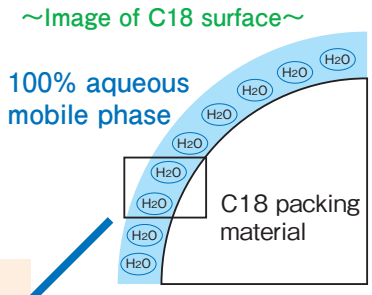
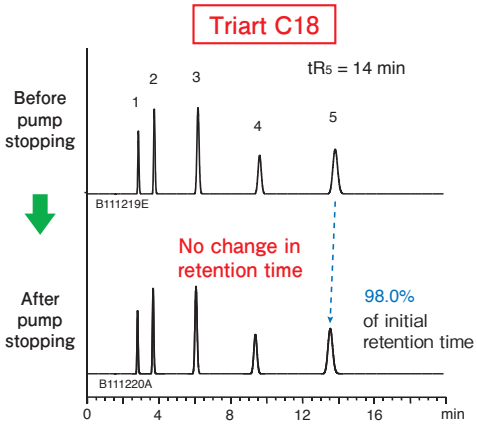
Effective for an analysis of highly polar compounds using 100% aqueous condition

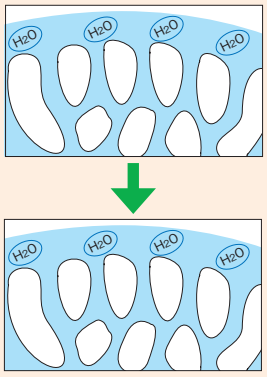
[Retention stability under 100% aqueous mobile phase]

Nucleic bases

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

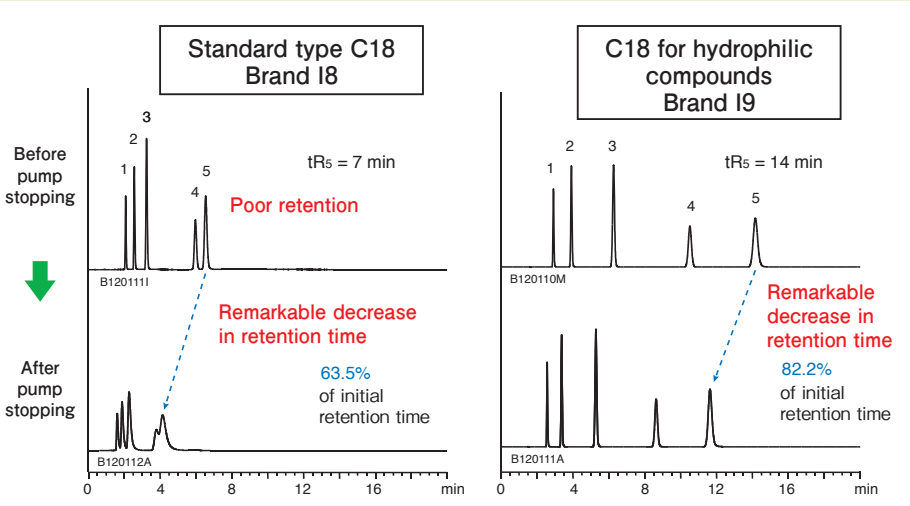


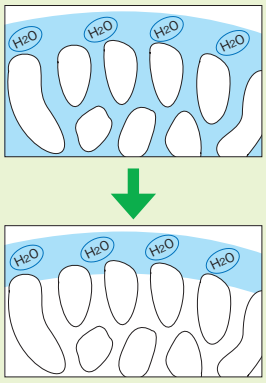




Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)
Flow rate	: 1.0 mL/min
Temperature	: 37℃
Detection	: UV at 254 nm

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.

