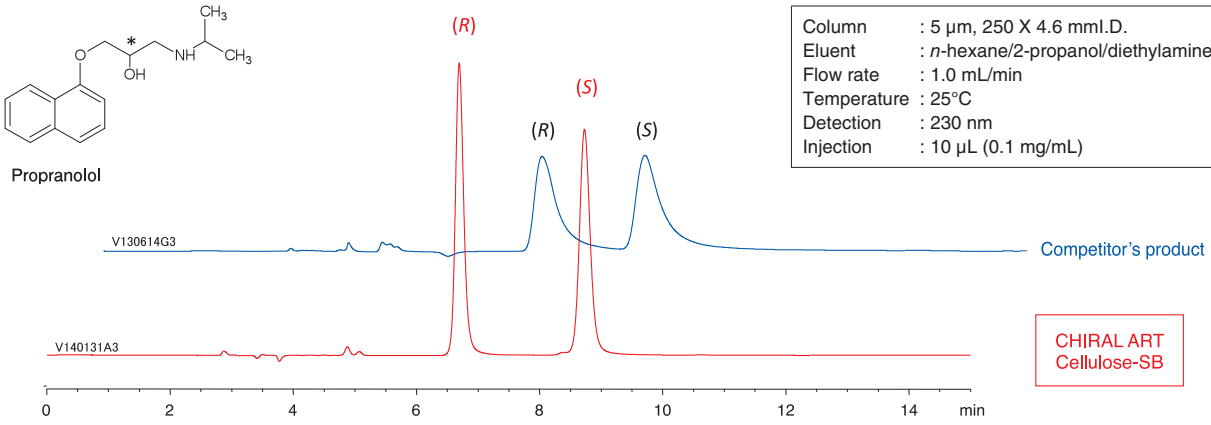
Useful for chiral separation of wide range of compounds

Compound	Mobile phase	Separation factor (α)							
		Immobilized type				Coated type			
		Amylose-SA	Competitor's product	Cellulose-SB	Competitor's product	Amylose-C	Competitor's product	Cellulose-C	Competitor's product
trans-Stilbene oxide	Hex/IPA (90/10)	2.7	2.8	1.6	1.9	2.9	3.0	2.3	2.2
Benzoin	Hex/IPA (90/10)	1.2	1.2	1.4	1.4	1.3	1.3	1.6	1.6
N-CBZ-DL-Alanine	Hex/IPA/TFA (80/20/0.1)	1.7	1.7	1.7	1.8	2.0	2.2	3.0	2.9
Ibuprofen	Hex/IPA/TFA (99/1/0.1)	1.1	1.1	1.1	1.1	1.1	1.1	1.3	1.2
Propranolol	Hex/IPA/DEA (80/20/0.1)	×	×	1.6	1.4	×	×	2.0	1.8
Verapamil	Hex/IPA/DEA (90/10/0.1)	1.2	1.2	×	×	1.3	1.3	×	×

Hex: *n*-hexane, IPA: 2-propanol, TFA: trifluoroacetic acid, DEA: diethylamine, ×: Not separated

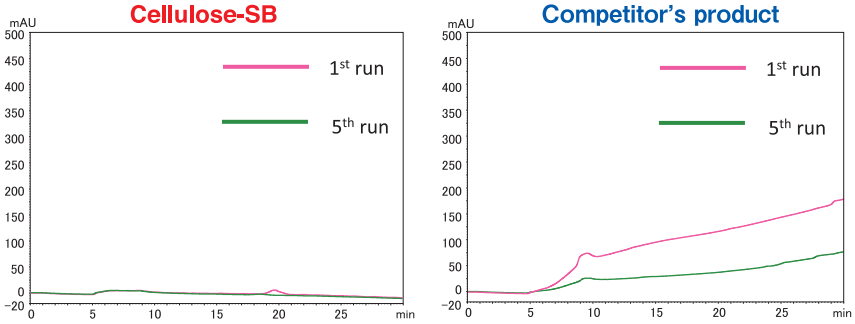
CHIRAL ART provide results comparable to other polysaccharide columns.

Excellent peak shape



CHIRAL ART provide good peak shapes on ionic and metal coordination compounds.

Low column bleeding

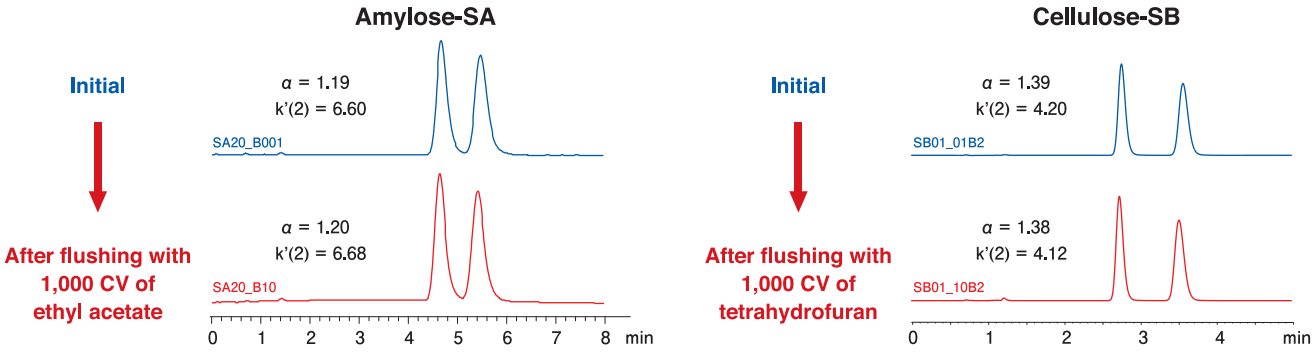


Gradient test
Column : 5 µm, 250 X 4.6 mmI.D.
Eluent : A) *n*-hexane
B) ethanol
2-80%B (0-30 min)
Flow rate : 1.0 mL/min
Temperature : 25°C
Detection : UV at 230 nm

CHIRAL ART Immobilized type show remarkably reduced background signal under the typical gradient condition. This low column bleeding of those columns provides high sensitivity on LC/MS analysis due to the very low ion suppression as well as stable baseline. CHIRAL ART Immobilized type offer excellent robustness on gradient analysis and highly sensitive analysis on LC/MS.

High solvent versatility (Immobilized type)

High solvent resistance



Retention rate of initial column performance

(after flushing with 1,000 CV of each solvent at 40°C)

*CV=Column Volume

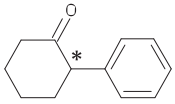
	Amylose-SA		Cellulose-SB	
	α	k'(2)	α	k'(2)
Ethyl acetate	100.3%	101.2%	100.0%	99.1%
Tetrahydrofuran	100.0%	100.0%	99.3%	98.0%
Dichloromethane	100.3%	100.6%	101.3%	99.6%

Column : 5 µm, 50 X 4.6 mmI.D.
Eluent : *n*-hexane/2-propanol (95/5)
Flow rate : 1.0 mL/min
Temperature : 25°C
Sample : Benzoin

On CHIRAL ART Amylose-SA and Cellulose-SB, the change in column performance after flushing with each solvent was less than 2%. They have high resistance to various solvents.

Method scouting

Solvent A \ Solvent B	2-propanol (IPA)	ethanol (EtOH)	tetrahydrofuran (THF)	methyl *tert*-butyl ether (MTBE)
n-hexane, Ratio (A/B) 95/5	α = 1.22, Rs = 3.33			
n-hexane, 90/10	α = 1.21, Rs = 2.78	α = 1.19, Rs = 2.51	α = 1.16, Rs = 2.31	Good Separation: α = 1.34, Rs = 4.52
n-hexane, 80/20	α = 1.19, Rs = 2.11	α = 1.21, Rs = 2.07		α = 1.30, Rs = 4.54



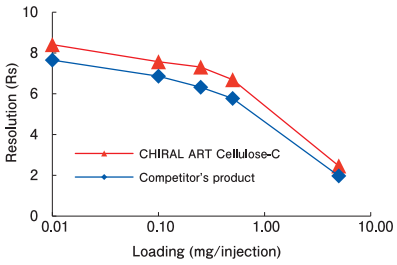
2-Phenylcyclohexanone

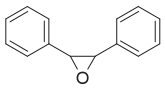
Column : CHIRAL ART Cellulose-SB 5 µm, 150 X 3.0 mmI.D.
Flow rate : 0.425 mL/min
Detection : UV at 220 nm
Temperature : 25°C

The chiral method scouting of 2-phenylcyclohexanone on CHIRAL ART Cellulose-SB is shown above. A mobile phase containing MTBE gave good separation. On CHIRAL ART Immobilized type with high solvent versatility, chromatographers can freely choose the most suitable mobile phase by considering the solubility, resolution and loadability of target compound based on the purpose of separation (e.g. analytical or preparative).

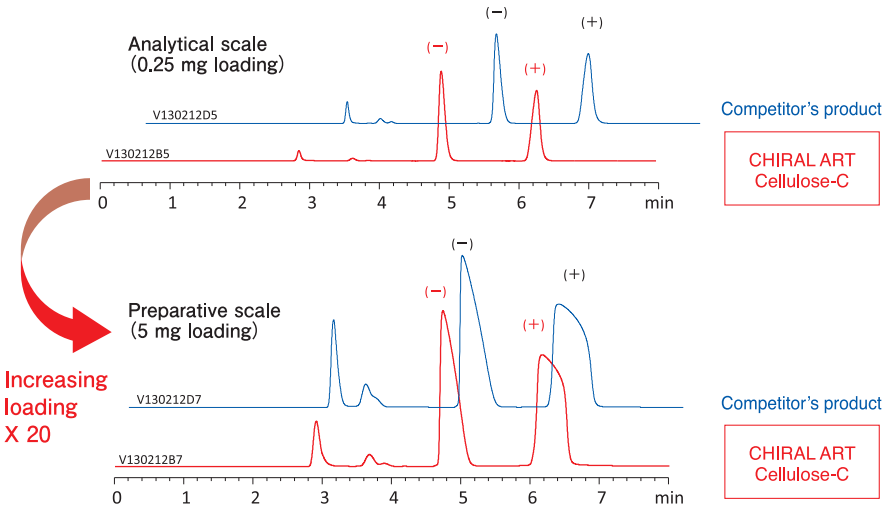
Effective for preparative separation of enantiomers

Suitable for high-loading preparation





trans-Stilbene oxide

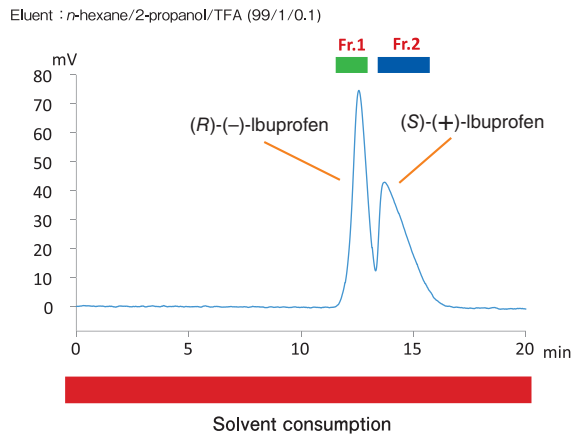


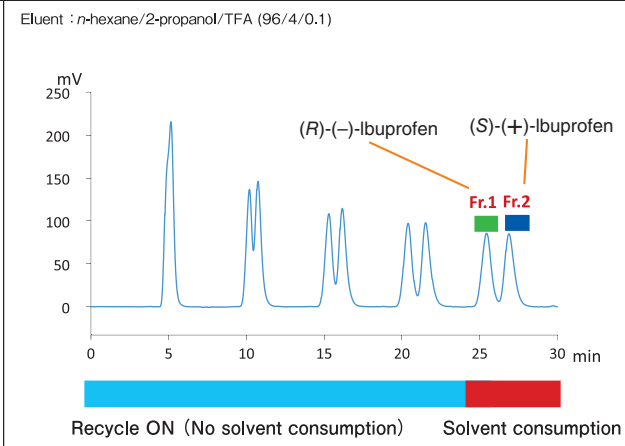
On both analytical and preparative separation, separation behavior of CHIRAL ART is equivalent to that of the competitor's product.

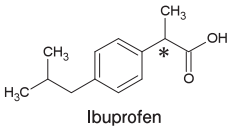
Column	: 5 µm, 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/ethanol (90/10)
Flow rate	: 1.0 mL/min

High purity purification utilizing recycling preparation

Single column separation	Recycling separation
・50 mg Loading ・Each corresponding peak was collected separately as Fr. 1 and Fr. 2.	・50 mg Loading ・Each corresponding peak was collected separately as Fr. 1 and Fr. 2 after several recycling runs.







Ibuprofen

	Single Column	Recycling
Enantiomeric purity (%ee) Fr.1 (*R*)-(–)-Ibuprofen Fr.2 (*S*)-(+)-Ibuprofen	 95.0 96.8	 98.4 99.2
Yield (%)	84	95
Solvent consumption (mL solvent/g product)	9,523	1,276

Column	: CHIRAL ART Cellulose-C 10 µm, 250 X 20 mmI.D.
Flow rate	: 20 mL/min
Detection	: UV at 265 nm
Injection	: 5 mL (10 mg/mL)
System	: LC-Forte/R

LC-Forte/R

Ibuprofen enantiomers were purified by utilizing recycling mode of multi preparative HPLC system, LC-Forte/R. Recycling chromatography is effective when method optimization of chiral isolation is difficult on single column separation. Recycling method offers high purity and high recovery purification. Furthermore, no solvent is consumed during recycling mode. It greatly contributes reduction of solvent consumption on purification.

✱ See P.109,110 for details of SFC (Supercritical Fluid Chromatography) Column Alcyon SFC.

Synthesized macromolecule-type

YMC CHIRAL NEA (R), (S)

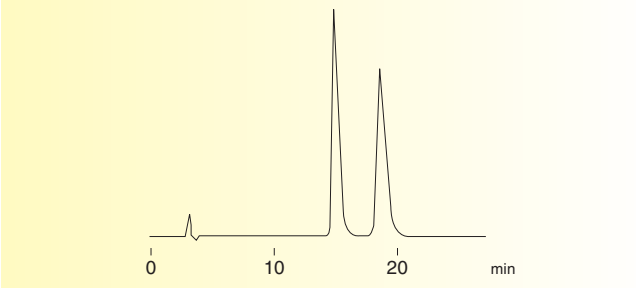
- Synthesized macromolecule-type chiral column
- Elution order can be reversed by selection (R) or (S)
- Can be used in both normal-phase and reversed-phase
- Available for bulk scale

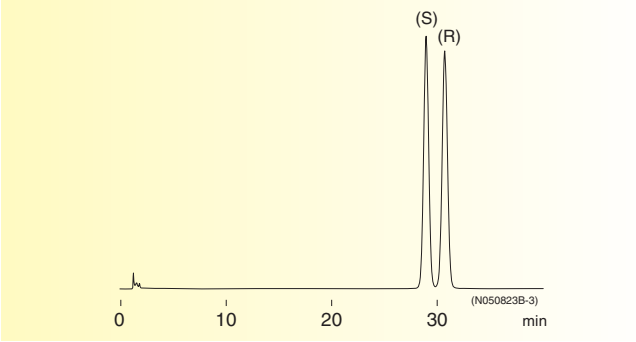
- Particle size : 5 µm
- Pore size : 300 Å
- Usable pH range : 2.0~6.5

Chiral polymer-bonded silicagel for optical isomer separation

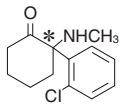
YMC CHIRAL NEA (R) and (S) are chiral polymerbonded silica gel for optical isomer separation. Chiral discrimination is based on the higher-order structure of chiral macromolecules, which includes hydrogen bonding, π-π interaction, hydrophobic interaction, etc. YMC CHIRAL NEA (R) and (S) have excellent durability and cost performance.

Used with a reversed-phase mobile phase



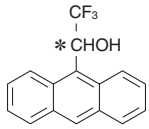


Ketamine



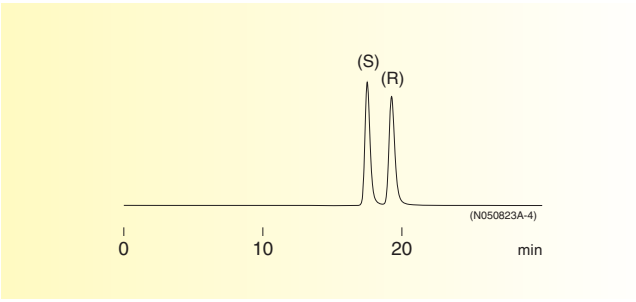
Column	: YMC CHIRAL NEA (R) 250 X 4.6 mmI.D.
Eluent	: acetonitrile/0.5 M $NaClO_4$ (40/60)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: UV at 268 nm

2,2,2-Trifluoro-1- (9-anthryl) ethanol

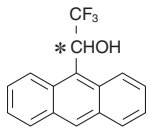


Column	: YMC CHIRAL NEA (R) 250 X 4.6 mmI.D.
Eluent	: acetonitrile/water (40/60)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 254 nm

Used with a normal-phase mobile phase

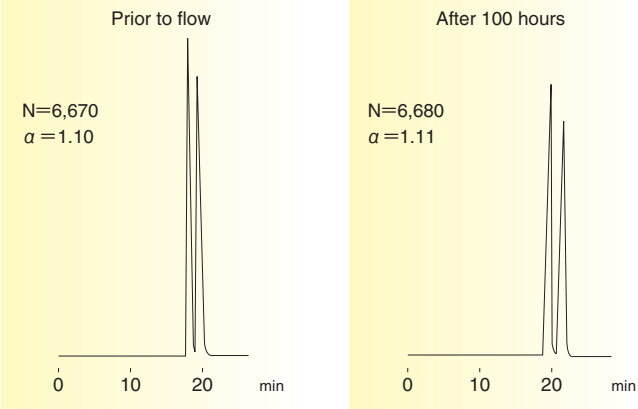


2,2,2-Trifluoro-1- (9-anthryl) ethanol



Column	: YMC CHIRAL NEA (R) 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/ethanol (98/2)
Flow rate	: 1.0 mL/min
Temparature	: 30°C
Detection	: UV at 254 nm

Durability



<Flow conditions>

Column	: YMC CHIRAL NEA (R)
Eluent	: acetonitrile/0.5 M $NaClO_4$ (40/60)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Time	: 100 hours

<Measurement conditions>

Eluent	: acetonitrile/0.5 M $NaClO_4$ (40/60)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: UV at 254 nm
Sample	: Propranolol

Cyclodextrine-type

YMC CHIRAL CD BR

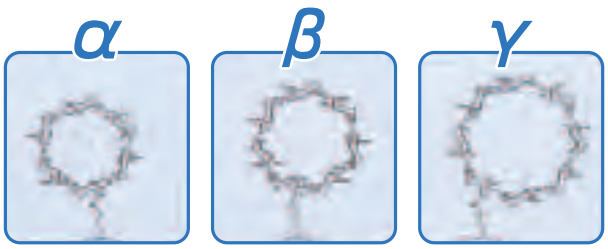
- Cyclodextrin type optical isomer separation column
- Useful for separation of optical isomers and structural isomers
- Three cavity types, α, β and γ, are available

- Particle size : 5 µm
- Pore size : 120 Å
- Usable pH range : 3.5~6.5

Optical isomer separation column utilizing host-guest interaction

YMC CHIRAL CD BR are composed of 3 types of optical isomer separation columns. Each column possesses α-, β- or γ-bromo-cyclodextrin as a functional group. Selection from the 3 types of columns enables analysis of a wide range of compounds. In addition, YMC CHIRAL CD BR show different selectivity from ODS because the separation is based on host-guest interaction. YMC CHIRAL CD BR are useful for separating structural isomers that are difficult to separate on ODS.

Three types; α, β and γ-CD BR are available



Cyclodextrine-type

YMC CHIRAL PREP CD ST/YMC CHIRAL PREP CD PM

- β-cyclodextrin modified silica gel packing material
- Can separate various optical isomers
- Can be used in both normal-phase and reversed-phase modes
- Bulk supply at kilogram scale is available
- Excellent cost performance
- Applicable to large-scale isolation by simulated moving bed (SMB) chromatography

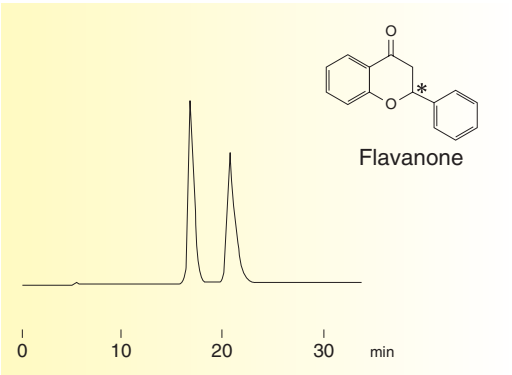
- Particle size : 10, 20, 50 µm
- Pore size : 120 Å
- Usable pH range : 2.0~7.0

Packing material for preparative isolation of optical isomers with excellent cost performance

YMC CHIRAL PREP CD ST/PM are suitable packing materials for preparative isolation of optical isomers. ST is suitable for use mainly in reversed-phase mode, while PM can be used in both normal-phase and reversed-phase modes. The cost is considerably less than that of the conventional packing materials for optical isomers. Therefore YMC CHIRAL PREP CD ST/PM are appropriate not only for semi-preparative isolation, but also for industrial isolation. They are also applicable to simulated moving bed (SMB) chromatography and axial compression columns.

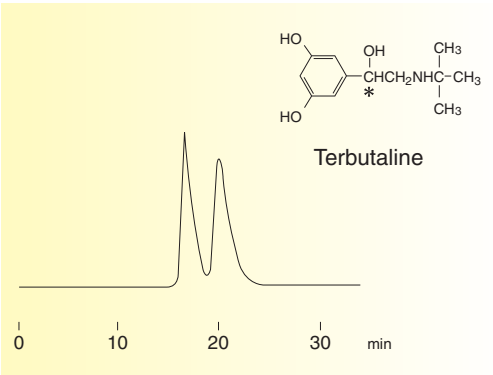
Can be used in both normal-phase and reversed-phase modes

Normal-phase mode



Column	: YMC CHIRAL PREP CD PM (10 µm, 120 Å) 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/ethanol (95/5)
Flow rate	: 0.5 mL/min
Temperature	: ambient
Detection	: UV at 254 nm
Injection	: 5 µL (1 mg/mL)

Reversed-phase mode



Column	: YMC CHIRAL PREP CD ST (10 µm, 120 Å) 250 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4 (pH 4.6)/acetonitrile (99/1)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: UV at 220 nm
Injection	: 5 µL (1 mg/mL)

In addition to water, alcohol, and acetonitrile, hexane or tetrahydrofuran can be used as mobile phase.

Ordering Information – Columns –

CHIRAL ART Amylose-SA : Immobilized type

Particle size	Column I.D. (mm)	Column length (mm)				
		50	75	100	150	250
3 µm	2.0	—	KSA99S03-L502WT	KSA99S03-1002WT	KSA99S03-1502WT	KSA99S03-2502WT
	3.0	KSA99S03-0503WT	KSA99S03-L503WT	KSA99S03-1003WT	KSA99S03-1503WT	KSA99S03-2503WT
	4.6	KSA99S03-0546WT	KSA99S03-L546WT	KSA99S03-1046WT	KSA99S03-1546WT	KSA99S03-2546WT
5 µm	4.6	—	—	—	KSA99S05-1546WT	KSA99S05-2546WT
	10	—	—	—	—	KSA99S05-2510WT
	20	—	—	—	—	KSA99S05-2520WX
	30	—	—	—	—	KSA99S05-2530WX

CHIRAL ART Cellulose-SB : Immobilized type

Particle size	Column I.D. (mm)	Column length (mm)				
		50	75	100	150	250
3 µm	2.0	—	KSB99S03-L502WT	KSB99S03-1002WT	KSB99S03-1502WT	KSB99S03-2502WT
	3.0	KSB99S03-0503WT	KSB99S03-L503WT	KSB99S03-1003WT	KSB99S03-1503WT	KSB99S03-2503WT
	4.6	KSB99S03-0546WT	KSB99S03-L546WT	KSB99S03-1046WT	KSB99S03-1546WT	KSB99S03-2546WT
5 µm	4.6	—	—	—	KSB99S05-1546WT	KSB99S05-2546WT
	10	—	—	—	—	KSB99S05-2510WT
	20	—	—	—	—	KSB99S05-2520WX
	30	—	—	—	—	KSB99S05-2530WX

CHIRAL ART Cellulose-SC : Immobilized type

Particle size	Column I.D. (mm)	Column length (mm)				
		50	75	100	150	250
5 µm	4.6	—	—	—	KSC99S05-1546WT	KSC99S05-2546WT
	10	—	—	—	—	KSC99S05-2510WT
	20	—	—	—	—	KSC99S05-2520WX
	30	—	—	—	—	KSC99S05-2530WX

CHIRAL ART Amylose-C : Coated type

Particle size	Column I.D. (mm)	Column length (mm)				
		50	75	100	150	250
5 µm	4.6	—	—	—	KAN99S05-1546WT	KAN99S05-2546WT
	10	—	—	—	—	KAN99S05-2510WT
	20	—	—	—	—	KAN99S05-2520WX
	30	—	—	—	—	KAN99S05-2530WX

CHIRAL ART Cellulose-C : Coated type

Particle size	Column I.D. (mm)	Column length (mm)				
		50	75	100	150	250
5 µm	4.6	—	—	—	KCN99S05-1546WT	KCN99S05-2546WT
	10	—	—	—	—	KCN99S05-2510WT
	20	—	—	—	—	KCN99S05-2520WX
	30	—	—	—	—	KCN99S05-2530WX

Alcyon SFC CSP Columns

Particle size	Column size inner diameter X length (mm)	Product number				
		Immobilized type			Coated type	
		CSP Amylose-SA	CSP Cellulose-SB	CSP Cellulose-SC	CSP Amylose-C	CSP Cellulose-C
5 µm	2.1 X 150	KSA99S05-15Q1WTS	KSB99S05-15Q1WTS	KSC99S05-15Q1WTS	KAN99S05-15Q1WTS	KCN99S05-15Q1WTS
	4.6 X 150	KSA99S05-1546WTS	KSB99S05-1546WTS	KSC99S05-1546WTS	KAN99S05-1546WTS	KCN99S05-1546WTS
	4.6 X 250	KSA99S05-2546WTS	KSB99S05-2546WTS	KSC99S05-2546WTS	KAN99S05-2546WTS	KCN99S05-2546WTS
	10 X 250	KSA99S05-2510WTS	KSB99S05-2510WTS	KSC99S05-2510WTS	KAN99S05-2510WTS	KCN99S05-2510WTS
	20 X 250	KSA99S05-2520WTS	KSB99S05-2520WTS	KSC99S05-2520WTS	KAN99S05-2520WTS	KCN99S05-2520WTS

Ordering Information – Columns –

YMC CHIRAL NEA(R)(S) : Reversed-phase

Phase dimension	Column I.D. (mm)	Column length (mm)				Guard cartridges	
		50	100	150	250	I.D. (mm)	10 mm length
NEA(R) 300 Å 5 µm	4.6	—	—	NR30S05-1546WT	NR30S05-2546WT	4.0	NR30S05-0104GC
NEA(S) 300 Å 5 µm	4.6	—	—	NS30S05-1546WT	NS30S05-2546WT	4.0	NS30S05-0104GC

YMC CHIRAL NEA(R)(S) : Normal-phase

Phase dimension	Column I.D. (mm)	Column length (mm)				Guard cartridges	
		50	100	150	250	I.D. (mm)	10 mm length
NEA(R) 300 Å 5 µm	4.6	—	—	CR30S05-1546WT	CR30S05-2546WT	4.0	CR30S05-0104GC
NEA(S) 300 Å 5 µm	4.6	—	—	CS30S05-1546WT	CS30S05-2546WT	4.0	CS30S05-0104GC

YMC CHIRAL PREP CD ST/PM

Phase dimension	Column I.D. (mm)	Column length (mm)				Guard cartridges	
		50	100	150	250	I.D. (mm)	10 mm length
ST 120 Å 10 µm	4.6	—	—	—	ST12S11-2546WT	4.0	ST12S11-0104GC
PM 120 Å 10 µm	4.6	—	—	—	PM12S11-2546WT	4.0	PM12S11-0104GC

YMC CHIRAL CD BR

Phase dimension	Column I.D. (mm)	Column length (mm)				Guard cartridges	
		50	100	150	250	I.D. (mm)	10 mm length
α-CD BR 120 Å 5 µm	4.6	—	—	DA12S05-1546WT	DA12S05-2546WT	4.0	DA12S05-0104GC
β-CD BR 120 Å 5 µm	4.6	—	—	DB12S05-1546WT	DB12S05-2546WT	4.0	DB12S05-0104GC
γ-CD BR 120 Å 5 µm	4.6	—	—	DG12S05-1546WT	DG12S05-2546WT	4.0	DG12S05-0104GC

*Guard cartridge holder required, part no. XPGCH-Q1.

Ordering Information – Packing Materials –

CHIRAL ART

Particle size (µm)	Product number				
	Immobilized type			Coated type	
	Amylose-SA	Cellulose-SB	Cellulose-SC	Amylose-C	Cellulose-C
5	KSA99S05	KSB99S05	KSC99S05	KAN99S05	KCN99S05
10	KSA99S11	KSB99S11	KSC99S11	KAN99S11	KCN99S11
20	KSA99S21	KSB99S21	KSC99S21	KAN99S21	KCN99S21

YMC CHIRAL PREP CD ST/PM

Phase dimension	Particle size (µm)	Product number
ST 120 Å	10	ST12S11
	20	ST12S21
	50	ST12S50
PM 120 Å	10	PM12S11
	20	PM12S21
	50	PM12S50

03

Ion Exchange Columns and Media/Size Exclusion Columns

Ion exchange columns

YMC-BioPro Ion Exchange Columns

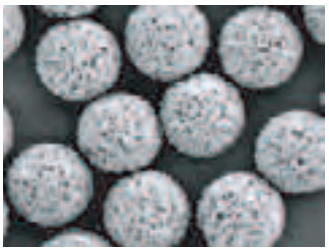
YMC-BioPro ion exchange columns are specially designed for separation of proteins, peptides, and nucleic acids.
YMC-BioPro ion exchange columns are available in QA and SP chemistries and are based on 5 µm porous and non-porous hydrophilic polymer beads with low nonspecific adsorption.

Ion exchange columns ideal for separation of proteins, peptides, and nucleic acids

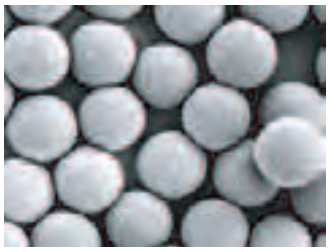
Features

- Ion exchange columns designed for analytical and laboratory-scale purification of proteins, peptides, and nucleic acids
- Newly developed hydrophilic polymer beads with low nonspecific adsorption
- Effective surface structure designed for maximum interaction with biomolecules
- Available in a strong anion exchanger (QA, quaternary ammonium) and a strong cation exchanger (SP, sulfopropyl)
- Non-porous type for increasing resolution and throughput
- Porous type for higher binding capacity and recovery

SEM images of polymer beads of YMC-BioPro ion exchange columns



Porous polymer beads



Non-porous polymer beads

Specifications

	YMC-BioPro QA	YMC-BioPro SP	YMC-BioPro QA-F	YMC-BioPro SP-F
Matrix	Hydrophilic porous polymer		Hydrophilic non-porous polymer	
Particle size (µm)	5		3, 5	
Charged group	$-CH_2N^+(CH_3)_3$	$-CH_2CH_2CH_2SO_3^-$	$-CH_2N^+(CH_3)_3$	$-CH_2CH_2CH_2SO_3^-$
Counter ion	Cl^-	Na^+	Cl^-	Na^+
Ion exchange capacity (meq/mL-resin)	0.075 - 0.100	0.070 - 0.095	0.075 - 0.110	0.230 - 0.290
Binding capacity (mg/mL-resin)	DBC >110 (BSA)	DBC >70 (human-IgG)	DBC >12 (BSA)	DBC >10 (human-IgG)
Usable temperature	4 ~ 60°C			
Usable pH range	2.0 ~ 12.0			
Column material	PEEK			

YMC-BioPro QA/YMC-BioPro SP

- Ion exchange column based on porous polymer beads
- Excellent resolution
- High binding capacity and high recovery of biomolecules
- Suitable for laboratory-scale purification

■ Matrix : Hydrophilic porous polymer beads
■ Usable pH range : 2.0~12.0

Ion exchange columns for analysis and laboratory-scale purification of proteins, peptides, and nucleic acids

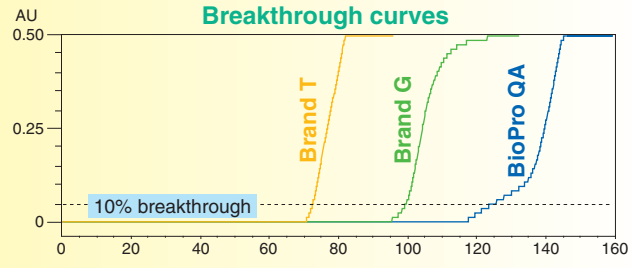
YMC-BioPro QA/SP columns are ion exchange columns based on porous hydrophilic polymer beads with low nonspecific adsorption of biomolecules. YMC-BioPro QA/SP columns have superior resolution, high binding capacity and high recovery of various biomolecules, and they allow highly effective analysis and laboratory-scale purification of biopharmaceutical proteins such as antibodies.

High binding capacity and recovery

Comparison of dynamic binding capacity (DBC) and recovery for BSA

	Dynamic binding capacity (mg/mL-resin, 10% breakthrough)	Eluted amount (mg/mL-resin)	Recovery* (%)
YMC-BioPro QA	126	120	95
Brand T (porous Q type)	73	58	79
Brand G (porous Q type)	100	35	35

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



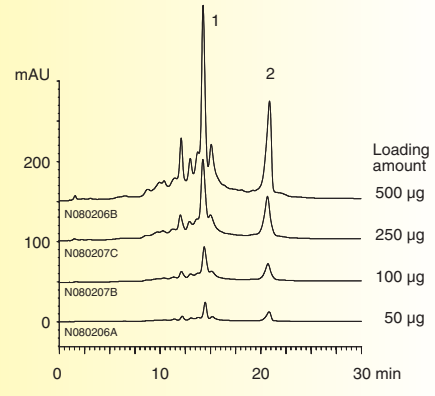
Column	: YMC-BioPro QA 50 X 4.6 mmI.D. Brand T (porous Q type) 50 X 4.6 mmI.D. Brand G (porous Q type) 50 X 5.0 mmI.D.
Linear velocity	: 180 cm/hr
Equilibration buffer	: 20 mM Tris-HCl (pH 8.6)
Elution buffer	: 20 mM Tris-HCl (pH 8.6) containing 1.0 M NaCl
Sample	: 1 mg/mL Bovine serum albumin (BSA) in equilibration buffer
Detection	: UV at 280 nm

YMC-BioPro QA gives the superior DBC and recovery compared with conventional porous polymer anion exchange columns. The surface structure of YMC-BioPro which is designed for maximum interaction with proteins provides high binding capacity, and the hydrophilic property of polymer beads remarkably reduces nonspecific adsorption of proteins.

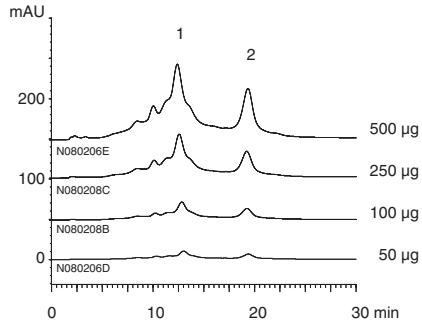
High loadability

Comparison of the effect of sample load on YMC-BioPro QA and commercial Q type column

YMC-BioPro QA 5 µm, 50 X 4.6 mmI.D.



Brand G (porous Q type) 10 µm, 50 X 5.0 mmI.D.



1. Ovalbumin
2. Trypsin inhibitor

Eluent	: A) 20 mM Tris-HCl (pH 8.1) B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl 10-80%B (0-30 min)
Flow rate	: 0.5 mL/min (180 cm/hr for 4.6 mmI.D., 150 cm/hr for 5.0 mmI.D.)
Temperature	: 25°C
Detection	: UV at 280 nm
Injection	: 100 µL

YMC-BioPro QA shows the excellent resolution and peak shapes even when the loading amount increases. The porous type YMC-BioPro columns are suitable for laboratory-scale purification of proteins.

Ion exchange columns

YMC-BioPro QA-F/YMC-BioPro SP-F

- Ion exchange column based on non-porous polymer beads
- High efficiency with low operating pressure
- 30 mm length column for ultra high-throughput analysis
- 100 mm length column for high-resolution analysis

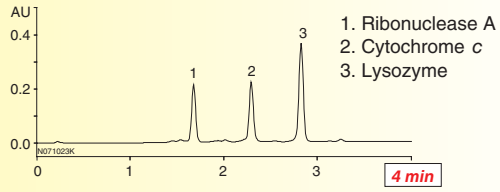
- Matrix : Hydrophilic non-porous polymer beads
- Usable pH range : 2.0~12.0

Ion exchange columns for high-throughput and high-resolution analysis of proteins, peptides, and nucleic acids

YMC-BioPro QA-F/SP-F columns are ion exchange columns based on non-porous hydrophilic polymer beads with high chemical and mechanical stability, and low nonspecific adsorption of biomolecules. The short columns (30 mm, 50 mm) are useful for the fast analysis at a higher flow rate, and the 100 mm length columns are best choice for the quality control assessment of biopharmaceuticals requiring a high-resolution.

Ultra high-throughput analysis of proteins

YMC-BioPro SP-F 5 µm, 30 X 4.6 mmI.D.

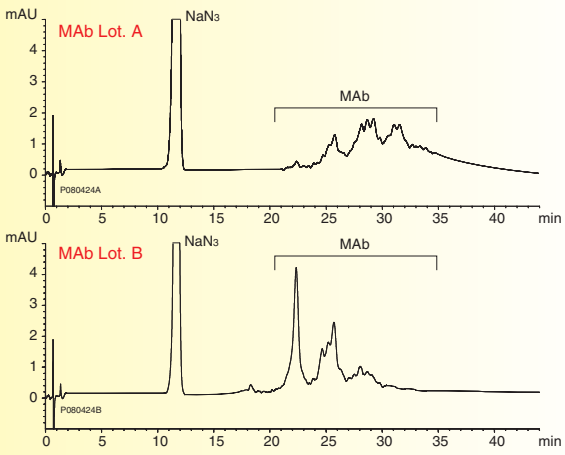


Eluent	: A) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8) B) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8) containing 0.5 M NaCl 0-100%B (0-4 min)
Flow rate	: 1.5 mL/min (540 cm/hr)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 20 µL
Pressure	: 4.8-5.2 MPa

The high mechanical stability of non-porous polymer beads and the short column length enable faster elution of proteins at a higher flow rate.

High-resolution analysis of proteins

YMC-BioPro QA-F 5 µm, 100 X 4.6 mmI.D.



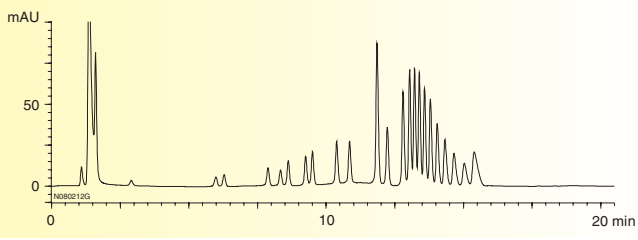
Monoclonal antibody (MAb) against human IgG4

Eluent	: A) 20 mM Tris-HCl (pH 8.1) B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl 10-25%B (0-60 min)
Flow rate	: 1.0 mL/min (360 cm/hr)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 14 µL (0.1 mg/mL)
Sample	: Mouse monoclonal IgG1 anti-human IgG4 (Purified by DEAE chromatography, containing NaN_3)

Two different lots of commercially available MAb purified by DEAE chromatography, are analyzed with 100 mm length column of YMC-BioPro QA-F. The MAb is resolved into several peaks, and the lot-to-lot variability is observed. 100 mm length column of YMC-BioPro QA-F/SP-F, which has high efficiency, is ideal for characterization of glycoproteins such as monoclonal antibodies and for quality control assessment of biopharmaceuticals.

High-resolution analysis of nucleic acids

YMC-BioPro QA-F 5 µm, 100 X 4.6 mmI.D.



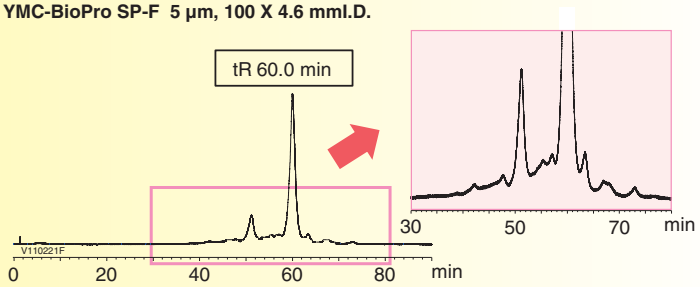
DNA fragments 1Kb DNA ladder (75 - 12,216 bp)

Eluent	: A) 20 mM Tris-HCl (pH 8.1) containing 0.7 M NaCl B) 20 mM Tris-HCl (pH 8.1) containing 1.0 M NaCl 0-100%B (0-30 min)
Flow rate	: 0.5 mL/min (180 cm/hr)
Temperature	: 25°C
Detection	: UV at 260 nm
Injection	: 20 µL (0.25 mg/mL)

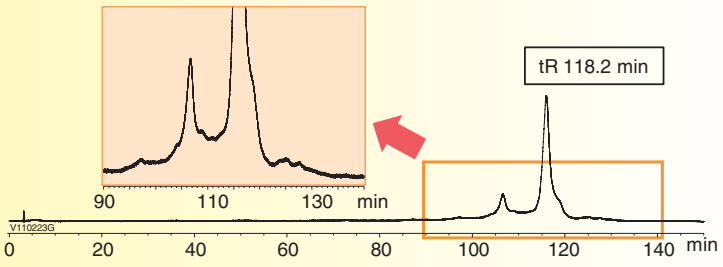
The separation of DNA fragments is shown. YMC-BioPro QA-F of 100 mm length column is good choice for high-resolution analysis of nucleic acids.

Monoclonal antibody (MAb) analysis on non-porous type cation exchange columns

YMC-BioPro SP-F 5 µm, 100 X 4.6 mmI.D.



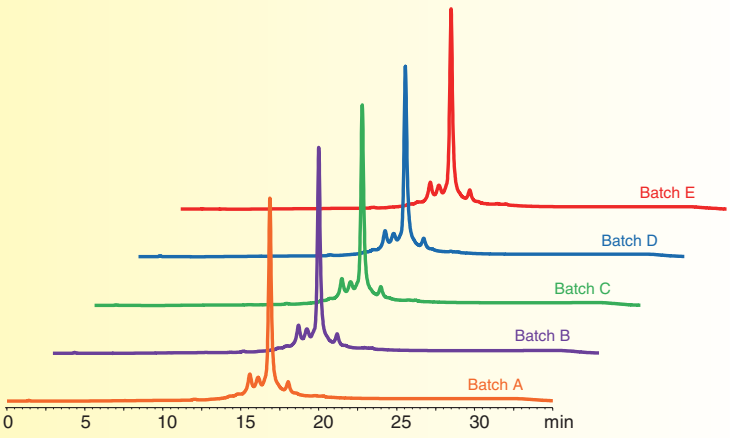
Competitor WCX column 10 µm, 250 X 4.0 mmI.D.



Eluent	: A) 20 mM MES-NaOH (pH 5.6) B) 20 mM MES-NaOH (pH 5.6) containing 0.2 M NaCl
Initial gradient conc.	: 35%B (70 mM NaCl)
Gradient slope	: 0.25%B/min (0.5 mM NaCl)
Flow rate	: 0.5 mL/min for 100 X 4.6 mmI.D., 0.378 mL/min for 250 X 4.0 mmI.D.
Temperature	: 30°C
Detection	: UV at 280 nm
Sample	: Humanized monoclonal IgG 1
Injection	: 10 µL

The separation of MAb is compared on SCX (YMC-BioPro SP-F) and WCX (competitor's) under the same gradient condition at pH 5.6. YMC-BioPro SP-F column provides the higher resolution of MAb in shorter analysis time than the competitor column.

Excellent batch-to-batch reproducibility



Column	: YMC-BioPro SP-F 5 µm, 100 X 4.6 mmI.D.
Eluent	: A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.5) B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.5) containing 0.2 M NaCl 0-50%B (0.5-30 min)
Flow rate	: 0.5 mL/min (180 cm/hr)
Temperature	: 25°C
Detection	: UV at 215 nm
Injection	: 10 µL
Sample	: monoclonal antibody (IgG1)

YMC-BioPro SP-F column exhibits excellent batch-to-batch reproducibility on MAb analysis, and even on resolution of peaks for small charge variants. All the gel batches are inspected by various quality control tests including HPLC analysis of MAb, and must pass rigorous criteria before release. YMC-BioPro ion exchange columns are the best choice for the quality control of MAb and other biopharmaceuticals.

Ion exchange media

BioPro SmartSep Q/S

- High-throughput purification by utilizing high mechanical strength polymer beads
- High binding capacity and high resolution over a wide range of flow rate
- Suitable for intermediate purification step and polishing step
- Available in strong ion exchangers (Q and S chemistries)
- Matrix : Hydrophilic porous polymer
- Usable pH range : 2.0~12.0

Ion exchange media for high-throughput purification of biopharmaceuticals

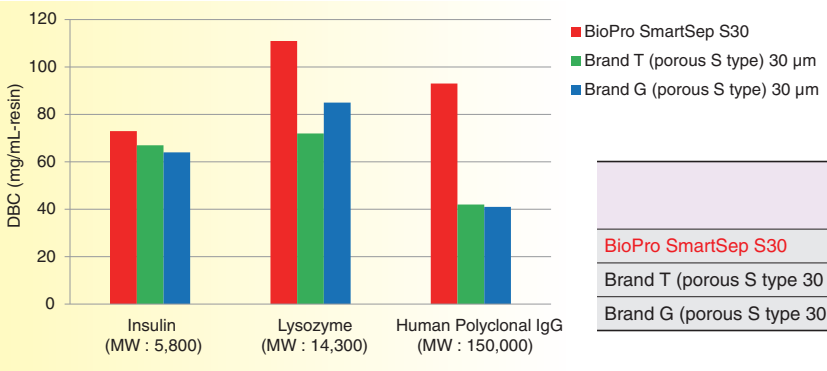
BioPro SmartSep are ion exchange media for high-throughput intermediate purification step and polishing step of biopharmaceuticals. BioPro SmartSep media are avairable in strong ion exchangers of hydrophilic porous polymer beads with low nonspecific adsorption and high binding capacity over a wide range of flow rate. BioPro SmartSep media show high resolution and recovery even at a high flow rate and high loading condition.

Specifications

	BioPro SmartSep Q10	BioPro SmartSep S10	BioPro SmartSep Q30	BioPro SmartSep S30
Matrix	Hydrophilic porous polymer			
Particle size (µm)	10		30	
Ion exchanger	-R-N$^+$(CH$_3$)$_3$	-R-SO$_3^-$	-R-N$^+$(CH$_3$)$_3$	-R-SO$_3^-$
Ion exchange capacity (meq/mL-resin)	> 0.08			
Binding capacity* (mg/mL-resin)	DBC > 100 (BSA)	DBC > 100 (lysozyme)	DBC > 100 (BSA)	DBC > 100 (lysozyme)
Usable pH range	2.0 ~ 12.0			
Characteristics	for high resolution purification		for industrial processes	

*DBC: dynamic binding capacity

High dynamic binding capacity (DBC) for various samples



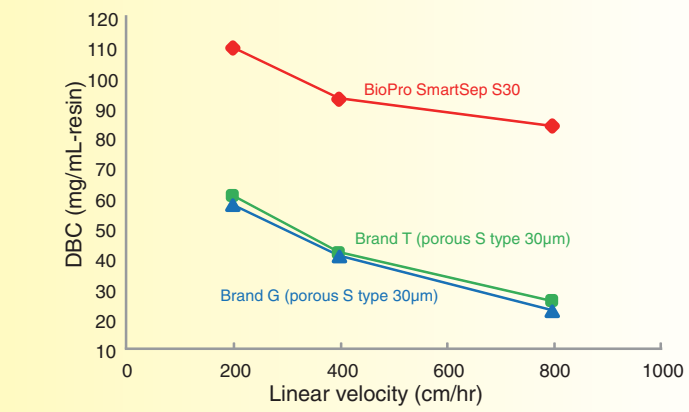
Conditions of DBC measurement*
Column : 50 X 5.0 mmI.D.
Flow rate : 400 cm/hr (1.32 mL/min)

*Please inquire us for details.

	DBC (mg/mL-resin, 10 % breakthrough)		
	Insulin	Lysozyme	Human Polyclonal IgG
BioPro SmartSep S30	73	111	93
Brand T (porous S type 30 µm)	67	72	42
Brand G (porous S type 30 µm)	64	85	41

BioPro SmartSep ion exchange media have higher DBC compared to conventional ion exchange media. Especially for IgG, BioPro SmartSep has more than twice as high DBC as competitors'. This feature of BioPro SmartSep makes purification productivity of IgG per unit time double or more.

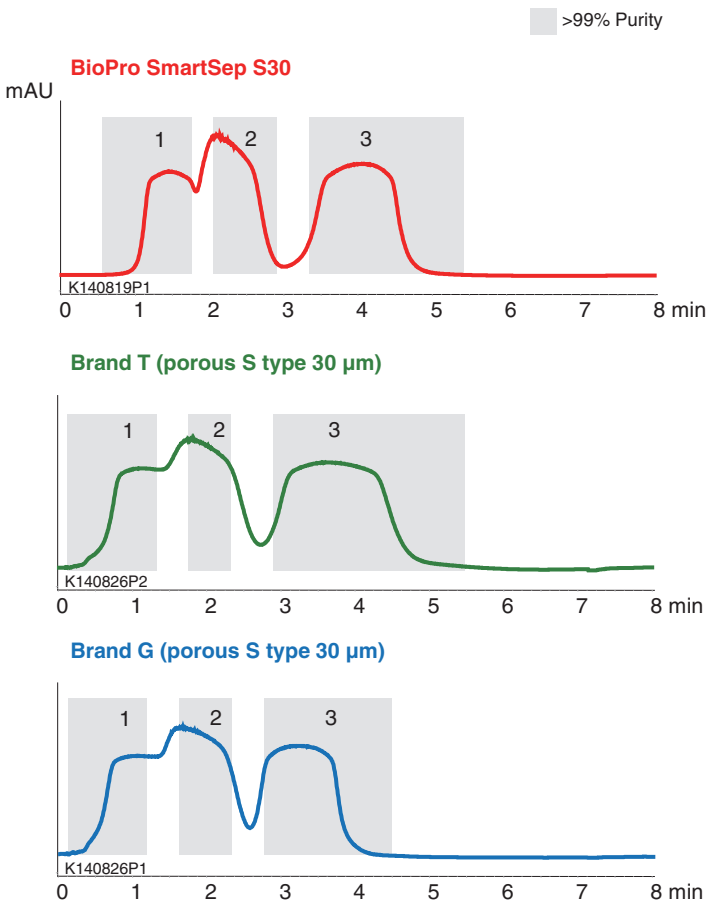
High dynamic binding capacity (DBC) over a wide range of flow rate



Column	: 50 X 5.0 mmI.D.
Equilibration buffer	: 20 mM citric acid-NaOH (pH 5.3)
Elution buffer	: Equilibration buffer containing 0.5 M NaCl
Flow rate	: 200-800 cm/hr (0.66-2.62 mL/min)
Temperature	: ambient (25°C)
Detection	: UV at 280 nm
Sample	: 1.5 mg/mL human polyclonal IgG in equilibration buffer

High DBC of BioPro SmartSep maintained even at a higher flow rate. So, they are suitable for the high-speed purification with 2-4 times of conventional flow rate. This feature offers significant improvement on productivity.

High resolution and excellent recovery



Column	: 50 X 5.0 mmI.D.
Eluent	: A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl 0-100%B, (0-30 column volumes)
Flow rate	: 1600 cm/hr (5.23 mL/min)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 30 mL (45 mg Proteins)
Sample	: 1. Ribonuclease A (0.5 mg/mL) 2. Cytochrome *c* (0.5 mg/mL) 3. Lysozyme (0.5 mg/mL)

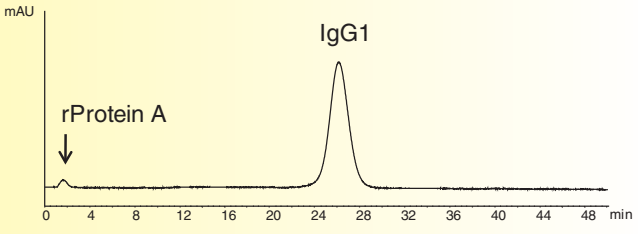
Comparison of recovery of proteins

	Recovery (99% Purity)			
	Ribonuclease A	Cytochrome *c*	Lysozyme	Total
BioPro SmartSep S30	90.9 %	80.3 %	99.2 %	90.6 %
Brand T (porous S type 30 µm)	80.6 %	59.6 %	98.3 %	80.1 %
Brand G (porous S type 30 µm)	72.5 %	70.2 %	97.2 %	80.2 %

BioPro SmartSep ion exchange media show high resolution and recovery even at a high flow rate and high loading condition. BioPro SmartSep ion exchange media offer high efficiency on intermediate purification step and polishing step requiring high resolution and recovery.

Purification of IgG1 (Anti-h TNF alpha IgG1)

Intermediate Purification (Cation Exchange Chromatography)



Column	: BioPro SmartStep S30 (30 µm) 50 X 5.0 mmI.D.
Eluent	: A) 20 mM citric acid-NaOH (pH 5.3) B) 20 mM citric acid-NaOH (pH 5.3) containing 0.5 M NaCl 0-100%B, (0-30 column volumes)
Flow rate	: 180 cm/hr (0.59 mL/min)
Temperature	: ambient
Detection	: UV at 280 nm
Sample	: Anti-h TNF alpha IgG1 (Affinity column eluate)
Injection	: 0.25 mL (0.1 mg IgG1)

This is an example that an IgG1 monoclonal antibody was purified from cell culture medium by BioPro SmartSep S30. In general, purification of antibody starts from clarification. After clarified, it is subjected to initial purification (capture step) by affinity chromatography (rProtein A), followed by ion exchange chromatography. In the capture step rProtein A derived from affinity media contaminate the elueate, then they are separated and removed by following ion exchange chromatography.

Ion exchange media

BioPro Ion Exchange Media

- High productivity on purification
- Suitable for capture step and intermediate purification step
- High binding capacity/high recovery/high resolution/low backpressure
- Screening Kit for media selection and method development available

■ Matrix : Hydrophilic porous polymer

Ion exchange media with high productivity/high cost-effectiveness

BioPro ion exchange media, which are based on hydrophilic polymer with low nonspecific adsorption, are designed for capture and intermediate purification of proteins and nucleotides. High dynamic binding capacity (DBC) and high recovery allow fast purification process at large scale. It offers high productivity on industrial purification of peptides, proteins, and nucleotides including biopharmaceuticals such as antibody.

Specifications

	BioPro Q	BioPro S	BioPro DA	BioPro CM
Matrix	Hydrophilic porous polymer			
Particle size (µm)	75		60	
Ion exchanger	$-R-N^+(CH_3)_3$	$-R-SO_3^-$	$-R-N(CH_3)_2$	-R-COOH
Ion exchange capacity (meq/mL-resin)	> 0.10		≧ 0.10	≧ 0.08
Binding capacity* (mg/mL-resin)	DBC > 160 (BSA)	DBC > 160 (lysozyme)	SBC ≧ 77 (human-IgG)	SBC ≧ 90 (human-IgG)
Usable pH range	2.0 ~ 12.0		Regular use : 3.0 ~ 12.0 Short term : 1.0 ~ 13.0	

*DBC: dynamic binding capacity, SBC: static binding capacity

High dynamic binding capacity (DBC) for proteins

BioPro ion exchange media have higher DBC of protein than commercial ion exchange media. BioPro ion exchange media are effective in protein purification from capture step requiring high capacity to intermediate step requiring high efficiency.

Anion exchanger	Particle size (µm)	Ion exchange capacity (meq/mL-resin)	DBC* (mg/mL-resin)
BioPro Q75	75	0.13	183
Brand G (porous Q type)	90	0.19	102

Cation exchanger	Particle size (µm)	Ion exchange capacity (meq/mL-resin)	DBC* (mg/mL-resin)
BioPro S75	75	0.12	192
Brand G (porous S type)	90	0.13	80

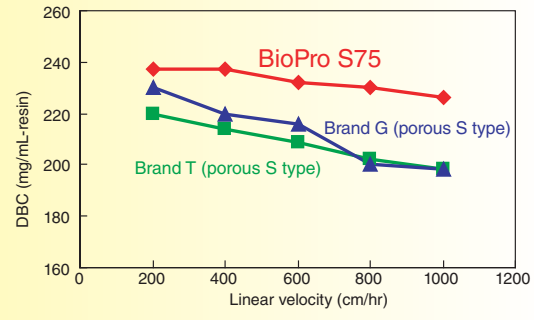
*Dynamic binding capacities were determined at 10% breakthrough under following conditions:

Column : 50 X 4.6 mmI.D.
Flow rate : 180 cm/hr (3.0 cm/min)

for anion-exchange media
Equilibration buffer : 20 mM Tris-HCl (pH 8.6)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.5 mg/mL BSA in equilibration buffer
Detection : UV at 280 nm

for cation-exchange media
Equilibration buffer : 20 mM Glycine-NaOH (pH 9.0)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.5 mg/mL Lysozyme in equilibration buffer
Detection : UV at 300 nm

High productivity on purification

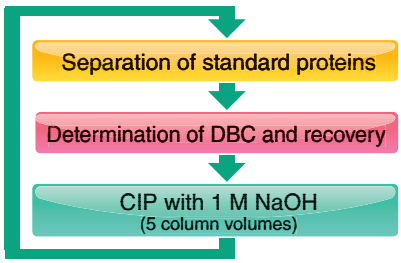


Column : 50 X 5.0 mmI.D.
Equilibration buffer : 20 mM Glycine-NaOH (pH 9.0)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.0 mg/mL Lysozyme in equilibration buffer
Detection : UV at 300 nm

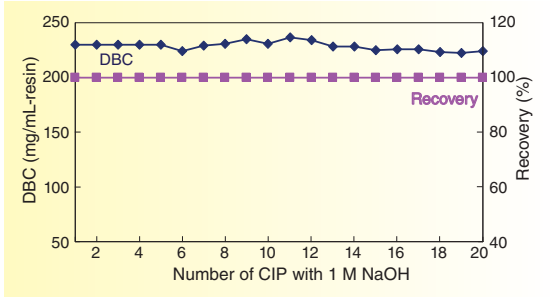
BioPro ion exchange media show high DBC over a wide range of linear velocity, and the diffierence of DBC is less than 5% between 200 cm/hr and 1000 cm/hr. BioPro ion exchange media give increased productivity and reduced cost in biopharmaceutical production.

Excellent durability (Stability on CIP)

Test protocols



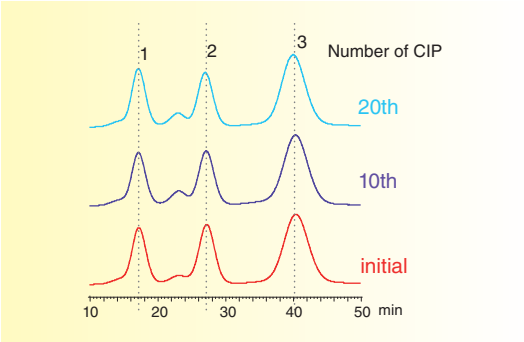
DBC and recovery



Conditions of DBC* measurement	
Column	: BioPro S75 50 X 5.0 mmI.D.
Flow rate	: 800 cm/hr (2.62 mL/min)
Equilibration buffer	: 20 mM Glycine-NaOH (pH 9.0)
Elution buffer	: 0.5 M NaCl in equilibration buffer
Sample	: 1.0 mg/mL Lysozyme in equilibration buffer
Temperature	: ambient
Detection	: UV at 300 nm

*DBC was determined at 10% breakthrough

Separation of standard proteins

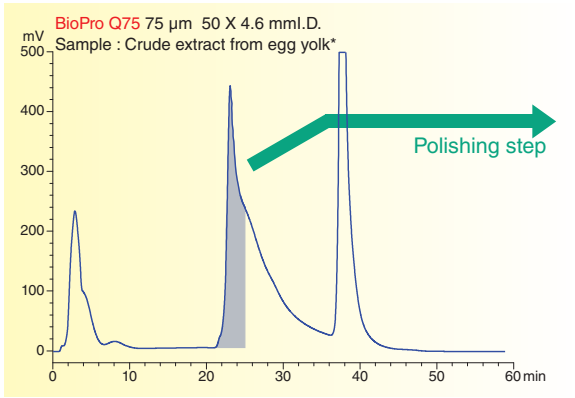


Conditions of separation of standard proteins	
Column	: BioPro S75 50 X 5.0 mmI.D.
Eluent	: A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl
Gradient	: 0-100%B (0-60 min; Linear)
Flow rate	: 180 cm/hr (0.59 mL/min)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 24 µL
Sample	: 1. Ribonuclease A, 2. Cytochrome *c*, 3. Lysozyme (0.5 mg/mL)

Cleaning in place (CIP) is an important procedure for cleaning and sterilization of columns used for protein purification. The DBC and the selectivity of proteins are unaffected following 20 cycles of CIP with 1 M NaOH. The high chemical stability of BioPro ion exchange media allow effective cleaning with alkaline solution.

Purification of IgY from egg yolk extract

Capture purification by ion exchange chromatography (IEC)

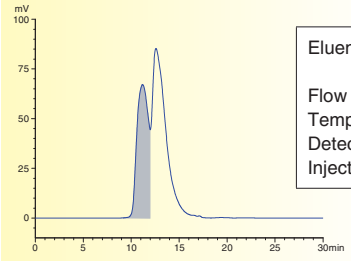


Eluent	: A) 20 mM Tris-HCl (pH 8.1) : B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl 10%B (0-15 min), 30%B (15-30 min), 90%B (30-40 min)
Flow rate	: 180 cm/hr (0.5 mL/min)
Temperature	: ambient
Detection	: UV at 280 nm
Injection	: 1 mL (ca. 20 mg Protein)

*Courtesy of Pharma Foods International Co., Ltd.

Polishing by size exclusion chromatography (SEC)

YMC-Pack Diol-200 5 µm 300 X 8.0 mmI.D.
Sample : Fraction from capture purification by IEC

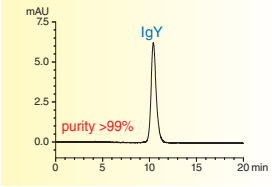


Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 6.9) containing 0.2 M NaCl
Flow rate	: 0.7 mL/min
Temperature	: ambient
Detection	: UV at 280 nm
Injection	: 1 mL (ca. 0.45 mg IgY)

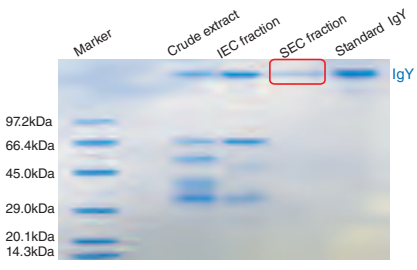
Analysis of purified fraction

SEC

YMC-Pack Diol-200 5 µm
300 X 4.6 mmI.D.
Fraction from polishing step by SEC



Non-reduced SDS-PAGE



Egg yolk antibody (IgY) can be isolated with high purity more than 99% by two chromatographic purification steps, which consist of a capture step by ion exchange chromatography on BioPro Q75 and a polishing step by size exclusion chromatography on YMC-Pack Diol-200.

Ion exchange columns

BioPro Ion Exchange Screening Kit

- Available in four chemistries: Strong ion exchangers (Q/S) and weak ion exchangers (DA/CM)
- Two column types (1 mL and 5 mL) that are ideal for media screening, development of purification method and loadability study
- Ion Exchange Selection Kit that consists of four different chemistries for fast and easy media screening
- Easy installation and convenient use

BioPro Ion Exchange Screening Kit is a kit of screening columns that are packed with BioPro ion exchange media designed for separation of proteins, nucleotides and other biomolecules. Various types of kit offer significant advantage and efficiency in media screening and purification method development.

Column Size

1 mL Type (26 X 7.0 mmI.D.)

- Media screening
- Purification method development

5 mL Type (26 X 15.6 mmI.D.)

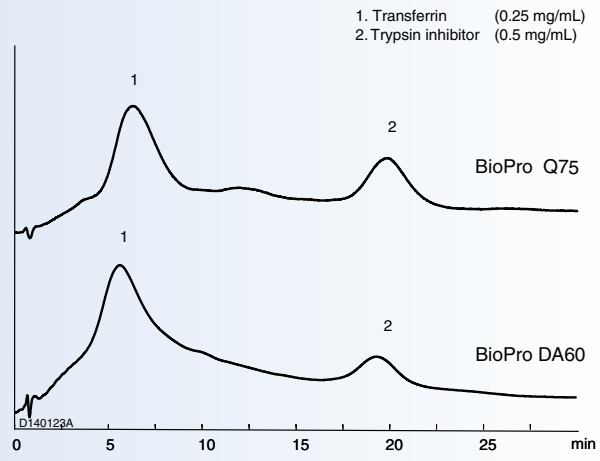
- Purification method development
- Loadability study
- Lab-scale purification

Specifications

	BioPro SmartSep Q BioPro Q	BioPro SmartSep S BioPro S	BioPro DA	BioPro CM
Matrix	Hydrophilic porous polymer			
Particle size (μm)	30/75		60	
Ion exchanger	-R-N$^+$(CH$_3$)$_3$	-R-SO$_3^-$	-R-N(CH$_3$)$_2$	-R-COOH
Usable pH range	2.0 ~ 12.0		Regular use : 3.0~12.0 Short term : 1.0~13.0	

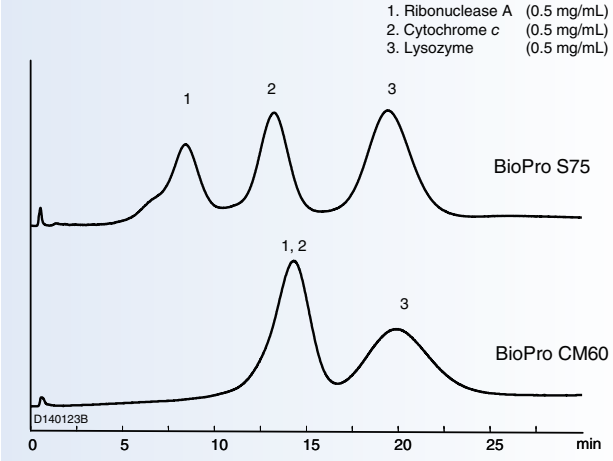
Application

Screening with anion exchange media



Column	: 1 mL type (26 X 7.0 mmI.D.)
Eluent	: A) 20 mM Tris-HCl (pH 8.1) B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl 10-80%B (0-30 min)
Flow rate	: 180 cm/hr (1.16 mL/min)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 20 μL

Screening with cation exchange media



Column	: 1 mL type (26 X 7.0 mmI.D.)
Eluent	: A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl 0-100%B (0-30 min)
Flow rate	: 180 cm/hr (1.16 mL/min)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 20 μL

YMC-Pack Diol

- 5 µm silica-based column with high mechanical stability
- Low-cost size exclusion chromatography (SEC) column
- Useful for molecular weight determination of proteins and sugars

- Particle size : 5 µm
- Pore size : 60, 120, 200, 300 Å
- Usable pH range : 5.0~7.5
- USP L20, L33, L59

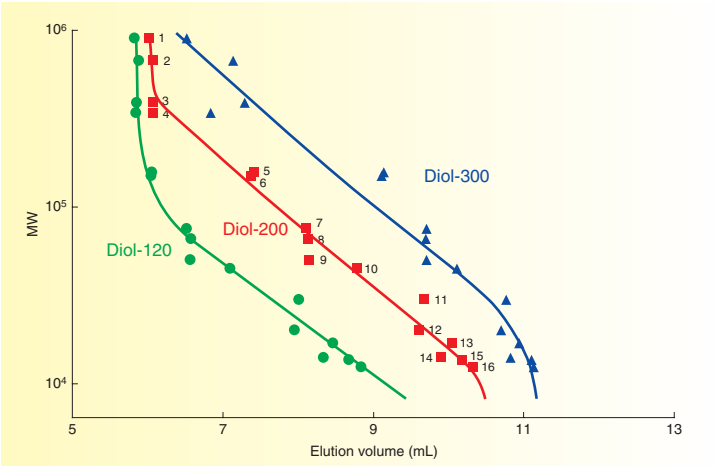
Silica-based size exclusion chromatography (SEC) column

YMC-Pack Diol is a size exclusion chromatography column based dihydroxypropyl-bonded silica, and available in four different pore sizes. Diol-120, 200, and 300 are suitable for separation or molecular weight determination of proteins with molecular weights of 5,000 to several hundred thousand. Diol-60 is the most suitable for separation of peptides or oligosaccharides whose molecular weights are 10,000 or less.

Specifications

Column	Base	Functional group	Pore size (Å)	Particle size (µm)	Usable pH range	Characteristics
Diol-60	Silica gel	Dihydroxypropyl	60	5	5.0 ~ 7.5	For molecular weight below 10,000
Diol-120			120			For molecular weight 5,000 to 100,000
Diol-200			200			For molecular weight 10,000 to ca. 500,000
Diol-300			300			For molecular weight ca. 50,000 to 1,000,000

Calibration curves of various proteins for three different pore sizes

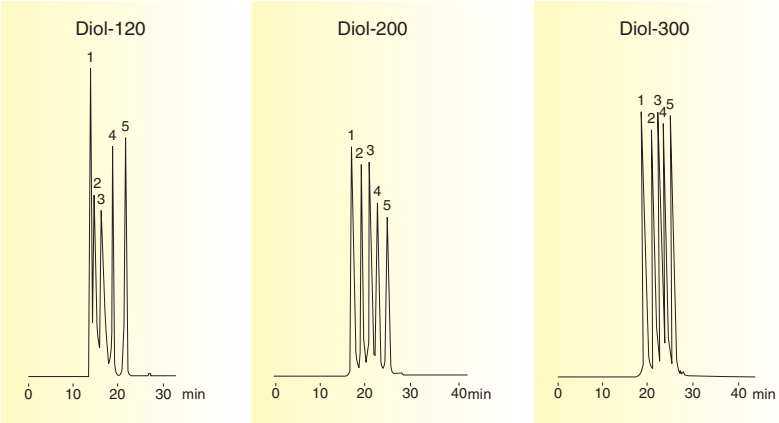


	MW
1. IgM	900,000
2. Thyroglobulin	670,000
3. IgA	390,000
4. Fibrinogen	340,000
5. γ-Globulin	158,000
6. IgG	150,000
7. Transferrin	75,000
8. HSA (human serum albumin)	66,000
9. α_1-Antitrypsin	50,000
10. Ovalbumin	45,000
11. Carbonic anhydrase	30,000
12. Trypsin inhibitor	20,100
13. Myoglobin	17,000
14. α-Lactalbumin	14,100
15. Ribonuclease A	13,700
16. Cytochrome *c*	12,400

Column	: YMC-Pack Diol 300 X 8.0 mmI.D.
Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0) containing 0.2 M NaCl
Flow rate	: 0.5 mL/min
Temperature	: 25°C
Detection	: UV at 280 nm

Diol-120, Diol-200 and Diol-300 are suitable for the separation or molecular weight determination of proteins with molecular weights of 5,000 to several hundred thousand.

Separation for standard protein markers

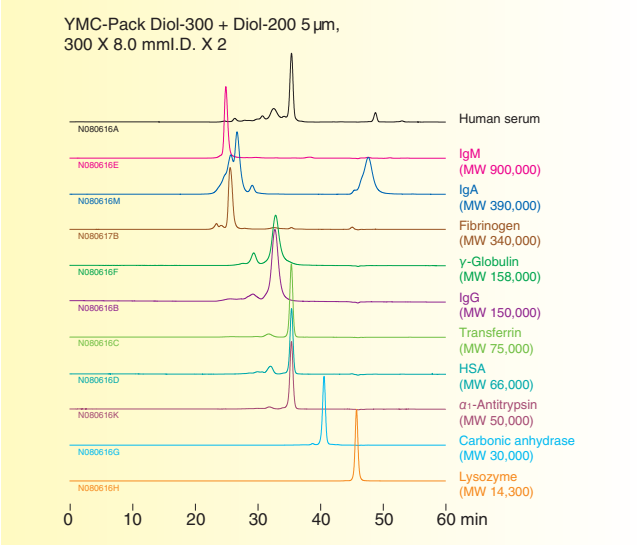


	MW
1. Glutamate dehydrogenase	290,000
2. Lactate dehydrogenase	142,000
3. Enolase	67,000
4. Adenylate kinase	32,000
5. Cytochrome *c*	12,400

Column	: YMC-Pack Diol 500 X 8.0 mmI.D.
Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0) containing 0.2 M NaCl
Flow rate	: 0.7 mL/min
Temperature	: ambient
Detection	: UV at 280 nm

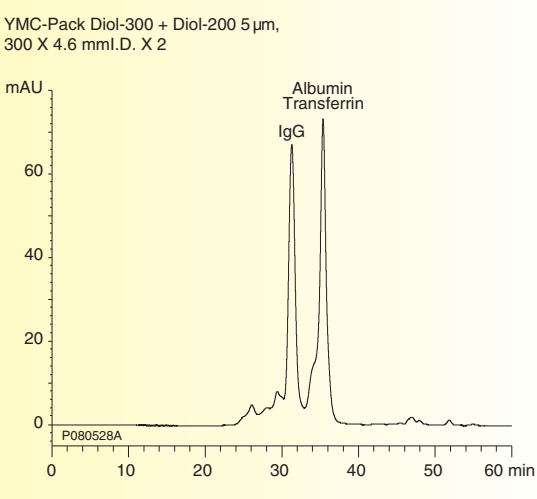
For molecular weight 10,000 to 500,000 compounds, Diol-200 is suitable for the separation.

Plasma constituents



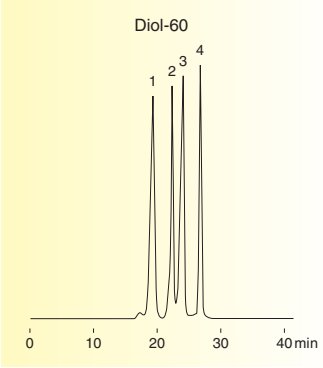
Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7. 0) containing 0.2 M NaCl
Flow rate	: 0.5 mL/min
Temperature	: ambient (25°C)
Detection	: UV at 280 nm

Proteins in mouse ascites fluid



Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0)
Flow rate	: 0.17 mL/min
Temperature	: ambient (25°C)
Detection	: UV at 220 nm
Injection	: 10 µL
Sample	: Mouse ascites fluid (60 times dilution with water)

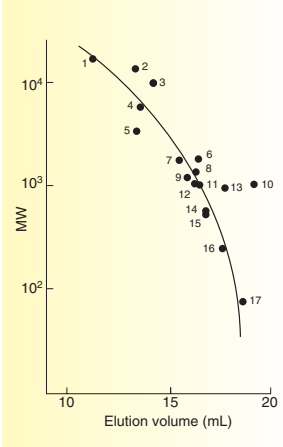
Separation for molecular weight below 10,000 peptides



	MW
1. Insulin (Bovine)	5,700
2. Neurotensin	1,672
3. Angiotensin II	1,040
4. Glycine	75

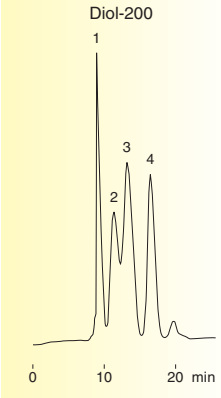
Column	: YMC-Pack Diol-60 500 X 8.0 mmI.D.
Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 7.0) containing 0.2 M NaCl/ acetonitrile (70/30)
Flow rate	: 0.7 mL/min
Temperature	: ambient
Detection	: UV at 215 nm

For molecular weight below 10,000 peptides, Diol-60 is suitable for the separation.

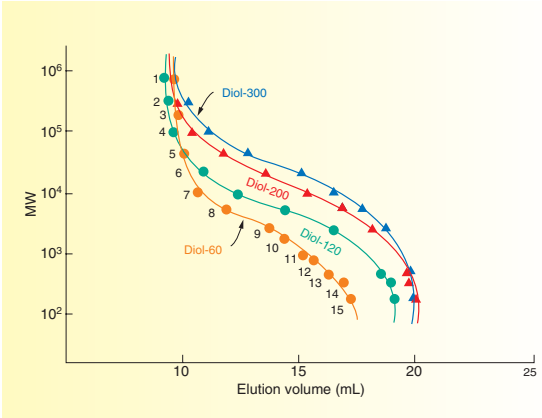


	MW
1. Myoglobin	17,000
2. Ribonuclease A	13,700
3. Cytochrome *c*	12,400
4. Insulin (Bovine)	5,700
5. Insulin B chain	3,496
6. α-Mating factor	1,684
7. Neurotensin	1,672
8. Angiotensin I	1,296
9. CCK-Octapeptide	1,143
10. Bradykinin	1,060
11. Angiotensin II	1,040
12. Oxytocin	1,007
13. Angiotensin III	931
14. Met-Enkephalin	574
15. Leu-Enkephalin	555
16. Tetraglycine	246
17. Glycine	75

Separation of oligo- and polysaccharide



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



	MW
1. Pullulan (P-800)	853,000
2. Pullulan (P-400)	380,000
3. Pullulan (P-200)	186,000
4. Pullulan (P-100)	100,000
5. Pullulan (P-50)	48,000
6. Pullulan (P-20)	23,700
7. Pullulan (P-10)	12,200
8. Pullulan (P-5)	5,800
9. Maltopentadecaose (G15)	2,448
10. Maltoundecaose (G11)	1,800
11. Maltoheptaose (G7)	1,152
12. Maltopentaose (G5)	824
13. Maltotriose (G3)	504
14. Maltose (G2)	342
15. Glucose (G1)	180

Column	: YMC-Pack Diol, 500 X 8.0 mmI.D.
Eluent	: water
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: RI

For separation or molecular weight determination of water-soluble oligo- and polysaccharides, Diol-60, Diol-120, Diol-200, and Diol-300 are useful individually or in combination.

Ordering Information – Columns –

YMC-BioPro QA/SP

Phase dimension	Column I.D. (mm)	Column length (mm)		
		30	50	100
QA porous 5 µm	4.6	QAA0S05-0346WP	QAA0S05-0546WP	QAA0S05-1046WP
SP porous 5 µm	4.6	SPA0S05-0346WP	SPA0S05-0546WP	SPA0S05-1046WP

YMC-BioPro QA-F/SP-F

Phase dimension	Column I.D. (mm)	Column length (mm)		
		30	50	100
QA-F non-porous 3 µm	4.6	QF00S03-0346WP	QF00S03-0546WP	QF00S03-1046WP
QA-F non-porous 5 µm	4.6	QF00S05-0346WP	QF00S05-0546WP	QF00S05-1046WP
SP-F non-porous 3 µm	4.6	SF00S03-0346WP	SF00S03-0546WP	SF00S03-1046WP
SP-F non-porous 5 µm	4.6	SF00S05-0346WP	SF00S05-0546WP	SF00S05-1046WP

YMC-Pack Diol (Stainless columns)

Phase dimension	Column I.D. (mm)	Column length (mm)		Guard column
		300	500	Column length (mm) 30 (Code:03)/50 (Code:05)
Diol-60 60 Å 5 µm	4.6	DL06S05-3046WT	—	—
	8.0	DL06S05-3008WT	DL06S05-5008WT	DL06S05-0308WTG
	20	DL06S05-3020WT	DL06S05-5020WT	DL06S05-0520WTG
Diol-120 120 Å 5 µm	4.6	DL12S05-3046WT	—	—
	8.0	DL12S05-3008WT	DL12S05-5008WT	DL12S05-0308WTG
	20	DL12S05-3020WT	DL12S05-5020WT	DL12S05-0520WTG
Diol-200 200 Å 5 µm	4.6	DL20S05-3046WT	—	—
	8.0	DL20S05-3008WT	DL20S05-5008WT	DL20S05-0308WTG
	20	DL20S05-3020WT	DL20S05-5020WT	DL20S05-0520WTG
Diol-300 300 Å 5 µm	4.6	DL30S05-3046WT	—	—
	8.0	DL30S05-3008WT	DL30S05-5008WT	DL30S05-0308WTG
	20	DL30S05-3020WT	DL30S05-5020WT	DL30S05-0520WTG

YMC-Pack Diol (Glass columns)

Phase dimension	Column I.D. (mm)	Column length (mm)	
		300	500
Diol-60 60 Å 5 µm	8.0	DL06S05-3008FG	DL06S05-5008FG
Diol-120 120 Å 5 µm	8.0	DL12S05-3008FG	DL12S05-5008FG
Diol-200 200 Å 5 µm	8.0	DL20S05-3008FG	DL20S05-5008FG
Diol-300 300 Å 5 µm	8.0	DL30S05-3008FG	DL30S05-5008FG

Ordering Information

Bulk media

Product name	Particle size (μm)	Product number
BioPro SmartSep Q10	10	QSA0S10
BioPro SmartSep S10		SSA0S10
BioPro SmartSep Q30	30	QSA0S30
BioPro SmartSep S30		SSA0S30
BioPro Q75	75	QAA0S75
BioPro S75		SPA0S75
BioPro DA60	60	DAM99S60
BioPro CM60		CMM99S60

BioPro Ion Exchange Screening Kit

Product name	Particle size (μm)	Specification	Column volume (mL)	Product number
Ion Exchange Selection Kit (BioPro Q75/S75/DA60/CM60)	75/60	1 each X 4 types	1	BPIESKS99-01PK
BioPro SmartSep Q30	30	5 / pack	1	BPQSA0S30-01PK
			5	BPQSA0S30-05PK
BioPro SmartSep S30			1	BPSSA0S30-01PK
			5	BPSSA0S30-05PK
BioPro Q75	75		1	BPQAA0S75-01PK
			5	BPQAA0S75-05PK
BioPro S75			1	BPSPA0S75-01PK
			5	BPSPA0S75-05PK
BioPro DA60	60		1	BPDAM99S60-01PK
			5	BPDAM99S60-05PK
BioPro CM60			1	BPCMM99S60-01PK
			5	BPCMM99S60-05PK

04

Hybrid Silica Based Columns

YMC-Triart

YMC-Triart is next-generation organic hybrid silica based columns, emphasizing versatility. The main features are superior durability, peak shape across all kind of compounds and reproducibility.
Having the same selectivity across different particle sizes, smooth method transfer between UHPLC and HPLC can be performed.
Moreover, various bonded phases supplement performance of C18 phase, and allow separations which C18 columns cannot achieve.

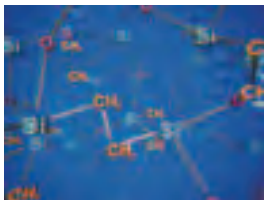
Various product lineup enables wide range of separation from UHPLC to HPLC analysis and even to preparative separation.

Features

- Effective for method screening with various chemistries
- Great chemical durability provided by hybrid particles
- Superior peak shapes for a wide range of compounds and in various conditions
- UHPLC compatible column with operating pressure up to 100 MPa packed with 1.9 µm particle
- Available in highly-durable semi-preparative column
- Smooth method transfer from UHPLC to HPLC analysis and even to HPLC purification

Versatile hybrid base material

YMC-Triart is based on novel organic/inorganic hybrid particles. The particle combines high mechanical stability and high efficiency derived from silica based packing material and high chemical stability derived from polymer based packing material. The granulation process utilizing microreactor technology enables continuous and highly controlled production of hybrid particles. The particle has uniform pore size distribution and smooth surface as well as uniform particle size. This feature greatly contributes to excellent peak shape and separation reproducibility.



Specifications

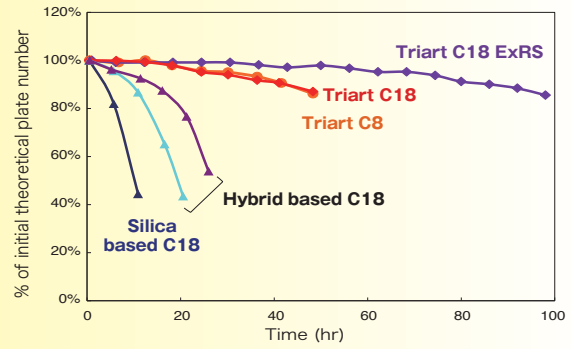
Product name	Triart C18	Triart C18 ExRS	Triart C8	Triart Phenyl	Triaty PFP	Triart Diol-HILIC
Functional group	-$C_{18}H_{37}$ (Standard type)	-$C_{18}H_{37}$ (high density bonding)	-C_8H_{17}	-$(CH_2)_4$- 	-$(CH_2)_3$- 	-CH_2CHCH_2 OH OH
Separation mode	Reversed-phase					HILIC
Base	Organic/inorganic hybrid silica					
Particle size (µm)	1.9, 3, 5					
Pore size (Å)	120	80	120			
Bonding	Trifunctional					
Carbon content (%) ※	20	25	17	17	15	12
Endcapping	Yes				No	
Usable pH range	1.0~12.0	1.0~12.0	1.0~12.0	1.0~10.0	1.0~8.0	2.0~10.0
100% aqueous compatibility	○	×	×	○	○	–
USP Classification	L1	L1	L7	L11	L43	L20

※ Containing 8% for hybrid silica base material.

Excellent durability

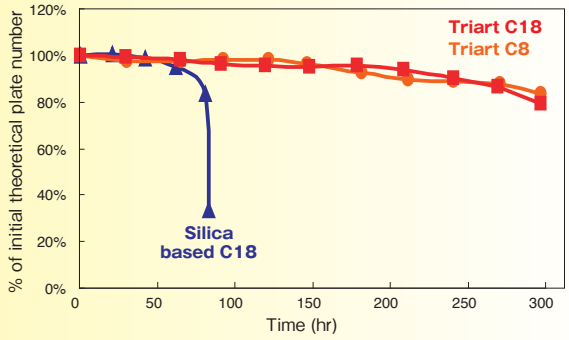
【Durability in high pH】

Phosphate buffer (pH 11.5), 40℃



Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: 50 mM K_2HPO_4-K_3PO_4 (pH 11.5)/methanol (90/10)
Flow rate	: 1.0 mL/min
Temperature	: 40℃
Sample	: benzyl alcohol

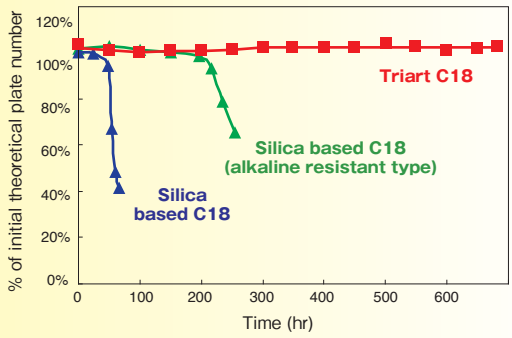
Triethylamine (pH 11.5), 40℃



Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: 50 mM triethylamine (pH 11.5)/methanol (90/10)
Flow rate	: 1.0 mL/min
Temperature	: 40℃
Sample	: benzyl alcohol

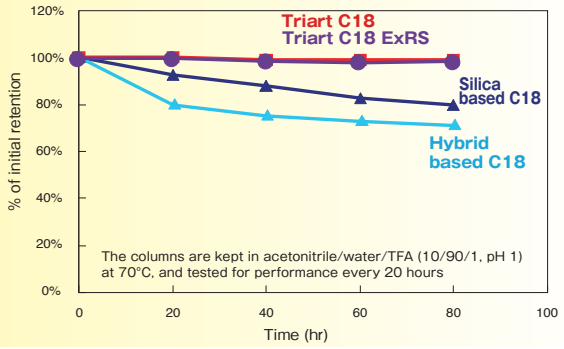
【Durability in high temperature】

pH 6.9, 70℃



Column	: 5 µm, 50 X 2.0 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/acetonitrile (90/10)
Flow rate	: 0.2 mL/min
Temperature	: 70℃
Sample	: phenol

pH 1, 70℃

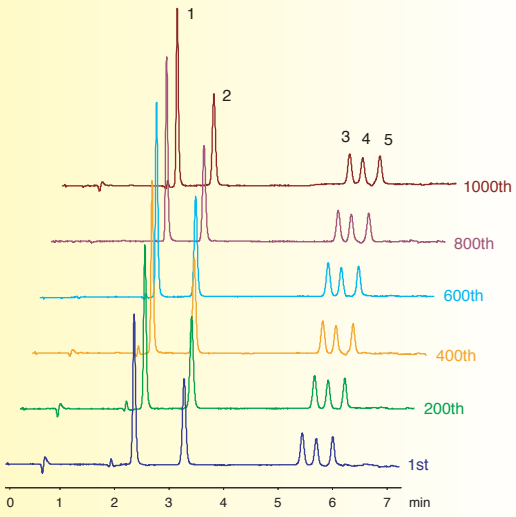


Test conditions	Column	: 5 µm, 50 X 2.0 mmI.D.
	Eluent	: acetonitrile/water (60/40)
	Flow rate	: 0.2 mL/min
	Temperature	: 37℃
	Sample	: butyl benzoate

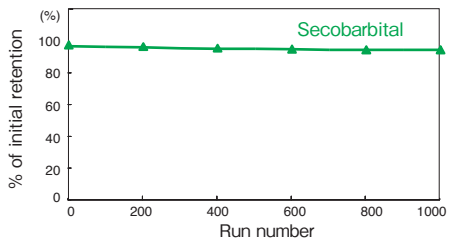
With innovative surface modification on organic hybrid silica, Triart columns show great chemical durability and they can be used over a wide pH range. Even at high-pH or high-temperature conditions, the lifetime of Triart C18, C18 ExRS and C8 is more than 10 times greater than that of conventional C18 columns and a few times greater than commercially available high alkaline-resistant C18 columns. When using under alkaline condition, organic buffers such as triethylamine make the column life longer than phosphate buffer. In addition, Triart is ideally suited for preparative purifications of various compounds or peptide analysis in the cases where trifluoroacetic acid (TFA) is frequently used, because it has high resistance to acids.

【Long column lifetime under chemically harsh conditions】

Continuous analysis with alkaline mobile phase (pH 9.5)



Barbiturates
1. Barbital
2. Phenobarbital
3. Hexobarbital
4. Pentobarbital
5. Secobarbital

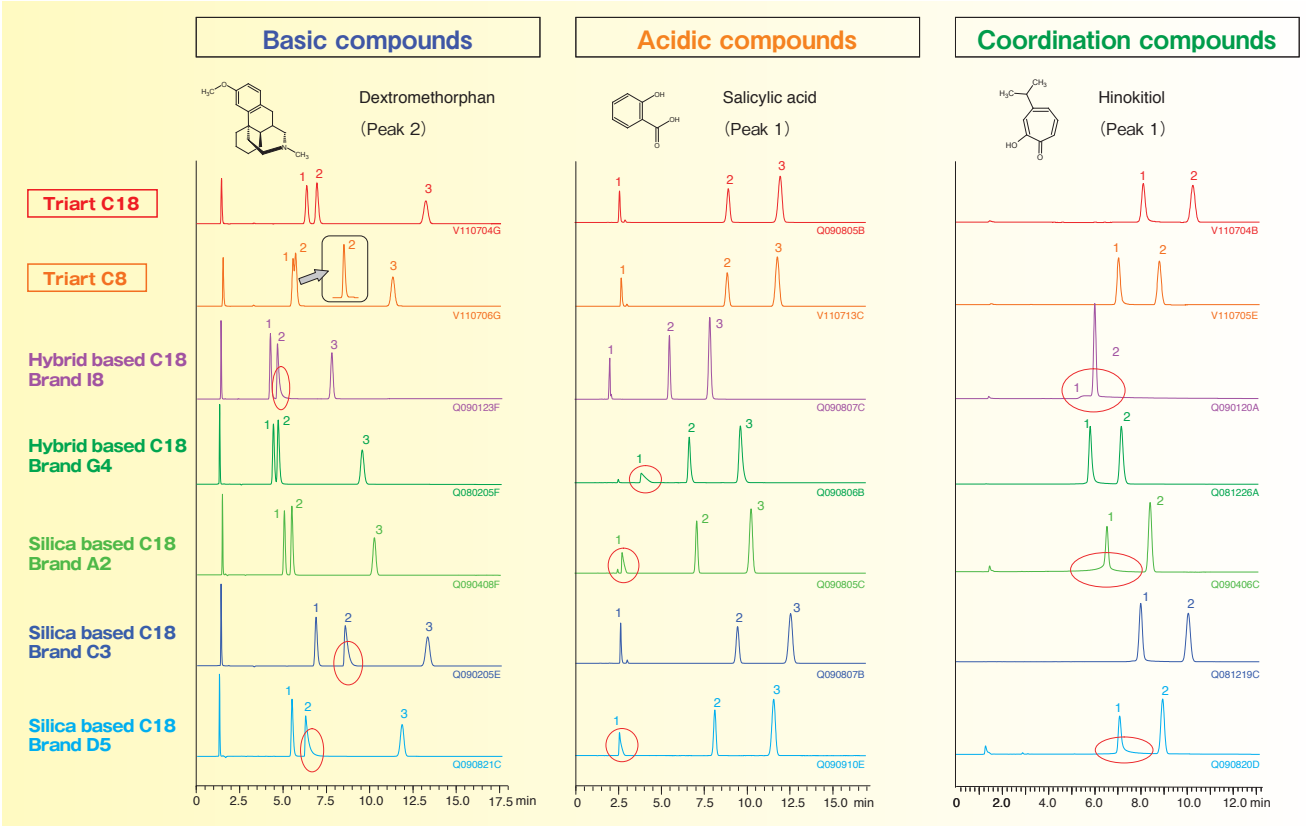


Column	: YMC-Triart C18 5 µm, 50 X 2.0 mmI.D.
Eluent	: A) 20 mM $HCOONH_4$-NH_3 (pH 9.5)
	B) methanol
	0-90%B (0-7 min)
Flow rate	: 0.2 mL/min
Temperature	: 25℃
Detection	: UV at 240 nm
Injection	: 1 µL

Triart shows great durability under alkaline mobile phase conditions, which is difficult for conventional silica columns. This assures stable analysis over a long period of time.

Great peak shapes without adsorption/peak tailing

【Comparison of chromatographic behavior】

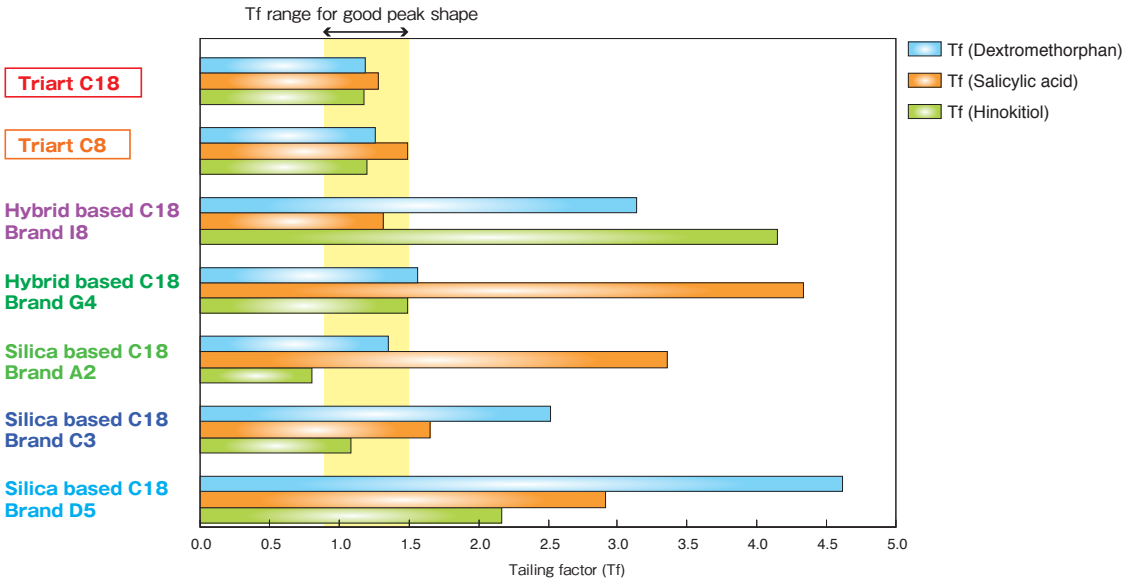


Column	: 150 X 3.0 mmI.D. or 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/acetonitrile (65/35)
Flow rate	: 0.425 mL/min for 3.0 mmI.D., 1.0 mL/min for 4.6 mmI.D.
Temperature	: 40℃
Detection	: UV at 235 nm
Sample	: 1. Chlorpheniramine 2. Dextromethorphan 3. Propyl paraben (I.S.)

Column	: 150 X 3.0 mmI.D. or 150 X 4.6 mmI.D.
Eluent	: 10 mM CH_3COOH-CH_3COONH_4 (pH 4.2)/acetonitrile (75/25)
Flow rate	: 0.425 mL/min for 3.0 mmI.D., 1.0 mL/min for 4.6 mmI.D.
Temperature	: 40℃
Detection	: UV at 254 nm
Sample	: 1. Salicylic acid 2. Methyl paraben (I.S.) 3. Cinnamic acid

Column	: 150 X 3.0 mmI.D. or 150 X 4.6 mmI.D.
Eluent	: acetonitrile/0.1% H_3PO_4 (40/60)
Flow rate	: 0.425 mL/min for 3.0 mmI.D., 1.0 mL/min for 4.6 mmI.D.
Temperature	: 40℃
Detection	: UV at 254 nm
Sample	: 1. Hinokitiol 2. Methyl benzoate (I.S.)

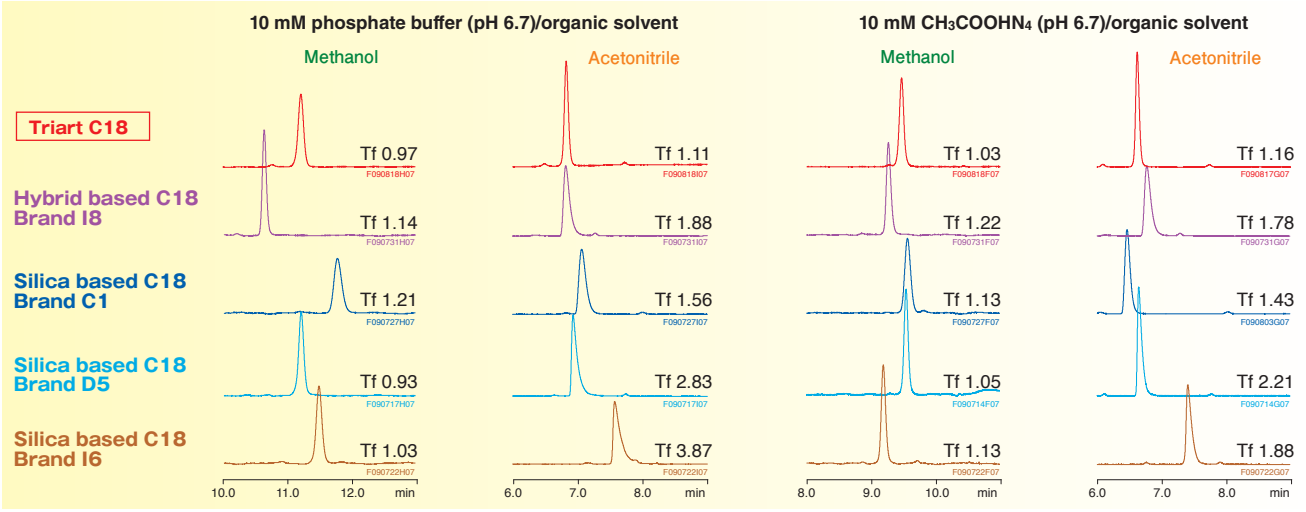
【Comparison of tailing factor】

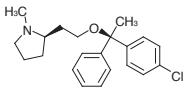


The peak tailing or fronting of ionic compounds are often caused by adsorption to residual silanol groups and/or surface impurities resulting from base materials or manufacturing process. Triart, based on hybrid silica material with little metal impurities and rigorously endcapped, provides symmetrical peak shapes for all types of compounds.