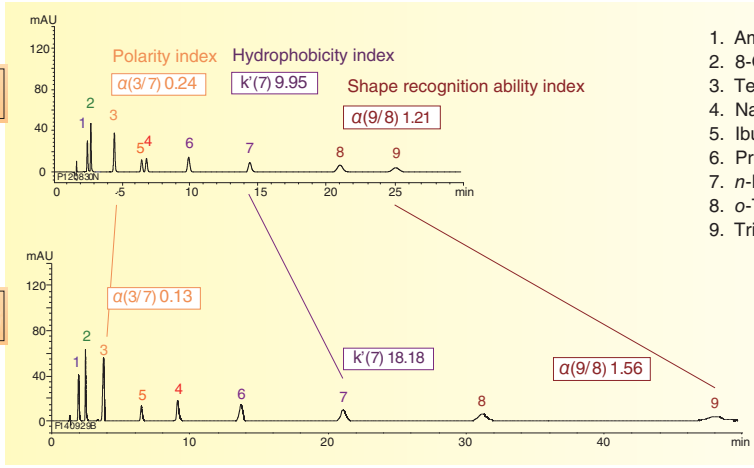
Alternative selectivity to standard C18 columns

YMC-Triart C18 ExRS

- Pore size : 8 nm
- Carbon content : 25%
- Usable pH range : 1.0~12.0
- USP L1

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

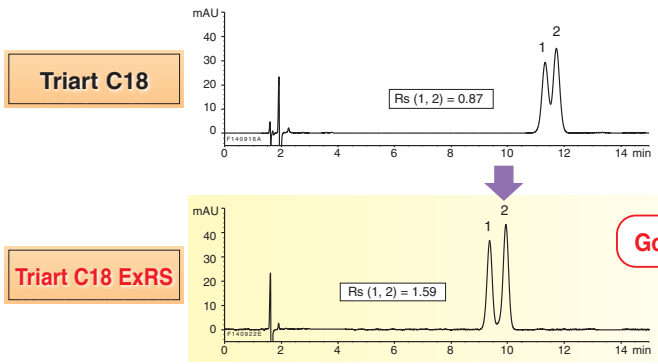
Comparison of fundamental separation selectivity



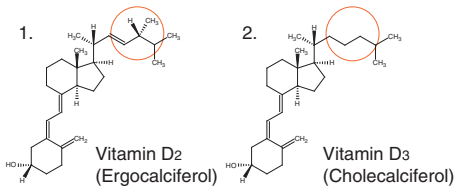
1. Amitriptyline (basic compound)
2. 8-Quinolinol (coordination compound)
3. Testosterone (polar compound)
4. Naphthalene (π-π interaction)
5. Ibuprofen (acidic compound)
6. Propylbenzene (hydrophobicity)
7. *n*-Butylbenzene (hydrophobicity)
8. *o*-Terphenyl (shape recognition ability)
9. Triphenylene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

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

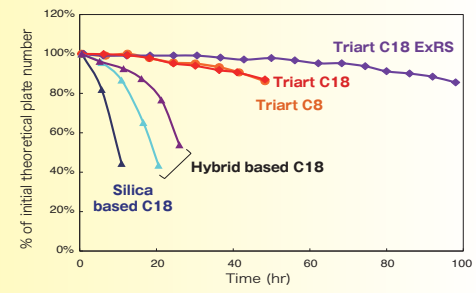


Column	: 5 µm, 150 X 3.0 mmI.D.
Eluent	: THF/acetonitrile (10/90)
Flow rate	: 0.425 mL/min
Temperature	: 30℃
Detection	: UV at 265 nm
Injection	: 4.25 µL (10 µg/mL)

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.

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

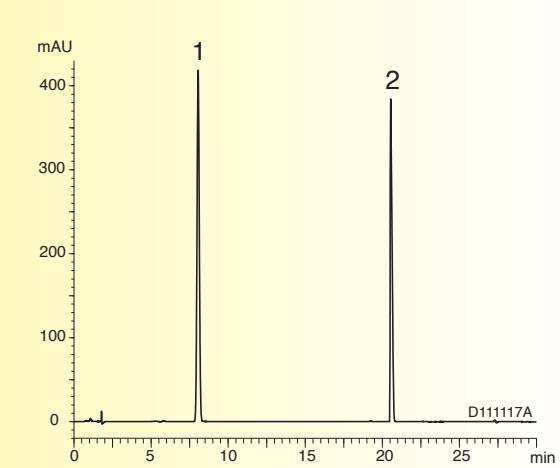
YMC-Triart C8

- Pore size : 12 nm
- Carbon content : 17%
- Usable pH range : 1.0~12.0
- USP L7

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

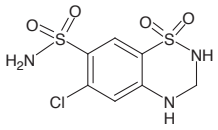
Comparable versatility to C18

【Analysis of drugs】



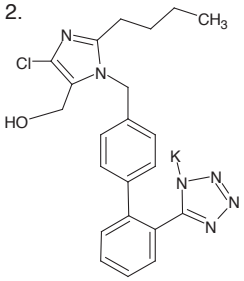
Losartan potassium / hydrochlorothiazide

1.