Superior peak shapes across various mobile phases

【Peak shape comparison of basic compound】



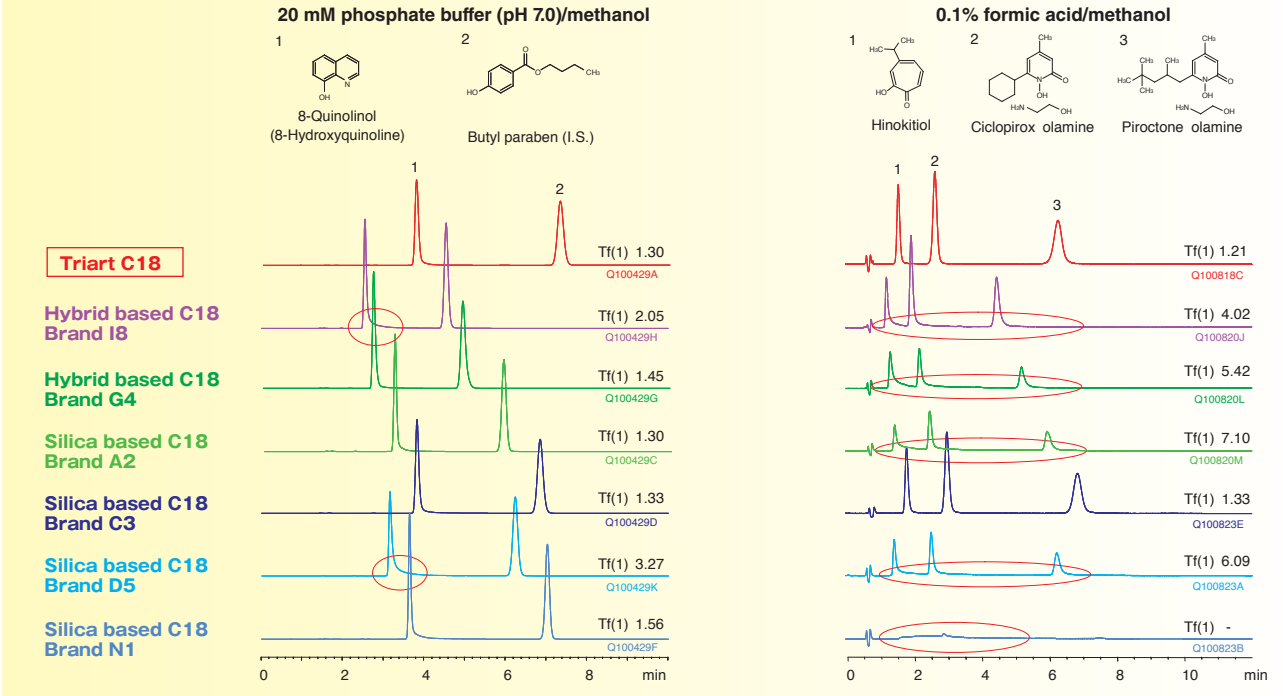


Clemastine

Column	: 5 µm, 50 X 2.0 mmI.D. or 50 X 2.1 mmI.D.
Eluent	: A) 10 mM KH_2PO_4-K_2HPO_4 (pH 6.7) or 10 mM CH_3COONH_4 (pH 6.7) B) methanol or acetonitrile 5-90%B (0-10 min), 90%B (10-15 min)
Flow rate	: 0.2 mL/min
Temperature	: 25℃
Detection	: UV at 230 nm

Clemastine is a well known basic compound which can easily tail on conventional ODS columns. Triart C18 can analyze clemastine without any peak deterioration with any kinds of buffer/solvent combinations.

【Peak shape comparison of coordination compounds】

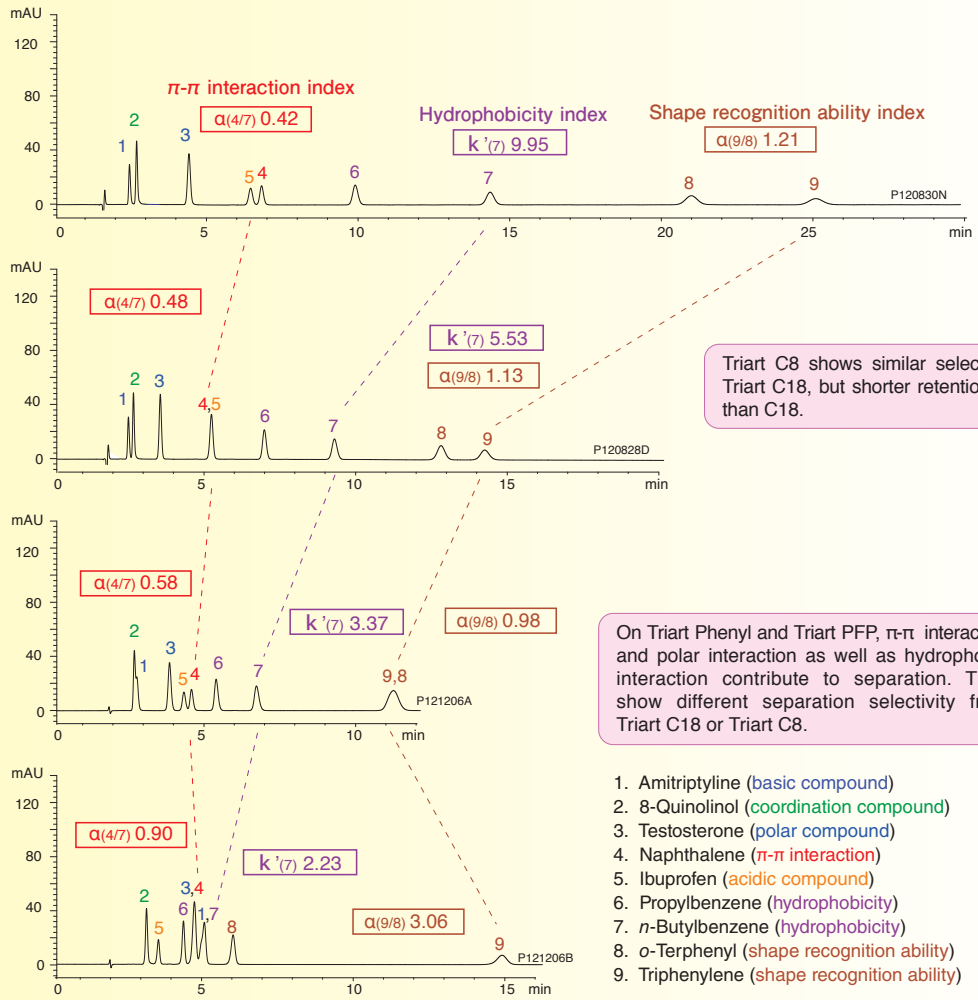


Column	: 5 µm or 3 µm, 150 X 4.6 mmI.D
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 7.0)/ methanol (35/65)
Flow rate	: 1.0 mL/min
Temperature	: 40℃
Detection	: UV at 254 nm
Injection	: 10 µL

Column	: 5 µm or 3 µm, 50 X 2.0 mmI.D. or 50 X 2.1 mmI.D
Eluent	: methanol/water/formic acid (65/35/0.1)
Flow rate	: 0.2 mL/min
Temperature	: 40℃
Detection	: UV at 310 nm
Injection	: 1 µL

Triart C18 is able to provide excellent peak shapes for coordination compounds which are often absorbed to a column, resulting from a strong interaction with impurities such as metal ion.

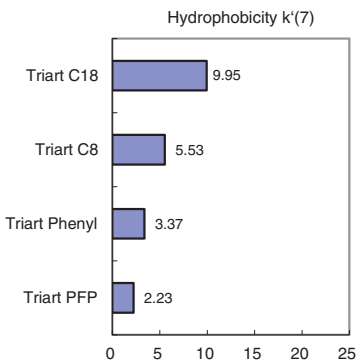
Comparison of separation selectivity among YMC-Triart

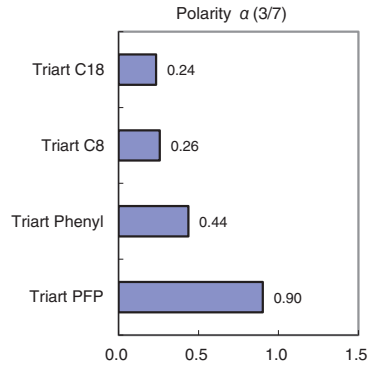


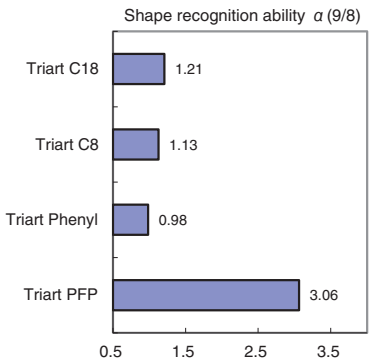
Triart C8 shows similar selectivity to Triart C18, but shorter retention times than C18.

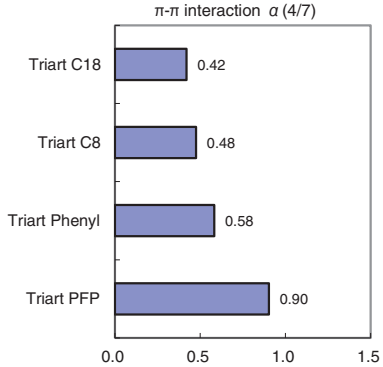
On Triart Phenyl and Triart PFP, π-π interaction and polar interaction as well as hydrophobic interaction contribute to separation. They show different separation selectivity from Triart C18 or Triart C8.

1. Amitriptyline (basic compound)
2. 8-Quinolinol (coordination compound)
3. Testosterone (polar compound)
4. Naphthalene (π-π interaction)
5. Ibuprofen (acidic compound)
6. Propylbenzene (hydrophobicity)
7. *n*-Butylbenzene (hydrophobicity)
8. *o*-Terphenyl (shape recognition ability)
9. Triphenylene (shape recognition ability)









Column	: 5 µm, 150 X 3.0 mmI.D.
Eluent	: 20 mM H_3PO_4-KH_2PO_4 (pH3.1)/ methanol (25/75)
Flow rate	: 0.425 mL/min
Temperature	: 40℃
Detection	: UV at 265 nm
Injection	: 4 µL

A mixture that consists of compounds with various characteristics is analyzed with reversed-phase Triart columns. In addition to hydrophobic interaction, secondary interactions such as π-π interaction and polar interaction are different from column to column. Those parameters have great impact on retention capacity (k') and separation factor (α). By utilizing the difference in separation characteristics, wide range of compounds can be well-separated with Triart.

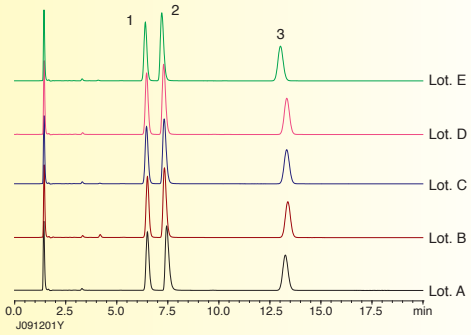
Quality control

【Excellent reproducibility】

Packing material

Triart C18 exhibits excellent lot-to-lot reproducibility for all types of compounds including basic and coordination compounds that often exhibits peak tailing or adsorption onto packing material.

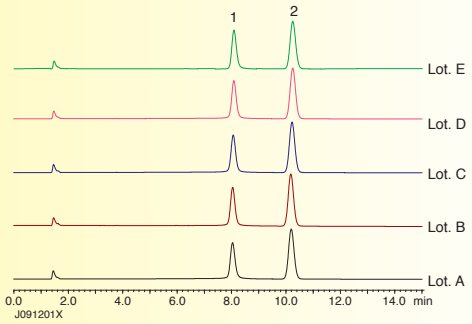
Basic compounds



1. Chlorpheniramine
2. Dextromethorphan
3. Propyl paraben (I.S.)

Column	: YMC-Triart C18 5 µm, 150 X 3.0 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/acetonitrile (65/35)
Flow rate	: 0.425 mL/min
Temperature	: 40℃
Detection	: UV at 235 nm

Coordination compound

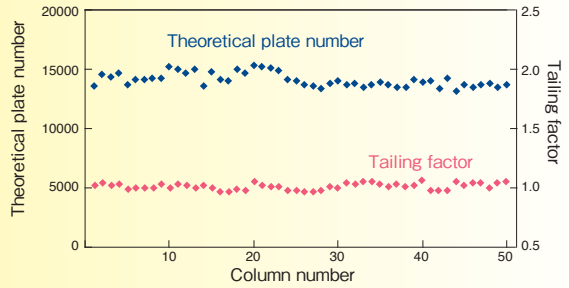


1. Hinokitiol
2. Methyl benzoate (I.S.)

Column	: YMC-Triart C18 5 µm, 150 X 3.0 mmI.D.
Eluent	: acetonitrile/0.1% H_3PO_4 (40/60)
Flow rate	: 0.425 mL/min
Temperature	: 40℃
Detection	: UV at 254 nm

Packed column

Rigorous control of theoretical plate number (N) and tailing factor (Tf) is performed on Triart C18 packed column.

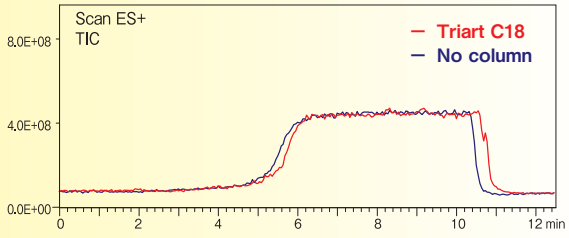


Column	: YMC-Triart C18 5 µm 150 X 4.6 mmI.D.
Eluent	: acetonitrile/water (60/40)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Sample	: butyl benzoate

Effective for high-sensitive analysis using LC/MS

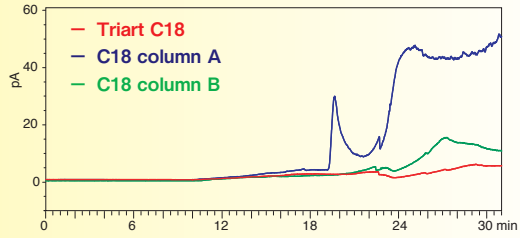
【Low bleeding】

LC/MS



Column	: 5 µm, 50 X 2.0 mmI.D.
Eluent	: A) water/formic acid (100/0.1) B) acetonitrile/formic acid (100/0.1) 5%B (0-1 min), 5-100%B (1-5 min), 100%B (5-10 min), 100-5%B (10-10.1 min), 5%B (10.1-12.5 min)
Flow rate	: 0.4 mL/min
Temperature	: 40℃
Detection	: ESI positive, TIC (Mass Range: 50-1000)

Corona* CAD*



Column	: 5 µm, 250 X 4.6 mmI.D.
Eluent	: A) water/formic acid (100/0.1) B) acetonitrile/formic acid (100/0.1) 5%B (0-5 min), 5-100%B (5-20 min), 100%B (20-30 min)
Flow rate	: 1.0 mL/min
Temperature	: 40℃
Detection	: Corona CAD

On Triart column, very low level of bleeding (leaching) is achieved thanks to the improvement of production procedure and of durability. Background noise of Triart C18 on LC/MS (TIC) is almost the same as blank run with no column. Also, baseline is almost stable on Corona CAD (Charged Aerosol Detector). These results prove that there is little bleeding from Triart C18 column. Very low background noise and high S/N ratio even with high-sensitive detectors are expected on Triart columns.

* Corona and CAD is a registered trademark of Thermo Fisher Scientific.

YMC-Triart 1.9 µm

- 1.9 µm column for UHPLC with operating pressure up to 100 MPa
- Same separation/selectivity as 3 µm and 5 µm
- Simple method transfer between conventional HPLC and UHPLC

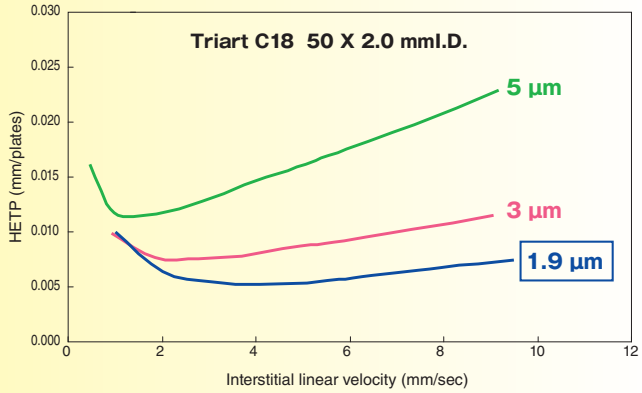
UHPLC column for ultra-fast separation and high resolution analysis

YMC-Triart 1.9 µm is designed for UHPLC with operating pressure up to 100 MPa. High resolution is achieved by 1.9 µm particles, and YMC-Triart 1.9 µm is effective for ultra fast separation with short columns. YMC-Triart 1.9 µm is suitable for high-throughput analysis by increasing flow rate. YMC-Triart shows the same peak shapes and separation selectivity across all particle sizes. This allows smooth method transfer between conventional HPLC and UHPLC. In addition, YMC-Triart 1.9 µm is also ideal as a high resolution column for peptide mapping and for separation of sample with complex constituents such as natural products.

Ideal for UHPLC analysis

【Correlation between linear velocity and column efficiency】

Van Deemter curves

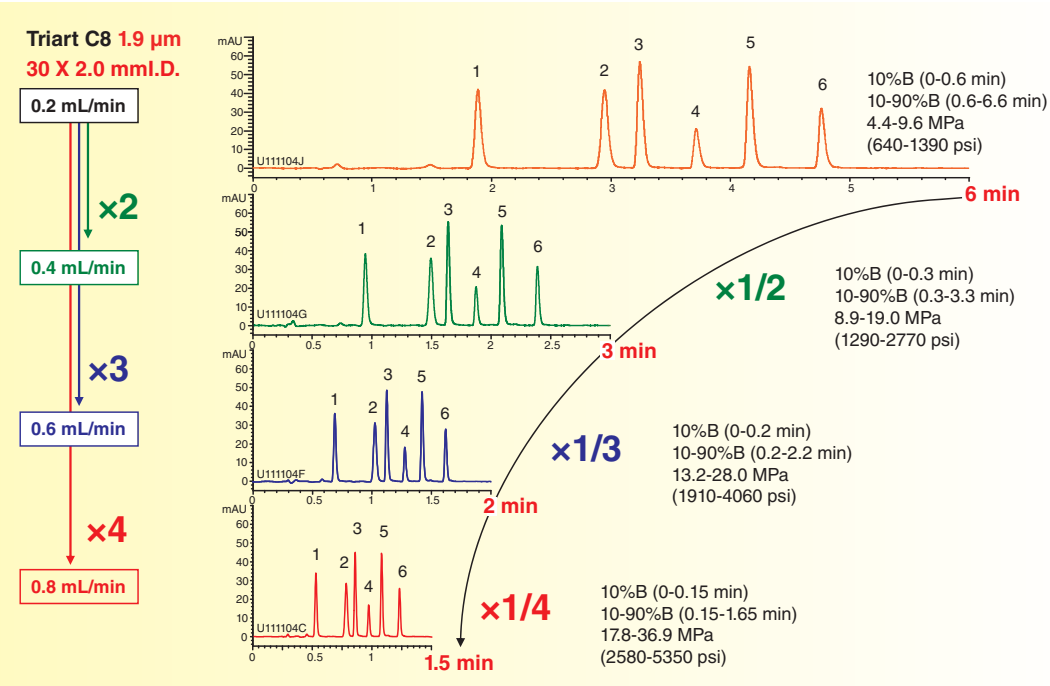


Eluent	: acetonitrile/water (60/40)
Temperature	: 25℃
Sample	: butyl benzoate

Triart 1.9 µm columns exhibit higher efficiency and maintain efficiency over a wide range of flow rate compared to 5 µm and 3 µm columns.

X axis : Interstitial linear velocity (Obtained by dividing column length by dead time (t0); the larger number means faster flow rate.)
Y axis : height equivalent of a theoretical plate (HETP; Obtained by dividing theoretical plate number by column length; the smaller number means higher column efficiency.)

【Increasing throughput】



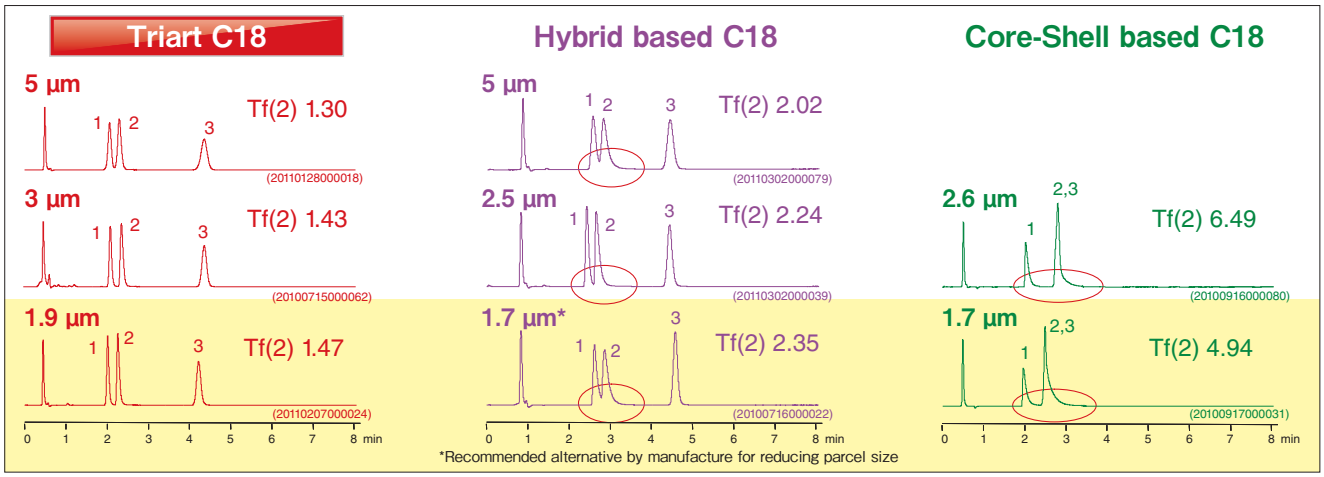
Drug substances
1. Hydrochlorothiazide
2. Valsartan
3. Losartan potassium
4. Amlodipine besilate
5. Atorvastatin calcium hydrate
6. Candesartan cilexetil

Eluent	: A) 10 mM CH_3COONH_4-CH_3COOH (pH 5.5) B) acetonitrile
Temperature	: 30℃
Detection	: UV at 254 nm
Injection	: 4 µL
System	: Agilent 1200SL

Triart C8 1.9 µm provides an ultrafast separation of six drug substances which are different in polarity and hydrophobicity within 1.5 minutes by using short column and increasing flow rate.

Seamless method transfer between HPLC and UHPLC

【Identical selectivity across various particle sizes】



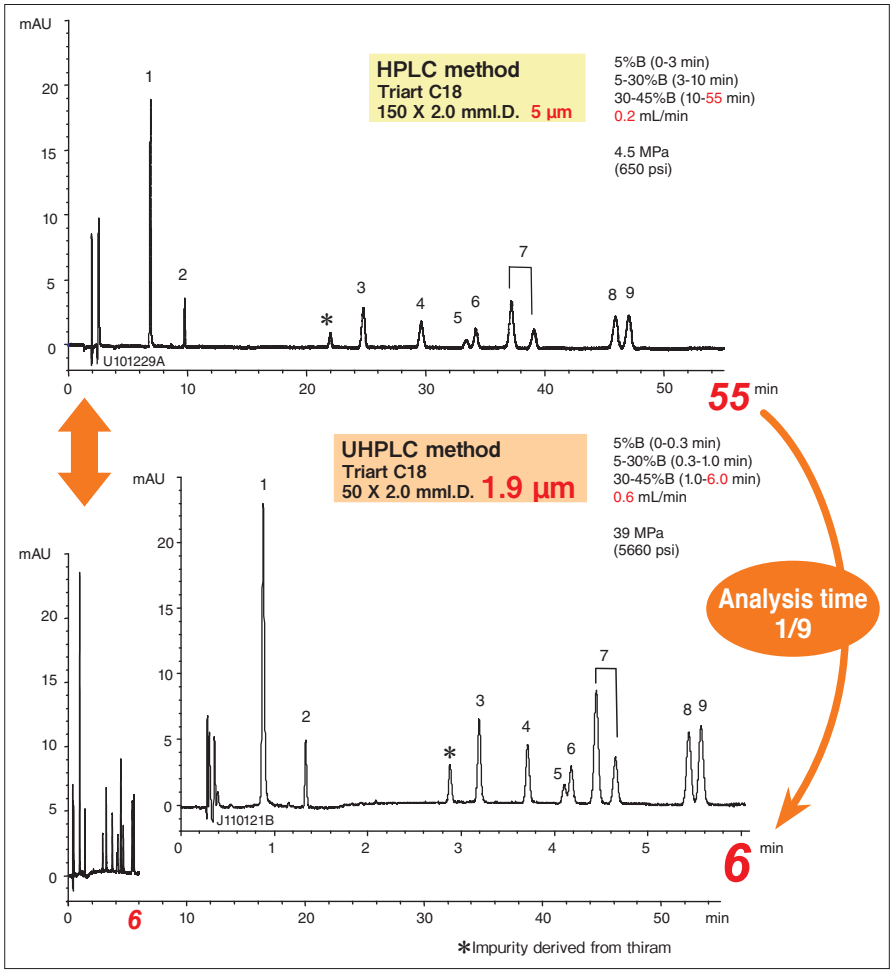
Basic drugs

1. Chlorpheniramine 2. Dextromethorphan 3. Propyl paraben (I.S.)

Column	: 50 X 2.0 mmI.D. or 2.1 mmI.D.
Eluent	: 20 mM KH_2PO_4-KH_2PO_4 (pH 6.9)/acetonitrile (65/35)
Flow rate	: 0.2 mL/min
Temperature	: 40℃
Detection	: UV at 235 nm

Triart columns show the identical selectivity and the excellent peak shapes of basic (ionic) compounds across all of the particle sizes including 1.9 µm. It allows predictable scale up from UHPLC to conventional HPLC and even to semi-preparative LC, and vice versa. In contrast, commercially available C18 columns often show some differences in selectivity, retention, and peak shape between different particle sizes.

【Method transfer between HPLC and UHPLC】



Eluent	: A) water/formic acid (100/0.1) B) acetonitrile/formic acid (100/0.1)
Temperature	: 40℃
Detection	: UV at 240 nm
Injection	: 1 µL (5 µg/mL)
System	: Agilent 1200SL

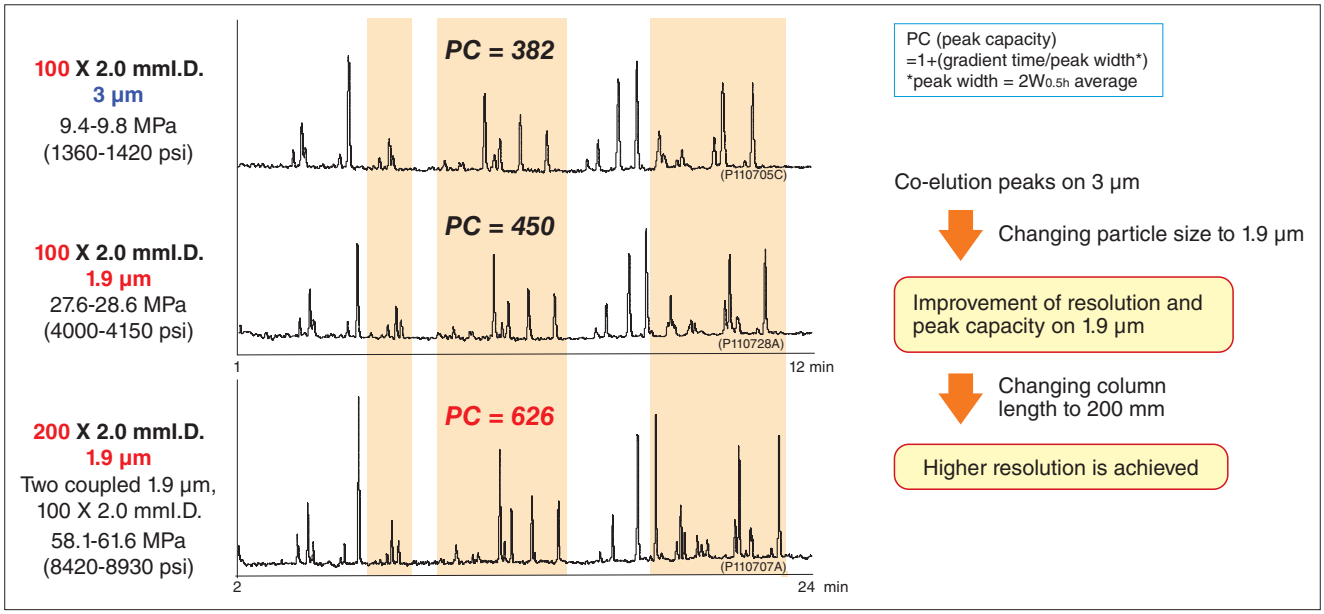
A 90% decrease of analysis time is achieved by transferring analysis method from conventional HPLC using 5 µm particle to UHPLC using 1.9 µm particle at three times faster linear velocity. Also, a method developed with UHPLC can easily be transferred to HPLC.

Agrichemicals

1. Oxine-copper (Copper 8-quinolinolate)
2. Asulam
3. Thiram
4. Triclopyr
5. Mecoprop
6. Flazasulfuron
7. Siduron
8. Halosulfuron-methyl
9. Azoxystrobin

Effective as a high resolution column

【Peptide mapping】

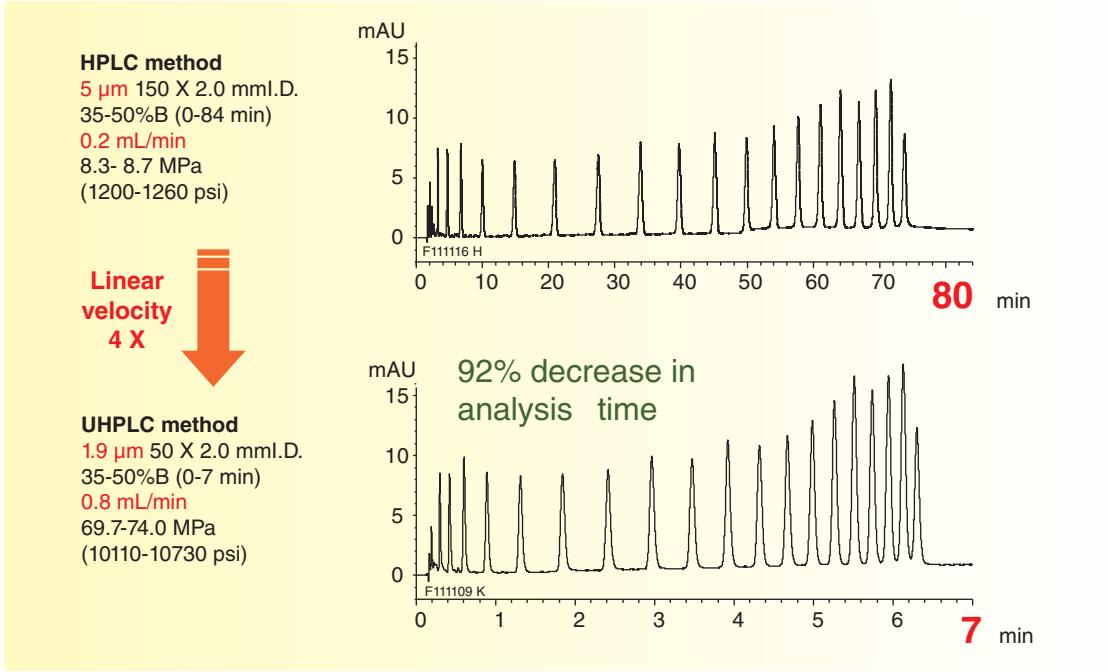


Column	: YMC-Triart C18	Temperature	: 70℃
Eluent	: A) water/TFA (100/0.1)	Detection	: UV at 220 nm
	B) acetonitrile/TFA (100/0.08)	Injection	: 10 µL for a single column
	5-40%B (0-15 min) for a single column		20 µL for two coupled columns
	5-40%B (0-30 min) for two coupled columns	Sample	: Triptic digest of Bovine Hemoglobin
Flow rate	: 0.4 mL/min	System	: Agilent 1290

YMC-Triart 1.9 µm has superior column efficiency, and a coupling of two 100 mm length of Triart 1.9 µm columns offers outstanding separation ability. This allows the precise separation in an analysis of complicated samples, such as peptide mapping.

Effective as a high resolution column

【Separation of oligonucleotides】



Column	: YMC-Triart C18
Eluent	: A) 10 mM di-*n*-butylamine-acetic acid (pH 6.0)
	B) methanol
Detection	: UV at 269 nm
Temperature	: 35℃
Injection	: 1 µL (5 nmol/mL)
Sample	: Oligonucleotides d(pT)2-20
System	: Agilent 1290

In the separation of oligonucleotides, 19 peaks are completely resolved within 7 minutes using Triart C18 1.9 µm UHPLC column. The separation is achieved within one tenths of analysis time on conventional HPLC method.

YMC-Triart C18

- Superior peak shape
- Usable over wide range of pH and temperature
- Usable with 100% aqueous mobile phase

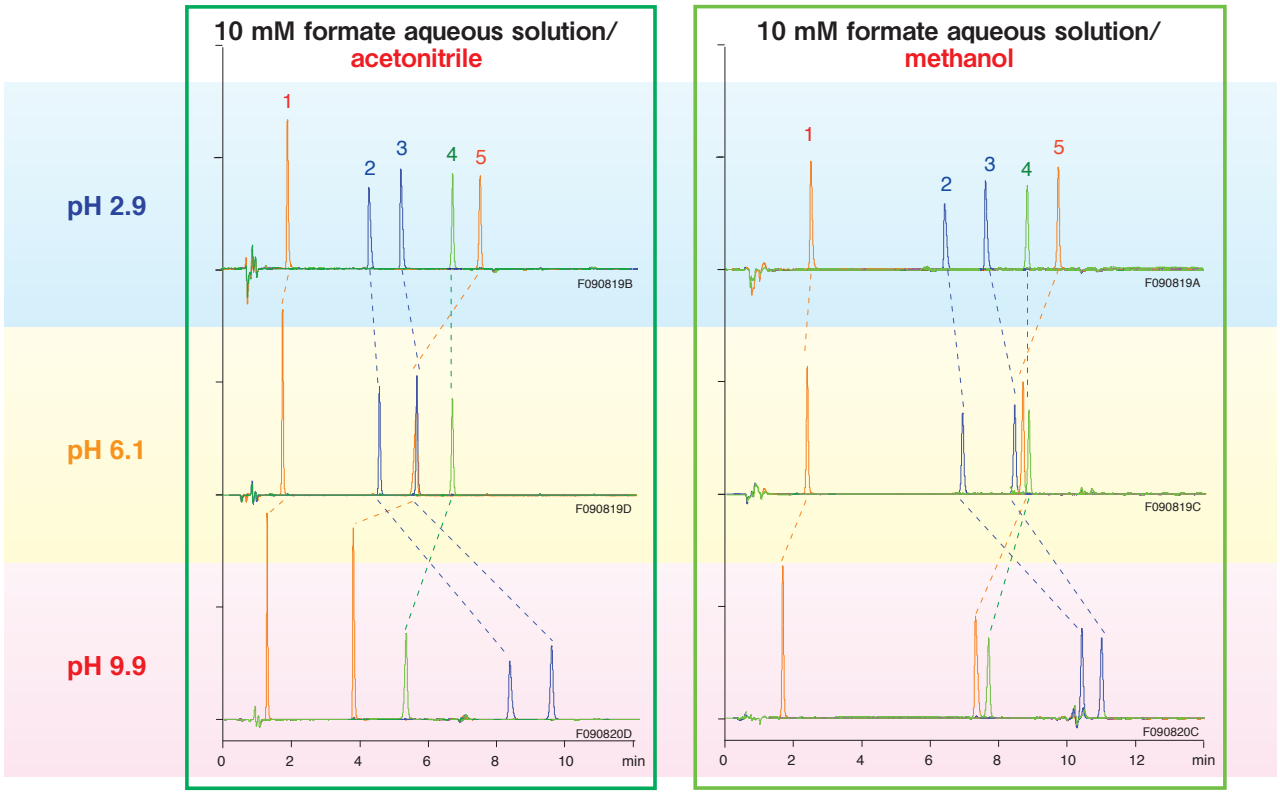
- Pore size : 120 Å
- Carbon content : 20%
- Usable pH range : 1.0~12.0
- USP L1

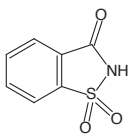
Highly durable column suitable as a first choice

One of the main features of YMC-Triart C18 is great chemical durability and outstanding peak shape. YMC-Triart C18 can be used under conditions of wide range of pH or high temperature. Preferable balance of surface hydrophobicity and hydrogen bonding capacity are achieved by the optimization of density of C18 bonded phase. This feature enables YMC-Triart C18 a first-choice column suitable for various separations. YMC-Triart C18 also performs well with 100% aqueous mobile phase and superior retention and reproducibility can be obtained.

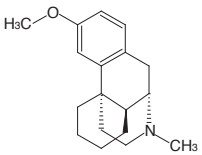
Flexibility in method development

【Efficient mobile phase screening for ionic compounds】

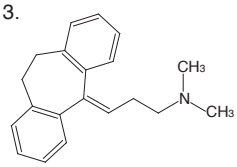


1. 

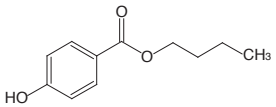
Saccharin
(Acidic compound)
pka=2.2

2. 

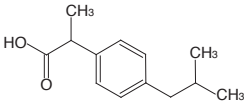
Dextromethorphan
(Basic compound)
pka=8.3

3. 

Amitriptyline
(Basic compound)
pka=9.4

4. 

n-Butylparaben
(Weakly acidic compound)
pka=8.3

5. 

Ibuprofen
(Acidic compound)
pka=4.4

Column	: YMC-Triart C18 5 µm 50 X 2.0 mmI.D.
Eluent	: A) 10 mM HCOOH for pH 2.9 10 mM $HCOONH_4$ for pH 6.1 10 mM $HCOONH_4$-NH_3 for pH 9.9 B) organic solvent 5-90%B (0-10 min), 90%B (10-15 min)
Flow rate	: 0.2 mL/min
Temperature	: 25℃
Detection	: UV at 230 nm

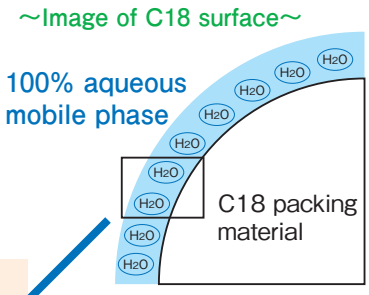
On reversed-phase HPLC, pH and organic solvent are the most important factors to control retention and selectivity. Triart C18 with wide usable pH range offers significant advantage in selection of mobile phase condition. Triart C18 delivers symmetrical peak shapes for all types of compounds. Moreover, this feature is independent from mobile phase pH and mobile phase condition. Chromatographers can choose the most optimal condition by combining various mobile phase conditions such as mobile phase pH, and types of organic solvent/buffer system.

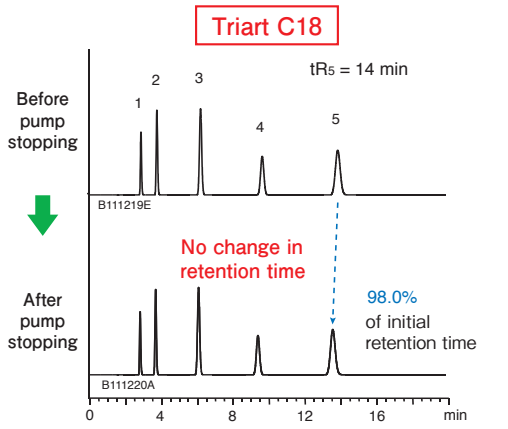
Effective for an analysis of highly polar compounds using 100% aqueous condition

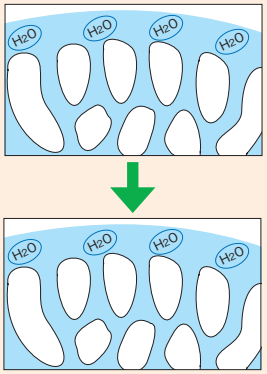
【Retention stability under 100% aqueous mobile phase】

Nucleic bases

1. Cytosine
2. Uracil
3. Guanine
4. Thymine
5. Adenine

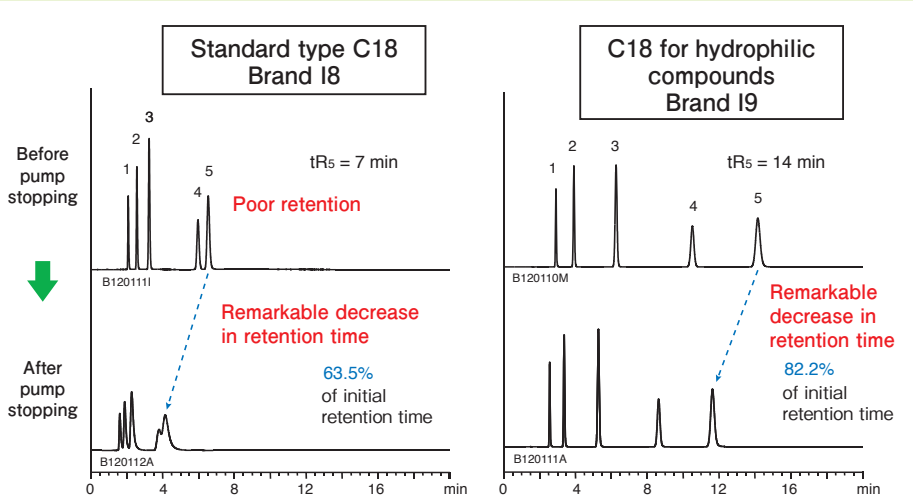


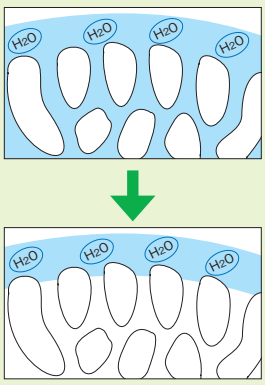




Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)
Flow rate	: 1.0 mL/min
Temperature	: 37℃
Detection	: UV at 254 nm

The surface of Triart C18 is well-hydrated even after stopping pump.
This provides longer and stable retention time of polar nucleic bases.





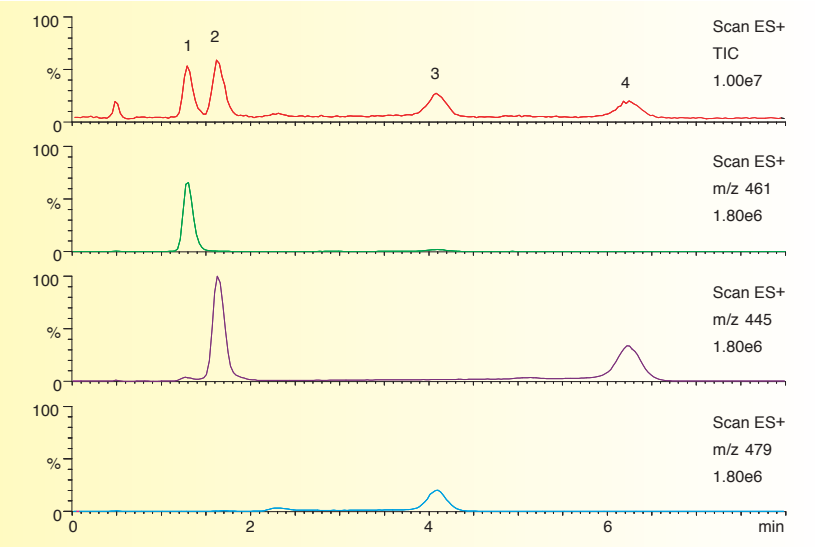
The surface of packing material is not fully hydrated. Compounds are not partitioned between mobile phase and stationary phase, and therefore its retention becomes shorter.

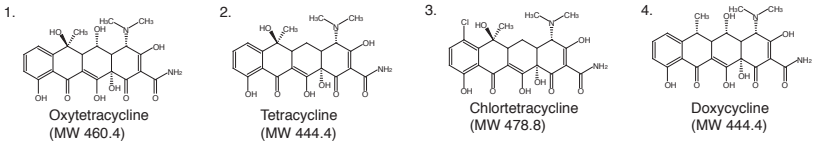
Under the 100% aqueous mobile phase, conventional C18 columns generally show poorer performance (retention and peak shape) due to low surface hydration caused by repulsion between aqueous mobile phase and hydrophobic bonded phase. There are several C18 columns that are compatible with 100% aqueous mobile phase in the market. Such columns exhibit excellent reproducibility and good retention ability of polar compounds achieved by sufficient surface hydration. On the other hand, classical silica base resin and bonded phase are easily degraded under such highly aqueous condition. Those aqueous compatible columns tend to have short lifetime.

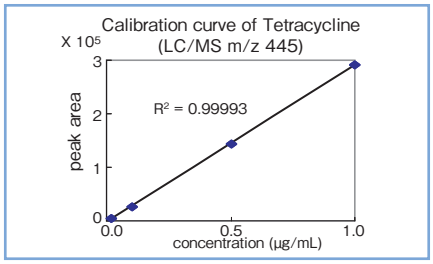
To overcome the shortcomings of classical silica-based columns designed for highly aqueous compatibility, Triart C18 is a highly durable C18 column with trifunctional bonding. C18 phase on the organic/inorganic hybrid silica. Triart C18 is designed to retain both moderate hydrogen bonding capacity and hydrophobicity on the surface by optimizing bonded density of C18 phase. Its versatility is ideal for the first choice ODS column, and also applicable to analyses of polar compounds with 100% aqueous mobile phase condition.

Suitable for high sensitive LC/MS analysis

【Analysis of Tetracycline antibiotics using LC/MS】







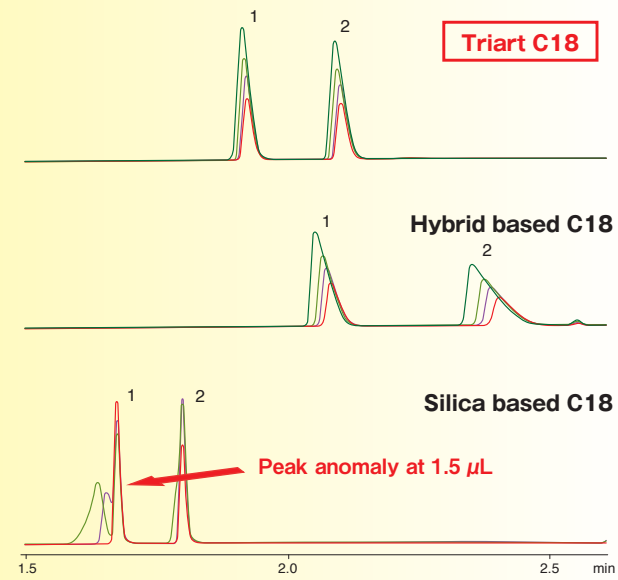
Column	: YMC-Triart C18 5 μm 50 X 2.0 mmI.D.
Eluent	: acetonitrile/water/formic acid (15/85/0.1)
Flow rate	: 0.4 mL/min
Temperature	: 40℃
Detection	: ESI positive mode
Injection	: 10 μL

Triart C18 with its low bleeding characteristics is ideal for high sensitivity analysis using LC/MS. In addition, Triart C18's surface inertness to basic compounds and coordination compounds offers excellent and reproducible peak shape for quantitating difficult to chromatograph compounds.

Minimizing strong solvent/sample loading effects

【Improvement of loadability】

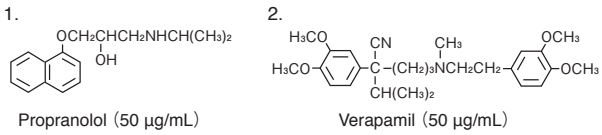
Influence of injection volume on peak shape



Sample dissolving solvent
acetonitrile

Injection volume
1.0 μL
1.5 μL
2.0 μL
3.0 μL

Column	: 5 μm, 50 X 2.0 mmI.D. or 2.1 mmI.D.
Eluent	: A) water/formic acid (100/0.1) B) acetonitrile/formic acid (100/0.1) 5%B (0-0.5 min), 5-100%B (0.5-2.5 min)
Flow rate	: 0.4 mL/min
Temperature	: 40℃
Detection	: UV at 275 nm



Triart C18 can tolerate larger injection volumes of samples containing solvents that have strong eluting ability (e.g., acetonitrile) while allowing for better peak shape than conventional columns. This can be important for a sample pretreated with higher concentrations of organic solvent, crude reaction samples and poorly soluble samples.

YMC-Triart C18 ExRS

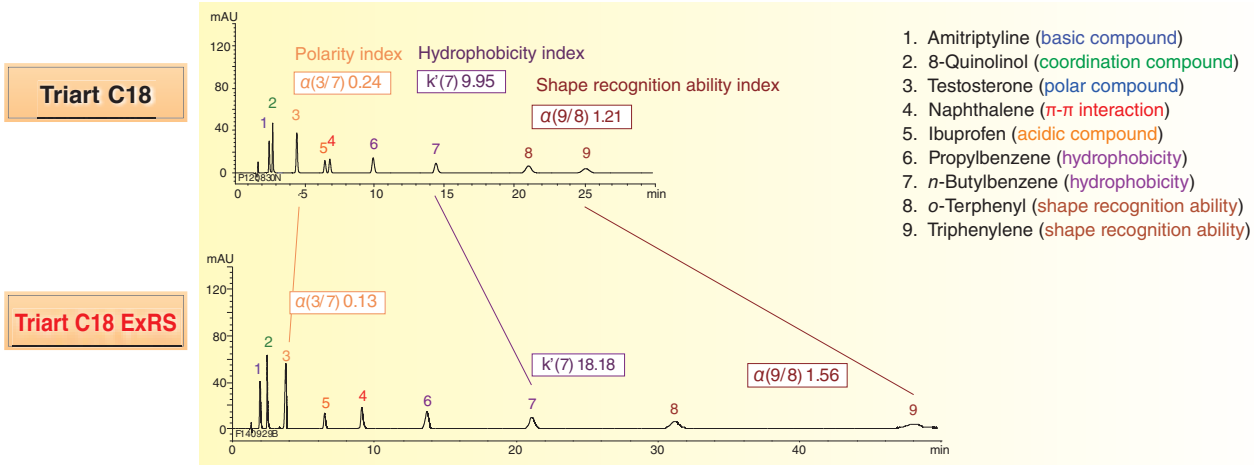
- C18 phase with high density bonding on organic/inorganic hybrid silica gel
- Excellent selectivity of isomers and structural analogs
- Superior chemical durability

- Pore size : 80 Å
- Carbon content : 25%
- Usable pH range : 1.0~12.0
- USP L1

Alternative selectivity to standard C18 columns

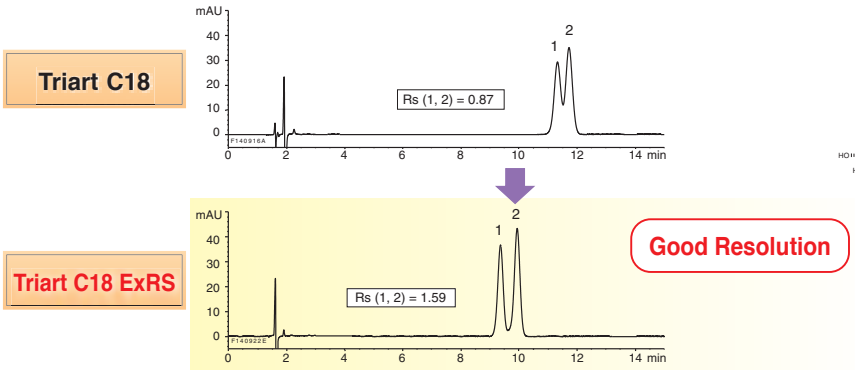
YMC-Triart C18 ExRS is C18 phase with high density bonding on organic/inorganic hybrid silica particles. In the case of YMC-Triart C18 ExRS, hydrophobicity is high due to the high carbon loading (25%). This makes YMC-TriartC18 ExRS suitable for use with hydrophobic isomers and structural analogs. Given the superior chemical and physical durability of YMC-Triart C18 ExRS, chromatographers are afforded additional flexibility in choosing separation conditions for both method development and routine column usage.