Hydrochlorothiazide

2.



Losartan potassium

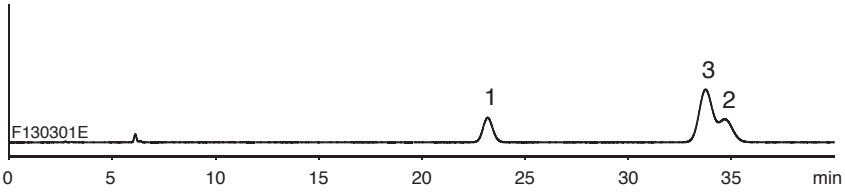
Column	: YMC-Triart C8 5 µm, 150 X 4.0 mmI.D.
Eluent	: A) phosphate buffer (pH 6.7)*/acetonitrile (93/7) B) acetonitrile 0-8%B (0-12 min), 8-62%B (12-28 min) * *Dissolve 1.25 g of KH_2PO_4 and 2.01 g of $Na_2HPO_4 \cdot 12H_2O$ in 1000 mL of water*
Flow rate	: 1.0 mL/min
Temperature	: 35℃
Detection	: 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.

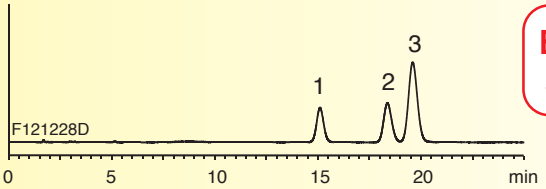
Ideal for separations of isomers or structural analogs

【Separation of positional isomers】

Triart C18



Triart C8

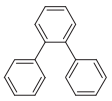


Baseline resolution in shorter analysis time

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

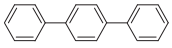
Terphenyl isomers

1.



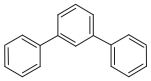
o -Terphenyl

2.



p -Terphenyl

3.



m -Terphenyl

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.

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

YMC-Triart Phenyl

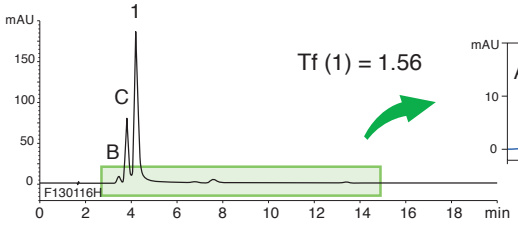
- Pore size : 12 nm
- Carbon content : 17%
- Usable pH range : 1.0~10.0
- USP L11

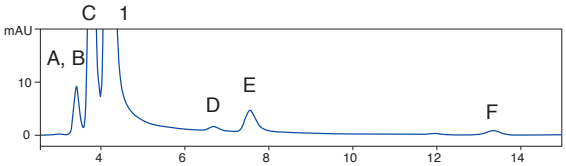
- Unique selectivity due π-π interaction
- Ideal for separations of aromatic compounds or compounds having long conjugated system
- Excellent resolution without adsorption and tailing

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

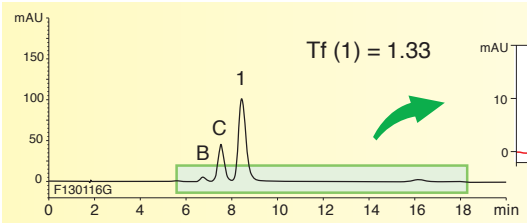
[Ideal for aromatic compounds and compounds having long conjugated system]