Comparison of fundamental separation selectivity

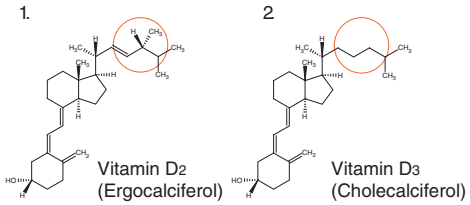


A mixture that consists of compounds with various characteristics is analyzed with Triart C18 and Triart C18 ExRS. Triart C18 ExRS has lower polarity and higher hydrophobicity than the standard Triart C18 column. It also shows improved planar cognitive ability.

Ideal for separations of structural analogs



Good Resolution

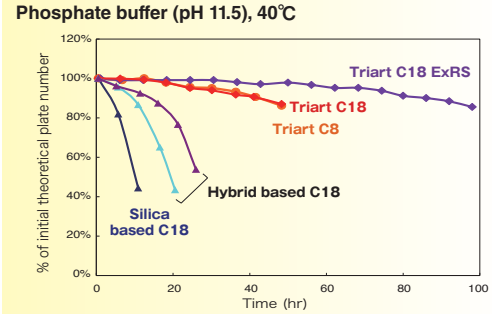


Column	: 5 µm, 150 X 3.0 mmI.D.
Eluent	: THF/acetonitrile (10/90)
Flow rate	: 0.425 mL/min
Temperature	: 30℃
Detection	: UV at 265 nm
Injection	: 4.25 µL (10 µg/mL)

Triart C18 ExRS is effective for separating of structural analogs. This feature is especially useful for separating pharmaceuticals with structurally similar impurities

Improved durability

Phosphate buffer (pH 11.5), 40℃



Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: 50 mM K_2HPO_4-K_3PO_4 (pH 11.5)/ methanol (90/10)
Flow rate	: 1.0 mL/min
Temperature	: 40℃
Sample	: benzyl alcohol

High density bonding of C18 greatly contributes to improved chemical durability.

YMC-Triart C8

- Alternative to the more widely-used C18
- Usable over wide range of pH and temperature
- Ideal for separations of isomers or structural analogs

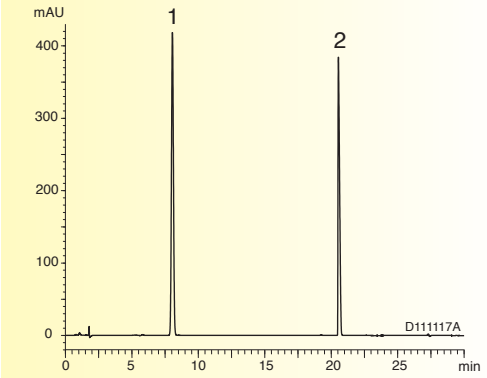
- Pore size : 120 Å
- Carbon content : 17%
- Usable pH range : 1.0~12.0
- USP L7

Effective for fast analysis of compounds with low polarity or for separation of isomers

YMC-Triart C8 is a versatile column with excellent chemical durability that is equivalent to YMC-Triart C18. YMC-Triart C8 is suitable for fast analysis of samples containing hydrophobic compounds that are strongly retained on C18 columns or samples containing compounds with large difference in hydrophobicity.
In addition, its high bonded density provides high cognitive ability to separate compounds with structural differences. YMC-Triart C8 is also ideal for the separation of isomers and structural analogs.

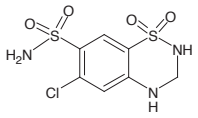
Comparable versatility to C18

【Analysis of drugs】



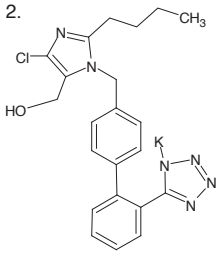
Losartan potassium / hydrochlorothiazide

1.



Hydrochlorothiazide

2.



Losartan potassium

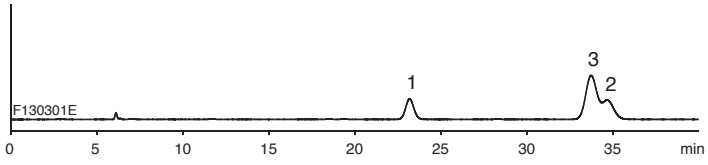
Column	: YMC-Triart C8 5 µm, 150 X 4.0 mmI.D.
Eluent	: A) phosphate buffer (pH 6.7)*/acetonitrile (93/7)
	B) acetonitrile
	0-8%B (0-12 min), 8-62%B (12-28 min)
	** Dissolve 1.25 g of KH_2PO_4 and 2.01 g of $Na_2HPO_4 \cdot 12H_2O$ in 1000 mL of water*
Flow rate	: 1.0 mL/min
Temperature	: 35℃
Detection	: UV at 280 nm
Injection	: 20 µL
(The United States Pharmacopeia 34th; Assay)	

Triart C8 has good chemical durability and peak shapes as good as Triart C18. It is useful in various fields including pharmaceutical products, food and natural products.

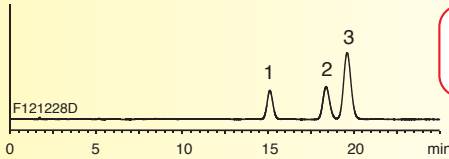
Ideal for separations of isomers or structural analogs

【Separation of positional isomers】

Triart C18



Triart C8



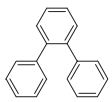
Baseline resolution in shorter analysis time

Triart C8 provides superior resolution of Terphenyl isomers to Triart C18. The higher bonded density of C8 contributes to recognition of small difference in structure though the elution profile is similar between C18 and C8. Additionally, C8 phase offers shorter retention time than C18 phase thanks to the low hydrophobicity. These unique characteristics are effective for fast analysis of isomers and compounds with low polarity.

Column	: 5 µm, 150 X 3.0 mmI.D.
Eluent	: methanol/water (75/25)
Flow rate	: 0.425 mL/min
Temperature	: 30℃
Detection	: UV at 254 nm

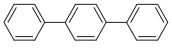
Terphenyl isomers

1.



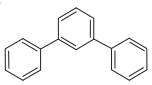
o -Terphenyl

2.



p -Terphenyl

3.



m -Terphenyl

YMC-Triart Phenyl

- Unique selectivity due π-π interaction
- Ideal for separations of aromatic compounds or compounds having long conjugated system
- Excellent resolution without adsorption and tailing

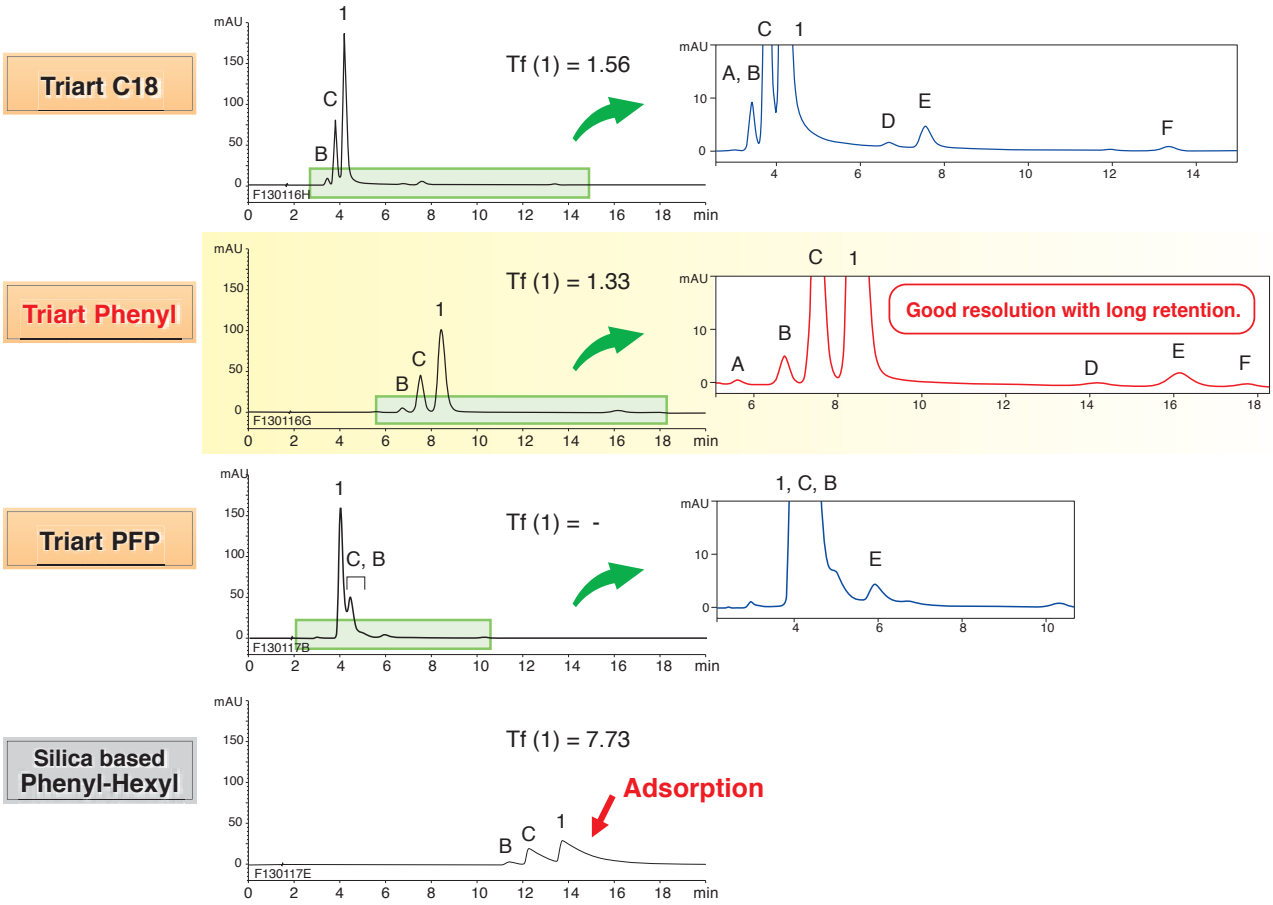
- Pore size : 120 Å
- Carbon content : 17%
- Usable pH range : 1.0~10.0
- USP L11

Effective for separation of compounds having long conjugated system by utilizing π-π interaction

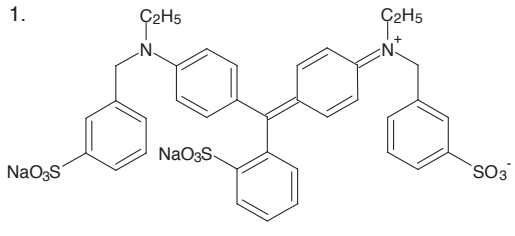
YMC-Triart Phenyl is a phenylbutyl group bonded phase. Well balanced hydrophobic interaction and π-π interaction that is unique to phenyl group has been achieved by optimization of bonded density and spacer chain length (C4). Especially, compounds with aromatic ring or long conjugated system tend to have strong retention. YMC-Triart Phenyl is ideal for separations of such isomers or structural analogs. The surface modification common among YMC-Triart provides high durability and excellent peak shape without absorption.

Unique selectivity due to π-π interaction and superior peak shape without adsorption

[Ideal for aromatic compounds and compounds having long conjugated system]



Brilliant Blue FCF and its impurities



Brilliant blue FCF

A - F : Structural analogs in Brilliant Blue FCF reagent

Column	: 5 µm, 150 X 3.0 or 4.6 mmI.D.
Eluent	: methanol/0.1% H_3PO_4 (45/55)
Flow rate	: 0.425 mL/min for 3.0 mmI.D. 1.0 mL/min for 4.6 mmI.D.
Temperature	: 40℃
Detection	: UV at 630 nm

Brilliant blue FCF of acidic triphenylmethane dye and its impurities (presumed to be by-products having similar structure) can not be separated well with Triart C18. On the other hand, they are retained well on Triart Phenyl, and excellent separation and peak shape are obtained. Strong adsorption and poor resolution is observed on a commercially available phenylhexyl column. When it comes to separations of aromatic compounds or compounds with long conjugated system, Triart Phenyl is more suitable than C18 due to strong retention by π-π interaction.

YMC-Triart PFP

- Alternative selectivity to C18/C8 due to unique polar interaction
- Superior shape recognition ability / steric selectivity
- Ideal for separations of polar compounds or isomers

- Pore size : 120 Å
- Carbon content : 15%
- Usable pH range : 1.0~8.0
- USP L43

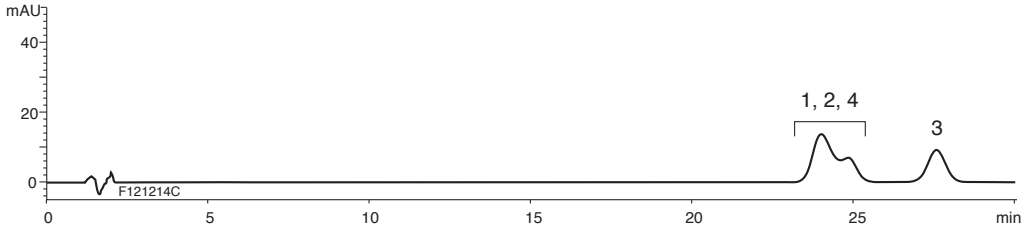
Effective for separation of polar compounds or isomers provided by unique polar interaction

YMC-Triart PFP is a pentafluorophenyl group bonded phase. The selectivity is unique due to various interactions such as hydrophobic, π-π, and dipole-dipole. YMC-Triart PFP is effective especially for improving separation of aromatic compounds, nitro compounds, and compounds with halogen because the selectivity is very different from other columns.

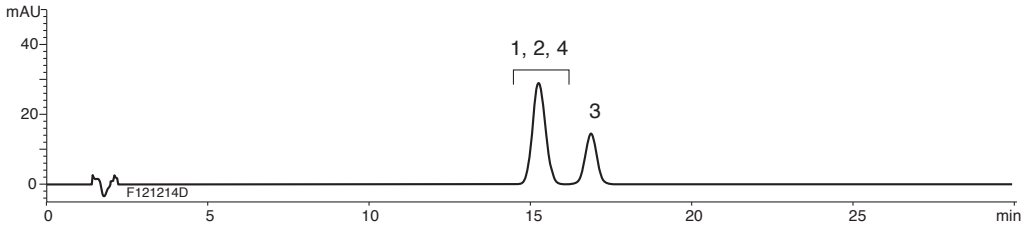
Effective for separation of polar compounds or isomers

[Unique separation provided by various interactions]

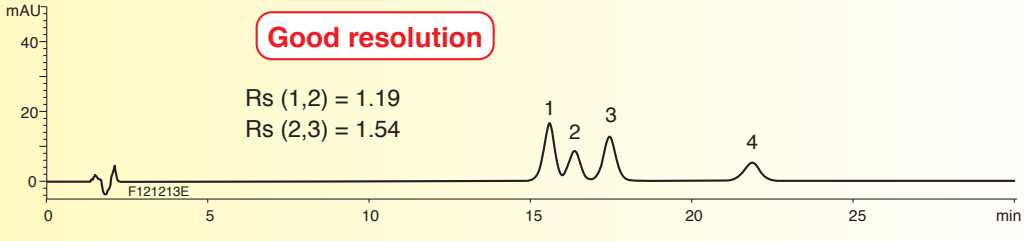
Triart C18



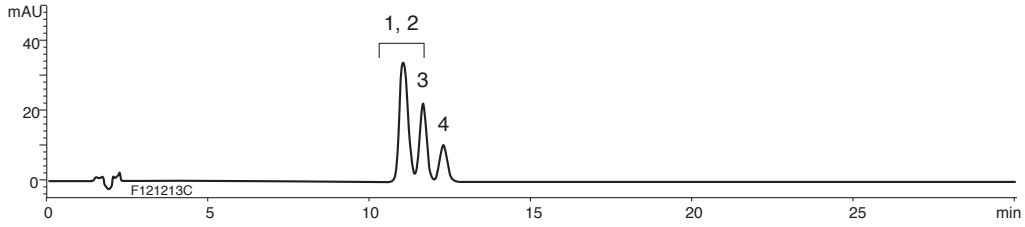
Triart Phenyl



Triart PFP

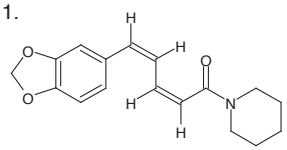


Silica based PFP



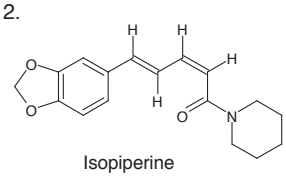
Piperine *cis-trans* isomers

1.



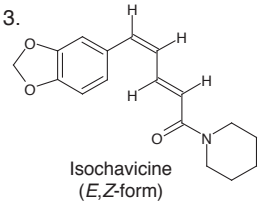
Chavicine
(*Z*,*Z*-form)

2.



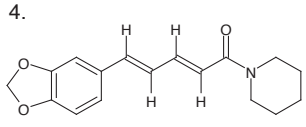
Isopiperine
(*Z*,*E*-form)

3.



Isochavicine
(*E*,*Z*-form)

4.



Piperine
(*E*,*E*-form)

Column	: 5 µm, 150 X 3.0 or 4.6 mmI.D.
Eluent	: acetonitrile/0.1% formic acid (40/60)
Flow rate	: 0.425 mL/min for 3.0 mmI.D. 1.0 mL/min for 4.6 mmI.D.
Temperature	: 25℃
Detection	: UV at 280 nm

Since the differences in hydrophobicity of cis-trans isomers of piperine, which is a pungent component contained in pepper, are small, commonly used reversed phase columns are not able to separate them. However Triart PFP can work well because Triart PFP can recognize minor charge localization in a molecule due to various interactions such as π-π and dipole-dipole. It shows high selectivity for compounds with small structural difference.

YMC-Triart Diol-HILIC

- Ideal for separations of highly polar compounds, which are hardly retained on a reversed-phase column
- Superior durability and usable under wide range of mobile phase conditions
- Excellent reproducibility with less ionic adsorption

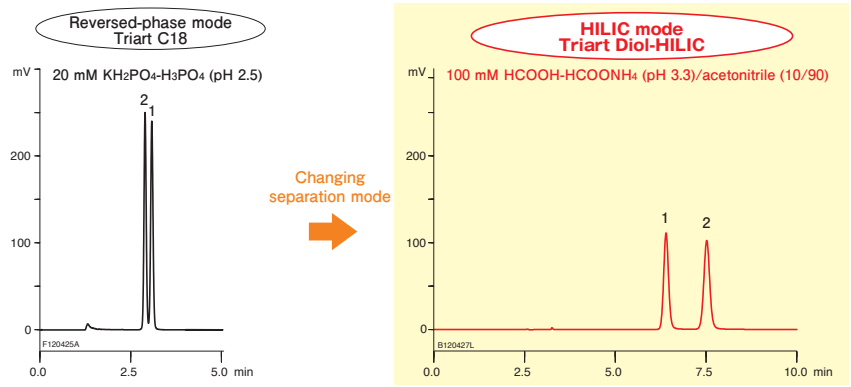
- Pore size : 120 Å
- Carbon content : 12%
- Usable pH range : 2.0~10.0
- USP L20

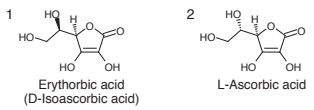
Effective for separation of highly polar compounds

YMC-Triart Diol-HILIC is a HILIC (hydrophilic interaction chromatography) column based on an organic/inorganic hybrid particle synthesized with dihydroxypropyl group. YMC-Triart Diol-HILIC is ideal for a separation of polar and hydrophilic compounds which are not retained on reversed-phase (C18, C8, and others) chromatography. YMC-Triart Diol-HILIC based on organic/inorganic hybrid particle provides excellent durability and is usable across a wide pH range. Low nonspecific adsorption provided by ionically neutral dihydroxypropyl group offers quantitative analysis with high reproducibility.

Ideal for separation of highly polar compounds which are hardly retained on a reversed-phase column

【Comparison of reversed-phase and HILIC separations】



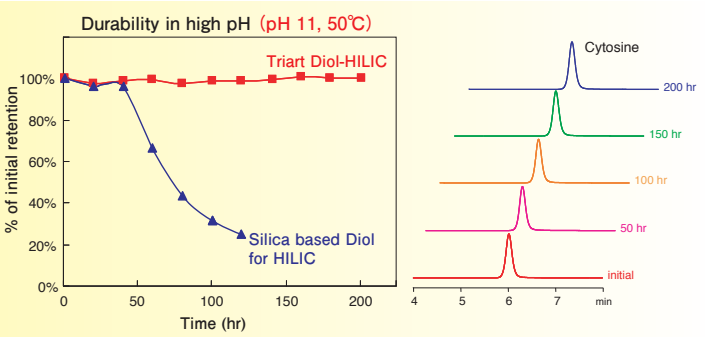


Column	: 5 µm, 150 X 3.0 mmI.D.
Flow rate	: 0.425 mL/min
Temperature	: 40℃
Detection	: UV at 254 nm
Injection	: 4 µL

Triart C18 (reversed-phase) shows very weak retention and poor resolution of L-ascorbic acid and its stereoisomer (erythorbic acid) even with a 100% aqueous mobile phase. On the other hand, Triart Diol-HILIC shows strong retention and better resolution of these compounds with a mobile phase containing 90% organic solvent.

Excellent durability and reproducibility in wide range of conditions

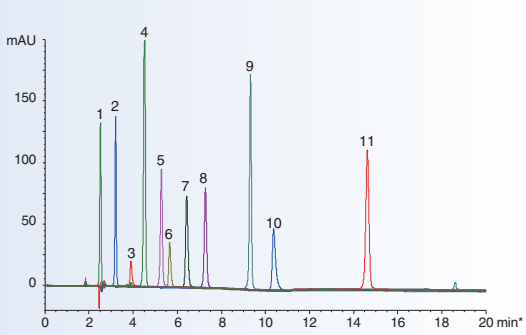
【Extended lifetime in chemically challenging condition】



Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: acetonitrile/water/NH_3 (90/10/0.1) pH 11.3
Temperature	: 50℃
Flow rate	: 1.0 mL/min
Sample	: cytosine

Triart Diol-HILC provides highly reproducible separations even in high pH (pH 11) and at high temperature (50℃). Triart Diol-HILIC shows extremely long column lifetime even in such chemically harsh condition compared to conventional silica-based Diol column.

Application (F121012A)



Water soluble vitamins

1. Caffeine
2. Nicotinamide
3. Pyridoxine hydrochloride
4. Riboflavin
5. Orotic acid
6. Erythorbic acid (D-Isoascorbic acid)
7. L-Ascorbic acid
8. Nicotinic acid
9. 2-*O*-α-D-Glucopyranosyl-L-ascorbic acid (Ascorbic acid 2-glucoside)
10. Thiamine hydrochloride
11. Cyanocobalamin

Column	: YMC-Triant Diol-HILIC (5 µm, 120 Å), 150 X 3.0 mmI.D.
Eluent	: A) acetonitrile/200mM HCOOH-HCOONH4 (pH 3.6)/water (90/5/5) B) acetonitrile/200mM HCOOH-HCOONH4 (pH 3.6)/water (50/5/45) 0-75%B (0-20 min)
Flow rate	: 0.425 mL/min
Temperature	: 40℃
Detection	: UV at 254 nm
injection	: 4 µL (50 µg/mL)

Ordering Information – Columns –

Maximum pressure : 100 MPa for 1.9 µm, 45 MPa for 3 µm and 5 µm; Style of endfitting : Parker style (UPLC compatible)

YMC-Triart C18

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 33 (code:H3)	50	75	100	150	250
120 Å 1.9 µm	2.0	TA12SP9-0202PT	TA12SP9-0302PT	TA12SP9-0502PT	TA12SP9-L502PT	TA12SP9-1002PT	TA12SP9-1502PT	-
	2.1	TA12SP9-02Q1PT	TA12SP9-03Q1PT	TA12SP9-05Q1PT	TA12SP9-L5Q1PT	TA12SP9-10Q1PT	TA12SP9-15Q1PT	-
	3.0	-	-	TA12SP9-0503PT	TA12SP9-L503PT	TA12SP9-1003PT	TA12SP9-1503PT	-
120 Å 3 µm	2.1	TA12S03-02Q1PTH	TA12S03-H3Q1PTH	TA12S03-05Q1PTH	TA12S03-L5Q1PTH	TA12S03-10Q1PTH	TA12S03-15Q1PTH	-
	3.0	-	-	TA12S03-0503PTH	TA12S03-L503PTH	TA12S03-1003PTH	TA12S03-1503PTH	-
	4.6	-	TA12S03-H346PTH	TA12S03-0546PTH	TA12S03-L546PTH	TA12S03-1046PTH	TA12S03-1546PTH	TA12S03-2546PTH
120 Å 5 µm	2.1	TA12S05-02Q1PTH	TA12S05-H3Q1PTH	TA12S05-05Q1PTH	TA12S05-L5Q1PTH	TA12S05-10Q1PTH	TA12S05-15Q1PTH	-
	3.0	-	-	TA12S05-0503PTH	TA12S05-L503PTH	TA12S05-1003PTH	TA12S05-1503PTH	-
	4.6	-	TA12S05-H346PTH	TA12S05-0546PTH	TA12S05-L546PTH	TA12S05-1046PTH	TA12S05-1546PTH	TA12S05-2546PTH

YMC-Triart C18 ExRS

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 33 (code:H3)	50	75	100	150	250
80 Å 1.9 µm	2.0	TAR08SP9-0202PT	TAR08SP9-0302PT	TAR08SP9-0502PT	TAR08SP9-L502PT	TAR08SP9-1002PT	TAR08SP9-1502PT	-
	2.1	TAR08SP9-02Q1PT	TAR08SP9-03Q1PT	TAR08SP9-05Q1PT	TAR08SP9-L5Q1PT	TAR08SP9-10Q1PT	TAR08SP9-15Q1PT	-
	3.0	-	-	TAR08SP9-0503PT	TAR08SP9-L503PT	TAR08SP9-1003PT	TAR08SP9-1503PT	-
80 Å 3 µm	2.1	TAR08S03-02Q1PTH	TAR08S03-H3Q1PTH	TAR08S03-05Q1PTH	TAR08S03-L5Q1PTH	TAR08S03-10Q1PTH	TAR08S03-15Q1PTH	-
	3.0	-	-	TAR08S03-0503PTH	TAR08S03-L503PTH	TAR08S03-1003PTH	TAR08S03-1503PTH	-
	4.6	-	TAR08S03-H346PTH	TAR08S03-0546PTH	TAR08S03-L546PTH	TAR08S03-1046PTH	TAR08S03-1546PTH	TAR08S03-2546PTH
80 Å 5 µm	2.1	TAR08S05-02Q1PTH	TAR08S05-H3Q1PTH	TAR08S05-05Q1PTH	TAR08S05-L5Q1PTH	TAR08S05-10Q1PTH	TAR08S05-15Q1PTH	-
	3.0	-	-	TAR08S05-0503PTH	TAR08S05-L503PTH	TAR08S05-1003PTH	TAR08S05-1503PTH	-
	4.6	-	TAR08S05-H346PTH	TAR08S05-0546PTH	TAR08S05-L546PTH	TAR08S05-1046PTH	TAR08S05-1546PTH	TAR08S05-2546PTH

YMC-Triart C8

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 33 (code:H3)	50	75	100	150	250
120 Å 1.9 µm	2.0	TO12SP9-0202PT	TO12SP9-0302PT	TO12SP9-0502PT	TO12SP9-L502PT	TO12SP9-1002PT	TO12SP9-1502PT	-
	2.1	TO12SP9-02Q1PT	TO12SP9-03Q1PT	TO12SP9-05Q1PT	TO12SP9-L5Q1PT	TO12SP9-10Q1PT	TO12SP9-15Q1PT	-
	3.0	-	-	TO12SP9-0503PT	TO12SP9-L503PT	TO12SP9-1003PT	TO12SP9-1503PT	-
120 Å 3 µm	2.1	TO12S03-02Q1PTH	TO12S03-H3Q1PTH	TO12S03-05Q1PTH	TO12S03-L5Q1PTH	TO12S03-10Q1PTH	TO12S03-15Q1PTH	-
	3.0	-	-	TO12S03-0503PTH	TO12S03-L503PTH	TO12S03-1003PTH	TO12S03-1503PTH	-
	4.6	-	TO12S03-H346PTH	TO12S03-0546PTH	TO12S03-L546PTH	TO12S03-1046PTH	TO12S03-1546PTH	TO12S03-2546PTH
120 Å 5 µm	2.1	TO12S05-02Q1PTH	TO12S05-H3Q1PTH	TO12S05-05Q1PTH	TO12S05-L5Q1PTH	TO12S05-10Q1PTH	TO12S05-15Q1PTH	-
	3.0	-	-	TO12S05-0503PTH	TO12S05-L503PTH	TO12S05-1003PTH	TO12S05-1503PTH	-
	4.6	-	TO12S05-H346PTH	TO12S05-0546PTH	TO12S05-L546PTH	TO12S05-1046PTH	TO12S05-1546PTH	TO12S05-2546PTH

YMC-Triart Phenyl

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 33 (code:H3)	50	75	100	150	250
120 Å 1.9 µm	2.0	TPH12SP9-0202PT	TPH12SP9-0302PT	TPH12SP9-0502PT	TPH12SP9-L502PT	TPH12SP9-1002PT	TPH12SP9-1502PT	-
	2.1	TPH12SP9-02Q1PT	TPH12SP9-03Q1PT	TPH12SP9-05Q1PT	TPH12SP9-L5Q1PT	TPH12SP9-10Q1PT	TPH12SP9-15Q1PT	-
	3.0	-	-	TPH12SP9-0503PT	TPH12SP9-L503PT	TPH12SP9-1003PT	TPH12SP9-1503PT	-
120 Å 3 µm	2.1	TPH12S03-02Q1PTH	TPH12S03-H3Q1PTH	TPH12S03-05Q1PTH	TPH12S03-L5Q1PTH	TPH12S03-10Q1PTH	TPH12S03-15Q1PTH	-
	3.0	-	-	TPH12S03-0503PTH	TPH12S03-L503PTH	TPH12S03-1003PTH	TPH12S03-1503PTH	-
	4.6	-	TPH12S03-H346PTH	TPH12S03-0546PTH	TPH12S03-L546PTH	TPH12S03-1046PTH	TPH12S03-1546PTH	TPH12S03-2546PTH
120 Å 5 µm	2.1	TPH12S05-02Q1PTH	TPH12S05-H3Q1PTH	TPH12S05-05Q1PTH	TPH12S05-L5Q1PTH	TPH12S05-10Q1PTH	TPH12S05-15Q1PTH	-
	3.0	-	-	TPH12S05-0503PTH	TPH12S05-L503PTH	TPH12S05-1003PTH	TPH12S05-1503PTH	-
	4.6	-	TPH12S05-H346PTH	TPH12S05-0546PTH	TPH12S05-L546PTH	TPH12S05-1046PTH	TPH12S05-1546PTH	TPH12S05-2546PTH

YMC-Triart PFP

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 33 (code:H3)	50	75	100	150	250
120 Å 1.9 µm	2.0	TPF12SP9-0202PT	TPF12SP9-0302PT	TPF12SP9-0502PT	TPF12SP9-L502PT	TPF12SP9-1002PT	TPF12SP9-1502PT	-
	2.1	TPF12SP9-02Q1PT	TPF12SP9-03Q1PT	TPF12SP9-05Q1PT	TPF12SP9-L5Q1PT	TPF12SP9-10Q1PT	TPF12SP9-15Q1PT	-
	3.0	-	-	TPF12SP9-0503PT	TPF12SP9-L503PT	TPF12SP9-1003PT	TPF12SP9-1503PT	-
120 Å 3 µm	2.1	TPF12S03-02Q1PTH	TPF12S03-H3Q1PTH	TPF12S03-05Q1PTH	TPF12S03-L5Q1PTH	TPF12S03-10Q1PTH	TPF12S03-15Q1PTH	-
	3.0	-	-	TPF12S03-0503PTH	TPF12S03-L503PTH	TPF12S03-1003PTH	TPF12S03-1503PTH	-
	4.6	-	TPF12S03-H346PTH	TPF12S03-0546PTH	TPF12S03-L546PTH	TPF12S03-1046PTH	TPF12S03-1546PTH	TPF12S03-2546PTH
120 Å 5 µm	2.1	TPF12S05-02Q1PTH	TPF12S05-H3Q1PTH	TPF12S05-05Q1PTH	TPF12S05-L5Q1PTH	TPF12S05-10Q1PTH	TPF12S05-15Q1PTH	-
	3.0	-	-	TPF12S05-0503PTH	TPF12S05-L503PTH	TPF12S05-1003PTH	TPF12S05-1503PTH	-
	4.6	-	TPF12S05-H346PTH	TPF12S05-0546PTH	TPF12S05-L546PTH	TPF12S05-1046PTH	TPF12S05-1546PTH	TPF12S05-2546PTH

YMC-Triart Diol-HILIC

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 33 (code:H3)	50	75	100	150	250
120 Å 1.9 µm	2.0	TDH12SP9-0202PT	TDH12SP9-0302PT	TDH12SP9-0502PT	TDH12SP9-L502PT	TDH12SP9-1002PT	TDH12SP9-1502PT	-
	2.1	TDH12SP9-02Q1PT	TDH12SP9-03Q1PT	TDH12SP9-05Q1PT	TDH12SP9-L5Q1PT	TDH12SP9-10Q1PT	TDH12SP9-15Q1PT	-
	3.0	-	-	TDH12SP9-0503PT	TDH12SP9-L503PT	TDH12SP9-1003PT	TDH12SP9-1503PT	-
120 Å 3 µm	2.1	TDH12S03-02Q1PTH	TDH12S03-H3Q1PTH	TDH12S03-05Q1PTH	TDH12S03-L5Q1PTH	TDH12S03-10Q1PTH	TDH12S03-15Q1PTH	-
	3.0	-	-	TDH12S03-0503PTH	TDH12S03-L503PTH	TDH12S03-1003PTH	TDH12S03-1503PTH	-
	4.6	-	TDH12S03-H346PTH	TDH12S03-0546PTH	TDH12S03-L546PTH	TDH12S03-1046PTH	TDH12S03-1546PTH	TDH12S03-2546PTH
120 Å 5 µm	2.1	TDH12S05-02Q1PTH	TDH12S05-H3Q1PTH	TDH12S05-05Q1PTH	TDH12S05-L5Q1PTH	TDH12S05-10Q1PTH	TDH12S05-15Q1PTH	-
	3.0	-	-	TDH12S05-0503PTH	TDH12S05-L503PTH	TDH12S05-1003PTH	TDH12S05-1503PTH	-
	4.6	-	TDH12S05-H346PTH	TDH12S05-0546PTH	TDH12S05-L546PTH	TDH12S05-1046PTH	TDH12S05-1546PTH	TDH12S05-2546PTH

※ See P.120 for preparative columns other than those listed above.

Ordering Information – Columns –

Maximum pressure : 10-25 MPa, depending on dimensions; Style of endfitting : Waters (W) style

YMC-Triart C18

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 35 (code:H5)	50	75	100	150	250
120 Å 3 µm	2.0	TA12S03-0202WT	TA12S03-0302WT	TA12S03-0502WT	TA12S03-L502WT	TA12S03-1002WT	TA12S03-1502WT	-
	3.0	-	-	TA12S03-0503WT	TA12S03-L503WT	TA12S03-1003WT	TA12S03-1503WT	-
	4.6	-	TA12S03-H546WT	TA12S03-0546WT	TA12S03-L546WT	TA12S03-1046WT	TA12S03-1546WT	TA12S03-2546WT
120 Å 5 µm	2.0	TA12S05-0202WT	TA12S05-0302WT	TA12S05-0502WT	TA12S05-L502WT	TA12S05-1002WT	TA12S05-1502WT	-
	3.0	-	-	TA12S05-0503WT	TA12S05-L503WT	TA12S05-1003WT	TA12S05-1503WT	-
	4.0	-	-	-	-	-	TA12S05-1504WT	TA12S05-2504WT
	4.6	-	TA12S05-H546WT	TA12S05-0546WT	TA12S05-L546WT	TA12S05-1046WT	TA12S05-1546WT	TA12S05-2546WT
	6.0	-	-	-	-	-	TA12S05-1506WT	TA12S05-2506WT
	10	-	-	-	-	-	TA12S05-1510WT	TA12S05-2510WT

YMC-Triart C8

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 35 (code:H5)	50	75	100	150	250
120 Å 3 µm	2.0	TO12S03-0202WT	TO12S03-0302WT	TO12S03-0502WT	TO12S03-L502WT	TO12S03-1002WT	TO12S03-1502WT	-
	3.0	-	-	TO12S03-0503WT	TO12S03-L503WT	TO12S03-1003WT	TO12S03-1503WT	-
	4.6	-	TO12S03-H546WT	TO12S03-0546WT	TO12S03-L546WT	TO12S03-1046WT	TO12S03-1546WT	TO12S03-2546WT
120 Å 5 µm	2.0	TO12S05-0202WT	TO12S05-0302WT	TO12S05-0502WT	TO12S05-L502WT	TO12S05-1002WT	TO12S05-1502WT	-
	3.0	-	-	TO12S05-0503WT	TO12S05-L503WT	TO12S05-1003WT	TO12S05-1503WT	-
	4.0	-	-	-	-	-	TO12S05-1504WT	TO12S05-2504WT
	4.6	-	TO12S05-H546WT	TO12S05-0546WT	TO12S05-L546WT	TO12S05-1046WT	TO12S05-1546WT	TO12S05-2546WT
	6.0	-	-	-	-	-	TO12S05-1506WT	TO12S05-2506WT
	10	-	-	-	-	-	TO12S05-1510WT	TO12S05-2510WT

YMC-Triart Phenyl

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 35 (code:H5)	50	75	100	150	250
120 Å 3 µm	2.0	TPH12S03-0202WT	TPH12S03-0302WT	TPH12S03-0502WT	TPH12S03-L502WT	TPH12S03-1002WT	TPH12S03-1502WT	-
	3.0	-	-	TPH12S03-0503WT	TPH12S03-L503WT	TPH12S03-1003WT	TPH12S03-1503WT	-
	4.6	-	TPH12S03-H546WT	TPH12S03-0546WT	TPH12S03-L546WT	TPH12S03-1046WT	TPH12S03-1546WT	TPH12S03-2546WT
120 Å 5 µm	2.0	TPH12S05-0202WT	TPH12S05-0302WT	TPH12S05-0502WT	TPH12S05-L502WT	TPH12S05-1002WT	TPH12S05-1502WT	-
	3.0	-	-	TPH12S05-0503WT	TPH12S05-L503WT	TPH12S05-1003WT	TPH12S05-1503WT	-
	4.0	-	-	-	-	-	TPH12S05-1504WT	TPH12S05-2504WT
	4.6	-	TPH12S05-H546WT	TPH12S05-0546WT	TPH12S05-L546WT	TPH12S05-1046WT	TPH12S05-1546WT	TPH12S05-2546WT
	6.0	-	-	-	-	-	TPH12S05-1506WT	TPH12S05-2506WT
	10	-	-	-	-	-	TPH12S05-1510WT	TPH12S05-2510WT

YMC-Triart PFP

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 35 (code:H5)	50	75	100	150	250
120 Å 3 µm	2.0	TPF12S03-0202WT	TPF12S03-0302WT	TPF12S03-0502WT	TPF12S03-L502WT	TPF12S03-1002WT	TPF12S03-1502WT	-
	3.0	-	-	TPF12S03-0503WT	TPF12S03-L503WT	TPF12S03-1003WT	TPF12S03-1503WT	-
	4.6	-	TPF12S03-H546WT	TPF12S03-0546WT	TPF12S03-L546WT	TPF12S03-1046WT	TPF12S03-1546WT	TPF12S03-2546WT
120 Å 5 µm	2.0	TPF12S05-0202WT	TPF12S05-0302WT	TPF12S05-0502WT	TPF12S05-L502WT	TPF12S05-1002WT	TPF12S05-1502WT	-
	3.0	-	-	TPF12S05-0503WT	TPF12S05-L503WT	TPF12S05-1003WT	TPF12S05-1503WT	-
	4.0	-	-	-	-	-	TPF12S05-1504WT	TPF12S05-2504WT
	4.6	-	TPF12S05-H546WT	TPF12S05-0546WT	TPF12S05-L546WT	TPF12S05-1046WT	TPF12S05-1546WT	TPF12S05-2546WT
	6.0	-	-	-	-	-	TPF12S05-1506WT	TPF12S05-2506WT
	10	-	-	-	-	-	TPF12S05-1510WT	TPF12S05-2510WT

YMC-Triart Diol-HILIC

Phase dimension	Column I.D. (mm)	Column length (mm)						
		20	30 (code:03)/ 35 (code:H5)	50	75	100	150	250
120 Å 3 µm	2.0	TDH12S03-0202WT	TDH12S03-0302WT	TDH12S03-0502WT	TDH12S03-L502WT	TDH12S03-1002WT	TDH12S03-1502WT	-
	3.0	-	-	TDH12S03-0503WT	TDH12S03-L503WT	TDH12S03-1003WT	TDH12S03-1503WT	-
	4.6	-	TDH12S03-H546WT	TDH12S03-0546WT	TDH12S03-L546WT	TDH12S03-1046WT	TDH12S03-1546WT	TDH12S03-2546WT
120 Å 5 µm	2.0	TDH12S05-0202WT	TDH12S05-0302WT	TDH12S05-0502WT	TDH12S05-L502WT	TDH12S05-1002WT	TDH12S05-1502WT	-
	3.0	-	-	TDH12S05-0503WT	TDH12S05-L503WT	TDH12S05-1003WT	TDH12S05-1503WT	-
	4.0	-	-	-	-	-	TDH12S05-1504WT	TDH12S05-2504WT
	4.6	-	TDH12S05-H546WT	TDH12S05-0546WT	TDH12S05-L546WT	TDH12S05-1046WT	TDH12S05-1546WT	TDH12S05-2546WT

※ See P.120 for preparative columns other than those listed above.

Ordering Information – Guard Cartridge Columns –

EXP®Guard Cartridge Column

Phase dimension	Column I.D. (mm)	(pack of 3) 5 mm length
Triart C18 120 Å 1.9 µm	2.1	TA12SP9-E5Q1CC
	3.0	TA12SP9-E503CC
Triart C18 ExRS 80 Å 1.9 µm	2.1	TAR08SP9-E5Q1CC
	3.0	TAR08SP9-E503CC
Triart C8 120 Å 1.9 µm	2.1	TO12SP9-E5Q1CC
	3.0	TO12SP9-E503CC
Triart Phenyl 120 Å 1.9 µm	2.1	TPH12SP9-E5Q1CC
	3.0	TPH12SP9-E503CC
Triart PFP 120 Å 1.9 µm	2.1	TPF12SP9-E5Q1CC
	3.0	TPF12SP9-E503CC

* EXP®Guard cartridge holder required, part no. XPCHUHP.
* EXP is a registered trademark of Optimize Technologies, Inc.

Guard Cartridge Column

Phase dimension	Column I.D. (mm)	Quantity	10 mm length
Triart C18 120 Å 3 µm	2.1	5-pack	TA12S03-01Q1GC
	3.0		TA12S03-0103GC
	4.0		TA12S03-0104GC
Triart C18 ExRS 80 Å 3 µm	2.1	5-pack	TAR08S03-01Q1GC
	3.0		TAR08S03-0103GC
	4.0		TAR08S03-0104GC
Triart C8 120 Å 3 µm	2.1	5-pack	TO12S03-01Q1GC
	3.0		TO12S03-0103GC
	4.0		TO12S03-0104GC
Triart Phenyl 120 Å 3 µm	2.1	5-pack	TPH12S03-01Q1GC
	3.0		TPH12S03-0103GC
	4.0		TPH12S03-0104GC
Triart PFP 120 Å 3 µm	2.1	5-pack	TPF12S03-01Q1GC
	3.0		TPF12S03-0103GC
	4.0		TPF12S03-0104GC
Triart Diol-HILIC 120 Å 3 µm	2.1	5-pack	TDH12S03-01Q1GC
	3.0		TDH12S03-0103GC
	4.0		TDH12S03-0104GC

Phase dimension	Column I.D. (mm)	Quantity	10 mm length
Triart C18 120 Å 5 µm	2.1	5-pack	TA12S05-01Q1GC
	3.0		TA12S05-0103GC
	4.0		TA12S05-0104GC
	10	2-pack	TA12S05-0110CC
Triart C18 ExRS 80 Å 5 µm	2.1	5-pack	TAR08S05-01Q1GC
	3.0		TAR08S05-0103GC
	4.0		TAR08S05-0104GC
	10	2-pack	TAR08S05-0110CC
Triart C8 120 Å 5 µm	2.1	5-pack	TO12S05-01Q1GC
	3.0		TO12S05-0103GC
	4.0		TO12S05-0104GC
	10	2-pack	TO12S05-0110CC
Triart Phenyl 120 Å 5 µm	2.1	5-pack	TPH12S05-01Q1GC
	3.0		TPH12S05-0103GC
	4.0		TPH12S05-0104GC
	10	2-pack	TPH12S05-0110CC
Triart PFP 120 Å 5 µm	2.1	5-pack	TPF12S05-01Q1GC
	3.0		TPF12S05-0103GC
	4.0		TPF12S05-0104GC
	10	2-pack	TPF12S05-0110CC
Triart Diol-HILIC 120 Å 5 µm	2.1	5-pack	TDH12S05-01Q1GC
	3.0		TDH12S05-0103GC
	4.0		TDH12S05-0104GC

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

05

Core-Shell Columns

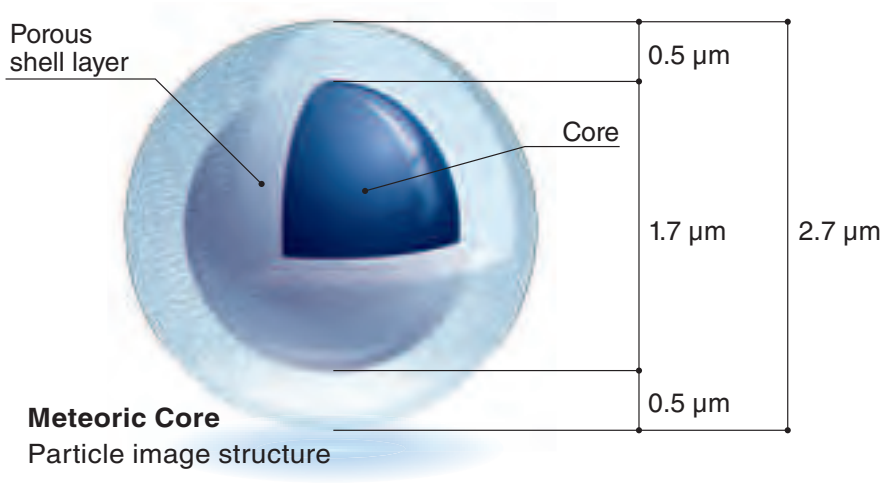
Meteoric Core

Meteoric Core is Core-Shell columns with outstanding resolution for UHPLC & HPLC. Meteoric Core can be used across a wide pH range and provides excellent peak shape for basic and coordination compounds compared to conventional columns or competitors'. This feature enables smoother method development. Meteoric Core is ideal for ultra fast and high resolution analysis. Meteoric Core can reduce its backpressure by half compared to sub-2 µm columns with the same resolution as this. Meteoric Core can be used with conventional HPLC as well as UHPLC.

Core-Shell columns with outstanding resolution for UHPLC & HPLC

Features

- Ultra fast analysis and excellent resolution
- Excellent peak shape on basic and coordination compounds
- Wide usable pH range
- Low column bleeding and ideal for LC/MS



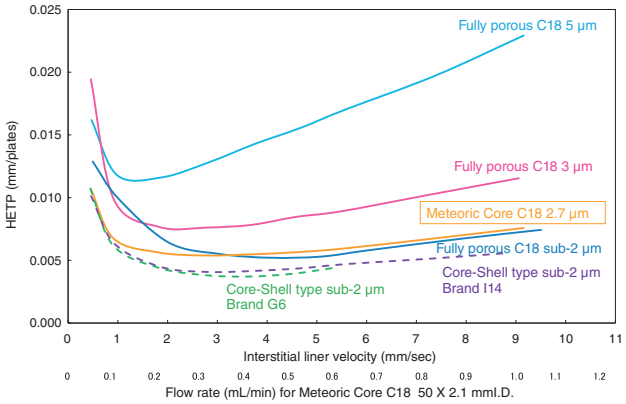
Meteoric Core
Particle image structure

Specifications

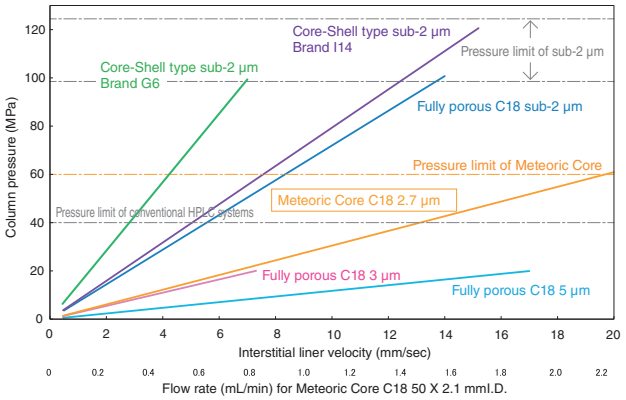
	Meteoric Core C18	Meteoric Core C18 BIO	Meteoric Core C8
Base	Core-Shell type silica gel		
Particle size (µm)	2.7		
Pore size (Å)	80	160	80
Specific surface area (m^2/g)	150	90	150
Bonding	Trifunctional		
Carbon content (%)	7	5	5
Endcapping	Yes		
Usable pH range	1.5~10.0	1.5~10.0	1.5~9.0
USP classification	L1	L1	L7

Advantages of Core-Shell column packing material

Van Deemter Curves : Correlation between linear velocity and column efficiency



Column Pressure : Correlation between linear velocity and column backpressure

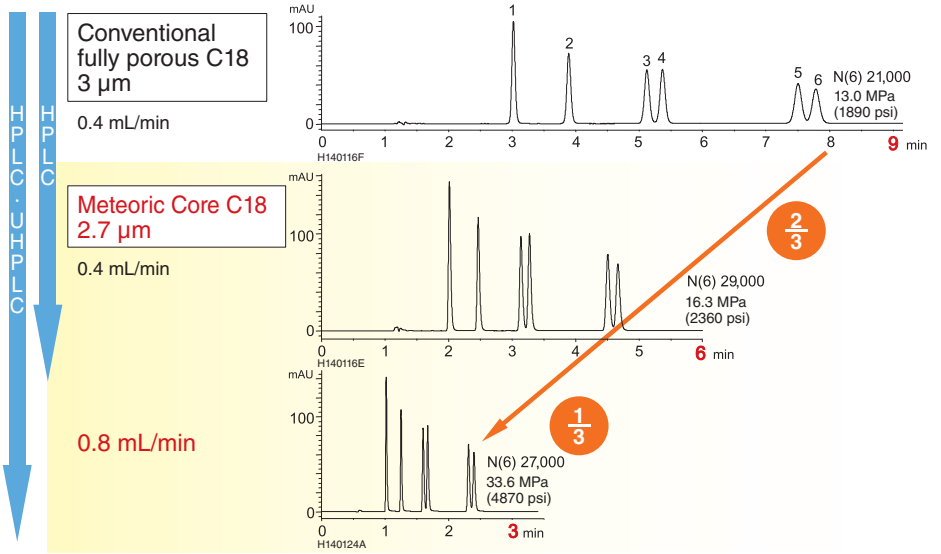


Meteoric Core C18 has high column efficiency which is almost equivalent to sub-2 µm columns over a wide range of flow rate.
The operating pressure of Meteoric Core is one half to one fifths of sub-2 µm Core-Shell type columns.
High throughput analysis using Meteoric Core could be expected even with longer length columns since the usable maximum flow rate of it is higher than competitors' sub-2 µm Core-Shell.

Column	: 50 X 2.0 or 2.1 mmI.D.
Eluent	: acetonitrile/water (60/40)
Temperature	: 25°C
Sample	: butyl benzoate

Ultrafast analysis and excellent resolution

Ultrafast separation of Parabens: Typically difficult-to-separate geometric isomers

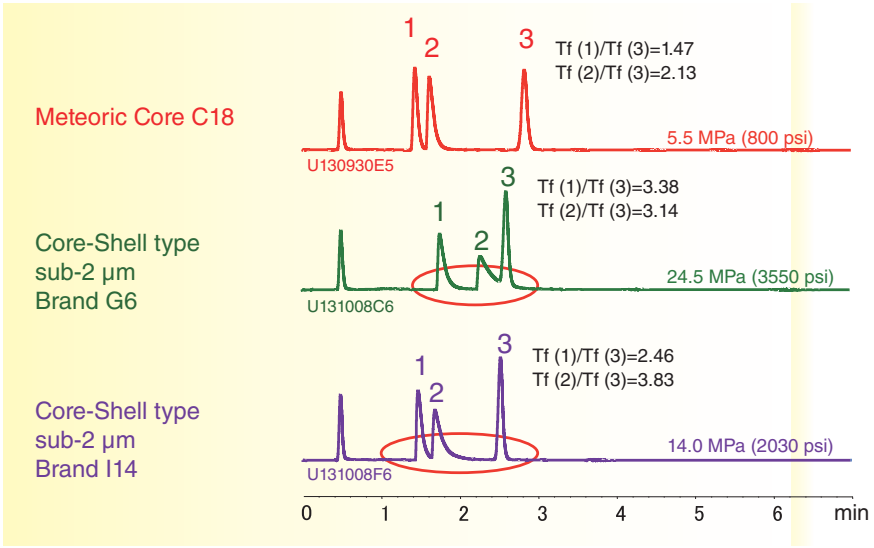


1. Methyl *p*-hydroxybenzoate
2. Ethyl *p*-hydroxybenzoate
3. Isopropyl *p*-hydroxybenzoate
4. Propyl *p*-hydroxybenzoate
5. Isobutyl *p*-hydroxybenzoate
6. Butyl *p*-hydroxybenzoate

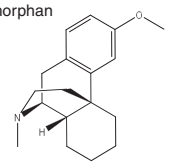
Column	: 150 X 3.0 mmI.D.
Eluent	: acetonitrile/water (50/50)
Temperature	: 30°C
Detection	: UV at 270 nm

Meteoric Core C18 can shorten the analysis time by two thirds compared to the conventional fully porous C18 column with the same column dimension and under the same analysis condition. Moreover, it maintains the theoretical plate number at a two times faster flow rate. It allows us to decrease analysis time by one thirds while maintaining resolution, and at an operating pressure less than 5,000 psi.

Excellent peak shape on basic compounds



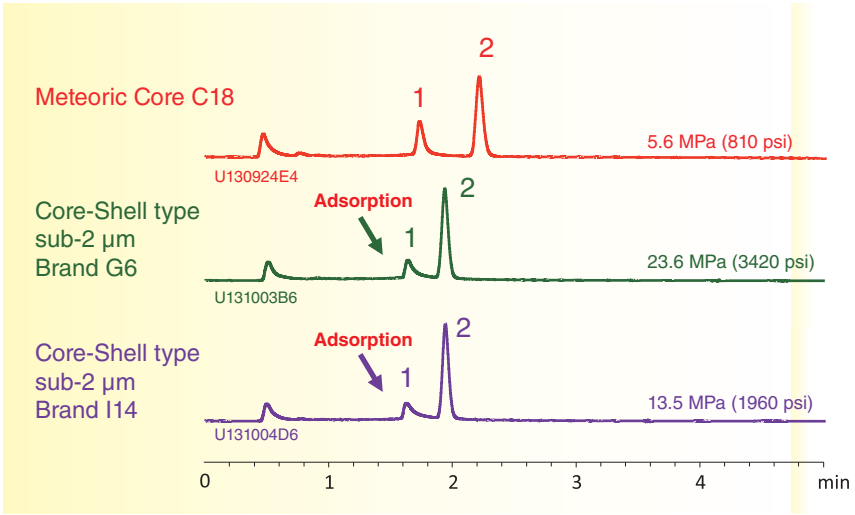
Dextromethorphan
(Peak 2)



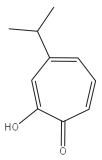
Column	: 50 X 2.1 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/ acetonitrile (65/35)
Flow rate	: 0.2 mL/min
Temperature	: 40°C
Detection	: UV at 235 nm
Sample	: 1. Chlorpheniramine 2. Dextromethorphan 3. Propyl *p*-hydroxybenzoate (I.S.)

Meteoric Core C18 column is a high resolution column which provides excellent peak shapes for basic compounds (Peak 1 and 2) compared to sub-2 µm Core-Shell columns. Chromatographers can expect ultrafast analysis of basic compounds with highly quantitative and sensitive analysis by using Meteoric Core C18.

Excellent peak shape on coordination compounds

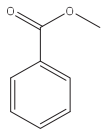


1.



Hinokitiol

2.



Methyl benzoate (I.S.)

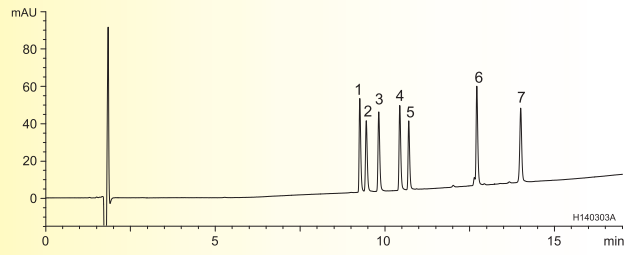
Column	: 50 X 2.1 mmI.D.
Eluent	: acetonitrile/0.1% phosphoric acid (40/60)
Flow rate	: 0.2 mL/min
Temperature	: 40°C
Detection	: UV at 254 nm

Meteoric Core C18 is able to provide excellent peak shapes for coordination compounds which are often adsorbed to a column, resulting from a strong interaction with impurities such as trace amount of metal ion. Meteoric Core is suitable for a quantitative analysis of coordination compounds.

Peptide/Protein separation

Meteoric Core C18 BIO with wider pore size: Appropriate for separation of peptides/proteins whose molecular weight are up to 30,000

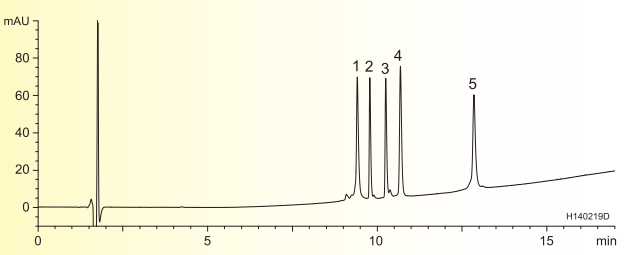
Peptides (MW 574 - 3,465)



1. BAM-12P (MW 1,425)
2. [D-Ala^2,Met^5]-Enkephalinamide (MW 587)
3. Met-Enkephalin (MW 574)
4. [D-Ala^2,Met^5]-Enkephalin (MW 588)
5. α-Endorphin (MW 1,746)
6. γ-Endorphin (MW 1,859)
7. β-Endorphin (MW 3,465)

Column	: Meteoric Core C18 BIO 2.7 µm 150 X 2.1 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 15-55%B (0-15 min), 55%B (15-17 min)
Flow rate	: 0.2 mL/min
Temperature	: 40°C
Detection	: UV at 220 nm
Pressure	: 14.9-16.1 MPa (2160-2330 psi)

Peptides/Proteins (MW 4,300 - 25,700)



1. Cytochrome *c* (MW 12,400)
2. Insulin (bovine) (MW 5,700)
3. Amyloid β-protein (MW 4,300)
4. Lysozyme (MW 14,000)
5. α-Chymotrypsinogen A (MW 25,700)

Column	: Meteoric Core C18 BIO 2.7 µm 150 X 2.1 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 20-70%B (0-15 min), 70%B (15-17 min)
Flow rate	: 0.2 mL/min
Temperature	: 40°C
Detection	: UV at 220 nm
Pressure	: 12.8-16.1 MPa (1860-2330 psi)

Ordering Information -Columns-

Meteoric Core C18

Phase dimension	Column I.D. (mm)	Column length (mm)				
		30	50	75	100	150
80 Å 2.7 µm	2.1	CAS08SQ7-03Q1PT	CAS08SQ7-05Q1PT	CAS08SQ7-L5Q1PT	CAS08SQ7-10Q1PT	CAS08SQ7-15Q1PT
	3.0	CAS08SQ7-0303PT	CAS08SQ7-0503PT	CAS08SQ7-L503PT	CAS08SQ7-1003PT	CAS08SQ7-1503PT
	4.6	CAS08SQ7-0346PT	CAS08SQ7-0546PT	CAS08SQ7-L546PT	CAS08SQ7-1046PT	CAS08SQ7-1546PT

Meteoric Core C18 BIO

Phase dimension	Column I.D. (mm)	Column length (mm)				
		30	50	75	100	150
160 Å 2.7 µm	2.1	CAW16SQ7-03Q1PT	CAW16SQ7-05Q1PT	CAW16SQ7-L5Q1PT	CAW16SQ7-10Q1PT	CAW16SQ7-15Q1PT
	3.0	CAW16SQ7-0303PT	CAW16SQ7-0503PT	CAW16SQ7-L503PT	CAW16SQ7-1003PT	CAW16SQ7-1503PT
	4.6	CAW16SQ7-0346PT	CAW16SQ7-0546PT	CAW16SQ7-L546PT	CAW16SQ7-1046PT	CAW16SQ7-1546PT

Meteoric Core C8

Phase dimension	Column I.D. (mm)	Column length (mm)				
		30	50	75	100	150
80 Å 2.7 µm	2.1	COS08SQ7-03Q1PT	COS08SQ7-05Q1PT	COS08SQ7-L5Q1PT	COS08SQ7-10Q1PT	COS08SQ7-15Q1PT
	3.0	COS08SQ7-0303PT	COS08SQ7-0503PT	COS08SQ7-L503PT	COS08SQ7-1003PT	COS08SQ7-1503PT
	4.6	COS08SQ7-0346PT	COS08SQ7-0546PT	COS08SQ7-L546PT	COS08SQ7-1046PT	COS08SQ7-1546PT

06

Reversed-Phase C18 Columns (ODS)

Types and characteristics of C18 packing materials

Octadecyl-silica (ODS) is the industry standard packing material for HPLC applications. YMC offers packing materials with an impressive assortment of functional groups for liquid chromatography and a selection of ODS columns that is far ahead of all others in variety. We also offer hybrid-silica based C18 packing materials that are widely applicable to a variety of fields, from microanalysis to large-scale isolation.

Types of C18 packing materials

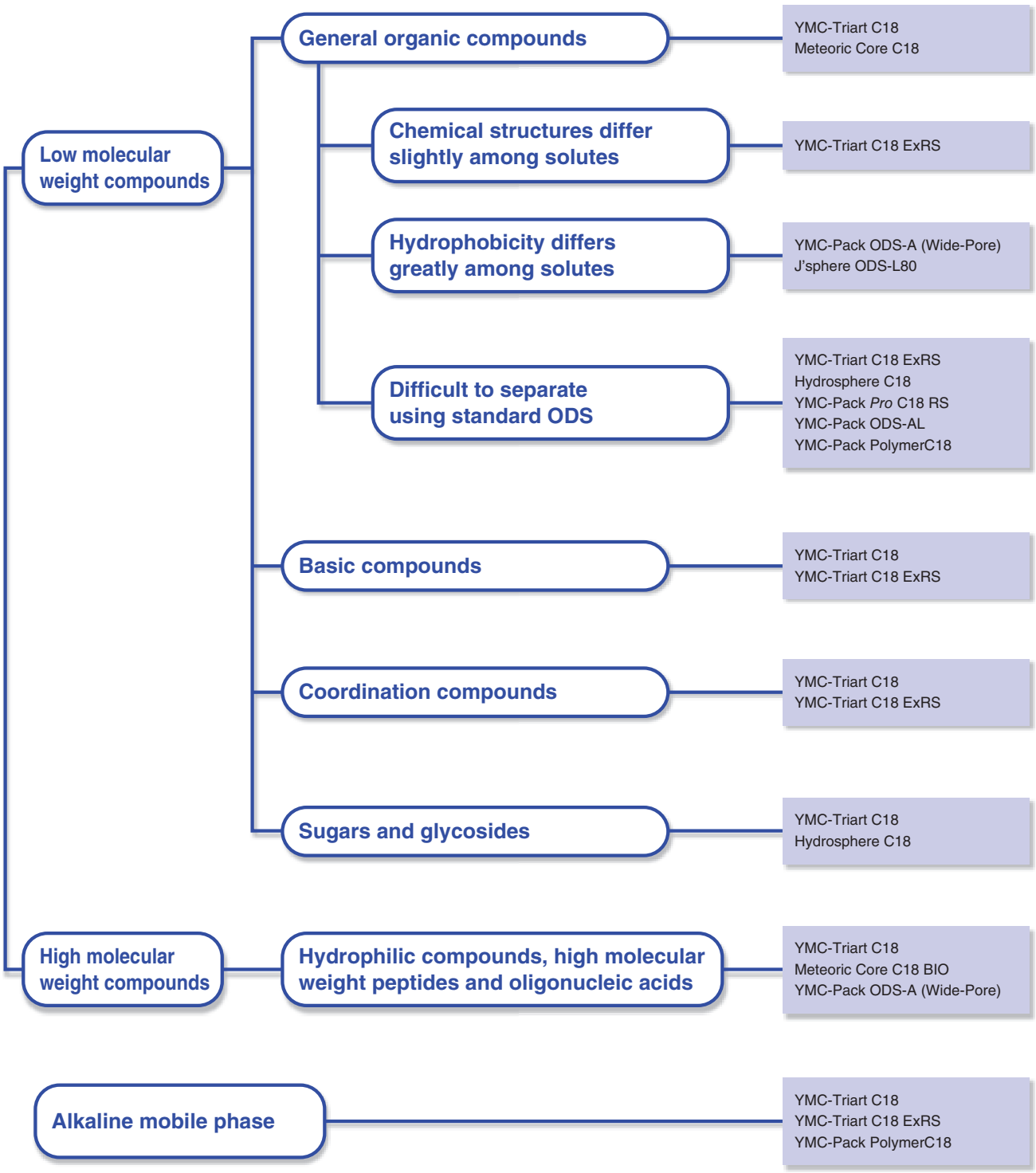
Base	Products
Hybrid silica	YMC-Triart C18 YMC-Triart C18 ExRS
Core-Shell type silica	Meteoric Core
Silica	YMC-Pack *Pro* C18 Hydrosphere C18 YMC-Pack *Pro* C18 RS YMC-Pack ODS series J'sphere ODS series
Polymer	YMC-Pack PolymerC18

Types and characteristics of C18 packing materials

Product name		Pore size (Å)	Particle size (μm)	C%	Silanol treatment	Usable pH range	Characteristics	Pages
YMC-Triart	C18	120	1.9 3 5	20	Yes	1.0~12.0	● Versatile hybrid silica based ODS column ● Great chemical durability ● Suitable as a first choice column	59~61
	C18 ExRS	80		25			● Versatile hybrid silica based ODS column ● Great chemical durability ● Excellent selectivity of isomers and structural analogs	62
Meteoric Core	C18	80	2.7	7	Yes	1.5~10.0	● Core-Shell type ODS ● Ultra fast analysis and excellent resolution ● Superior separation of basic compounds	72~75
	C18 BIO	160		5				
Pro series	*Pro* C18	120	2 3 5 10	16	Yes	2.0~8.0	● Processed with YMC CO., LTD.'s advanced endcapping technology ● Superior separation of basic compounds	83, 84
	Hydrosphere C18	120	2 3 5	12			● Superior separation of hydrophilic compounds ● Can be used with 100% water mobile phase	83, 85
	Pro C18 RS	80	3 5	22		1.0~10.0	● Highly durable ODS ● Superior separation of basic compounds and hydrophobic compounds	86
YMC-Pack ODS series	ODS-A	120	3 5 10	17	Yes	2.0~7.5	● Currently in use worldwide	87
		200	5 10	12			● ODS with wide pore size ● For separation of peptides and proteins	
		300	3 5 10	7				
	ODS-AM	120	3 5	17			● Outstanding lot-to-lot reproducibility	87
	ODS-AQ	120	3 5 10	14			● Superior separation of hydrophilic compounds	88
		200	5 10	10				
	ODS-AL	120	5	17	No		● For separation utilizing residual silanol	88
J'sphere ODS series	ODS-H80	80	4	22	Yes	1.0~9.0	● High carbon ODS	89
	ODS-M80	80	4	14		2.0~7.5	● Medium carbon ODS	
	ODS-L80	80	4	9			● Low carbon ODS	
YMC-Pack PolymerC18		—	6 10	—	— —	2.0~13.0	● Polymer-based ODS	89

Guides for selecting C18 packing materials

YMC offers 15 types of ODS columns, each with unique separation characteristics. The proper selection of packing material is therefore a key factor in the establishment of efficient separation conditions. Selection of packing materials without sufficient consideration of the separation characteristics may result in an expense of much time and effort in separating a target material. YMC-Triart C18 is suitable as a first choice column with excellent durability.



Features of *Pro* series ODS columns

Pro series high performance reversed-phase columns feature advanced endcapping technology and quality assurance which is ready for validation. The *Pro* series includes three kinds of ODS, each with unique separation characteristics. We provide products with excellent performance and stable quality all over the world to fulfill the needs of the pharmaceutical industry, in which production, as well as research and development, are increasingly globalized.

Providing products with stable quality all over the world

Features

- Silica gel base, low in metal impurities
- Processed with advanced endcapping technology
- Superior separation of basic compounds
- Useful for LC/MS
- Excellent durability
- Excellent reproducibility
- Two types of test reports are included with each column

Standard ODS column with high versatility

YMC-Pack *Pro* C18

YMC-Pack *Pro* C18 is a high performance monofunctional ODS column providing standard hydrophobicity, high resolution, high durability and excellent reproducibility. It is highly versatile in almost all fields, including pharmaceutical products, agricultural chemicals, foods, and natural products.

Low carbon ODS column, useful for separation of hydrophilic compounds

Hydrosphere C18

Hydrosphere C18 is an ODS column designed to maintain maximum hydrophilicity without activating the silica surface. It can be used with 100% water mobile phase, a problematic mobile phase for conventional ODS columns. Hydrosphere C18 is useful for separating hydrophilic compounds.

High carbon ODS column, useful for separation of highly hydrophobic compounds

YMC-Pack *Pro* C18 RS

YMC-Pack *Pro* C18 RS is a high carbon trifunctional ODS bonding, characterized by high resolution and high durability. It is applicable to a wide range of compounds. The separation of compounds with relatively high hydrophobicity and those that differ only slightly in hydrophobicity, such as structural isomers, is outstanding. It also has excellent resistance to acid and alkali, making it useful under demanding separation conditions.

Specifications

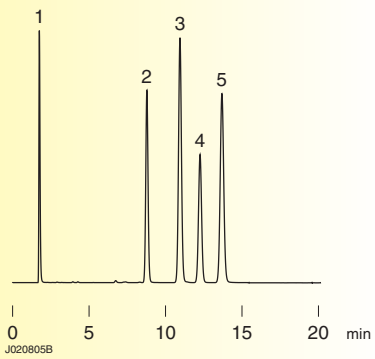
	Pro C18	Hydrosphere C18	*Pro* C18 RS
Particle size (µm)	2 , 3 , 5 , 10	2 , 3 , 5	3 , 5
Pore size (Å)	120	120	80
Specific surface area (m^2/g)	330	330	510
Carbon content	16%	12%	22%
Bonding	monofunctional	monofunctional	trifunctional
Usable pH range	2.0~8.0	2.0~8.0	1.0~10.0
Characteristics	Standard type	Separation for hydrophilic compounds	High carbon ODS

Three kinds of ODS, each with different separation characteristics

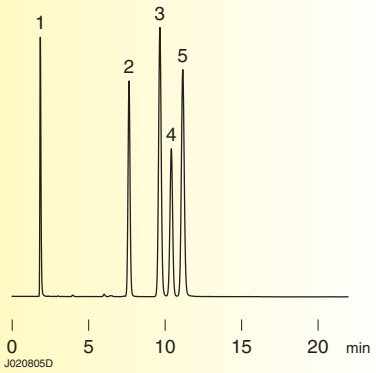
The three kinds of ODS columns in the *Pro* series each have unique carbon content and separation characteristics, including hydrophobicity, shape recognition ability, and hydrogen-bonding capacity. Selection according to the analyte and mobile phase of *Pro* C18 with standard hydrophobicity, *Pro* C18 RS with high hydrophobicity, or Hydrosphere C18 with low hydrophobicity, facilitates method development.

Hydrophobicity and shape recognition ability of *Pro* series ODS

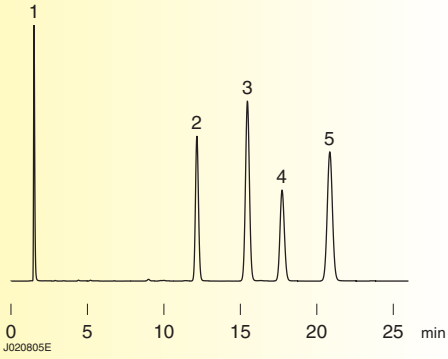
YMC-Pack *Pro* C18



Hydrosphere C18



YMC-Pack *Pro* C18 RS



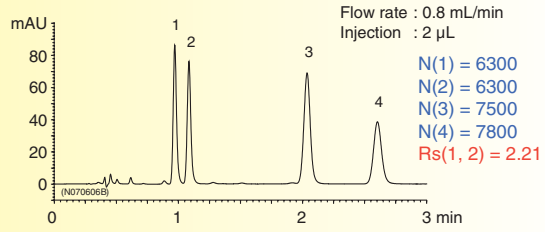
1. Uracil
2. *n*-Butylbenzene
3. *o*-Terphenyl
4. *n*-Amylbenzene
5. Triphenylene

Column size	: 150 X 4.6 mmI.D.
Eluent	: methanol/water (80/20)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

UltraHT series applicable for conventional LC system

50 X 3.0 mmI.D.

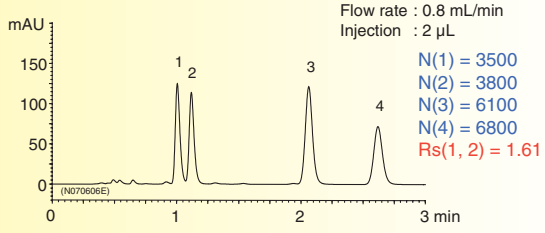
Conventional semi-micro LC system (cell volume 2.5 µL, path length 5 mm)



Flow rate : 0.8 mL/min
Injection : 2 µL

N(1) = 6300
N(2) = 6300
N(3) = 7500
N(4) = 7800
Rs(1, 2) = 2.21

Conventional LC system (cell volume 8 µL, path length 10 mm)

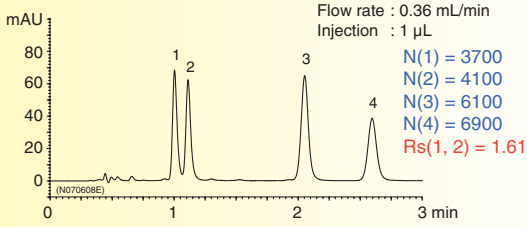


Flow rate : 0.8 mL/min
Injection : 2 µL

N(1) = 3500
N(2) = 3800
N(3) = 6100
N(4) = 6800
Rs(1, 2) = 1.61

50 X 2.0 mmI.D.

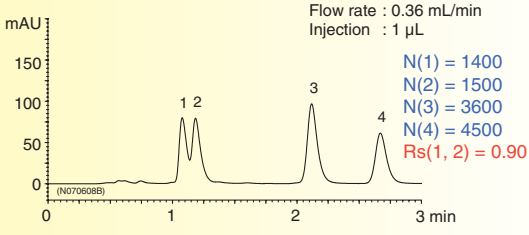
Conventional semi-micro LC system (cell volume 2.5 µL, path length 5 mm)



Flow rate : 0.36 mL/min
Injection : 1 µL

N(1) = 3700
N(2) = 4100
N(3) = 6100
N(4) = 6900
Rs(1, 2) = 1.61

Conventional LC system (cell volume 8 µL, path length 10 mm)



Flow rate : 0.36 mL/min
Injection : 1 µL

N(1) = 1400
N(2) = 1500
N(3) = 3600
N(4) = 4500
Rs(1, 2) = 0.90

YMC-UltraHT series can be used for fast analysis with conventional LC system, as its pressure is lower than commercial sub-2 µm columns. Considering the extra column band broadening, the column of 3.0 mmI.D. is more applicable for conventional LC system than the column of 2.0 mmI.D..

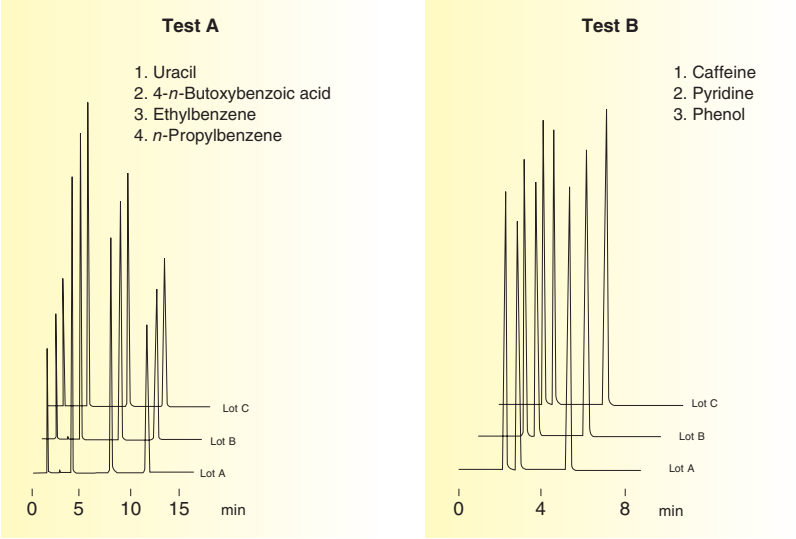
Cephalosporin antibiotics

1. Cephalexin
2. Cefaclor
3. Cephaloglycin
4. Cephaloridine

Column	: YMC-UltraHT *Pro* C18
Eluent	: acetonitrile/20 mM KH_2PO_4 (10/90)
Temperature	: 37°C
Detection	: UV at 260 nm

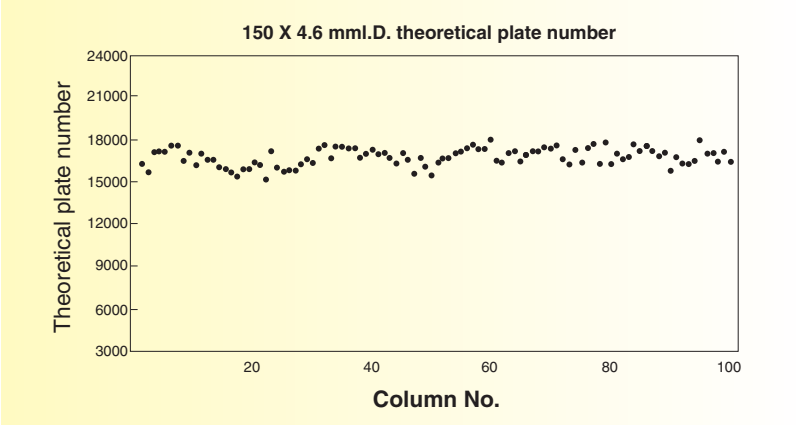
Excellent lot-to-lot reproducibility

batch-to-batch



A three-lot comparison is shown on the left. Excellent reproducibility is achieved in separating hydrophilic, basic and acidic compounds, as well as hydrophobic compounds.

column-to-column



Advanced packing technology results in high column efficiency. All packed columns are inspected and controlled according to the strictest quality control criteria for column performance ever, including theoretical plate number testing.

Two types of test reports

<Packing Material Test Report>

This report describes basic physical properties of silica gel, including particle size, pore size and metal content, carbon loading after modification, and the specifications and results of separation characteristics tests.

<Column Test Report>

The Column Test Report shows the theoretical plate number and tailing factor to indicate column performance. For convenience in deterioration evaluation, this report includes all analytical conditions including sample concentration as well.

Each *Pro* series includes both, a Column Test Report and a Packing Material Test Report, to certify lot-to-lot and column-to-column reproducibility.

Ultra-Fast LC column

YMC-UltraHT

YMC-UltraHT is a C18 bonded-phase based on highly efficient 2 µm spherical silica particles. YMC-UltraHT series columns are specifically designed for high-speed and high throughput analysis in various fields such as pharmaceuticals, foods, and environmentals. YMC-UltraHT has two products. *Pro* C18 as our standard ODS, and Hydrosphere C18 for hydrophilic compounds. Both of them show the same selectivity and superior peak shapes as 3 µm and 5 µm *Pro* series, allowing for an easy method transfer from conventional HPLC to ultra-fast HPLC without changing elution conditions.

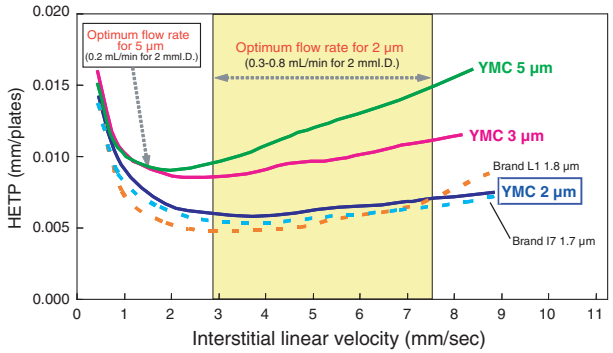
2 µm ODS column ideal for Ultra-Fast LC

Features

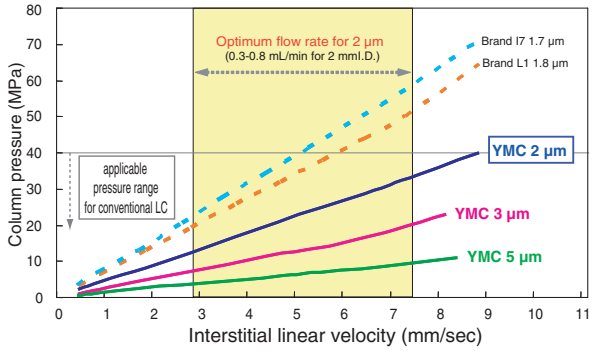
- Superior column performance at higher flow rate and higher pressure
- Reduced analysis time while maintaining excellent resolution
- Excellent resolution with back pressure less than that of sub-2 µm
- Applicable to both conventional HPLC and specific ultra pressure LC system
- Same selectivity and superior peak shapes as 3 µm and 5 µm *Pro* series
- Simple method transfer from conventional HPLC on *Pro* series; no need to change elution conditions

Characteristics of 2 µm packing material

Van Deemter curves



Column pressure



YMC-UltraHT series shows nearly the same efficiency as sub-2 µm columns for ultra fast LC system and reduces the column pressure significantly.

Column	: 50 X 2.0 or 2.1 mmI.D.
Eluent	: acetonitrile/water (60/40)
Temperature	: 25°C
Sample	: butyl benzoate

Specifications

	Pro C18	Hydrosphere C18
Particle size (µm)	2	
Pore size (Å)	120	
Specific surface area (m^2/g)	330	
Carbon content	16%	12%
Bonding	monofunctional	
Usable pH range	2.0~8.0	
Characteristics	Standard type	For polar analytes

Analytical columns

YMC-Pack *Pro* C18

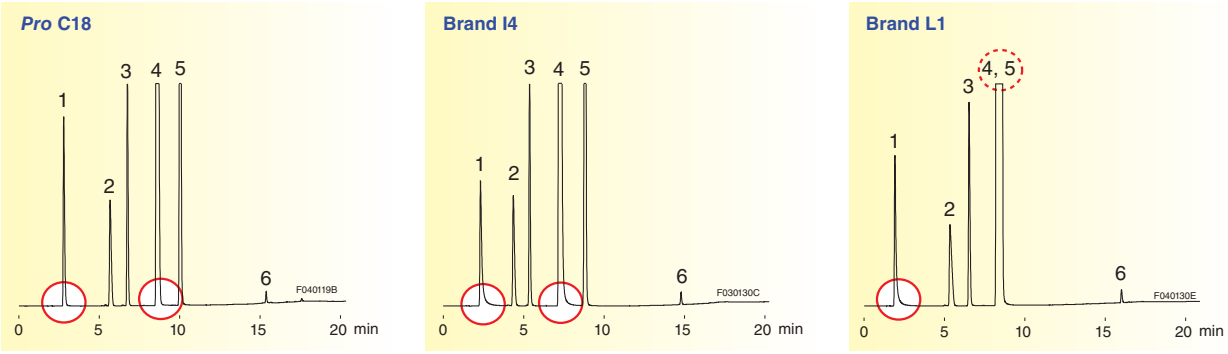
- Superior separation of basic compounds
- Processed with advanced endcapping technology
- Excellent reproducibility
- Utilizes highly pure silica gel base

- Pore size : 120 Å
- Carbon content : 16%
- Usable pH range : 2.0~8.0
- USP L1

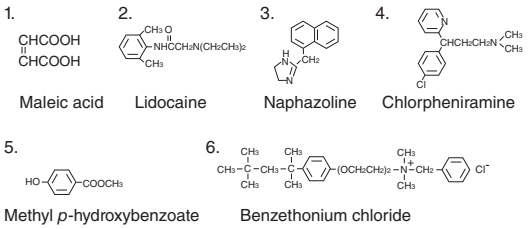
Perfectly endcapped ODS

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

Versatility ODS column in almost all fields



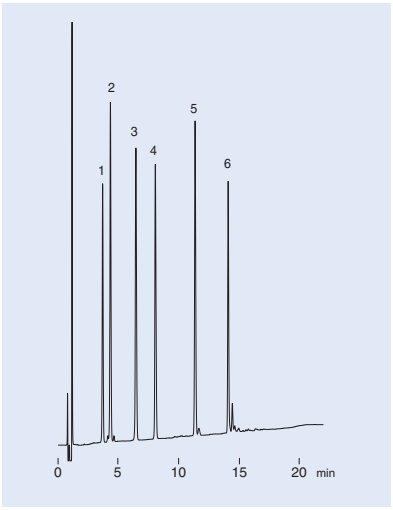
Nose drops (OTC)



Column	: 150 X 4.6 mmI.D. (5 µm)
Eluent	: A) 20 mM KH_2PO_4-H_3PO_4 (pH 2.5) B) methanol 20-90%B (0-15 min), 90%B (15-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 260 nm

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

Application (A990121B)



Peptides

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

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

Hydrosphere C18

- Strong retention of hydrophilic compounds
- Can be used with 100% water mobile phase
- Superior separation of basic compounds
- Excellent reproducibility
- Utilizes highly pure silica gel base

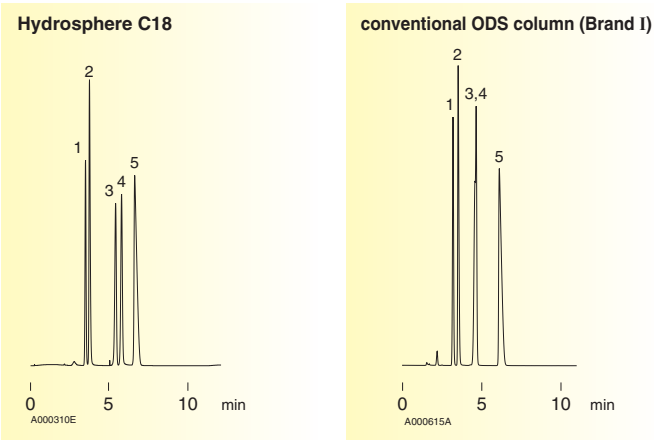
- Pore size : 120 Å
- Carbon content : 12%
- Usable pH range : 2.0~8.0
- USP L1

Hydrophilic ODS

Hydrosphere C18 is designed to maintain adequate hydrophilicity on the packing surface for superior separation of hydrophilic compounds. Hydrophilic compounds are retained with much greater affinity than with conventional ODS columns, permitting the product to be used with 100% water mobile phase, a problematic mobile phase for conventional ODS columns. Hydrosphere C18 is useful for separating a wide range of compounds, including nucleic acids and their derivatives, organic acids, saccharides, glycosides and peptides.

Appropriate for separation of hydrophilic compounds

Separation of organic acids

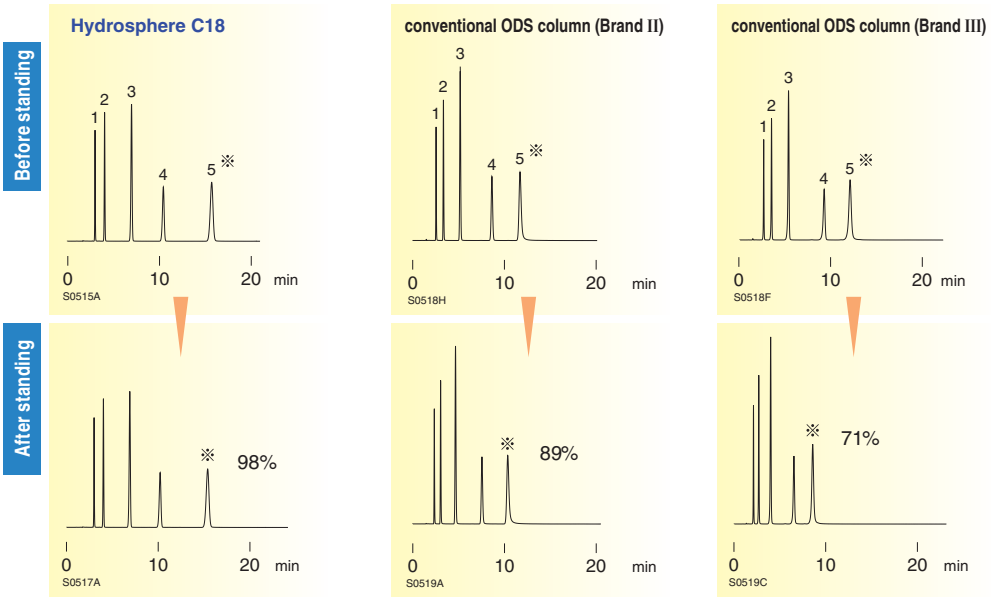


High hydrophilicity of the Hydrosphere C18 packing material surface enables longer retention and superior separation of citric acid and fumaric acid as compared to a conventional ODS column (Brand I).

1. Lactic acid
2. Acetic acid
3. Citric acid
4. Fumaric acid
5. Succinic acid

Column	: 150 X 4.6 mmI.D.
Eluent	: 20 mM NaH_2PO_4-H_3PO_4 (pH 2.8)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 210 nm

Reproducibility of retention time when used with 100% water mobile phase



After completion of analysis, the flow was stopped and the columns were left to stand overnight (ca. 15 hours).

1. Cytosine
2. Uracil
3. Guanine
4. Thymine
5. Adenine

Column	: 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

When conventional ODS columns are used with 100% water mobile phase, the apparent hydrophobicity decreases due to repulsive interactions between water and hydrophobic groups on the surface of the packing materials, reducing retention of compounds. In the experiment illustrated here, columns filled with 100% water mobile phase were left to stand overnight. Retention times of nucleic acid bases were analyzed before and after standing and compared. The retention times of adenine after standing decreased to 89% of the original value for Brand II and to 71% of the original Brand III value. By contrast, Hydrosphere C18 retained 98% of its original retention for adenine. Hydrosphere C18 is designed to maintain adequate hydrophilicity on the packing surface so that hydration can be achieved, and when Hydrosphere C18 is used with mobile phase containing no organic solvent, the retention time is not significantly shortened and highly reproducible chromatograms can be obtained.

Analytical columns

YMC-Pack *Pro* C18 RS

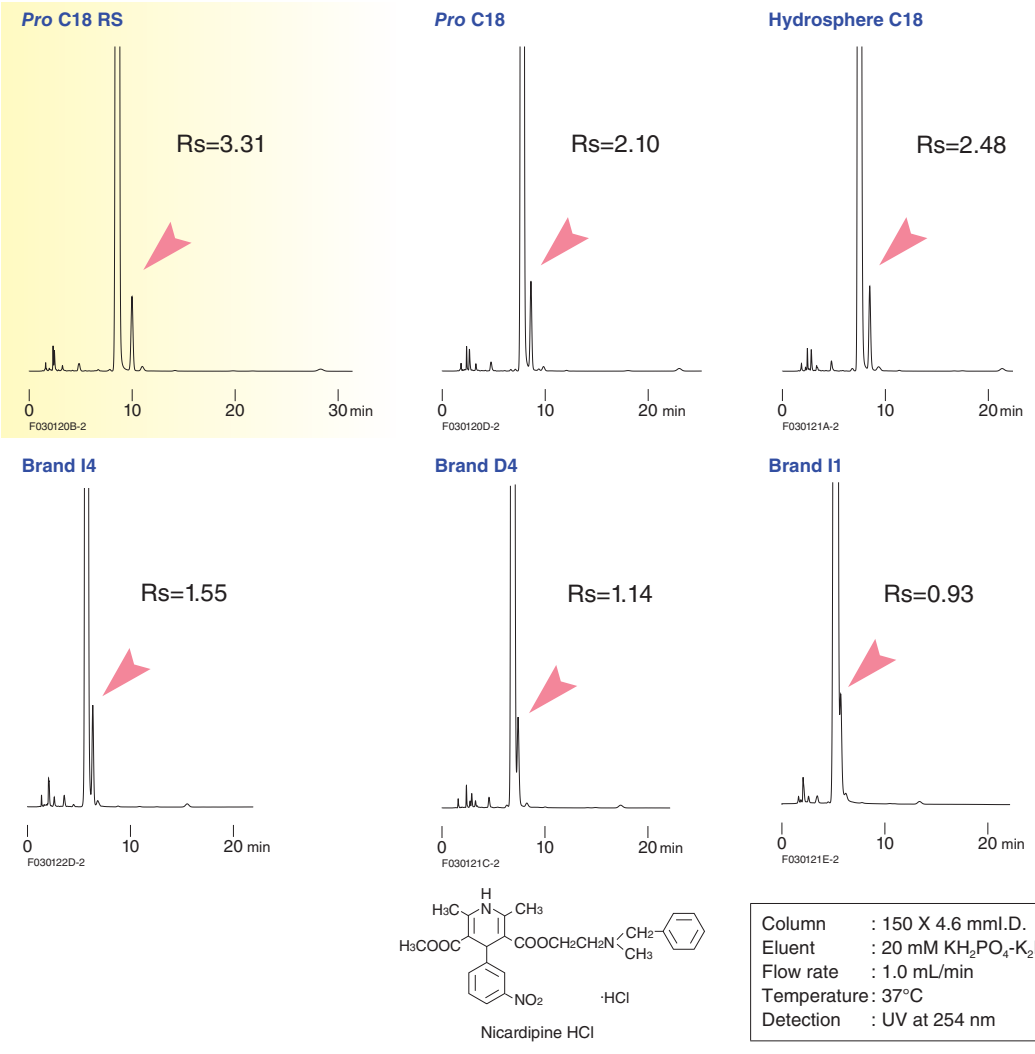
- Excellent acid resistance and alkaline resistance (pH 1 to 10)
- Superior separation of structural isomers and basic compounds
- Excellent reproducibility
- Utilizes highly pure silica gel base

- Pore size : 80 Å
- Carbon content : 22%
- Usable pH range : 1.0~10.0
- USP L1

High carbon ODS

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

Nicardipine hydrochloride



Nicardipine HCl

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

Column	: 150 X 4.6 mmI.D. 5 µm
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/methanol (25/75)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

Analytical columns

YMC-Pack ODS-A

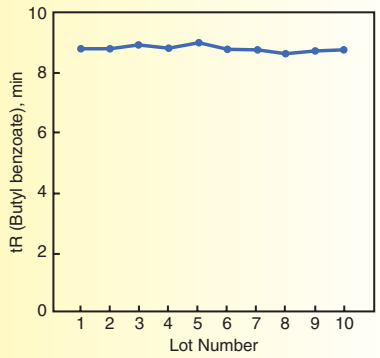
- Conventional ODS column
- Currently in use worldwide

- Pore size : 120, 200, 300 Å
- Carbon content : 17%, 12%, 7%
- Usable pH range : 2.0~7.5
- USP L1

Standard ODS

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

Quality control system for excellent performance



The graph indicates lot-to-lot reproducibility with respect to hydrophobic interaction for 10 lots, an essential column performance characteristic. Extremely stable lot-to-lot reproducibility of the hydrophobic surface is achieved by strict control of variables.
In addition to measurement of the physical properties, a wide range of compounds including hydrophobic, acidic, basic and coordination compounds are analyzed under optimal conditions to evaluate column performance.

Analytical columns

YMC-Pack ODS-AM

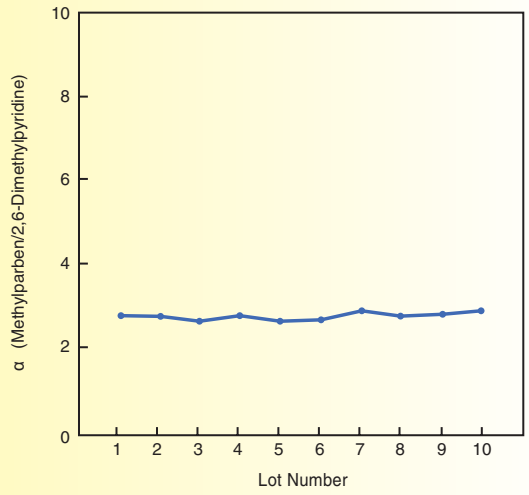
- Similar to ODS-A in selectivity
- Excellent reproducibility
- Useful for quality control purposes

- Pore size : 120 Å
- Carbon content : 17%
- Usable pH range : 2.0~7.5
- USP L1

ODS with outstanding lot-to-lot reproducibility

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

Special attention is given to lot-to-lot reproducibility



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

Analytical columns

YMC-Pack ODS-AQ

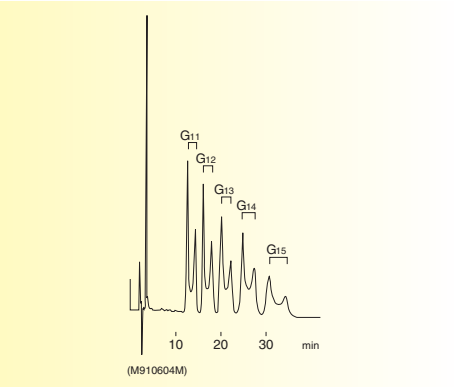
- Useful for separation of hydrophilic compounds
- Can be used with 100% water mobile phase
- Different selectivity from conventional ODS

- Pore size : 120, 200 Å
- Carbon content : 14%, 10%
- Usable pH range : 2.0~7.5
- USP L1

Hydrophilic ODS

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

Useful for separation of sugars



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

1. Maltoundecaose (G_{11})
2. Maltododecaose (G_{12})
3. Maltotridecaose (G_{13})
4. Maltotetradecaose (G_{14})
5. Maltopentadecaose (G_{15})

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

Analytical columns

YMC-Pack ODS-AL

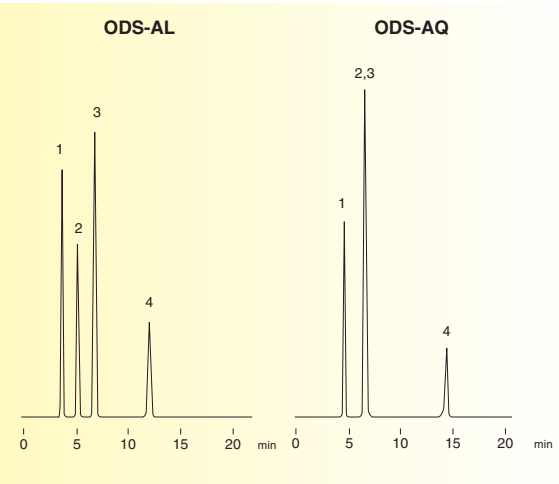
- ODS with residual silanol groups
- Utilizes secondary interaction caused by silanol groups

- Pore size : 120 Å
- Carbon content : 17%
- Usable pH range : 2.0~7.5
- USP L1

Non-endcapped ODS

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

Utilizes residual silanol groups for separation



Disinfectants

1. Benzoic acid
2. Salicylic acid
3. Theophylline (I.S.)
4. Phenol

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

Column	: YMC-Pack ODS-AL and ODS-AQ (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: 100 mM KH_2PO_4-Na_2HPO_4 (pH 7.0)/methanol (75/25)
Flow rate	: 0.8 mL/min
Temperature	: 30°C
Detection	: UV at 270 nm

(Conditions described in Japanese Pharmacopoeia 16th ed.)

Analytical columns

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

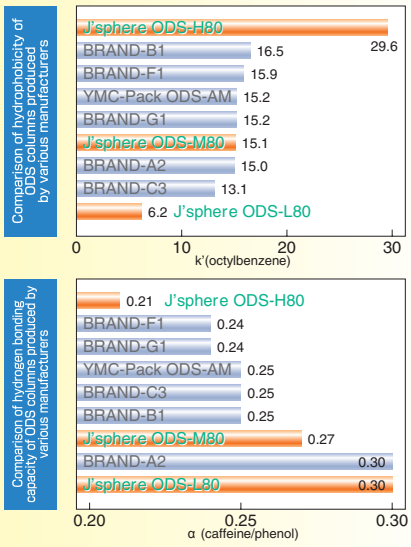
- Useful for method development
- High theoretical plate number

- Pore size : 80 Å
- Carbon content : ODS-H80 22% , ODS-M80 14% , ODS-L80 9%
- Usable pH range : ODS-H80 1.0~9.0, ODS-M80·L80 2.0~7.5
- USP L1

Three types of ODS, each with different ligand coverage

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

Differences in separation characteristics



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

Column	: 150 X 4.6 mmI.D.
Eluent	: acetonitrile/20 mM KH_2PO_4 (15/85)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

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

Analytical columns

YMC-Pack PolymerC18

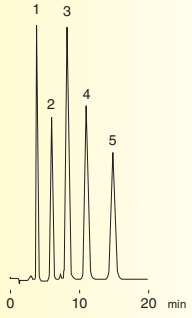
- Utilizes polymer base which is not affected by silanol
- Different separation characteristics from silica-based ODS
- Excellent pH stability

- Usable pH range : 2.0~13.0

Polymer type C18

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

Can be used with alkaline mobile phase



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

Column	: YMC-Pack PolymerC18 150 X 4.6 mmI.D.
Eluent	: 50 mM Na_2HPO_4-Na_3PO_4 (pH 11.0)/methanol (75/25)
Flow rate	: 0.5 mL/min
Temperature	: 30°C
Detection	: UV at 254 nm

Ordering Information -Columns-

YMC-UltraHT *Pro* C18/YMC-Pack *Pro* C18

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

YMC-UltraHT Hydrosphere C18/Hydroshere C18

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

YMC-Pack *Pro* C18 RS

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

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

※ See P.120, 121 for preparative columns other than those listed above.