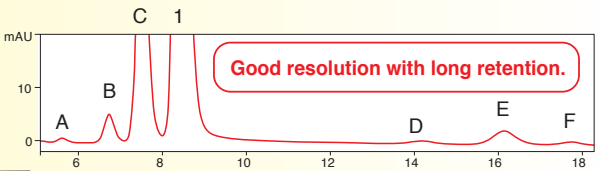
Triart C18



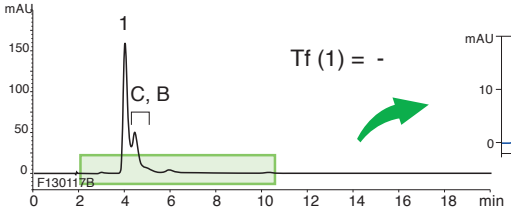


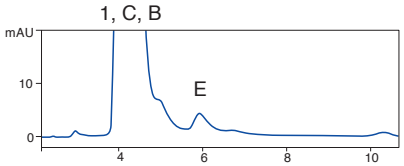
Triart Phenyl



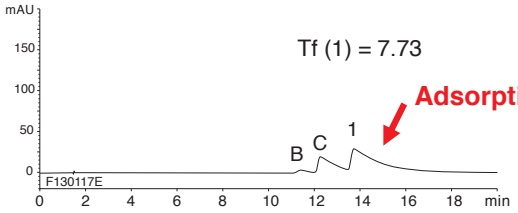


Triart PFP



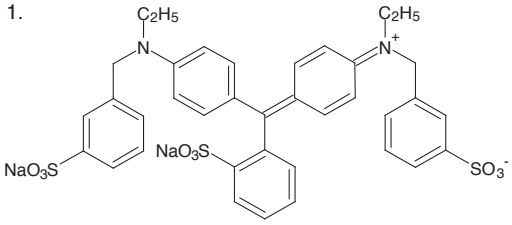


Silica based Phenyl-Hexyl



Brilliant Blue FCF and its impurities

1.



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.

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

YMC-Triart PFP

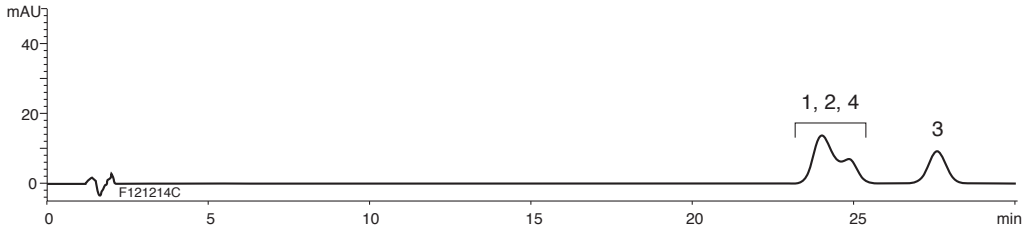
- Pore size : 12 nm
- Carbon content : 15%
- Usable pH range : 1.0~8.0
- USP L43

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

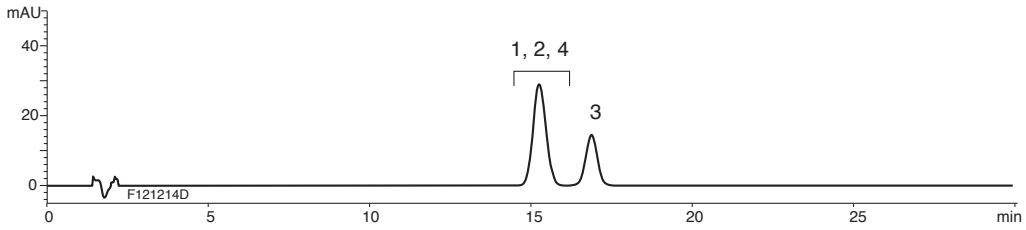
Effective for separation of polar compounds or isomers

[Unique separation provided by various interactions]