Ordering Information -Columns-

YMC-Pack ODS-A

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

YMC-Pack ODS-AM

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

YMC-Pack ODS-AQ

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

YMC-Pack ODS-AL

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

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

※ See P.120, 121 for preparative columns other than those listed above.

Ordering Information -Columns-

J'sphere

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

YMC-Pack PolymerC18

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

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

※ See P.121 for preparative columns other than those listed above.

07

Reversed-Phase Columns (Other than ODS)

Types and characteristics of reversed-phase columns

YMC reversed-phase columns include a variety of columns other than ODS, enabling column selection from a wide range of products to suit the sample characteristics.

Elution behavior dependent on alkyl chain length

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

Elution behavior affected by other factors

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

Types of reversed-phase columns (I)

ODS	$-C_{18}H_{37}$	Retention due to hydrophobicity High ↑ ↓ Low
C8	$-C_8H_{17}$	
C4	$-C_4H_9$	
TMS	$-CH_3$	

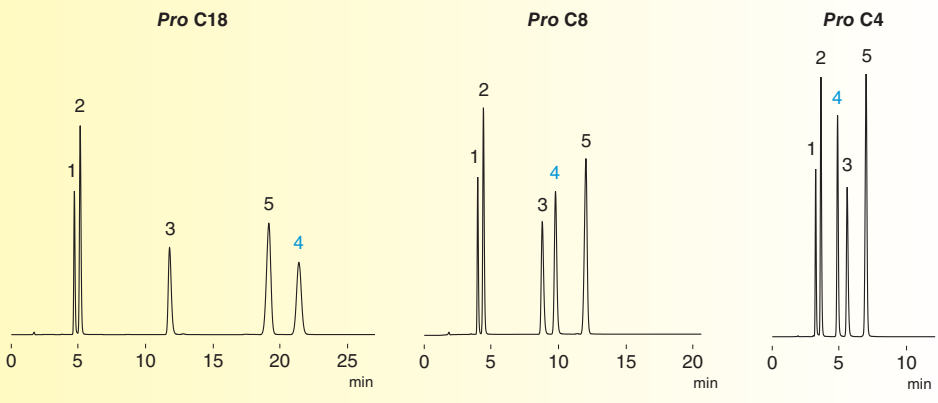
Types of reversed-phase columns (II)

Phenyl (Ph)		π electrons available
PFP		π electrons available
CN	$-(CH_2)_3-CN$	π electrons available Can be used also in normal-phase

Types and characteristics of reversed-phase columns (other than ODS)

Product name		Pore size (Å)	Particle size (μm)	C%	Silanol treatment	Usable pH range	Characteristics	Pages
YMC-Triart	C8	120	1.9, 3, 5	17	Yes	1.0 ~ 12.0	● Versatile hybrid silica based C8 column ● Ideal for separations of isomers or structural analogs	63
	Phenyl			17		1.0 ~ 10.0	● Versatile hybrid silica based Phenyl column ● Ideal for separations of aromatic compounds or compounds having long conjugated system	64
	PFP			15	No	1.0 ~ 8.0	● Versatile hybrid silica based PFP column ● Ideal for separations of polar compounds or isomers	65
Meteoric Core C8		80	2.7	5	Yes	1.5 ~ 9.0	● Core-Shell type C8 ● Ultra fast analysis and excellent resolution	72~75
Pro series	*Pro* C8	120	3, 5	10	Yes	2.0 ~ 7.5	● Processed with advanced endcapping technology ● Superior separation of basic compounds	96
	Pro C4	120	3, 5	7			● Processed with advanced endcapping technology ● Different selectivity from ODS	
YMC-Pack series	C_8	120	3, 5,10	10	Yes		● Moderate hydrophobicity ● Useful for separation of proteins and peptides	97
		200	5,10	7				
		300	5,10	4				
	C_4	120	3, 5,10	7			● Lower hydrophobicity than ODS and C8 ● Useful for separation of proteins and peptides	97
		200	5,10	5				
		300	5,10	3				
	TMS	120	3, 5,10	4			● Reversed-phase packing material with the lowest hydrophobicity	98
	Ph	120	3, 5,10	9			● Reversed-phase packing material with π electrons	98
	CN	120	3, 5,10	7			● Can be used in both normal-phase and reversed-phase modes	99
		300	5	3				
	PROTEIN-RP	200	5	4	—	1.5 ~ 7.5	● Useful for separation of proteins and peptides	99
YMCbasic		200	3, 5	7	Yes	2.0 ~ 7.5	● Superior separation of basic compounds ● Useful for separation of proteins and peptides	100
YMC Carotenoid		—	3, 5	—	—	2.0 ~ 7.5	● Useful for carotenoids separation	100

Elution behavior dependent on alkyl chain length

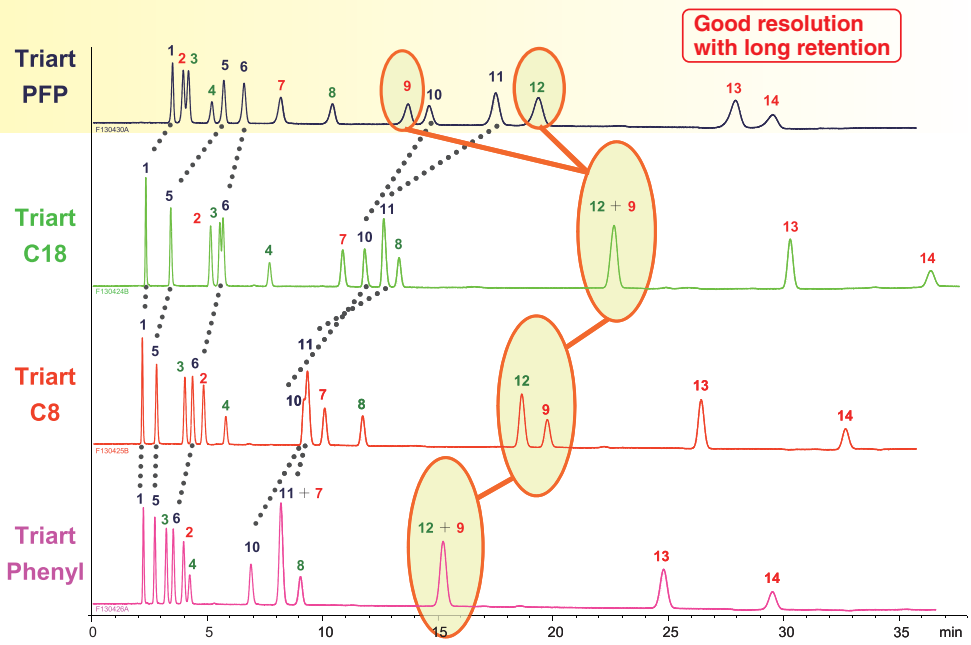


1. Toluene
2. Deoxycorticosterone acetate
3. Imipramine hydrochloride
4. Triphenylene
5. *n*-Amylbenzene

Column	: 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/methanol (25/75)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

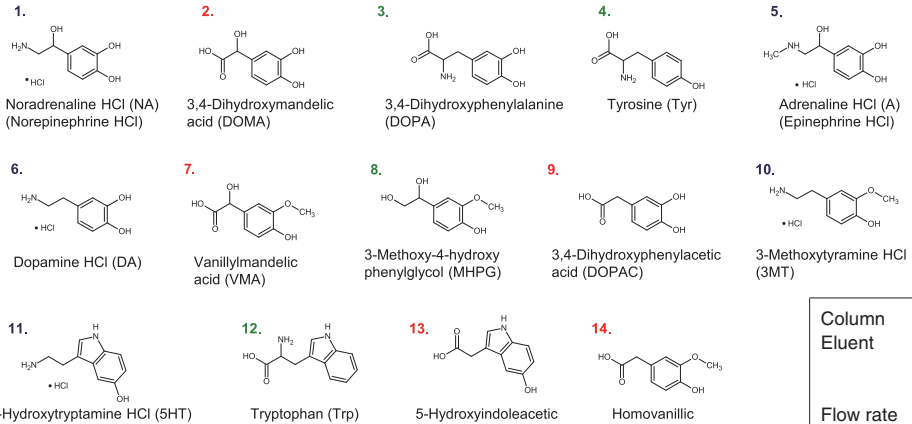
In this example, the retention behavior of a variety of compounds is shown to be dependent on the alkyl chain length of the stationary phase. Shorter alkyl chain lengths like C4 show reduced retention for neutral compounds due to the diminished hydrophobicity of the C4 stationary phase relative to longer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

Comparison of separation selectivity among YMC-Triart reversed-phase columns



Separation selectivity of YMC-Triart reversed-phase columns is compared on analysis of 14 biologically active amines and their related compounds. Retention time of each compound is summarized by type of compounds. As shown, Triart PFP column shows strong retention of basic compounds (peak 1, 5, 6, 10, 11). It is considered that basic compounds which has electron-donating characteristic and polarised PFP group/silanol group are strongly interacted, and as a result, Triart PFP shows longer retention time.

Biologically active amines and their related compounds



1. Noradrenaline HCl (NA) (Norepinephrine HCl)
2. 3,4-Dihydroxymandelic acid (DOMA)
3. 3,4-Dihydroxyphenylalanine (DOPA)
4. Tyrosine (Tyr)
5. Adrenaline HCl (A) (Epinephrine HCl)
6. Dopamine HCl (DA)
7. Vanillylmandelic acid (VMA)
8. 3-Methoxy-4-hydroxy phenylglycol (MHPG)
9. 3,4-Dihydroxyphenylacetic acid (DOPAC)
10. 3-Methoxytyramine HCl (3MT)
11. 5-Hydroxytryptamine HCl (5HT) (Serotonin HCl)
12. Tryptophan (Trp)
13. 5-Hydroxyindoleacetic acid (5HIAA)
14. Homovanillic acid (HVA)

Column	: 5 µm, 150 X 3.0 mmI.D.
Eluent	: A) 10 mM formic acid B) methanol containing 10 mM formic acid 0-20%B (0-30 min), 20%B (30-35 min)
Flow rate	: 0.425 mL/min
Temperature	: 25°C
Detection	: UV at 280 nm

Analytical columns

YMC-Pack *Pro* C8, C4

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

C8 ■ Pore size : 120 Å
■ Carbon content : 10%
■ Usable pH range : 2.0~7.5
■ USP L7

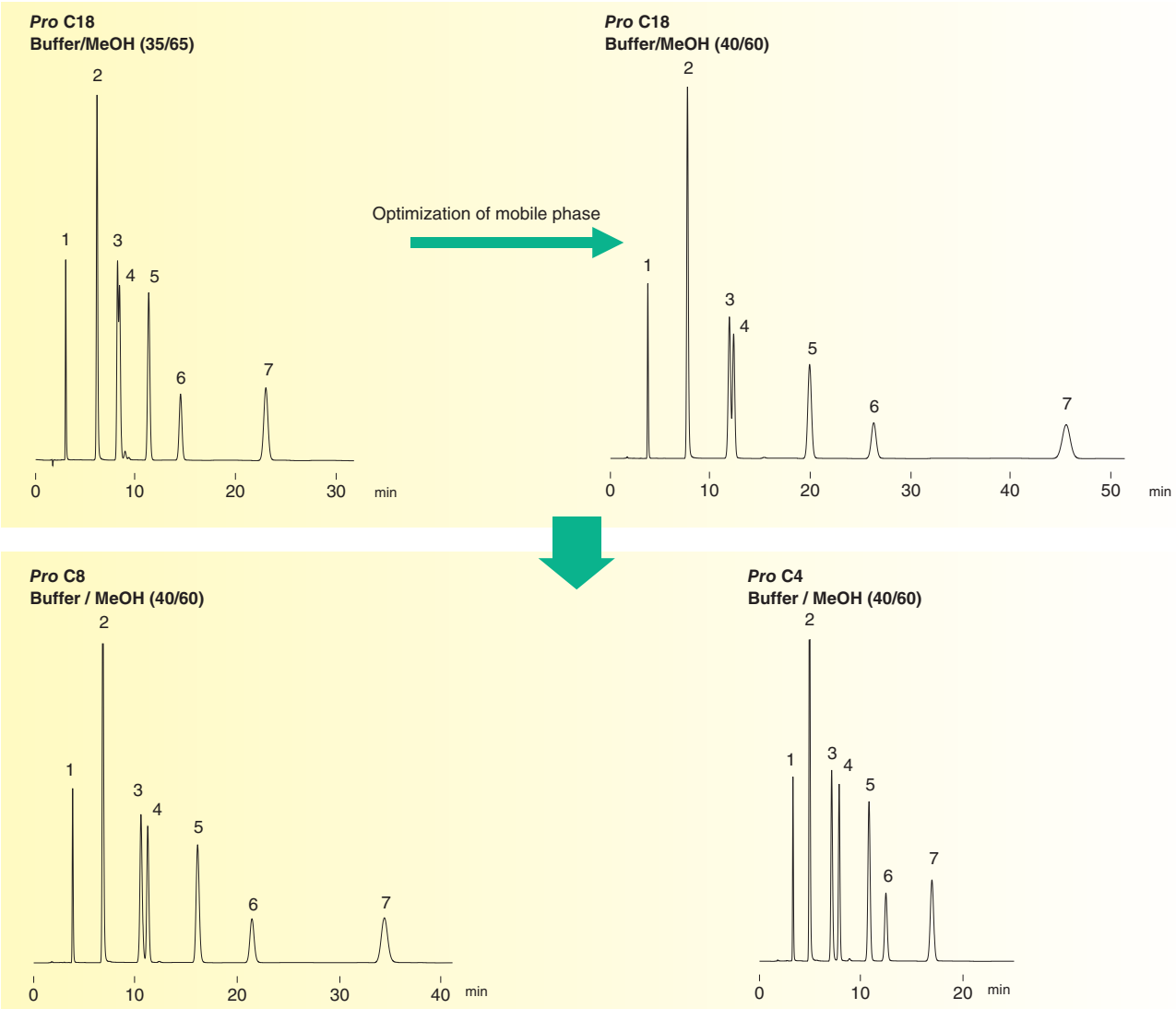
C4 ■ Pore size : 120 Å
■ Carbon content : 7%
■ Usable pH range : 2.0~7.5
■ USP L26

Highly endcapped C8 and C4 reversed-phase columns

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

Optimization of separation using *Pro* C8 and *Pro* C4

Separation of antiarrhythmics



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

Column	: 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/methanol
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

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

Analytical columns

YMC-Pack C_8

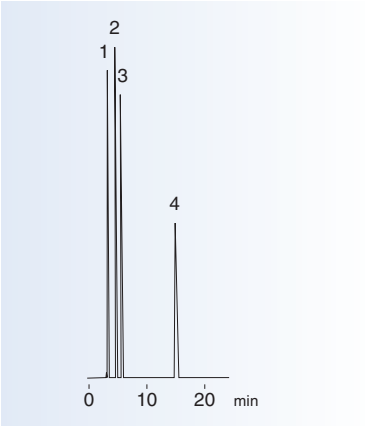
- Stationary phase with lower hydrophobicity than ODS
- Useful for separating samples with relatively high hydrophobicity
- Useful for separation of proteins and peptides

- Pore size : 120, 200, 300 Å
- Carbon content : 10%, 7%, 4%
- Usable pH range : 2.0~7.5
- USP L7

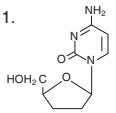
Reversed-phase column with moderate hydrophobicity

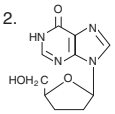
The hydrophobicity of YMC-Pack C_8 is moderate for a reversed-phase packing material. Retention times of samples on YMC-Pack C_8 tend to be shorter than those on ODS stationary phase. The moderate hydrophobicity of YMC-Pack C_8 makes it useful for separating samples with relatively high hydrophobicity.

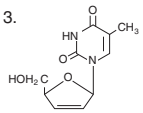
Application (K930311A)

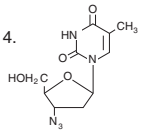


Anti-HIV nucleoside derivatives

1. 
ddC

2. 
ddI

3. 
d4T

4. 
AZT

Column	: YMC-Pack C_8 (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: methanol/10 mM KH_2PO_4 (10/60)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

Analytical columns

YMC-Pack C_4

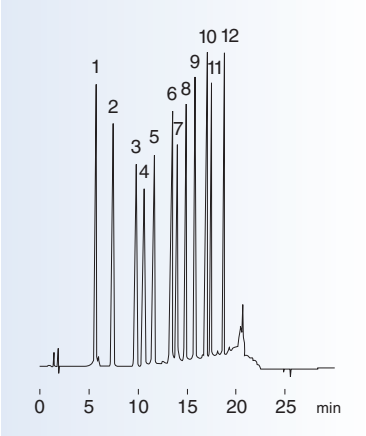
- Stationary phase with low hydrophobicity
- Different separation characteristics from ODS
- Useful for separation of proteins and peptides

- Pore size : 120, 200, 300 Å
- Carbon content : 7%, 5%, 3%
- Usable pH range : 2.0~7.5
- USP L26

Reversed-phase column with shorter alkyl chain

The YMC-Pack C_4 stationary phase surface hydrophobicity is lower than that of both ODS and C_8. Retention times of samples on YMC-Pack C_4 therefore tend to be shorter than those on ODS or C_8. Separation characteristics of YMC-Pack C_4 also differ from those of ODS. YMC-Pack C_4 achieves better separation than ODS for some types of samples.

Application (T920302A)



2,4-DNPH derivatives of aldehydes and ketones

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

Column	: YMC-Pack C_4 (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: A) tetrahydrofuran/water (10/90) B) acetonitrile 35%B (0-7 min), 35-65%B (7-18 min, linear), 100%B (18-19 min), 35%B (19-35 min)
Flow rate	: 1.5 mL/min
Temperature	: 30°C
Detection	: UV at 360 nm

Analytical columns

YMC-Pack TMS

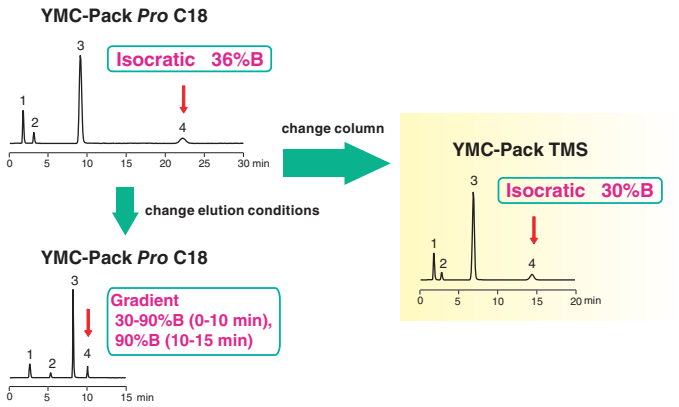
- Stationary phase with the lowest hydrophobicity among reversed-phase packing materials
- Different separation characteristics from ODS

- Pore size : 120 Å
- Carbon content : 4%
- Usable pH range : 2.0~7.5
- USP L13

Reversed-phase column with the lowest hydrophobicity

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

Shorten analysis time using TMS



Soy isoflavones

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

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

TMS enables analysis time of highly hydrophobic compounds to shorten.

Analytical columns

YMC-Pack Ph

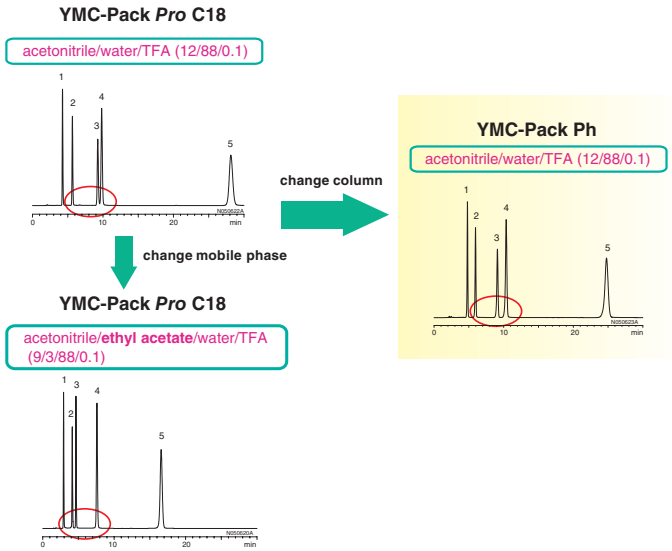
- Reversed-phase column with π electrons
- Unique selectivity due to π-π interaction
- Useful in cases where separation optimization is difficult to achieve using ODS

- Pore size : 120 Å
- Carbon content : 9%
- Usable pH range : 2.0~7.5
- USP L11

Different selectivity from ODS

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

Establishment of simple conditions using Ph



Catechins

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

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

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

Analytical columns

YMC-Pack CN

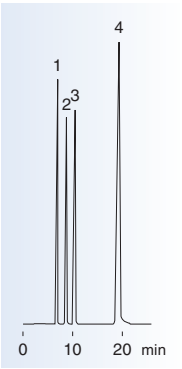
- Normal-phase and reversed-phase modes are selectable according to the purpose of analysis
- Low hydrophobicity
- Unique selectivity due to cyano group

- Pore size : 120, 300 Å
- Carbon content : 7%, 3%
- Usable pH range : 2.0~7.5
- USP L10

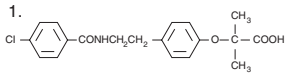
Column can be used in both normal-phase and reversed-phase modes

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

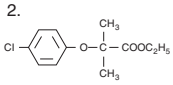
Application (S931025E)



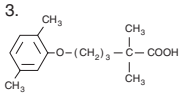
Anti-hyperlipidemia drugs

1. 

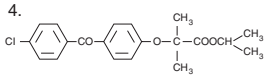
Bezafibrate

2. 

Clofibrate

3. 

Gemfibrozil

4. 

Fenofibrate

Column	: YMC-Pack CN (5 μm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: acetonitrile/methanol/water/acetic acid (20/20/60/1)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 275 nm

Analytical columns

YMC-Pack PROTEIN-RP

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

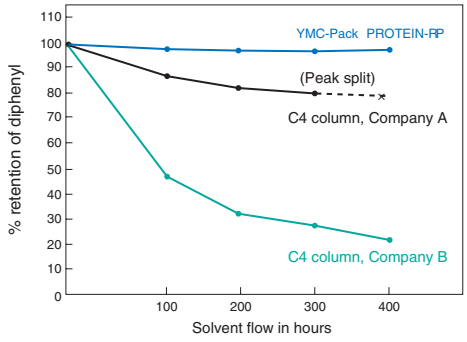
- Pore size : 200 Å
- Carbon content : 4%
- Usable pH range : 1.5~7.5
- USP L26

Reversed-phase column for separation of proteins or peptides

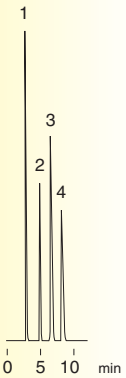
YMC-Pack PROTEIN-RP is a reversed-phase column utilizing a silica gel base. It contains a stationary phase, specifically designed for separation of proteins or peptides. Problems that are associated with conventional reversed-phase columns with short alkyl chain lengths are minimized. Robust column lifetime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

Improved durability when used with TFA solution

0.1%TFA condition



<Prior to flow>



Theoretical plate number (4) = 14,300

<After 500 hours>

Theoretical plate number (4) = 13,800

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

<Flow conditions>

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

<Measurement conditions>

Column	: YMC-Pack PROTEIN-RP 250 X 4.6 mmI.D.
Eluent	: acetonitrile/water (40/60)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 254 nm, 0.32 AUFS

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

Analytical columns

YMCbasic

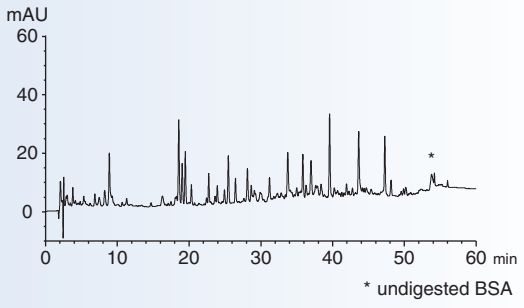
- Superior separation of basic compounds
- Useful for separation of peptides
- Secondary interaction minimized as much as possible

- Pore size : 200 Å
- Carbon content : 7%
- Usable pH range : 2.0~7.5
- USP L7

Column for separation of basic compounds

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

Application (N061027C)



Tryptic digest of BSA

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

Analytical columns

YMC Carotenoid

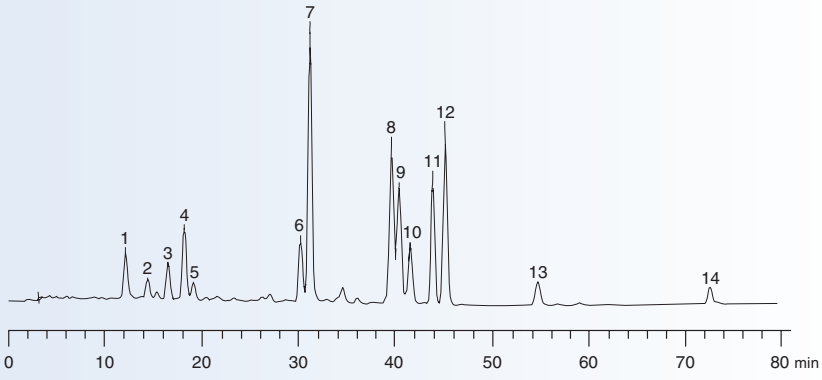
- Resolves polar and nonpolar geometric carotenoid isomers
- Separates carotenoids in blood samples, food products, natural product extracts, and commercial preparations
- Operates with low aqueous or non aqueous mobile phases desirable in LC/MS and prep fraction recovery

- Usable pH range : 2.0~7.5
- USP L62

Carotenoid analytical column

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

Application (A110401A)



Carotene and xanthophyll

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

Column	: YMC Carotenoid 250 X 4.6 mmI.D.
Eluent	: A) methanol/MTBE*/H_2O (81/15/4) B) methanol/MTBE*/H_2O (6/90/4) 0-100%B (0-90 min)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: UV at 450 nm

*methyl *tert*-butyl ether

Ordering Information -Columns-

YMC-Pack *Pro* C8

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

YMC-Pack *Pro* C4

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

YMC-Pack C_8

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

YMC-Pack C_4

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

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

※ See P.122 for preparative columns other than those listed above.

08

Normal-Phase/SFC Columns

Analytical columns

YMC-Pack SIL, YMC-Pack SIL-06

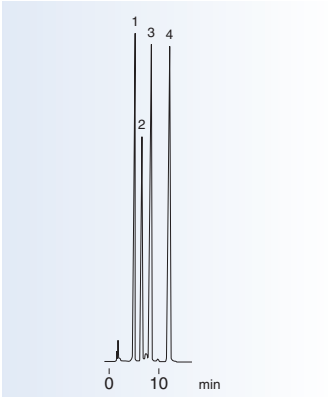
- High quality spherical porous silica gel
- Normal-phase separation due to surface silanol groups
- Two different pore sizes are available
- Useful for separation of compounds with similar structures

- Pore size : 60, 120 Å
- Usable pH range : 2.0~7.5
- USP L3

Standard normal-phase column

YMC-Pack SIL is suitable for separation of fat-soluble compounds using non-polar mobile phase and separation of positional isomers that are difficult to separate in reversed-phase mode. SIL-06 (pore size 60 Å) has greater adsorption properties than SIL (pore size 120 Å) due to its larger specific surface area, and is generally useful for separating natural products with a low molecular weight.

Application (G910523S)



Tocopherol isomers

1. α -Tocopherol
2. β -Tocopherol
3. γ -Tocopherol
4. σ -Tocopherol

Column	: YMC-Pack SIL (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: *n*-hexane/THF/acetic acid (97/3/0.25)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 295 nm

Analytical columns

YMC-Pack Diol-NP

- Silica gel bonded with dihydroxypropyl groups
- Normal-phase separation using non-polar solvents
- Useful for hydrophilic interaction chromatography (HILIC)
- Different separation characteristics from bare silica gel

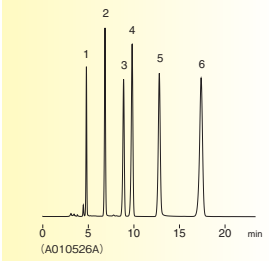
- Pore size : 60, 120 Å
- Usable pH range : 2.0~7.5
- USP L20

Different separation characteristics from bare silica gel

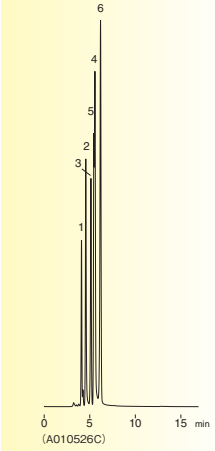
YMC-Pack Diol-NP shows retention behavior of normal-phase chromatography when it is used with low-polarity mobile phases. Hydroxyl groups on the surface of the stationary phase act as polar groups. YMC-Pack Diol-NP is as widely applicable to normal-phase separation as silica gel. It is also useful in cases where separation optimization is difficult to achieve using bare silica gel. In addition, it is available for HILIC mode separation by using organic/water mobile phases.

Separation characteristics of Diol-NP and SIL

YMC-Pack Diol-NP (5 µm, 120 Å)



YMC-Pack SIL (5 µm, 120 Å)



1. Phenol
2. Catechol
3. Resorcinol
4. Hydroquinone
5. Pyrogallol
6. Phloroglucinol

Column	: 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/ethanol (80/20)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 254 nm

Differences in separation characteristics of Diol-NP and SIL for separating phenols are shown on the left. Diol-NP shows longer retention and better separation than SIL in separating these compounds.

Analytical columns

YMC-Pack CN

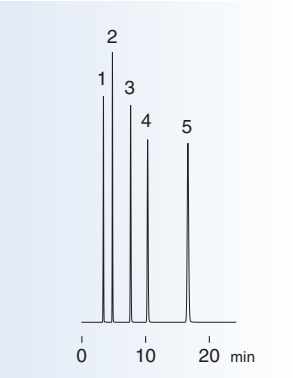
- Silica gel chemically bonded with cyanopropyl groups
- For both normal-phase and reversed-phase modes
- Different separation characteristics from bare silica gel
- Faster column equilibration than bare silica gel

■ Pore size : 120 Å
■ Usable pH range : 2.0~7.5
■ USP L10

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

YMC-Pack CN shows retention behavior of normal-phase chromatography when it is used with low-polarity mobile phases such as hexane. Since YMC-Pack CN stationary phase surface is less polar than bare silica gel, the retention times of analytes are generally shorter than with bare silica gel. YMC-Pack CN is therefore appropriate for samples having too strong retention when analyzed using bare silica gel. In contrast, YMC-Pack CN shows retention behavior of reversed-phase chromatography when it is used with high polarity mobile phase, such as methanol and water. Although separation modes are selectable according to the purpose of separation, it is preferable to use one column dedicated for one separation mode in consideration of the life of the column.

Application (A010619A)



Nitroaniline isomers

1. Toluene
2. Nitrobenzene
3. *o*-Nitroaniline
4. *m*-Nitroaniline
5. *p*-Nitroaniline

Column	: YMC-Pack CN (5 µm, 120 Å) 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/2-propanol (80/20)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 254 nm

Analytical columns

YMC-Pack PVA-Sil

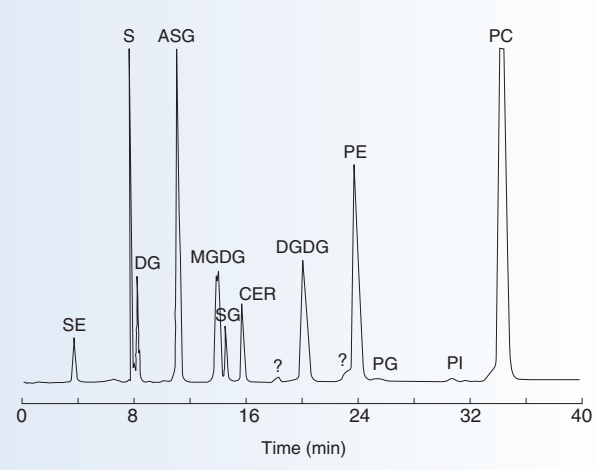
- Vinyl alcohol polymerised silica
- High stability and reproducibility

■ Pore size : 120 Å
■ Usable pH range : 2.0~9.5
(Recommended pH range : 2.0~7.5)
■ USP L24

Polyvinyl alcohol functionalized silica

YMC-Pack PVA-Sil, bonded with a monomolecular polymer coating of vinyl alcohol (PVA), completely covers both external and internal surfaces of the silica support, protecting it against aggressive, high pH buffers and solvents. The PVA polymer shell on PVA-Sil deactivates the silica support while providing a hydrophilic surface.

Application



Potato Lipids

Column	: YMC-Pack PVA-Sil (5 µm, 120 Å), 250 X 4.6 mmI.D.
Flow rate	: 1 to 2 mL/min
Eluent	: A) 2-methylpentane/methyl *tert*-butyl ether (98/2)
	B) 2-propanol/acetonitrile/$CHCl_3$/CH_3COOH (84/8/8/0.025)
	C) 2-propanol/water/triethylamine (50/50/0.2)
Gradient	: T_{min} : 0 5 15 40 40.1 45 50
	B% : 0 20 52 52 70 0 0
	C% : 0 0 4 14 0 0 0
Flow (mL/min)	: 1 1 1 1.4 1.4 2 2
Nebuliser temperature : 25°C, Evaporation temperature : 35°C	
Detector : ELSD	
Sample	
S : Sterols CER : Cerebrosides	
SE : Sterol Esters	SG : Steryl glycosides
MGDG : Monogalactosyldiacylglycerols	DGDG : Digalactosyldiacylglycerols
PE : Phosphatidylethanolamine	PG : Phosphatidyl glycerols
PC : Phosphatidylcholine	ASG : Acylsterylglycosides
PI : Phosphatidylinositol	DG : Diacylglycerol

Literature: W.W. Christie; R.A. Urwin, J. High Resol. Chromatogr., Vol. 18 (1995) P97 - 100

Analytical columns

YMC-Pack Polyamine Ⅱ

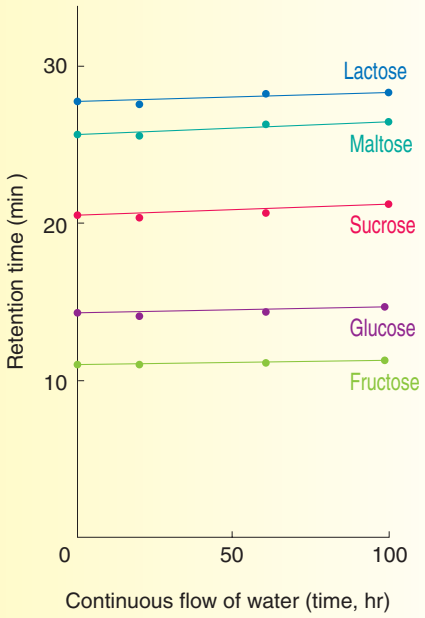
- Silica gel chemically bonded with polyamine
- The most suitable column for separation of sugars
- Useful for separation of hydrophilic compounds including vitamins
- Useful for separation of fat-soluble compounds using nonaqueous mobile phase
- Higher durability than conventional silica-based amino columns

■ Pore size : 120 Å
■ Usable pH range : 2.0~7.5

Amino column with improved durability

YMC-Pack Polyamine Ⅱ is a silica-based packing bonded with polyamine. It is particularly useful for separation of sugars. The column lifetime of YMC-Pack Polyamine Ⅱ in aqueous mobile phase is longer than conventional silica-based amino columns, and thus is applicable to separation of oligosaccharides using mobile phase with relatively higher water content. In addition, YMC-Pack Polyamine Ⅱ can be used to separate ionic compounds with a combination of normal-phase mode and weak anion exchange mode.

Excellent durability

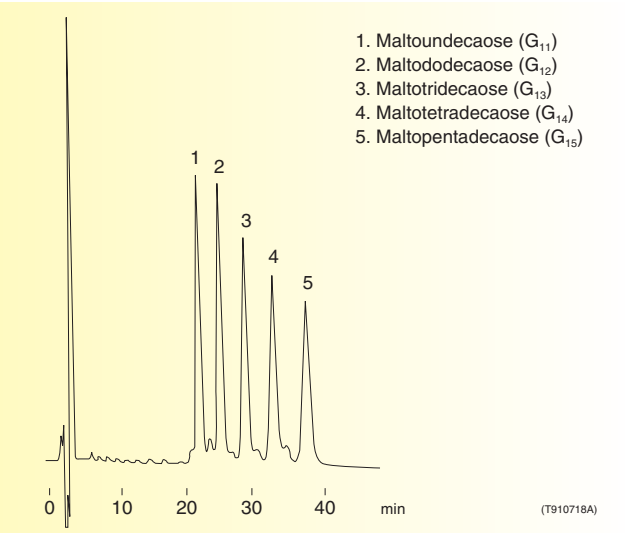


Even in a hard flow durability test using a mobile phase that consists only of water, the retention time of sugars changes little.

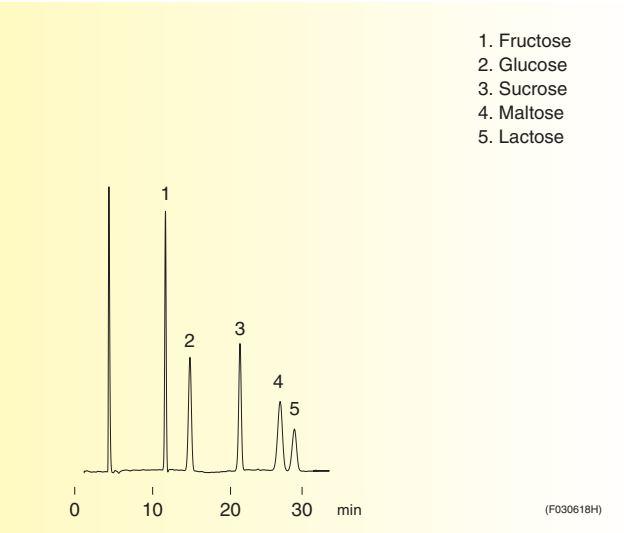
<Flow conditions>
Column : YMC-Pack Polyamine Ⅱ 250 X 4.6 mmI.D.
Eluent : water
Flow rate : 1.0 mL/min
Temperature : ambient
Time : 100 hours

<Analytical conditions>
Eluent : acetonitrile/water (75/25)
Flow rate : 1.0 mL/min
Temperature : 26°C
Detection : RI, 32 X 10^{-6} RIU/FS

The most suitable columns for separation of sugars, including oligosaccharides

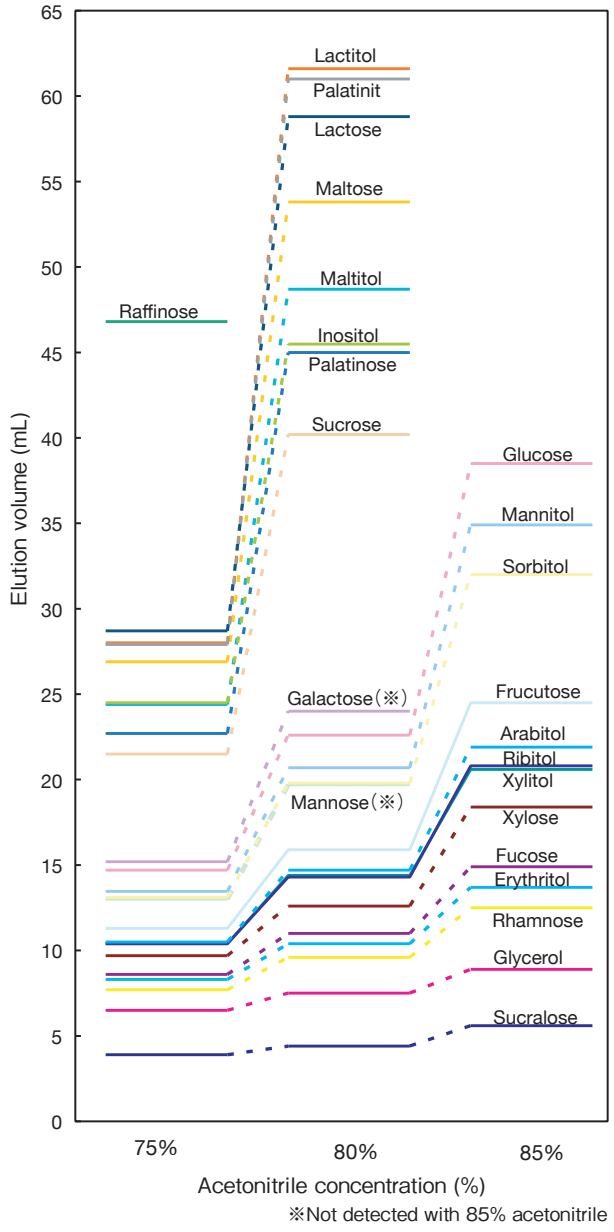


Column : YMC-Pack Polyamine Ⅱ 250 X 4.6 mmI.D.
Eluent : acetonitrile/water (55/45)
Flow rate : 1.0 mL/min
Temperature : 26°C
Detection : RI, 32 X 10^{-6} RIU/FS



Column : YMC-Pack Polyamine Ⅱ 250 X 4.6 mmI.D.
Eluent : acetonitrile/water (75/25)
Flow rate : 1.0 mL/min
Temperature : 25°C
Detection : RI, 32 X 10^{-6} RIU/FS

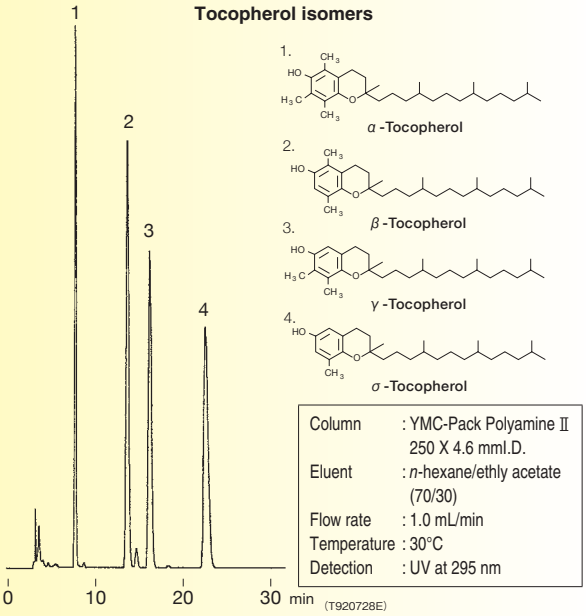
Elution volume of sugars and sugar alcohols



※Not detected with 85% acetonitrile

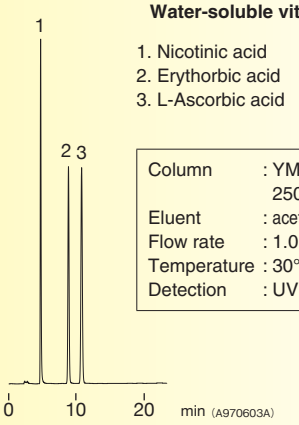
For normal-phase separation

Tocopherol isomers



Column	: YMC-Pack Polyamine Ⅱ 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/ethly acetate (70/30)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 295 nm

Water-soluble vitamin



1. Nicotinic acid
2. Erythorbic acid
3. L-Ascorbic acid

Column	: YMC-Pack Polyamine Ⅱ 250 X 4.6 mmI.D.
Eluent	: acetonitrile/50 mM $NH_4H_2PO_4$ (70/30)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 250 nm

YMC-Pack Polyamine Ⅱ is applicable for separation of fat-soluble vitamins and water-soluble vitamins as a normal-phase column that can be used with water or buffer and various organic solvents.

Analytical columns

YMC-Pack NH_2

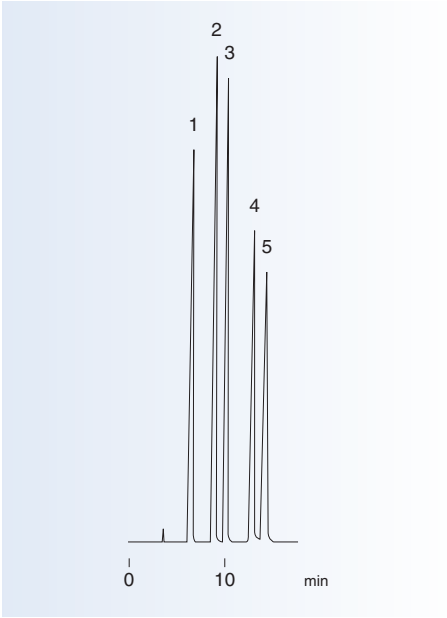
- Silica gel chemically bonded with aminopropyl groups
- Useful for separation of sugars
- Enables normal-phase mode separation using aqueous or nonaqueous mobile phase

- Pore size : 120 Å
- Usable pH range : 2.0~7.5
- USP L8

Normal-phase separation column utilizing amino groups

YMC-Pack NH_2 is a normal-phase separation column utilizing the polarity of primary amino groups. It is also applicable to separations utilizing weak anion exchange. YMC-Pack NH_2 is often used for separation of sugars.

Application (T920525D)



Nucleotides

1. 5'-CMP
2. 5'-AMP
3. 5'-UMP
4. 5'-IMP
5. 5'-GMP

Column	: YMC-Pack NH_2 (5 µm, 12 nm) 250 X 4.6 mmI.D.
Eluent	: 50 mM KH_2PO_4-H_3PO_4 (pH 3.5)
Flow rate	: 1.0 mL/min
Temperature	: 40°C
Detection	: UV at 260 nm

Analytical columns

YMC-Pack PA-G

- Silica gel chemically bonded with polyamine
- Useful for separation of acidic oligosaccharides

- Pore size : 120 Å
- Usable pH range : 4.0~7.5

Normal-phase separation column utilizing amino groups

YMC-Pack PA-G is useful for separation of acidic oligosaccharides. YMC-Pack PA-G is similar selectivity as YMC-Pack PA.

Alcyon SFC

- Available in chiral and achiral stationary phases
- Faster separation with high resolution
- Excellent durability
- Great reduction of solvent consumption

Alcyon SFC column is supercritical fluid chromatography (SFC) column, and available in chiral/achiral stationary phases. Alcyon SFC columns are specifically packed in a SFC compatible hardware and are tested under SFC conditions. The low viscosity of supercritical carbon dioxide allows for analytical separations 3-5 times faster than those for normal phase HPLC.

Specifications

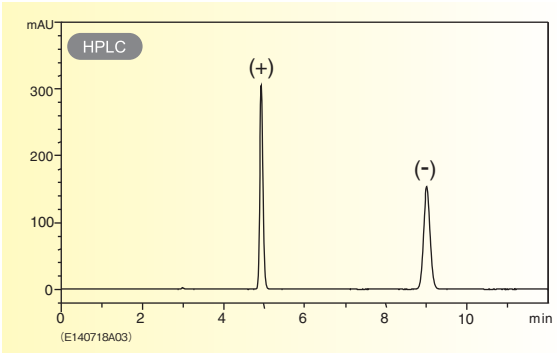
CHIRAL

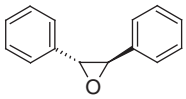
Product name	Alcyon SFC CSP Amylose-SA	Alcyon SFC CSP Cellulose-SB	Alcyon SFC CSP Cellulose-SC	Alcyon SFC CSP Amylose-C	Alcyon SFC CSP Cellulose-C
Type	Immobilized type			Coated type	
Chiral selector	Amylose tris(3,5-dimethylphenylcarbamate)	Cellulose tris(3,5-dimethylphenylcarbamate)	Cellulose tris(3,5-dichlorophenylcarbamate)	Amylose tris(3,5-dimethylphenylcarbamate)	Cellulose tris(3,5-dimethylphenylcarbamate)
Particle size	5 µm				
Pressure limit	Inner diameter of 2.1 and 4.6 mm: 30 MPa Inner diameter of 10 and 20 mm: 20 MPa				

ACHIRAL

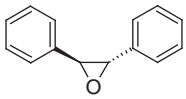
Product name	Alcyon SFC Triart C18	Alcyon SFC Triart Diol	Alcyon SFC Triart PFP	Alcyon SFC CN	Alcyon SFC SIL
Functional group	$-C_{18}H_{37}$	$-CH_2CHCH_2$ (OH OH)	$-(CH_2)_3-C_6H_2F_4$	$-(CH_2)_3-CN$	-OH
Base	Organic/inorganic hybrid silica			Silica gel	
Particle size	5 µm				
Pressure limit	Inner diameter of 2.1 and 4.6 mm: 30 MPa Inner diameter of 10 and 20 mm: 20 MPa				

Faster separation with high resolution



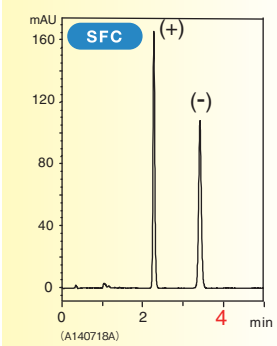


(+)- R,R-*trans*-Stilbene oxide



(-)- S,S-*trans*-Stilbene oxide

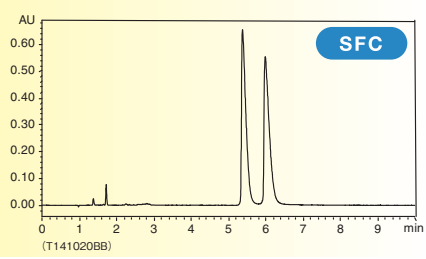
Column	: CHIRAL ART Amylose-C (5 µm) 250 X 4.6 mmI.D.
Eluent	: *n*-hexane/2-propanol (90/10)
Flow rate	: 1.0 mL/min
Temperature	: 25°C
Detection	: UV at 220 nm

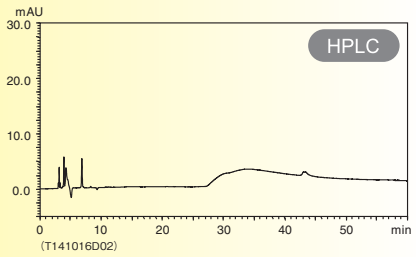


Column	: Alcyon SFC CSP Amylose-C (5 µm) 250 X 4.6 mmI.D.
Eluent	: CO_2/methanol (60/40)
Flow rate	: 3.0 mL/min
Temperature	: 40°C
Detection	: UV at 220 nm
Back pressure	: 17.2 MPa (2500 psi)

Faster chiral separation of trans-Stilbene oxide is achieved on supercritical fluid chromatography compared to HPLC separation. Lower viscosity and a bigger diffusion coefficient of supercritical fluid provide rapid separation of both chiral and achiral compounds.

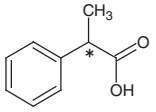
Excellent peak shape under mobile phase without the addition of acid





<SFC condition>
Column : Alcyon SFC CSP Cellulose-C (5 µm) 250 X 4.6 mmI.D.
Eluent : CO_2/methanol (98/2)
Flow rate : 3.0 mL/min
Temperature : 35°C
Detection : UV at 220 nm
Back pressure : 10.3 MPa (2000 psi)

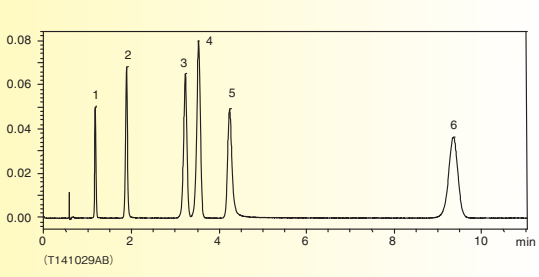
<HPLC condition>
Column : CHIRAL ART Cellulose-C (5 µm) 250 X 4.6 mmI.D.
Eluent : *n*-hexane/2-propanol (99/1)
Flow rate : 1.0 mL/min
Temperature : 25°C
Detection : UV at 220 nm

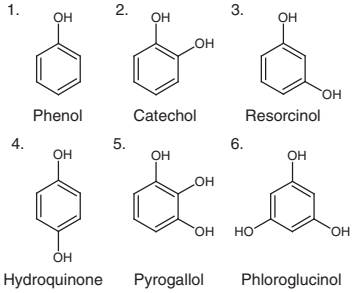


2-Phenylpropionic acid

Excellent peak shape of 2-Phenylpropionic acid is obtained on SFC chiral separation. Under HPLC conditions, peak shape is very broad with mobile phase containing no additive such as acid. On SFC, on the other hand, peak shapes are very good just with mixture of CO_2 and methanol. It is considered that supercritical carbon dioxide acts as acid.

Excellent peak shape on coordination compounds

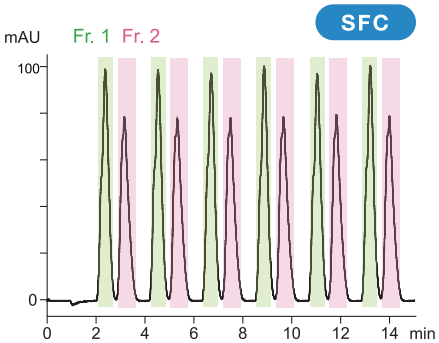




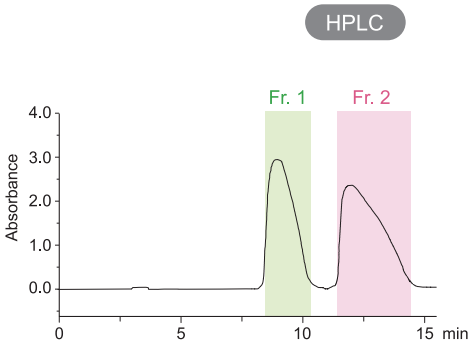
<SFC condition>
Column : Alcyon SFC Triart Diol (5 µm) 250 X 4.6 mmI.D.
Eluent : CO_2/methanol (88/12)
Flow rate : 3.0 mL/min
Temperature : 30°C
Detection : UV at 230 nm
Back pressure : 10.3 MPa (2000 psi)

Six phenols were analyzed with good separation using Alcyon SFC Triart Diol column.
Excellent peak shape is obtained even on coordination compounds such as Catechol and Pyrogallol.

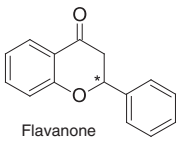
Cost effective purification using SFC



SFC	Fr. 1	Fr. 2
Enantiomeric purity	100%ee	99.8%ee
Yield	94.5%	95.6%



HPLC	Fr. 1	Fr. 2
Enantiomeric purity	100%ee	99.7%ee
Yield	95.7%	93.7%



Flavanone

<SFC condition>
Column : Alcyon SFC CSP Amylose-C (5 µm) 250 X 20 mmI.D.
Eluent : CO_2/ethanol (80/20)
Flow rate : 60 mL/min
Temperature : 30°C
Detection : UV at 280 nm
Back pressure : 15 MPa (2180 psi)
Injection : 1.5 mL (20 mg/mL)

<HPLC condition>
Column : CHIRAL ART Amylose-C (5 µm) 250 X 20 mmI.D.
Eluent : *n*-hexane/ethanol (90/10)
Flow rate : 20 mL/min
Temperature : ambient
Detection : UV at 220 nm
Injection : 3 mL (20 mg/mL)

Column : 250 X 20 mmI.D.		SFC		HPLC	
		Fr.1	Fr.2	Fr.1	Fr.2
Enantiomeric purity	(%ee)	>99.9	99.8	>99.9	99.7
Yield	(%)	94.5	95.6	95.7	93.7
Productivity*1	(mg product / hr)	340	344	172	169
Fractionated liquid volume	(L solvent / g product)	0.39	0.57	1.15	2.88
Solvent consumption	(L solvent / g product)	about 2		about 7	
Cost factor *2		0.4		1	

*1 Calculated based on injections of every 2.5 minutes on SFC, and of every 9.0 minutes on HPLC.
*2 Calculated based on costs of solvents/CO2 and waste disposal. Cost on SFC is calculated when the cost on HPLC is fixed as 1.

Alcyon SFC columns show excellent peak shape even on preparative separation at high loading condition. As a result, purification with high purity and high recovery will be achieved. Alcyon SFC columns offer purification with higher efficiency and lower solvent consumption.

Ordering Information -Columns-

YMC-Pack SIL

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	4.6	—	—	SL12S03-1046WT	SL12S03-1546WT	—	4.0	SL12S03-0104GC
	6.0	—	—	SL12S03-1006WT	SL12S03-1506WT	—		
120 Å 5 µm	4.6	—	—	SL12S05-1046WT	SL12S05-1546WT	SL12S05-2546WT	4.0	SL12S05-0104GC
	6.0	—	—	SL12S05-1006WT	SL12S05-1506WT	SL12S05-2506WT		
	10	—	—	—	SL12S05-1510WT	SL12S05-2510WT	10	SL12S05-0110CC

YMC-Pack SIL-06

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
60 Å 5 µm	4.6	—	—	SL06S05-1046WT	SL06S05-1546WT	SL06S05-2546WT	4.0	SL06S05-0104GC
	6.0	—	—	SL06S05-1006WT	SL06S05-1506WT	SL06S05-2506WT		
	10	—	—	—	SL06S05-1510WT	SL06S05-2510WT	10	SL06S05-0110CC

YMC-Pack Diol-NP

*Shipping solvent for Diol-NP is hexane/2-propanol (99.5/0.5). In case of using eluent including water, take care of miscibility.

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
Diol-60 60 Å 5 µm	3.0	—	—	—	DN06S05-1503WT	—	3.0	DN06S05-0103GC
	4.6	—	—	DN06S05-1046WT	DN06S05-1546WT	DN06S05-2546WT	4.0	DN06S05-0104GC
Diol-120 120 Å 5 µm	2.0	—	—	—	DN12S05-1502WT	—	2.1	DN12S05-01Q1GC
	3.0	—	—	—	DN12S05-1503WT	—	3.0	DN12S05-0103GC
	4.6	DN12S05-0546WT	—	DN12S05-1046WT	DN12S05-1546WT	DN12S05-2546WT	4.0	DN12S05-0104GC

YMC-Pack CN

*Shipping solvent for CN is methanol/water (60/40). Please take care of miscibility in normal-phase separation.

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

YMC-Pack PVA-Sil

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 5 µm	4.6	PV12S05-0546WT	—	PV12S05-1046WT	PV12S05-1546WT	PV12S05-2546WT	4.0	PV12S05-0104GC

YMC-Pack Polyamine Ⅱ

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 5 µm	4.6	—	—	—	PB12S05-1546WT	PB12S05-2546WT	4.0	PB12S05-0104GC
	6.0	—	—	—	PB12S05-1506WT	PB12S05-2506WT		
	10	—	—	—	—	PB12S05-2510WT	10	PB12S05-0110CC

YMC-Pack NH2

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 5 µm	4.6	—	—	NH12S05-1046WT	NH12S05-1546WT	NH12S05-2546WT	4.0	NH12S05-0104GC
	6.0	—	—	NH12S05-1006WT	NH12S05-1506WT	NH12S05-2506WT		
	10	—	—	—	NH12S05-1510WT	NH12S05-2510WT	10	NH12S05-0110CC

YMC-Pack PA-G

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 5 µm	4.6	—	—	—	PG12S05-1546WT	PG12S05-2546WT	4.0	PG12S05-0104GC

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

※ See P.123 for preparative columns other than those listed above.

Ordering Information -Columns-

Alcyon SFC Columns : CHIRAL

Particle size (µm)	Column size inner diameter X length (mm)	Product number		
		CSP Amylose-SA	CSP Cellulose-SB	CSP Cellulose-SC
5	2.1 X 150	KSA99S05-15Q1WTS	KSB99S05-15Q1WTS	KSC99S05-15Q1WTS
	4.6 X 150	KSA99S05-1546WTS	KSB99S05-1546WTS	KSC99S05-1546WTS
	4.6 X 250	KSA99S05-2546WTS	KSB99S05-2546WTS	KSC99S05-2546WTS
	10 X 250	KSA99S05-2510WTS	KSB99S05-2510WTS	KSC99S05-2510WTS
	20 X 250	KSA99S05-2520WTS	KSB99S05-2520WTS	KSC99S05-2520WTS

Particle size (µm)	Column size inner diameter X length (mm)	Product number	
		CSP Amylose-C	CSP Cellulose-C
5	2.1 X 150	KAN99S05-15Q1WTS	KCN99S05-15Q1WTS
	4.6 X 150	KAN99S05-1546WTS	KCN99S05-1546WTS
	4.6 X 250	KAN99S05-2546WTS	KCN99S05-2546WTS
	10 X 250	KAN99S05-2510WTS	KCN99S05-2510WTS
	20 X 250	KAN99S05-2520WTS	KCN99S05-2520WTS

Alcyon SFC Columns : ACHIRAL

Particle size (µm)	Column size inner diameter X length (mm)	Product number		
		Triart C18	Triart Diol	Triart PFP
5	2.1 X 150	TA12S05-15Q1WTS	TDN12S05-15Q1WTS	TPF12S05-15Q1WTS
	4.6 X 150	TA12S05-1546WTS	TDN12S05-1546WTS	TPF12S05-1546WTS
	4.6 X 250	TA12S05-2546WTS	TDN12S05-2546WTS	TPF12S05-2546WTS

Particle size (µm)	Column size inner diameter X length (mm)	Product number	
		CN	SIL
5	2.1 X 150	CN12S05-15Q1WTS	SL12S05-15Q1WTS
	4.6 X 150	CN12S05-1546WTS	SL12S05-1546WTS
	4.6 X 250	CN12S05-2546WTS	SL12S05-2546WTS
	10 X 250	CN12S05-2510WTS	SL12S05-2510WTS
	20 X 250	CN12S05-2520WTS	SL12S05-2520WTS

Ordering Information -Columns-

YMC-Pack TMS

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

YMC-Pack Ph

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

YMC-Pack CN

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

YMC-Pack PROTEIN-RP

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

YMCbasic

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

YMC Carotenoid

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

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

※ See P.122, 123 for preparative columns other than those listed above.

09

Preparative Columns

Preparative packed columns

Overview of optimization methods for isolation/purification

An overview of the methods for selecting optimum conditions for isolation/purification and conducting efficient isolation, as well as points to check are given below.

Selection of a preparative column: General comments

1) Selecting the separation mode of chromatography

When more than one mode is available for the separation of samples, the following points should be considered for the selection of an appropriate separation mode:

(1) Resolution : Selectivity of the packing material for the compound of interest
(2) Load : Capacity of the packing material
(3) Speed : Isolation time

2) Column size

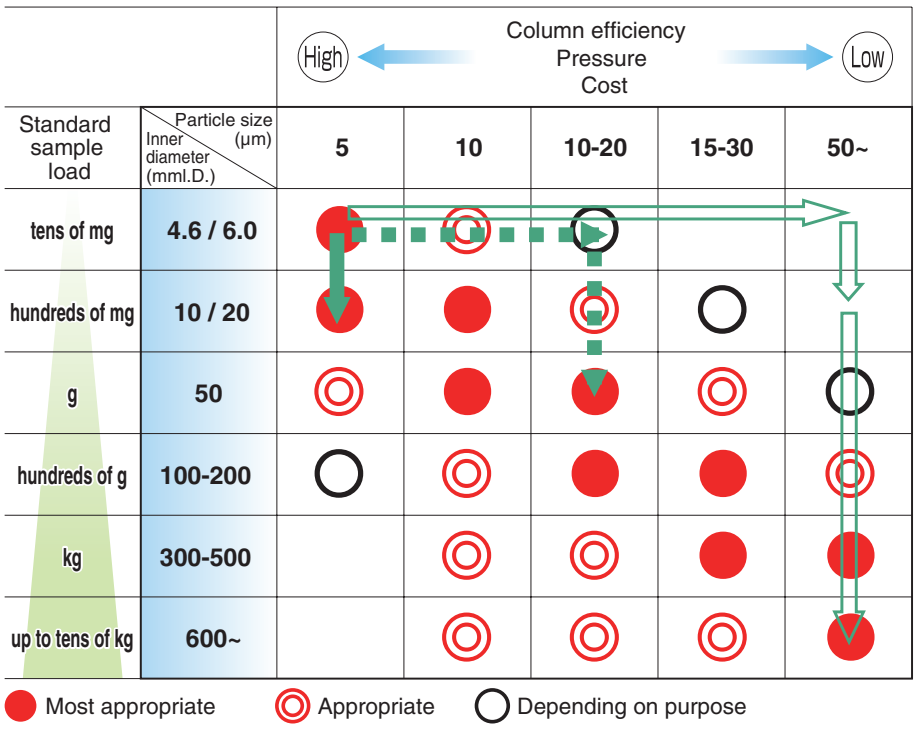
The table shown in below provides a rough guide for selection of column inner diameters and packing material particle sizes.

(1) Column inner diameter : Sample load is proportional to the column cross-sectional area. It is necessary to select a column inner diameter suitable for the sample load.

(2) Packing material particle size : Smaller particle gives higher column efficiency, however, costs higher and increases column pressure. In addition, the equipment used needs to be resistant to the pressure. When the target component and the nearest peak are very near and the highest resolution is needed, packing materials with small particle size are useful. In contrast, larger particle sizes result in lower column efficiency, but result in lower prices and lower column pressure.

(3) Column length : Longer column gives higher resolution and higher sample load, but the column pressure becomes higher and the separation takes longer.

General guidance for selection of preparative columns



The analytical conditions established using the analytical column are scaled up to the intended preparative scale in the direction shown by the arrow

Steps for performing a preparative separation

1) Consider screening packing materials that can be scaled for preparative isolations. If you suspect that larger quantities of the compound needing purification will be required in the future, consider performing your analytical scale investigations on a packing material that is available in preparative particle sizes (10 micron and larger). As the requirements for the purified product become greater at later stages of the project, you will have the option to isolate larger quantities of material on larger particle sizes in larger columns on the same packing chemistry. This is an important consideration if the compound should be required in much larger quantities as the project matures.
2) Perform selectivity studies on analytical scale columns (4.6 mm I.D. and smaller) on a variety of packing materials under several sets of conditions. Automated software programs may be particularly helpful in predicting the most desirable separation modes and in helping to choose the best chromatographic conditions for your separations in the shortest amount of time.
3) Once the best resolution is obtained, perform loading studies on the analytical scale column. Evaluate product purity at variable loadings and select the maximum load allowed for a desired product purity.
4) Select the size of preparative column that will be needed by scaling up the separation based on the loading obtained on the analytical column. If possible, use the same particle size and column length to achieve predictable preparative results.
Scale up the loading of the preparative column based on the ratio of the cross-sectional areas of the preparative and anayltical columns.
5) Perform the preparative separation and evaluate the yield and purity.

Relationship between column inner diameter and flow rate/sample load

Column inner diameter (mmI.D.)	4.6	10	20	50	100	200	500	1000
Cross-sectional area	1	4.7	19	118	473	1,890	11,800	47,300
Flow rate (mL /min)	0.5	2.4	9.5	60	235	950	6,000 (6 L)	24,000 (24 L)
	1	4.7	19	120	470	1,900	12,000 (12 L)	47,000 (47 L)
Sample loading (mg)	5	25	100	600	2,500	10,000	60,000 (60 g)	240,000 (240 g)

Flow rate equation

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

F : Analytical column flow rate (mL/min)
F' : Preparative column flow rate (mL/min)
Dc : Analytical column inner diameter (mm)
Dc' : Preparative column inner diameter (mm)
∗Use the same equation to calculate the sample load.

When the same packing material and column length are used the preparative flow rate and sample load are proportional to the column cross-sectional area. Additionally, the resolution and column pressure experienced on the preparative column would be approximately the same as that experienced for the analytical scale separation.

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

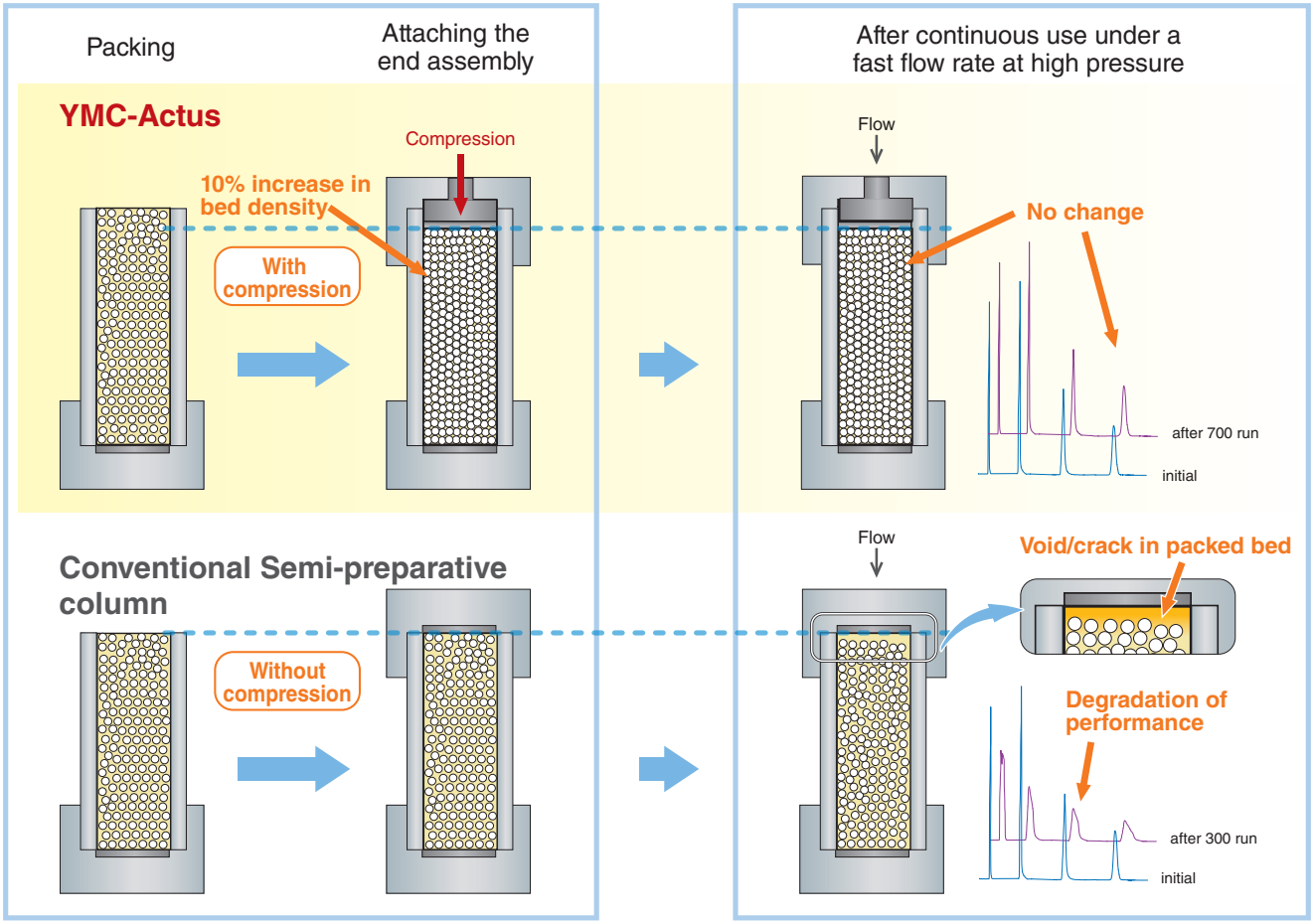
YMC-Actus series are semi-preparative HPLC columns that have excellent column durability and efficiency by applying axial compression technology. YMC-Actus series columns show high durability under high flow rate or steep gradient conditions and desirable for milligram scale preparative HPLC of various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

Specification

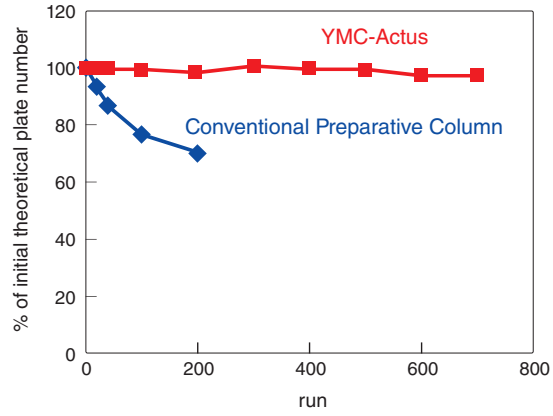
Packing material		Pore size (Å)	Particle size (µm)	C%	Usable pH range	Characteristics
Triart series	Triart C18	120	5	20	1.0~12.0	● Superior peak shape ● Usable over wide range of pH and temperature ● Usable with 100% aqueous mobile phase
	Triart C18 ExRS	80	5	25		● Excellent selectivity of isomers and structural analogs ● Superior chemical durability
	Triart C8	120	5	17		● Compete with the versatility of C18 ● Usable over wide range of pH and temperature ● Ideal for separations of isomers or structural analogs
	Triart Phenyl	120	5	17	1.0~10.0	● Unique selectivity due to π-π interaction ● Excellent resolution without adsorption and tailing
	Triart PFP	120	5	15	1.0~8.0	● Alternative selectivity to C18/C8 due to unique polar interaction ● Superior planar cognitive ability / steric selectivity ● Ideal for separations of compounds or isomers
Pro series	*Pro* C18	120	5	16	2.0~8.0	● High performance ODS packing material
	Hydrosphere C18	120	5	12		● Can be used with 100% water mobile phase ● Superior separation for hydrophilic compounds
	Pro C18 RS	80	5	22	1.0~10.0	● High carbon ODS packing material, high durability
	Pro C8	120	5	10	2.0~7.5	● Processed with advanced endcapping technology ● Superior separation of basic compounds
YMC-Pack series	ODS-A	120	5	17	2.0~7.5	● Standard ODS from analytical to preparative
	ODS-AQ	120	5	14		● Good separation for hydrophilic compounds

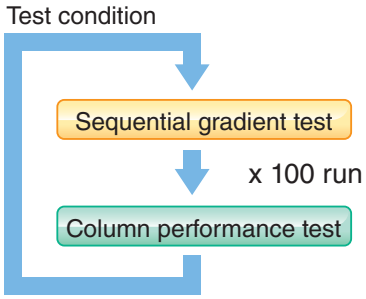
Great durability achieved by applying axial compression technology

[Excellent durability provided by improved bed density]



Column durability study





Sequential gradient test
(high-speed and high-pressure)
Column size : 5 µm, 50 X 20 mmI.D. or 50 X 19 mmI.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 : ~17 MPa

Column performance test
Column size : 5 µm, 50 X 20 mmI.D. X or 50 X 19 mmI.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

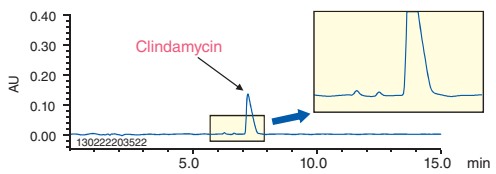
YMC-Triart C18 5 µm, 150 X 4.6 mmI.D.

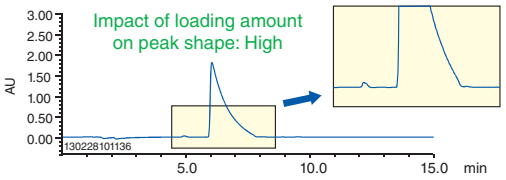
0.01 mg Loading (10 µL injection, 1.0 mg/mL in water)

0.5 mg Loading (10 µL injection, 50 mg/mL in water)

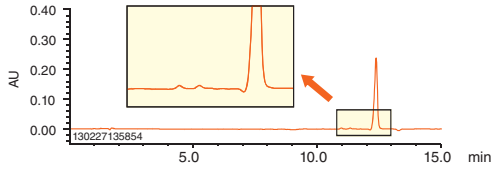
Increasing loading amount

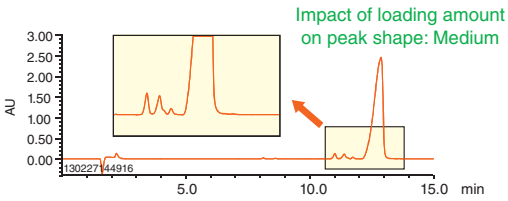
pH 2.7



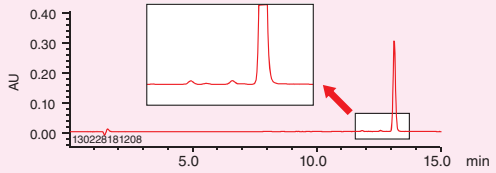


pH 6.7

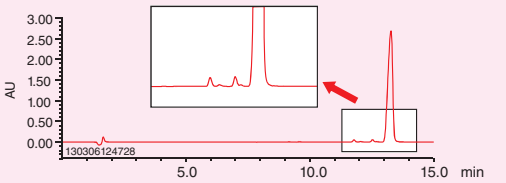




pH 9.8



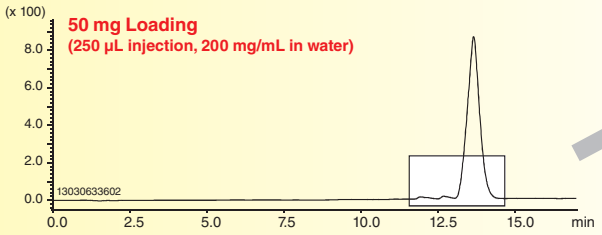
Impact of loading amount on peak shape: Low ····▸ Effective for purification at high loading

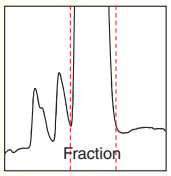


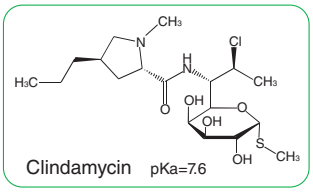
Purification at pH 9.8

YMC-Actus Triart C18 5 µm, 150 X 20 mmI.D.

50 mg Loading
(250 µL injection, 200 mg/mL in water)

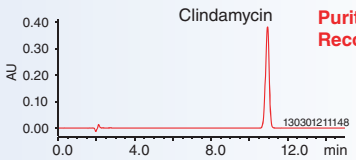






Eluent	: A) 20 mM HCOOH for pH 2.7 20 mM $HCOONH_4$ for pH 6.7 20 mM $HCOONH_4$-NH_3 for pH 9.8 B) acetonitrile 10-75%B (0-15 min)
Flow rate	: 1.0 mL/min for 150 X 4.6 mmI.D. 18.9 mL/min for 150 X 20 mmI.D.
Temperature	: 25°C for 150 X 4.6 mmI.D. ambient for 150 X 20 mmI.D.
Detection	: UV at 210 nm
Pressure	: 7.0 MPa for 150 X 4.6 mmI.D. 8.4 MPa for 150 X 20 mmI.D.

Fraction analysis



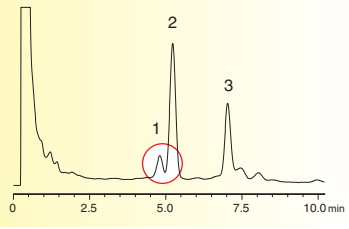
Column	: YMC-Triart C18 5 µm 150 X 4.6 mmI.D.
Eluent	: 50 mM KH_2PO_4 (pH 7.5 adjusted by 8 M KOH)/ acetonitrile (55/45)
Flow rate	: 1.0 mL/min
Temperature	: 25°C
Detection	: UV at 210 nm
Injection	: 20 µL

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.

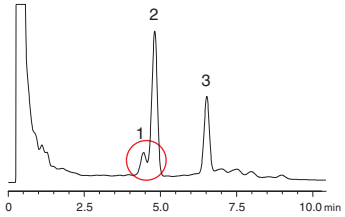
Purification of hydrophobic compounds with similar structure –Capsaicinoids in red pepper–

Analysis

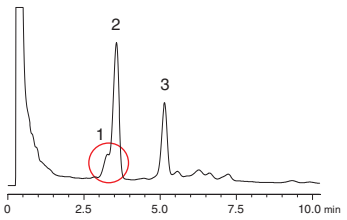
YMC-Pack *Pro* C18 RS 5 µm
50 X 4.6 mmI.D.
2.0 mL/min, 20 µL injection



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

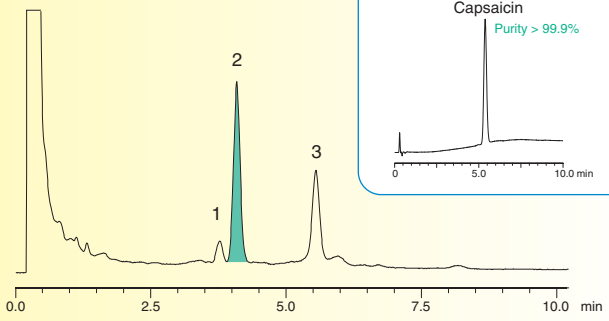


Brand I8 5 µm,
50 X 4.6 mmI.D.
2.0 mL/min, 20 µL injection



Purification

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

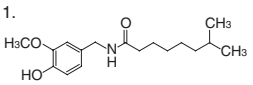


After purification: YMC-Pack *Pro* C18 RS 5 µm, 50 X 4.6 mmI.D.

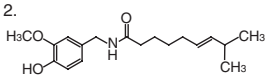
Capsaicin

Purity > 99.9%

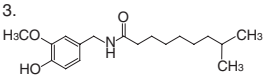
1. Nordihydrocapsaicin



2. Capsaicin



3. Dihydrocapsaicin



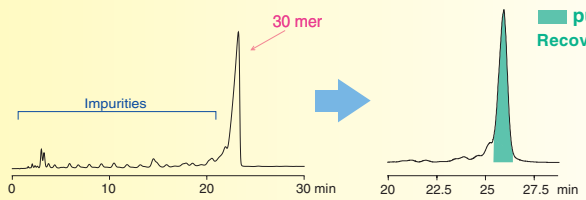
Eluent	: A) methanol/water/TFA (50/50/0.1) B) methanol/TFA (100/0.1) 10-30%B (0-5 min), 30%B (5-10 min)
Temperature	: 25°C for 50 X 4.6 mmI.D. ambient for 50 X 20 mmI.D.
Detection	: UV at 280 nm
Sample	: methanol extract of a commercial cayenne pepper (1 g cayenne pepper/3 mL)

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–

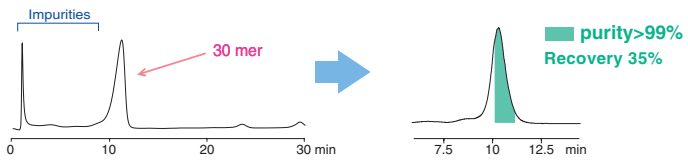
Analysis **Hydrosphere C18 5 µm,**
50 X 4.6 mmI.D.
1.0 mL/min, 5 µL injection

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



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

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



Crude synthetic 30 mer oligonucleotide
5'-CCGCTCGAGCTAAAAAAAGCCTGTGTTACC-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 Triart C18 (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	TA12S05-0520WX	—	TA12S05-1020WX	TA12S05-1520WX	TA12S05-2520WX	TA12S05-0120CC
	30	TA12S05-0530WX	TA12S05-L530WX	TA12S05-1030WX	TA12S05-1530WX	TA12S05-2530WX	TA12S05-0130CC

YMC-Actus Triart C18 ExRS (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
80 Å 5 µm	20	TAR08S05-0520WX	—	TAR08S05-1020WX	TAR08S05-1520WX	TAR08S05-2520WX	TAR08S05-0120CC
	30	TAR08S05-0530WX	TAR08S05-L530WX	TAR08S05-1030WX	TAR08S05-1530WX	TAR08S05-2530WX	TAR08S05-0130CC

YMC-Actus Triart C8 (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	TO12S05-0520WX	—	TO12S05-1020WX	TO12S05-1520WX	TO12S05-2520WX	TO12S05-0120CC
	30	TO12S05-0530WX	TO12S05-L530WX	TO12S05-1030WX	TO12S05-1530WX	TO12S05-2530WX	TO12S05-0130CC

YMC-Actus Triart Phenyl (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	TPH12S05-0520WX	—	TPH12S05-1020WX	TPH12S05-1520WX	TPH12S05-2520WX	TPH12S05-0120CC
	30	TPH12S05-0530WX	TPH12S05-L530WX	TPH12S05-1030WX	TPH12S05-1530WX	TPH12S05-2530WX	TPH12S05-0130CC

YMC-Actus Triart PFP (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	TPF12S05-0520WX	—	TPF12S05-1020WX	TPF12S05-1520WX	TPF12S05-2520WX	TPF12S05-0120CC
	30	TPF12S05-0530WX	TPF12S05-L530WX	TPF12S05-1030WX	TPF12S05-1530WX	TPF12S05-2530WX	TPF12S05-0130CC

YMC-Actus *Pro* C18 (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	AS12S05-0520WX	—	AS12S05-1020WX	—	—	AS12S05-0120CC
	30	AS12S05-0530WX	AS12S05-L530WX	AS12S05-1030WX	—	—	AS12S05-0130CC

YMC-Actus Hydrosphere C18 (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	HS12S05-0520WX	—	HS12S05-1020WX	—	—	HS12S05-0120CC
	30	HS12S05-0530WX	HS12S05-L530WX	HS12S05-1030WX	—	—	HS12S05-0130CC

YMC-Actus *Pro* C18 RS (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
80 Å 5 µm	20	RS08S05-0520WX	—	RS08S05-1020WX	—	—	RS08S05-0120CC
	30	RS08S05-0530WX	RS08S05-L530WX	RS08S05-1030WX	—	—	RS08S05-0130CC

YMC-Actus ODS-A (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	AA12S05-0520WX	—	AA12S05-1020WX	—	—	AA12S05-0120CC
	30	AA12S05-0530WX	AA12S05-L530WX	AA12S05-1030WX	—	—	AA12S05-0130CC

YMC-Actus ODS-AQ (Pressure limit : 30 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges
		50	75	100	150	250	10 mm length
120 Å 5 µm	20	AQ12S05-0520WX	—	AQ12S05-1020WX	—	—	AQ12S05-0120CC
	30	AQ12S05-0530WX	AQ12S05-L530WX	AQ12S05-1030WX	—	—	AQ12S05-0130CC

* Guard cartridge holder required, part no. XPCHSPW2 for 20 mmI.D. and XPCHSPW3 for 30 mmI.D.

Ordering Information -Columns-

YMC-Pack *Pro* C18 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	AS12S05-1520WT	AS12S05-2520WT	AS12S05-0520WTG
	30	—	AS12S05-1530WT	—	AS12S05-0530WTG

Hydrosphere C18 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	HS12S05-1520WT	HS12S05-2520WT	HS12S05-0520WTG

YMC-Pack *Pro* C18 RS (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
80 Å 5 µm	20	—	RS08S05-1520WT	RS08S05-2520WT	RS08S05-0520WTG

YMC-Pack ODS-A (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	AA12S05-1520WT	AA12S05-2520WT	AA12S05-0520WTG
	30	—	AA12S05-1530WT	AA12S05-2530WT	AA12S05-0530WTG
	50	—	—	AA12S05-2552AR	AA12S05-0552ARG
200Å 5 µm	20	—	AA20S05-1520WT	AA20S05-2520WT	AA20S05-0520WTG
	30	—	—	AA20S05-2530WT	AA20S05-0530WTG
	50	—	—	AA20S05-2552AR	AA20S05-0552ARG
300Å 5 µm	20	—	AA30S05-1520WT	AA30S05-2520WT	AA30S05-0520WTG
	30	—	AA30S05-1530WT	AA30S05-2530WT	AA30S05-0530WTG
	50	—	—-	AA30S05-2552AR	AA30S05-0552ARG

YMC-Pack ODS-AQ (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	AQ12S05-1520WT	AQ12S05-2520WT	AQ12S05-0520WTG
	30	—	AQ12S05-1530WT	AQ12S05-2530WT	AQ12S05-0530WTG
	50	—	—	AQ12S05-2552AR	AQ12S05-0552ARG
200Å 5 µm	20	—	AQ20S05-1520WT	AQ20S05-2520WT	AQ20S05-0520WTG
	30	—	—	AQ20S05-2530WT	AQ20S05-0530WTG
	50	—	—	AQ20S05-2552AR	AQ20S05-0552ARG

YMC-Pack ODS-AM (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	AM12S05-1020WT	AM12S05-1520WT	AM12S05-2520WT	AM12S05-0520WTG
	30	AM12S05-1030WT	AM12S05-1530WT	AM12S05-2530WT	AM12S05-0530WTG
	50	—	—	AM12S05-2552AR	AM12S05-0552ARG

YMC-Pack ODS-AL (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	AL12S05-1020WT	AL12S05-1520WT	AL12S05-2520WT	AL12S05-0520WTG
	30	AL12S05-1030WT	AL12S05-1530WT	AL12S05-2530WT	AL12S05-0530WTG
	50	—	—	AL12S05-2552AR	AL12S05-0552ARG

J'sphere ODS-H80, ODS-M80, ODS-L80 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
ODS-H80 80 Å 4 µm	20	—	JH08S05-1520WT	JH08S05-2520WT	JH08S05-0520WTG
ODS-M80 80 Å 4 µm	20	—	JM08S05-1520WT	JM08S05-2520WT	JM08S05-0520WTG
ODS-L80 80 Å 4 µm	20	—	JL08S05-1520WT	JL08S05-2520WT	JL08S05-0520WTG

Ordering Information -Columns-

YMC-Pack *Pro* C8 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	—	OS12S05-2520WT	OS12S05-0520WTG

YMC-Pack *Pro* C4 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	—	BS12S05-2520WT	BS12S05-0520WTG

YMC-Pack C_8 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	OC12S05-1020WT	OC12S05-1520WT	OC12S05-2520WT	OC12S05-0520WTG
	30	OC12S05-1030WT	OC12S05-1530WT	OC12S05-2530WT	OC12S05-0530WTG
	50	—	—	OC12S05-2552AR	OC12S05-0552ARG
200Å 5 µm	20	—	OC20S05-1520WT	OC20S05-2520WT	OC20S05-0520WTG
	30	—	—	OC20S05-2530WT	OC20S05-0530WTG
	50	—	—	OC20S05-2552AR	OC20S05-0552ARG
300Å 5 µm	20	—	OC30S05-1520WT	OC30S05-2520WT	OC30S05-0520WTG
	30	—	—	OC30S05-2530WT	OC30S05-0530WTG
	50	—	—	OC30S05-2552AR	OC30S05-0552ARG

YMC-Pack C_4 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	BU12S05-1020WT	BU12S05-1520WT	BU12S05-2520WT	BU12S05-0520WTG
	30	BU12S05-1030WT	BU12S05-1530WT	BU12S05-2530WT	BU12S05-0530WTG
	50	—	—	BU12S05-2552AR	BU12S05-0552ARG
200Å 5 µm	20	—	BU20S05-1520WT	BU20S05-2520WT	BU20S05-0520WTG
	30	—	—	BU20S05-2530WT	BU20S05-0530WTG
	50	—	—	BU20S05-2552AR	BU20S05-0552ARG
300Å 5 µm	20	—	BU30S05-1520WT	BU30S05-2520WT	BU30S05-0520WTG
	30	—	—	BU30S05-2530WT	BU30S05-0530WTG
	50	—	—	BU30S05-2552AR	BU30S05-0552ARG

YMC-Pack TMS (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	TM12S05-1020WT	TM12S05-1520WT	TM12S05-2520WT	TM12S05-0520WTG
	30	TM12S05-1030WT	TM12S05-1530WT	TM12S05-2530WT	TM12S05-0530WTG
	50	—	—	TM12S05-2552AR	TM12S05-0552ARG

YMC-Pack Ph (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	PH12S05-1020WT	PH12S05-1520WT	PH12S05-2520WT	PH12S05-0520WTG
	30	PH12S05-1030WT	PH12S05-1530WT	PH12S05-2530WT	PH12S05-0530WTG
	50	—	—	PH12S05-2552AR	PH12S05-0552ARG

YMC-Pack CN (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	CN12S05-1020WT	CN12S05-1520WT	CN12S05-2520WT	CN12S05-0520WTG
	30	CN12S05-1030WT	CN12S05-1530WT	CN12S05-2530WT	CN12S05-0530WTG
	50	—	—	CN12S05-2552AR	CN12S05-0552ARG
300Å 5 µm	20	—	CN30S05-1520WT	CN30S05-2520WT	CN30S05-0520WTG
	30	—	—	CN30S05-2530WT	CN30S05-0530WTG
	50	—	—	CN30S05-2552AR	CN30S05-0552ARG

Ordering Information -Columns-

YMC-Pack PROTEIN-RP (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
5 µm	20	—	PR99S05-1520WT	PR99S05-2520WT	PR99S05-0520WTG

YMC Carotenoid (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
5 µm	20	—	CT99S05-1520WT	CT99S05-2520WT	—

YMC-Pack SIL (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	SL12S05-1020WT	SL12S05-1520WT	SL12S05-2520WT	SL12S05-0520WTG
	30	SL12S05-1030WT	SL12S05-1530WT	SL12S05-2530WT	SL12S05-0530WTG
	50	—	—	SL12S05-2552AR	SL12S05-0552ARG

YMC-Pack SIL-06 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
60 Å 5 µm	20	SL06S05-1020WT	SL06S05-1520WT	SL06S05-2520WT	SL06S05-0520WTG
	30	SL06S05-1030WT	SL06S05-1530WT	SL06S05-2530WT	SL06S05-0530WTG
	50	—	—	SL06S05-2552AR	SL06S05-0552ARG

YMC-Pack Diol-NP (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
Diol-60 60 Å 5 µm	20	—	DN06S05-1520WT	DN06S05-2520WT	—
Diol-120 120 Å 5 µm	20	—	DN12S05-1520WT	DN12S05-2520WT	—

YMC-Pack Polyamine Ⅱ (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	—	PB12S05-2520WT	PB12S05-0520WTG

YMC-Pack NH_2 (Pressure limit : 10 MPa)

Phase dimension	Column I.D. (mm)	Column length (mm)			Guard column
		100	150	250	50 mm length
120 Å 5 µm	20	—	NH12S05-1520WT	NH12S05-2520WT	NH12S05-0520WTG
	30	—	—	NH12S05-2530WT	NH12S05-0530WTG

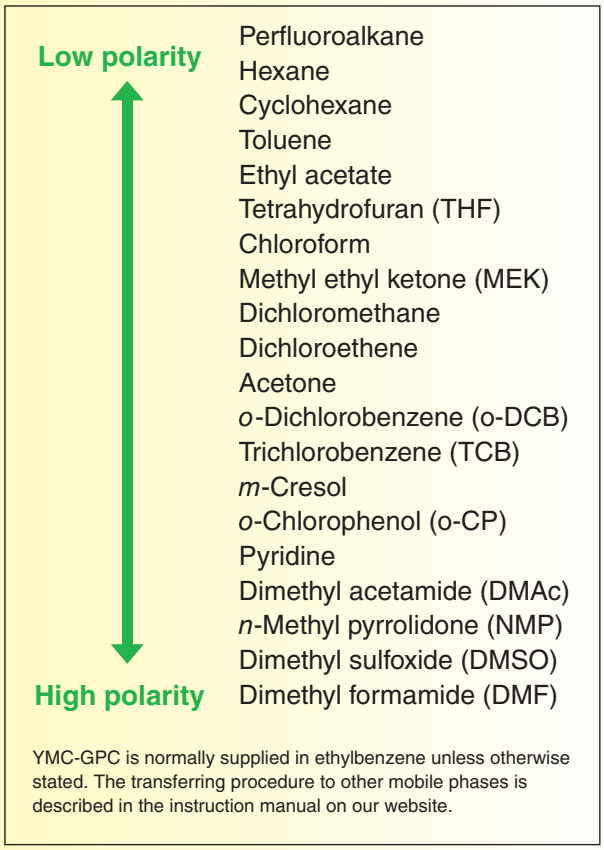
YMC-GPC series

- 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.

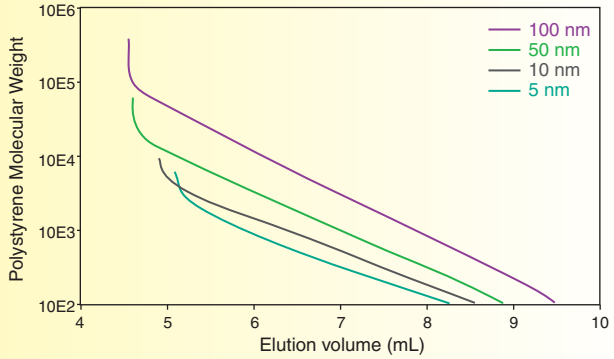
Compatible with various organic solvents



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.

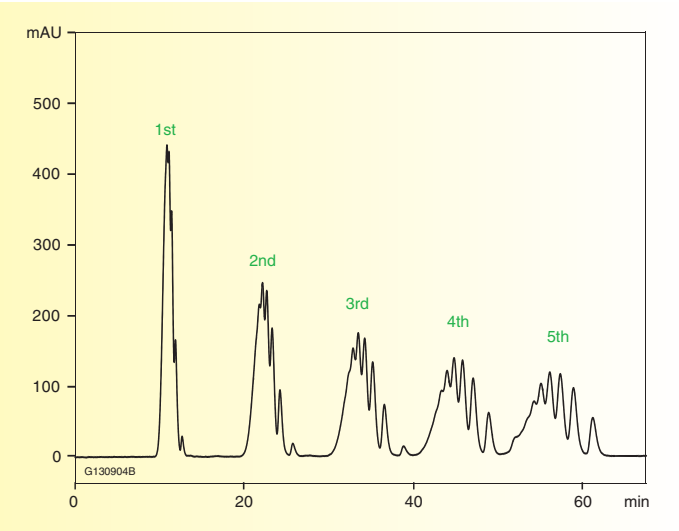
Calibration curves



Column	: 300 X 7.5 mmI.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 µm, 100 Å) 600 X 20 mmI.D.
Eluent	: chloroform
Flow rate	: 10 mL/min
Detection	: UV at 254 nm
Sample	: polystyrene oligomers (50 mg/mL)
Injection	: 1.4 mL
System	: LC-Forte/R (※)

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.

(※) See p.166, 167 for information of LC-Forte/R.

Ordering Information

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	20 X 600	GP05S10-6020PT
YMC-GPC T2000-40	10 µm		40 X 600	GP05S10-6040WT
YMC-GPC T4000	100 Å	~ 4,000	20 X 600	GP10S10-6020PT
YMC-GPC T4000-40	10 µm		40 X 600	GP10S10-6040WT
YMC-GPC T30000	500 Å	500 ~ 30,000	20 X 600	GP50S10-6020PT
YMC-GPC T30000-40	10 µm		40 X 600	GP50S10-6040WT
YMC-GPC T60000	1000 Å	500 ~ 60,000	20 X 600	GPA0S10-6020PT
YMC-GPC T60000-40	10 µm		40 X 600	GPA0S10-6040WT
YMC-GPC T10M	MIX	500 ~ 10,000,000	20 X 600	GP9BS10-6020PT
YMC-GPC T10M-40	10 µm		40 X 600	GP9BS10-6040WT

Guard columns

Product name	Particle size	Column size inner diameter X length (mm)	Product number
Guard columns YMC-GPC-G	10 µm	7.5 X 50	GP99S10-05V5PTG
Guard columns YMC-GPC-40G		25 X 25	GP99S10-G525PTG

Flash chromatography column

YMC-DispoPackAT

- Excellent resolution and reproducibility
- High resolution over a wide range of flow rate
- Compatible with all common Flash Systems
- Fast and easy installation

Specification

Type	Cap fixed	
Shape	spherical	irregular
Particle size (µm)	25	50
Pressure tolerance	1.38 MPa (300 g: 1.24 MPa)	
Available bondings	SIL, NH2, Diol, ODS	
Column connection	IN: Luer lock / OUT: Luer slip (800 g: M6 female)	
Available sizes	12 g, 40 g, 120 g, 300 g, 800 g	

Ordering Information

Phase dimension	Size (g)	Pack Qty	Product number	
			spherical S-25 µm	irregular S-50 µm
SIL	12	24	DPA12SLK08S2524	DPA12SLK06I5224
	40	12	DPA40SLK08S2512	DPA40SLK06I5212
	120	6	DPAA2SLK08S2506	DPAA2SLK06I5206
	300	1	DPAC0SLK08S2501	DPAC0SLK06I5201
	800	1	DPAH0SLK08S2501	DPAH0SLK06I5201
NH2	12	24	DPA12NHK08S2524	DPA12NHK15I5224
	40	12	DPA40NHK08S2512	DPA40NHK15I5212
	120	6	DPAA2NHK08S2506	DPAA2NHK15I5206
	300	1	DPAC0NHK08S2501	DPAC0NHK15I5201
	800	1	DPAH0NHK08S2501	DPAH0NHK15I5201
Diol	12	24	DPA12DLK08S2524	DPA12DLK15I5224
	40	12	DPA40DLK08S2512	DPA40DLK15I5212
	120	6	DPAA2DLK08S2506	DPAA2DLK15I5206
	300	1	DPAC0DLK08S2501	DPAC0DLK15I5201
	800	1	DPAH0DLK08S2501	DPAH0DLK15I5201
ODS	12	24	DPA12ABK08S2524	DPA12ABK15I5224
	40	12	DPA40ABK08S2512	DPA40ABK15I5212
	120	6	DPAA2ABK08S2506	DPAA2ABK15I5206
	300	1	DPAC0ABK08S2501	DPAC0ABK15I5201
	800	1	DPAH0ABK08S2501	DPAH0ABK15I5201

10

Packing Materials

Packing materials

Packing materials for preparative separation

YMC offers various packing materials according to the usage. Thorough quality control of packing materials is carried out for excellent batch-to-batch reproducibility. YMC packing materials are valued highly in various fields, including pharmaceuticals, foods, and chemicals all over the world. DMF (Drug Master File) registration indicates the high level of reliability of the YMC products. YMC packing materials are broadly classified into three categories; for HPLC, flash/open chromatography, and bio process chromatography.

for HPLC

YMC offers packing materials based on organic/inorganic hybrid silica (YMC-Triart) and silica gel. YMC packing materials with various phases and particle sizes meet any purpose and requirement. It is effective also in semi-preparative separation as well as industrial separation using axial compression column.
YMC offers an automatic self-packing type of dynamic axial compression column DAD/DAU and preparative HPLC system K-Prep adequate for the packing materials.