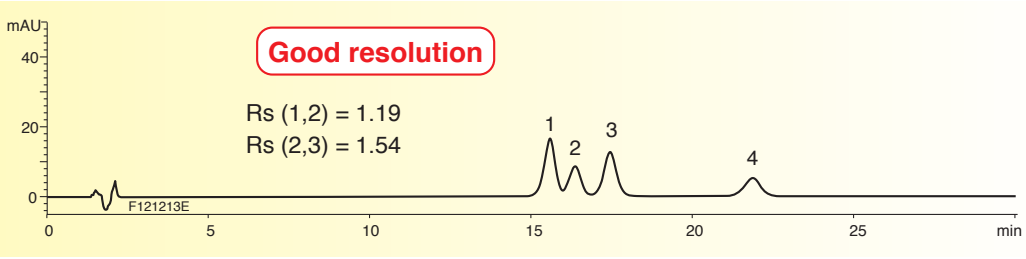
Triart C18



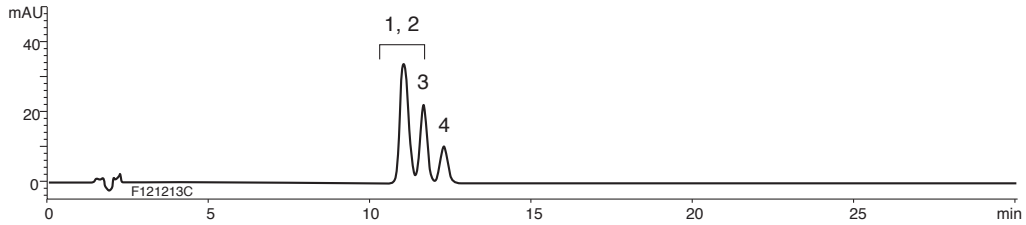
Triart Phenyl



Triart PFP

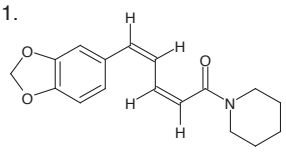


Silica based PFP

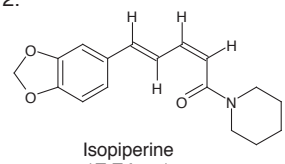


Piperine *cis-trans* isomers

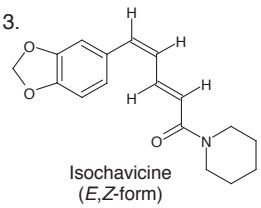
1. Chavicine (*Z,Z*-form)



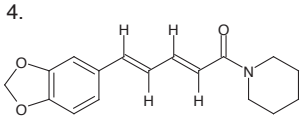
2. Isopiperine (*Z,E*-form)



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.

Effective for separation of highly polar compounds

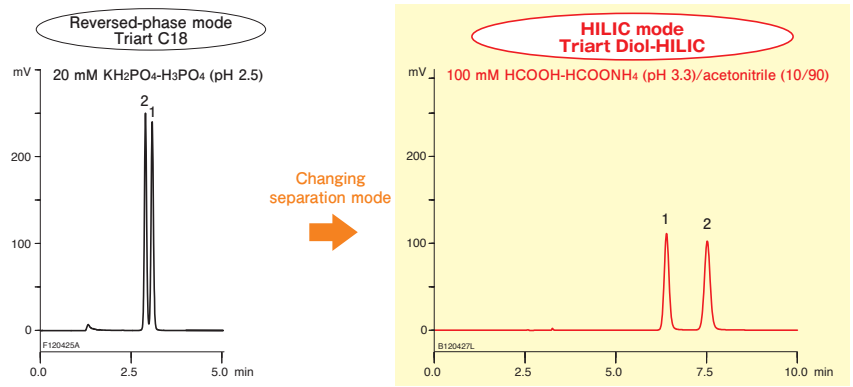
YMC-Triart Diol-HILIC

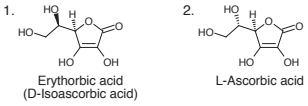
- Pore size : 12 nm
- Carbon content : 12%
- Usable pH range : 2.0~10.0
- USP L20

- 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

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

[Comparison of reversed-phase and HILIC separations]



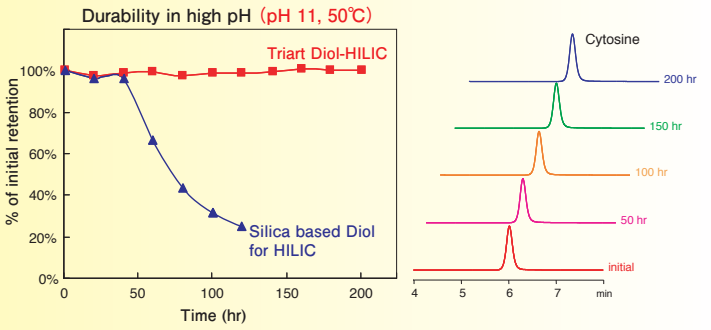


Column	: 5 µm, 150 X 3.0 mmI.D.
Flow rate	: 0.425 mL/min
Temperature	: 40℃
Detection	: UV at 254 nm
Injection	: 4 µL

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]