DAD

K-Prep

for Flash/Open Column Chromatography

YMC packing materials for flash/open chromatography have spherical 25 µm and irregular 50 µm, and the phases are SIL, NH2, Diol and ODS. We also have spherical 75, 150 µm of SIL, ODS packing materials for open column chromatography.
LC-Forte/R designed for MPLC as well as preparative HPLC is ideal for separation using these packing materials.

LC-Forte/R

for Bio Process Chromatography

BioPro SmartSep/BioPro ion exchange media are adequate for the biopharmaceuticals and protein purification. BioPro SmartSep/BioPro, which are based on hydrophilic polymer with low nonspecific adsorption, are designed for capture step to polishing step of proteins and nucleotides. High dynamic binding capacity (DBC) and high recovery allow fast purification process at large scale. They offer high productivity on industrial purification of peptides, proteins, and nucleotides including biopharmaceuticals such as antibody.
Various types of screening kit offer significant advantage and efficiency in media screening and purification method development.
YMC offers biochromatography devices and columns.

*See P.160 for details of preparative systems

YMC Pilot Column

BioStream

Packing materials for HPLC

Specifications

Product	Characteristics	Particle size (μm)	Pore size (Å)	Usable pH range	Pages
Triart C18	Suitable as a first choice ODS packing with excellent durability	3, 5	120	1.0~12.0	59~61, 130
Triart Prep C18-S	Preparative ODS packing allows the effective cleaning of the gel with alkaline solution	10, 15, 20	120	2.0~10.0	130, 132~134
Triart C8	Effective for fast separation of compounds with low polarity or for separation of isomers	3, 5	120	1.0~12.0	63, 130
Triart Prep C8-S	Preparative C8 packing allows the effective cleaning of the gel with alkaline solution	10, 15, 20	200	2.0~10.0	130, 132~134
Triart SIL Triart Prep SIL	Organic/inorganic hybrid silica based packing material	3, 5, 10, 15, 20	120, 200	—	130, 132~134
ODS-A ODS-A-HG	Currently in use worldwide ODS with wide pore size available, useful for separation of proteins and peptides	3, 5	120, 200, 300	2.0~7.5	87, 130
		10, 15, 20, 50			130, 135
ODS-AM	Outstanding lot-to-lot reproducibility	3, 5	120	2.0~7.5	87, 130
ODS-AQ ODS-AQ-HG	Superior separation of hydrophilic compounds	3, 5	120, 200, 300	2.0~7.5	88, 130
		10, 15, 20, 50			130, 135
C_8 C_8-HG	Useful for separation of relatively highly hydrophobic compounds, useful for separation of proteins and peptides	3, 5	120, 200, 300	2.0~7.5	97, 130
		10, 15, 20, 50			135
C_4 C_4-HG	C4 with wide pore size available, useful for separation of proteins and peptides	3, 5	120, 200, 300	2.0~7.5	97, 130
		10, 15, 20, 50			135
TMS TMS-HG	Allowing rapid elution compared to other packing materials for retention based on hydrophobic interaction	3, 5	120, 200, 300	2.0~7.5	98, 130
		10, 15, 20, 50			135
Ph (Phenyl) Ph-HG	The π electron interaction gives a separation selectivity different from ODS	3, 5	120, 200, 300	2.0~7.5	98, 130
		10, 15, 20, 50			135
CN CN-HG	The medium polarity of the functional group allows selectable normal-phase and reversed-phase separation modes	3, 5	120, 200, 300	2.0~7.5	99, 130
		10, 15, 20, 50			135
YMCbasic	Superior separation of basic compounds and peptides	3, 5, 10	200	2.0~7.5	100
Omega	Superior separation of omega-fatty acids	10, 20, 50	—	2.0~7.5	—
SIL SIL-HG	Fully porous silica gel packing material, popular among normal-phase products	3, 5	60, 120, 200, 300	2.0~7.5	104, 130
		10, 15, 20, 50			130, 135
Diol Diol-HG	Useful for gel filtration or normal-phase applications	5	60, 120, 200, 300	2.0~7.5	45, 46
		10, 15, 20, 50			135
NH_2 NH_2-HG	Chemically bonded with aminopropyl groups	5	120, 200, 300	2.0~7.5	108
		10, 15, 20, 50			135
CHIRAL ART	Packing material with polysaccharide derivatives chiral selector	3, 5, 10, 20	—	2.0~9.0	26~29
PREP CD ST PREP CD PM	Useful for preparative isoration of optical isomer	10, 20, 50	120	2.0~7.0	31

Ordering Information -Packing materials for HPLC-

High resolution packing materials

Packing material	Particle size (μm)	Pore size (Å)	Product number
Triart C18	3	120	TA12S03
	5		TA12S05
Triart C8	3	120	TO12S03
	5		TO12S05
Triart SIL	3	120	TS12S03
	5		TS12S05
ODS-A	3	120	AA12S03
	5		AA12S05
	5	300	AA30S05
ODS-AM	3	120	AM12S03
	5		AM12S05
ODS-AQ	3	120	AQ12S03
	5		AQ12S05
C_8	5	120	OC12S05
	5	300	OC30S05
C_4	5	120	BU12S05
	5	300	BU30S05
TMS	5	120	TM12S05
Ph	5	120	PH12S05
CN	5	120	CN12S05
	5	300	CN30S05
SIL	5	60	SL06S05
	5	120	SL12S05
NH_2	5	120	NH12S05

Bulk packing materials

Packing material	Particle size (μm)	Pore size (Å)	Product number
Triart Prep C18-S	10	120	TAS12S11
	15		TAS12S16
	20		TAS12S21
Triart Prep C8-S	10	200	TOS20S11
	15		TOS20S16
	20		TOS20S21
Triart Prep SIL	10	120	TSS12S11
	15		TSS12S16
	20		TSS12S21
ODS-A-HG	10	120	AAG12S11
	15		AAG12S16
	20		AAG12S21
	50		AAG12S50
ODS-AQ-HG	10	120	AQG12S11
	15		AQG12S16
	20		AQG12S21
	50		AQG12S50
SIL-HG	10	120	SLG12S11
	15		SLG12S16
	20		SLG12S21
	50		SLG12S50

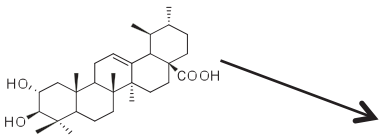
Scale up to preparative separation

To establish a preparative-scale separation and purification method, separation conditions are first developed in analytical scale, then shifted to preparative scale. For this scale-up, particle size, column inner diameter and length are selected based on sample load and specifications of a purification system to be used. Then, further studies are conducted to optimize the separation conditions and load for the selected particle size. (See P.114, 115 for details of optimization method for isolation/purification)
YMC offers packing materials for a wide range of applications from laboratory scale to plants scale. Furthermore, YMC's solid foundation of knowledge and resources help it purpose the most suitable preparative columns such as dynamic axial compression columns, and preparative systems as well as contract services for method development/optimization and/or execution of preparative purification.

Purification of corosolic acid from plant exract

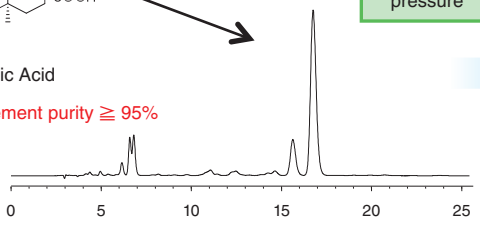
Analysis

5 µm, 120 Å, 250 X 4.6 mmI.D., 1.0 mL/min



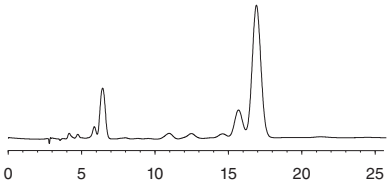
Corosolic Acid

Requirement purity ≧ 95%



Select particle size 10 µm, considered cost and column pressure

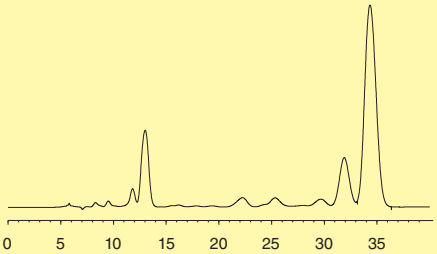
10 µm, 120 Å, 250 X 4.6 mmI.D., 1.0 mL/min



Deteriorate separation of impurities

Separation improvement to lower flow rate

10 µm, 120 Å, 250 X 4.6 mmI.D., 0.5 mL/min



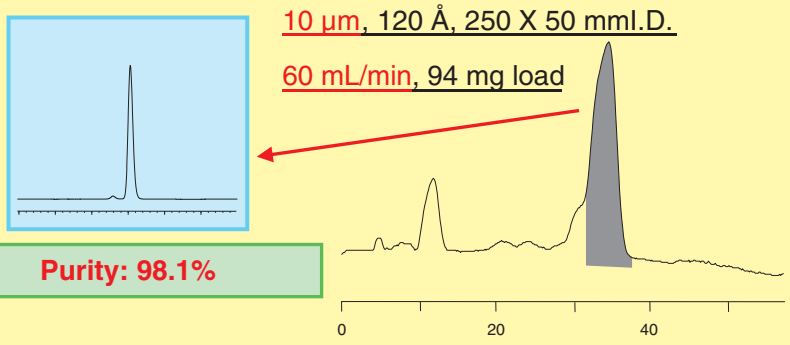
Optimization sample loading

Perform the preparative separation in the maximum load

Purification

10 µm, 120 Å, 250 X 50 mmI.D.

60 mL/min, 94 mg load



Purity: 98.1%

Column	: ODS-AQ
Eluent	: methanol/water/TFA (85/15/0.05)
Temperature	: ambient
Detection	: UV at 210 nm

Organic/inorganic hybrid silica packing materials

YMC-Triart

- Excellent mechanical stability
- Excellent chemical durability and compatible with alkaline solution
- Outstanding cost-effectiveness

■ Particle size: 3, 5, 10, 15, 20 µm

Applicable from laboratory scale purification to industrial scale

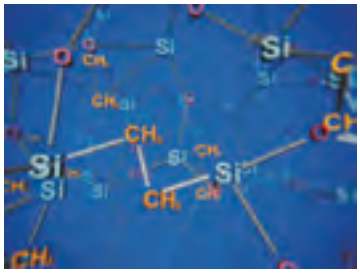
Triart, YMC-Triart and YMC-Triart Prep, are next-generation organic hybrid silica packing materials for preparative separation. Triart's excellent durability allows the effective cleaning of the gel with alkaline solution. It provides excellent mechanical stability, and can be packed into a column repeatedly. Longer lifetime of Triart greatly contributes to reduction of production cost.

Specifications

	Triart SIL	Triart C18	Triart C8	Triart Prep SIL	Triart Prep C18-S	Triart Prep C8-S
Particle size (µm)	3, 5			10, 15, 20		
Pore size (Å)	120			120, 200	120	200
Carbon content (%)	—	20	17	—	20	13
Usable pH range	—	1.0 ~12.0		—	2.0 ~10.0 for regular use (~12.0 for alkaline CIP)	

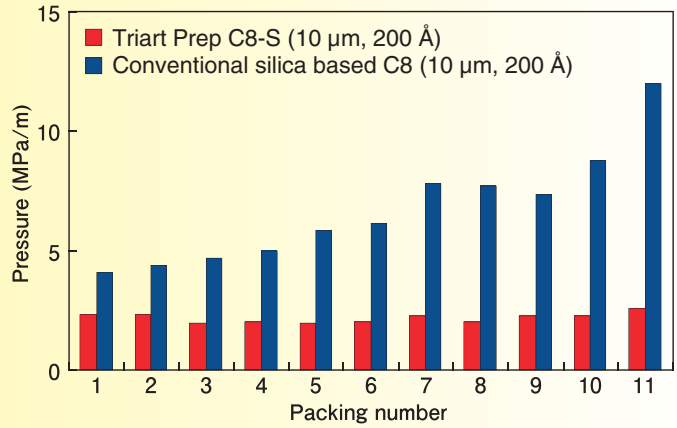
Versatile hybrid based material

YMC-Triart is based on novel organic/inorganic hybrid particles. The particle combines high mechanical stability and high efficiency derived from silica based packing material, and high chemical stability derived from polymer based packing material. The granulation process utilizing microreactor technology enables continuous and highly controlled production of hybrid particles. The particle has uniform pore size distribution and smooth surface as well as uniform particle size. This feature greatly contributes to excellent peak shape and separation reproducibility



Excellent mechanical stability

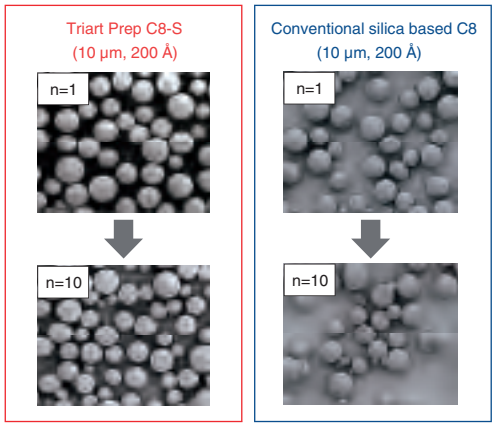
Change in column pressure



Column packing
Column size : 100 X 50 mmI.D., Packing pressure : 6.5 MPa

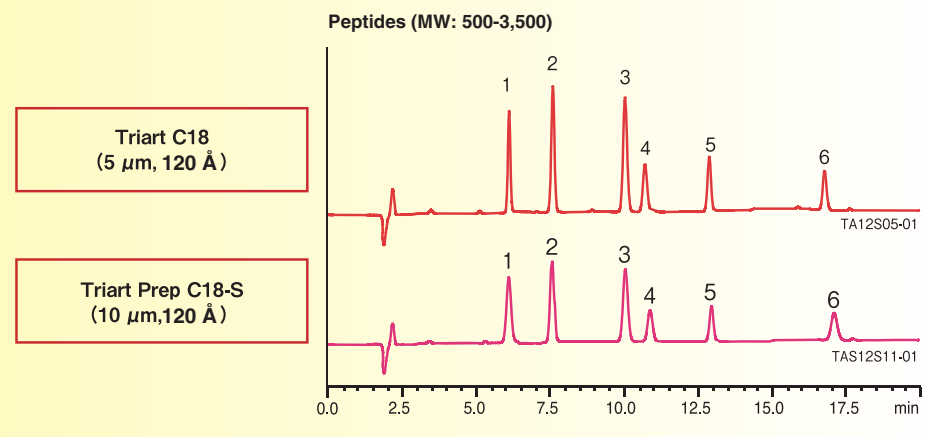
Pressure measurement
Eluent : methanol/water (85/15), Flow rate : 50 mL/min

SEM images



Triart Prep material still remained initial state after more than 10 times of repacking. On the other hand, conventional silica showed pressure increase or crush of particles. Triart Prep with its high mechanical stability enables longer column lifetime, and this feature provides reduction of purification cost.

Easy scale up from analytical to preparative

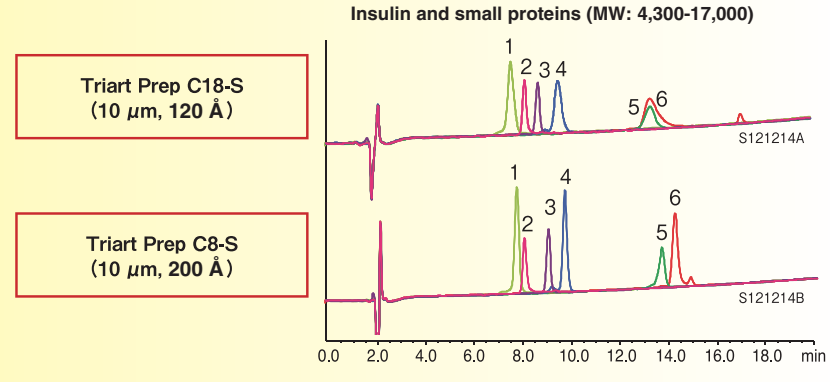


1. Oxytocin (MW 1,007)
2. Met-Enkephalin (MW 574)
3. Leu-Enkephalin (MW 556)
4. Neurotensin (MW 1,673)
5. γ-Endorphin (MW 1,859)
6. β-Endorphin (MW 3,465)

Column	: 150 X 4.6 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 20-40%B (0-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm
Injection	: 10 μL (0.167 mg/mL)

Triart Prep C18-S has identical selectivity to analytical Triart C18. A method established with analytical Triart C18 can be directly transferred to preparative scale with Triart Prep C18-S material.

Selection of optimal stationary phase

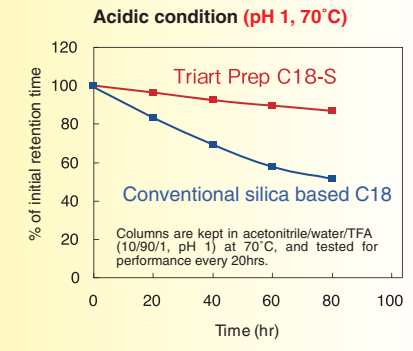


1. Cytochrome *c* (MW 12,400)
2. Insulin (bovine) (MW 5,700)
3. Amyloid β-protein (MW 4,300)
4. Lysozyme (MW 14,300)
5. α-Lactalbumin (MW 14,100)
6. Myoglobin (MW 17,000)

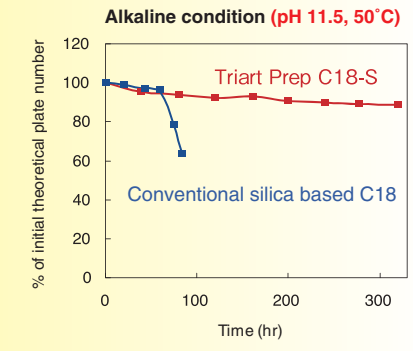
Column	: 150 X 4.6 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 25-60%B (0-20 min)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm
Injection	: 10 μL (0.1-0.2 mg/mL)

Proteins with molecular weight (MW) of 10,000 or larger are effectively separated with Triart Prep C8-S while there is little difference in separation of proteins with MW of less than 10,000 between Triart Prep C18-S and Triart Prep C8-S. It is useful to select optimal phase for establishing effective preparative method.

Excellent chemical durability



Column	: 10 μm, 120 Å, 250 X 4.6 mmI.D.
Eluent	: acetonitrile/water (60/40)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm
Sample	: *n*-butyl benzoate



Column	: 10 μm, 120 Å, 150 X 4.6 mmI.D.
Eluent	: 50 mM triethylamine in water/ 50 mM triethylamine in methanol (80/20)
Flow rate	: 1.0 mL/min
Temperature	: 50°C
Detection	: UV at 254 nm
Sample	: caffeine

Triart Prep materials provide strong acidity-proof in the lower pH condition and alkaline-proof in the higher pH. These features enables purification with a mobile phase containing TFA and cleaning with alkaline solution, which are often used on peptides and proteins purification.

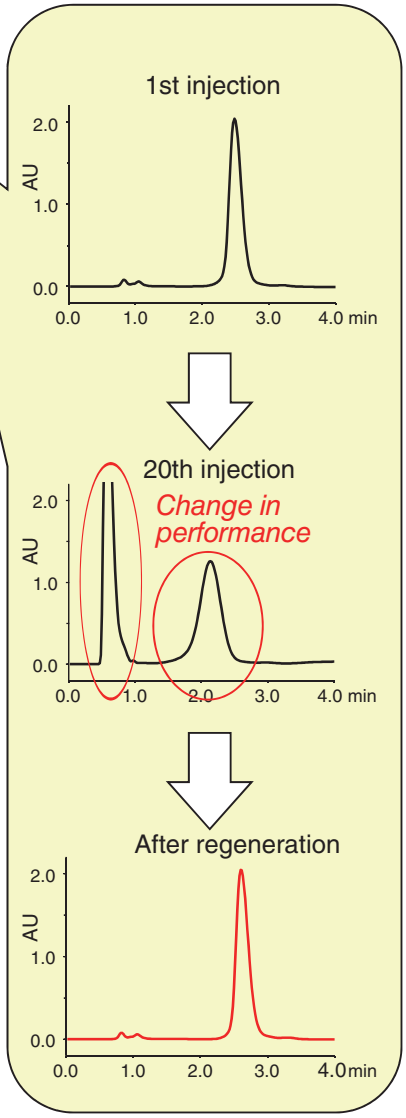
Regeneration with alkaline solution

Test procedure

Sample injection
(insulin in human serum)
Repeated 20 times

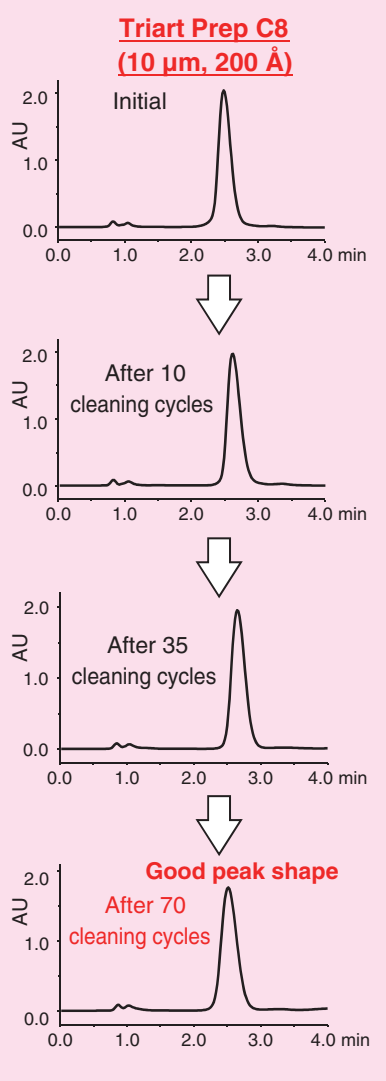
Cleaning with alkaline solution
0.1 M NaOH/acetonitrile (50/50)
10 column volumes

Neutralization and cleaning with organic solvent
1. acetonitrile/water (20/80)
2. acetonitrile/water (90/10)



Column	: 50 X 4.6 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile 29-36%B (0-2 min), 36%B (2-3 min), 29%B (3-6 min)
Flow rate	: 1.0 mL/min
Temperature	: 25˚C
Detection	: UV at 220 nm
Sample	: 10 mg/mL bovine insulin/human serum (2/1)
Injection	: 6 µL

Result



After repeated injection of crude serum sample, absorption of protein and/or other impurities on the surface of the packing material sometimes results in poor peak shape or degradation of retention capacity. In such case, alkaline washing procedure is generally adopted for regeneration and removing impurities on the packing materials. Hybrid silica based Triart Prep which shows strong resistance at high pH allows the effective cleaning of the gel with alkaline solution. This feature provides highly cost-effective purification of target compounds.

YMC*GEL HG

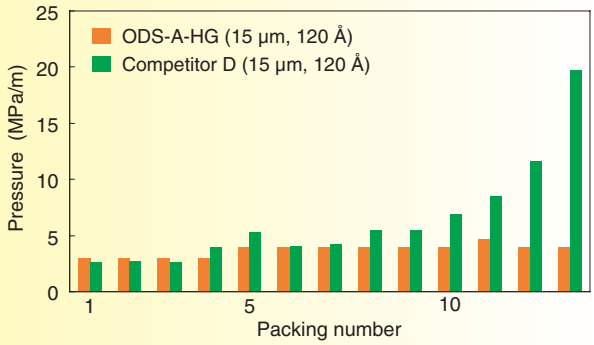
- High density and high strength silica gel
- Excellent mechanical suitability
- Narrow distribution of particle size and pore size

■ Particle size: 10, 15, 20, 50 µm

High strength packing material

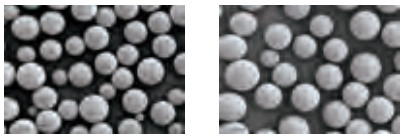
YMC*GEL HG is newly developed packing material based on high density and high strength silica gel. Excellent mechanical stability allows them to be used for a long term repacking into the dynamic axial compression column. YMC*GEL HG packing materials have same chemical modifications as YMC-Pack columns. This feature offers smooth and easy scale up from analytical to preparative conditions with high sample loading.

Excellent mechanical stability



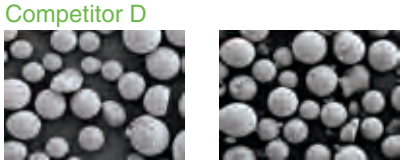
SEM images

ODS-A-HG



After 1st packing　　After 13th repacking

Competitor D



After 1st packing　　After 13th repacking

Packing conditions
Column size : 100 X 50 mmI.D., Packing pressure : 6.5 MPa

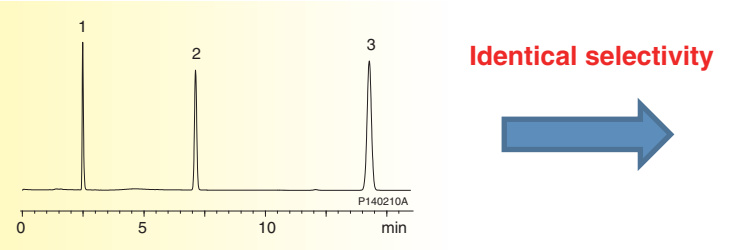
Test conditions
Eluent : methanol/water (85/15), Flow rate : 50 mL/min

High packing machanical stability of YMC*GEL HG is demonstrated by means of repeated of a dynamic axial compression column (DAC). Even after more than 10 repacking cycles for the same material the pressure does not increase. The absence of fines is proven by a constant backpressure.

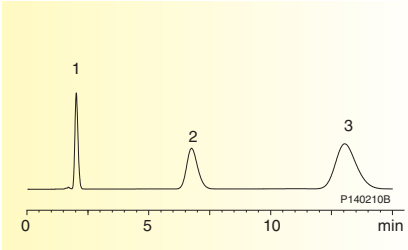
Easy scale up from analytical to preparative

Analysis　Particle size : 5 µm
Column : YMC-Pack ODS-AQ (120 Å) 250 X 4.6 mmI.D.
Flow rate : 1.0 mL/min

Purification　Particle size : 50 µm
Column : ODS-AQ-HG (120 Å) 250 X 10 mmI.D.
Flow rate : 4.7 mL/min



Identical selectivity



Eluent : acetonitrile/water (60/40)
Temperature : ambient
Detection : UV at 270 nm
Sample : 1. Uracil
2. Methyl benzoate
3. Naphthalene

YMC*GEL HG packing materials have same chemical modifications as YMC-Pack columns. This feature offers smooth and easy scale up from analytical to preparative conditions with high sample loading.

Packing materials

Packing materials for Flash/Open column chromatography

YMC offers both spherical and irregular types of packing materials for flash chromatography and open column chromatography.
Irregular packing materials are widely applicable from semi-preparative isolation to industrial preparation.
Spherical packing materials are characterized by high separability, excellent packing reproducibility, and better pressure profile.
In addition to normal phase chemistries (SIL, NH2 and Diol) that are widely used for flash chromatography, ODS for reversed-phase separation is also available.
NH2 is effective when it is difficult to elute basic compounds from SIL due to ionic adsorption.
Diol offers alternative selectivity to bare silica.
ODS is useful for the case where normal-phase can hardly be applied because of sample solubility in organic solvents and so on.
We recommend selecting optimal particle shape, size and chemistry by considering the required resolution, required amount of packing material and total purification cost.

for Flash chromatography (irregular / particle size : 50 µm)

Packing material	Product number
SIL	SLK06I52
NH2	NHK15I52
Diol	DLK15I52
ODS	ABK15I52

for Flash chromatography (spherical / particle size: 25 µm)

Packing material	Product number
SIL	SLF08S25
NH2	NHF08S25
Diol	DLF08S25
ODS	AAF08S25

for Open column chromatography (spherical)

Packing material	Particle size (µm)	Pore size (Å)	Product number
ODS-A	75	60	AA06S75
	150		AA06SA5
	75	120	AA12S75
	150		AA12SA5
SIL	75	120	SL12S75
	150		SL12SA5

BioPro SmartSep Q/S

- High-throughput purification by utilizing high mechanical strength polymer beads
- High binding capacity and high resolution over a wide range of flow rate
- Suitable for intermediate purification step and polishing step
- Available in strong ion exchangers (Q and S chemistries)

■ Matrix : Hydrophilic porous polymer
■ Usable pH range : 2.0~12.0

Ion exchange media for high-throughput purification of biopharmaceuticals

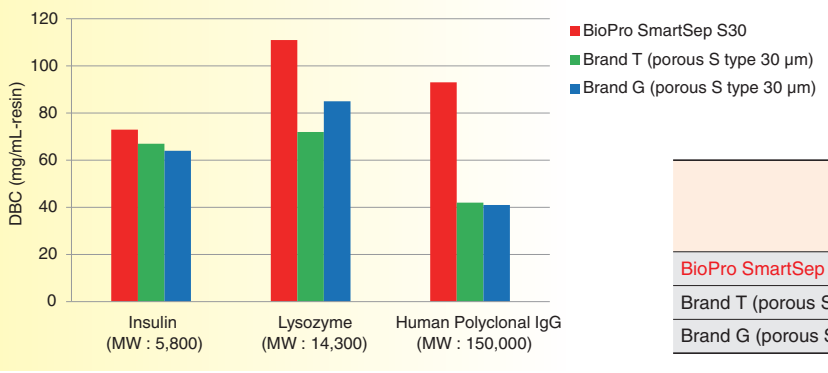
BioPro SmartSep are ion exchange media for high-throughput intermediate purification step and polishing step of biopharmaceuticals. BioPro SmartSep media are avairable in strong ion exchangers of hydrophilic porous polymer beads with low nonspecific adsorption and high binding capacity over a wide range of flow rate. BioPro SmartSep media show high resolution and recovery even at a high flow rate and high loading condition.

Specifications

	BioPro SmartSep Q10	BioPro SmartSep S10	BioPro SmartSep Q30	BioPro SmartSep S30
Matrix	Hydrophilic porous polymer			
Particle size (µm)	10		30	
Ion exchanger	-R-N$^+$(CH$_3$)$_3$	-R-SO$_3^-$	-R-N$^+$(CH$_3$)$_3$	-R-SO$_3^-$
Ion exchange capacity (meq/mL-resin)	> 0.08			
Binding capacity* (mg/mL-resin)	DBC > 100 (BSA)	DBC > 100 (lysozyme)	DBC > 100 (BSA)	DBC > 100 (lysozyme)
Usable pH range	2.0 ~ 12.0			
Characteristics	for high resolution purification		for industrial processes	

* DBC : dynamic binding capacity

High dynamic binding capacity (DBC) for various samples



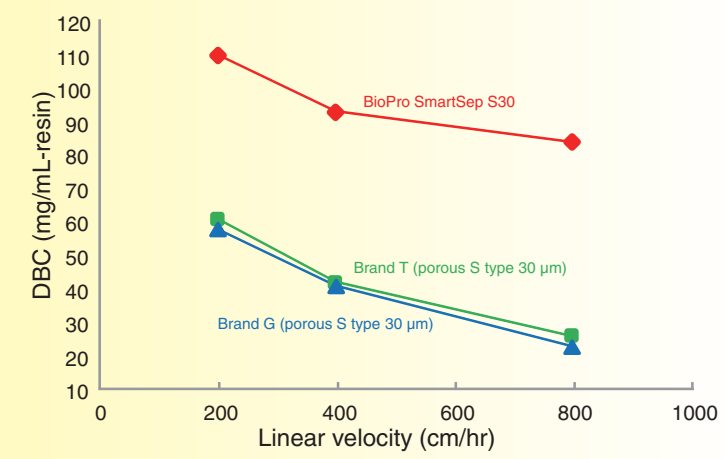
Conditions of DBC measurement*
Column : 50 X 5.0 mmI.D.
Flow rate : 400 cm/hr (1.32 mL/min)

*Please inquire us for details.

	DBC (mg/mL-resin, 10 % breakthrough)		
	Insulin	Lysozyme	Human Polyclonal IgG
BioPro SmartSep S30	73	111	93
Brand T (porous S type 30 µm)	67	72	42
Brand G (porous S type 30 µm)	64	85	41

BioPro SmartSep ion exchange media have higher DBC compared to conventional ion exchange media. Especially for IgG, BioPro SmartSep has more than twice as high DBC as competitors'. This feature of BioPro SmartSep makes purification productivity of IgG per unit time double or more.

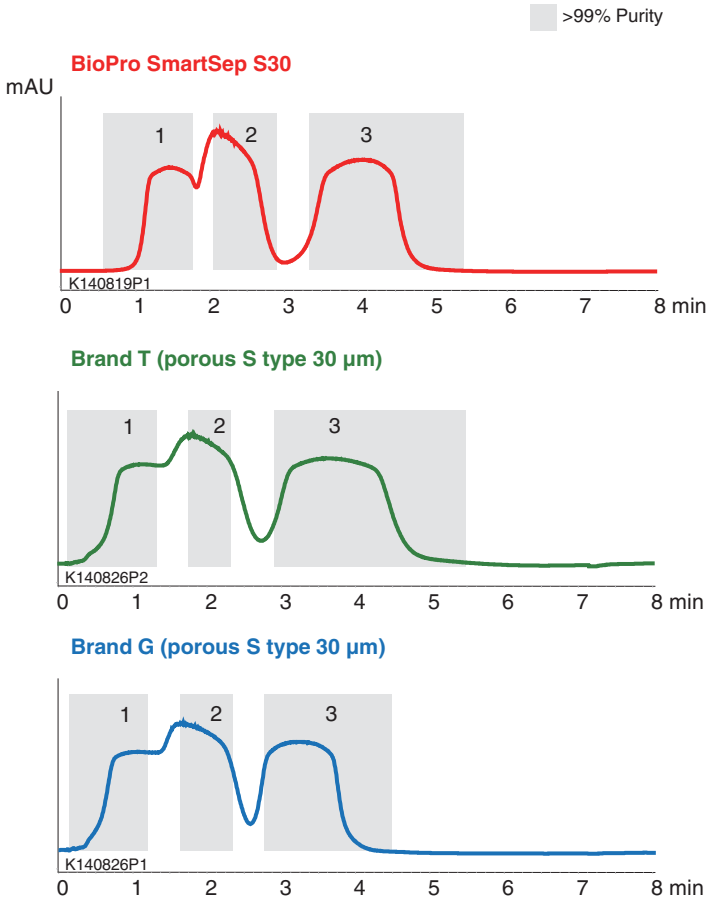
High Dynamic Binding Capacity (DBC) over a wide range of flow rate



Column : 50 X 5.0 mmI.D.
Equilibration buffer : 20 mM citric acid-NaOH (pH 5.3)
Elution buffer : Equilibration buffer containing. 0.5 M NaCl
Flow rate : 200-800 cm/hr (0.66-2.62 mL/min)
Temperature : ambient (25°C)
Detection : UV at 280 nm
Sample : 1.5 mg/mL human polyclonal IgG in equilibration buffer

High DBC of BioPro SmartSep maintained even at a higher flow rate. So, they are suitable for the high-speed purification with 2-4 times of conventional flow rate. This feature offers significant improvement on productivity.

High resolution and excellent recovery



Column	: 50 X 5.0 mmI.D.
Eluent	: A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl 0-100%B, (0-30 column volumes)
Flow rate	: 1600 cm/hr (5.23 mL/min)
Temperature	: 25°C
Detection	: UV at 220 nm
Injection	: 30 mL (45 mg Proteins)
Sample	: 1. Ribonuclease A (0.5 mg/mL) 2. Cytochrome *c* (0.5 mg/mL) 3. Lysozyme (0.5 mg/mL)

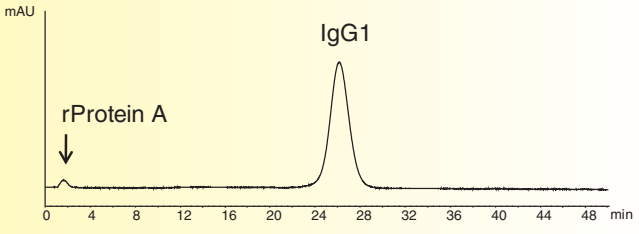
Comparison of recovery of proteins

	Recovery (99% Purity)			
	Ribonuclease A	Cytochrome *c*	Lysozyme	Total
BioPro SmartSep S30	90.9 %	80.3 %	99.2 %	90.6 %
Brand T (porous S type 30 µm)	80.6 %	59.6 %	98.3 %	80.1 %
Brand G (porous S type 30 µm)	72.5 %	70.2 %	97.2 %	80.2 %

BioPro SmartSep ion exchange media show high resolution and recovery even at a high flow rate and high loading condition. BioPro SmartSep ion exchange media offer high efficiency on intermediate purification step and polishing step requiring high resolution and recovery.

Purification of IgG1 (Anti-h TNF alpha IgG1)

Intermediate Purification (Cation Exchange Chromatography)



Column	: BioPro SmartStep S30 (30 µm) 50 X 5.0 mmI.D.
Eluent	: A) 20 mM citric acid-NaOH (pH 5.3) B) 20 mM citric acid-NaOH (pH 5.3) containing 0.5 M NaCl 0-100%B, (0-30 column volumes)
Flow rate	: 180 cm/hr (0.59 mL/min)
Temperature	: ambient
Detection	: UV at 280 nm
Sample	: Anti-h TNF alpha IgG1 (Affinity column eluate)
Injection	: 0.25 mL (0.1 mg IgG1)

This is an example that an IgG1 monoclonal antibody was purified from cell culture medium by BioPro SmartSep S30. In general, purification of antibody starts from clarification. After clarified, it is subjected to initial purification (capture step) by affinity chromatography (rProtein A), followed by ion exchange chromatography. In the capture step rProtein A derived from affinity media contaminate the elueate, then they are separated and removed by following ion exchange chromatography.

BioPro Ion Exchange Media

- High productivity on purification
- Suitable for captuer step and intermediate purification step
- High binding capacity/high recovery/high resolution/low backpressure
- Screening Kit for media selection and method development available

■ Matrix : Hydrophilic porous polymer

Ion exchange media with high productivity/ high cost-effectiveness

BioPro ion exchange media, which are based on hydrophilic polymer with low nonspecific adsorption, are designed for capture and intermediate purification of proteins and nucleotides. High dynamic binding capacity (DBC) and high recovery allow fast purification process at large scale. It offers high productivity on industrial purification of peptides, proteins, and nucleotides including biopharmaceuticals such as antibody.

Specification

	BioPro Q	BioPro S	BioPro DA	BioPro CM
Matrix	Hydrophilic porous polymer			
Particle size (µm)	75		60	
Ion exchanger	$-R-N^{+}(CH_3)_3$	$-R-SO_3^{-}$	$-R-N(CH_3)_2$	-R-COOH
Ion exchange capacity (meq/mL-resin)	> 0.10		≧ 0.10	≧ 0.08
Binding capacity* (mg/mL-resin)	DBC > 160 (BSA)	DBC > 160 (lysozyme)	SBC ≧ 77 (human-IgG)	SBC ≧ 90 (human-IgG)
Usable pH range	2.0 ~ 12.0		Regular use : 3.0 ~ 12.0 Short term : 1.0 ~ 13.0	

* DBC : dynamic binding capacity, SBC : stafic binding capacity

High dynamic binding capacity (DBC) for proteins

BioPro ion exchange media have higher DBC of protein than commercial ion exchange media. BioPro ion exchange media are effective in protein purification from capture step requiring high capacity to intermediate step requiring high efficiency.

Anion exchanger	Particle size (µm)	Ion exchange capacity (meq/mL-resin)	DBC* (mg/mL-resin)
BioPro Q75	75	0.13	183
Brand G (porous Q type)	90	0.19	102

Cation exchanger	Particle size (µm)	Ion exchange capacity (meq/mL-resin)	DBC* (mg/mL-resin)
BioPro S75	75	0.12	192
Brand G (porous S type)	90	0.13	80

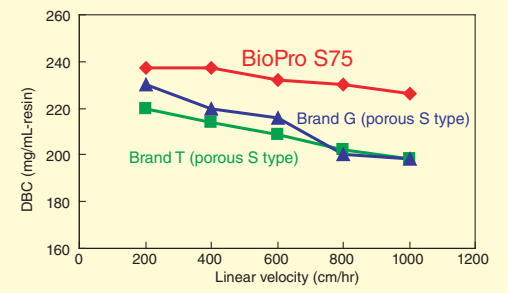
*Dynamic binding capacities were determined at 10% breakthrough under following conditions:

Column : 50 X 4.6 mmI.D.
Flow rate : 180 cm/hr (3.0 cm/min)

for anion-exchange media
Equilibration buffer : 20 mM Tris-HCl (pH 8.6)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.5 mg/mL BSA in equilibration buffer
Detection : UV at 280 nm

for cation-exchange media
Equilibration buffer : 20 mM Glycine-NaOH (pH 9.0)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.5 mg/mL Lysozyme in equilibration buffer
Detection : UV at 300 nm

High productivity on purification



Column : 50 X 5.0 mmI.D.
Equilibration buffer : 20 mM Glycine-NaOH (pH 9.0)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.0 mg/mL Lysozyme in equilibration buffer
Detection : UV at 300 nm

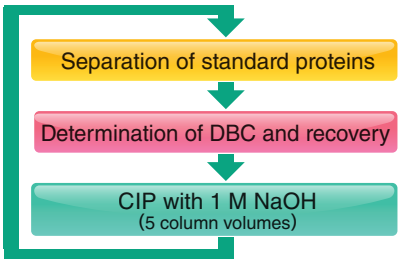
BioPro ion exchange media show high DBC over a wide range of linear velocity, and the diffierence of DBC is less than 5% between 200 cm/hr and 1000 cm/hr. BioPro ion exchange media give increased productivity and reduced cost in biopharmaceutical production.

Excellent durability

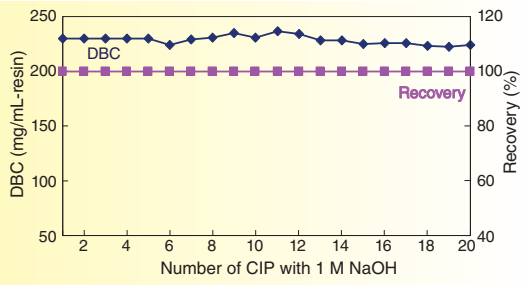
Stability on CIP

Cleaning in place (CIP) is an important procedure for cleaning and sterilization of columns used for protein purification. The DBC and the selectivity of proteins are unaffected following 20 cycles of CIP with 1 M NaOH. The high chemical stability of BioPro ion exchange media allow effective cleaning with alkaline solution.

Test protocols

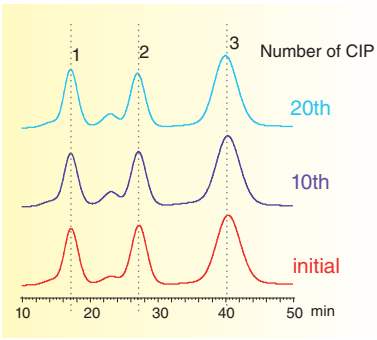


DBC and recovery



Conditions of DBC measurement
Column : BioPro S75 50 X 5.0 mmI.D.
Flow rate : 800 cm/hr (2.62 mL/min)
Equilibration buffer : 20 mM Glycine-NaOH (pH 9.0)
Elution buffer : 0.5 M NaCl in equilibration buffer
Sample : 1.0 mg/mL Lysozyme in equilibration buffer
Temperature : ambient
Detection : UV at 300 nm
∗ DBC was determined at 10% breakthrough

Separation of standard proteins

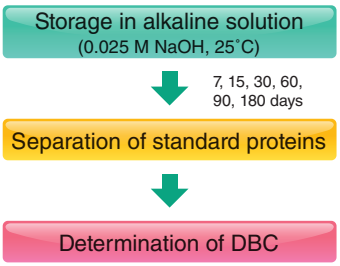


Conditions of separation of standard proteins
Column : BioPro S75 50 X 5.0 mmI.D.
Eluent : A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8)
B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl
Gradient : 0-100%B (0-60 min; Linear)
Flow rate : 180 cm/hr (0.59 mL/min)
Temperature : 25°C
Detection : UV at 220 nm
Injection : 24 µL
Sample : 1. Ribonuclease A, 2. Cytochrome *c*, 3. Lysozyme (0.5 mg/mL)

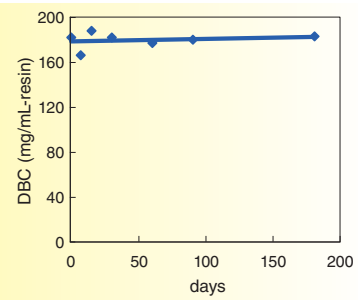
Stability on storage in alkaline solution

BioPro Q75 has high stability under alkaline condition. This feature is effective for storing the medium in alkaline solution* as well as CIP.

Test protocols

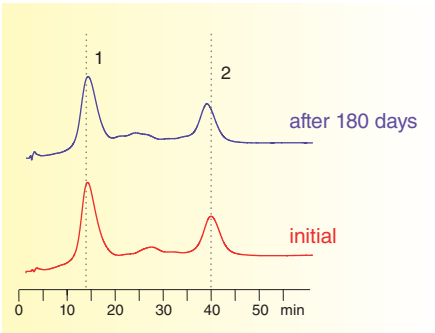


Change in DBC



Conditions of DBC measurement
Column : BioPro Q75 50 X 4.6 mmI.D.
Equilibration buffer : 20 mM Tris-HCl (pH 8.6)
Elution buffer : 0.5 M NaCl in equilibration buffer
Flow rate : 180 cm/hr (0.50 mL/min)
Sample : 1.5 mg/mL BSA in equilibration buffer
Temperature : 25°C
Detection : UV at 280 nm
∗ DBC was determined at 10% breakthrough

Separation of standard proteins

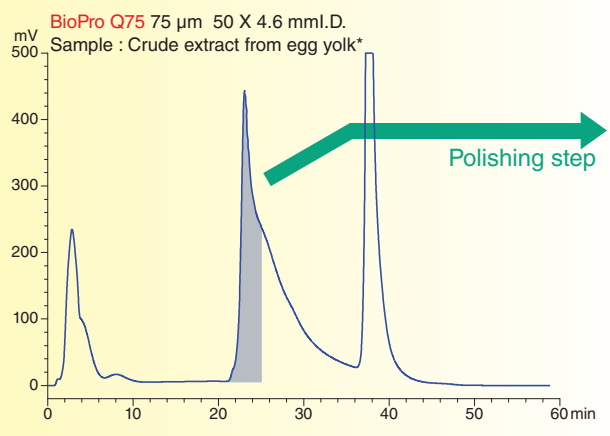


Conditions of separation of standard proteins
Column : BioPro Q75 50 X 4.6 mmI.D.
Eluent : A) 20 mM Tris-HCl (pH 8.1)
B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl
Gradient : 10-80%B (0-60 min; Linear)
Flow rate : 180 cm/hr (0.50 mL/min)
Temperature : 25 °C
Detection : UV at 220 nm
Injection : 20 µL
Sample : 1. Transferrin (0.25 mg/mL), 2. Trypsin inhibitor (0.5 mg/mL)

* We recommend storing the resin in 20% ethanol aqueous solution in general.

Purification of IgY from egg yolk extract

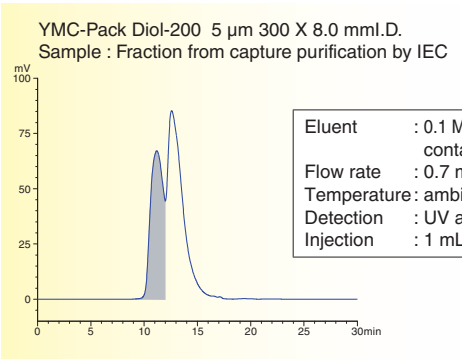
Capture purification by ion exchange chromatography (IEC)



Eluent	: A) 20 mM Tris-HCl (pH 8.1) B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl 10%B (0-15 min), 30%B (15-30 min), 90%B (30-40 min)
Flow rate	: 180 cm/hr (0.5 mL/min)
Temperature	: ambient
Detection	: UV at 280 nm
Injection	: 1 mL (ca. 20 mg Protein)

* Courtesy of Pharma Foods International Co., Ltd.

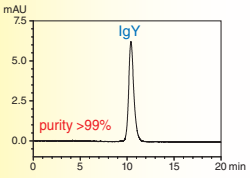
Polishing by size exclusion chromatography (SEC)



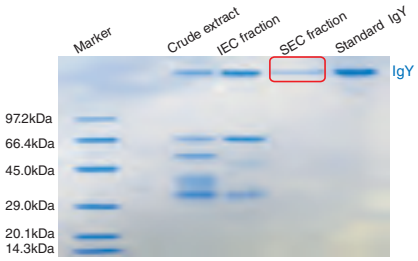
Eluent	: 0.1 M KH_2PO_4-K_2HPO_4 (pH 6.9) containing 0.2 M NaCl
Flow rate	: 0.7 mL/min
Temperature	: ambient
Detection	: UV at 280 nm
Injection	: 1 mL (ca. 0.45 mg IgY)

Analysis of purified fraction

SEC



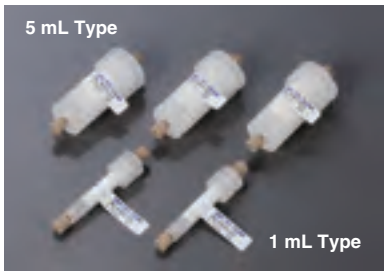
Non-reduced SDS-PAGE



Egg yolk antibody (IgY) can be isolated with high purity more than 99% by two chromatographic purification steps, which consist of a capture step by ion exchange chromatography on BioPro Q75 and a polishing step by size exclusion chromatography on YMC-Pack Diol-200.

Screening kit for media selection and method development

BioPro Ion Exchange Screening Kit is a kit of screening columns that are packed with BioPro ion exchange media designed for separation of proteins, nucleotides and other biomolecules. Various types of kit offer significant advantage and efficiency in media screening and purification method development.



- 1 mL Type (26 X 7.0 mmI.D.)
  - Media screening
  - Purification method development
- 5 mL Type (26 X 15.6 mmI.D.)
  - Purification method development
  - Loadability study
  - Lab-scale purification

See P.44 for details of Screening kit