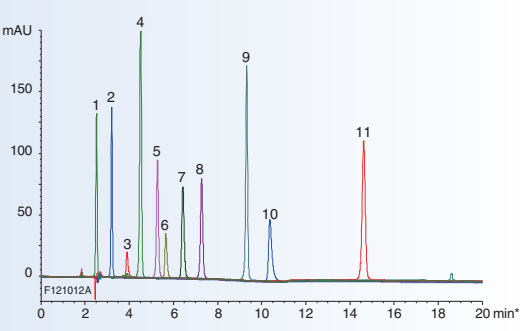


Column	: 5 µm, 150 X 4.6 mmI.D.
Eluent	: acetonitrile/water/NH_3 (90/10/0.1) pH 11.3
Temperature	: 50℃
Flow rate	: 1.0 mL/min
Sample	: cytosine

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

[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, 12 nm), 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)

UHPLC column for ultra-fast separation and high resolution analysis

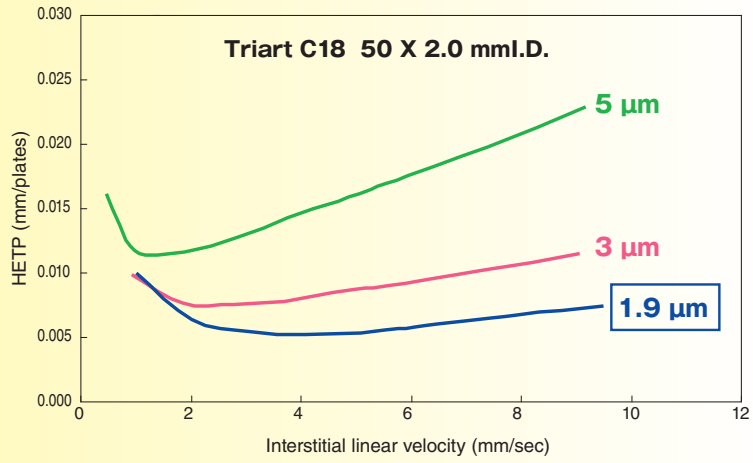
YMC-Triart 1.9 µm

- 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

Ideal for UHPLC analysis

[Correlation between linear velocity and column efficiency]

Van Deemter curves

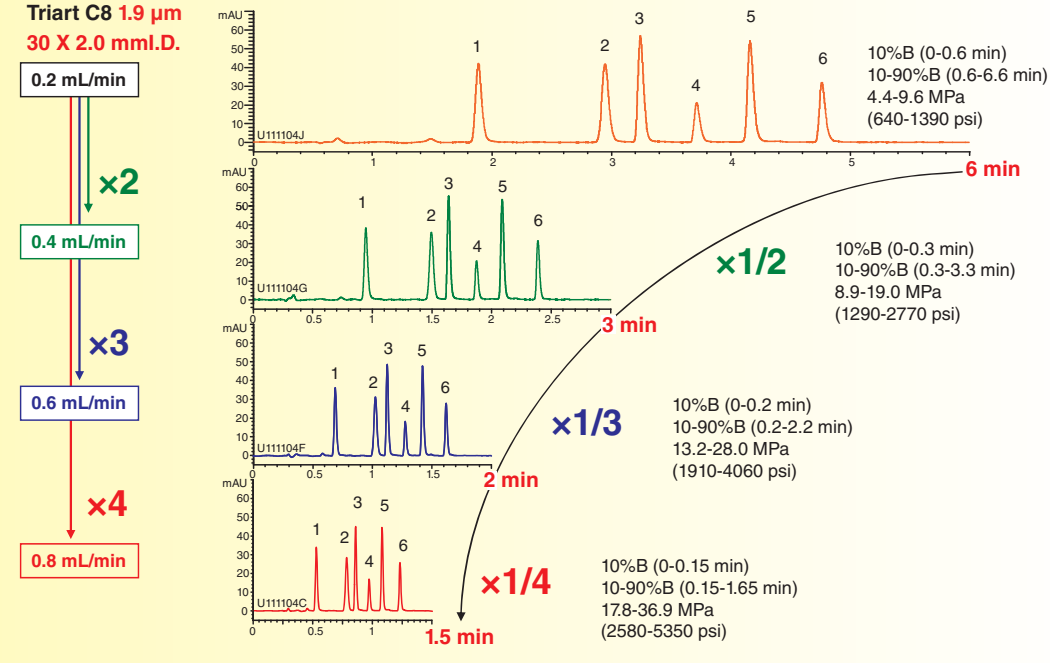


Eluent	: acetonitrile/water (60/40)
Temperature	: 25℃
Sample	: butyl benzoate

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

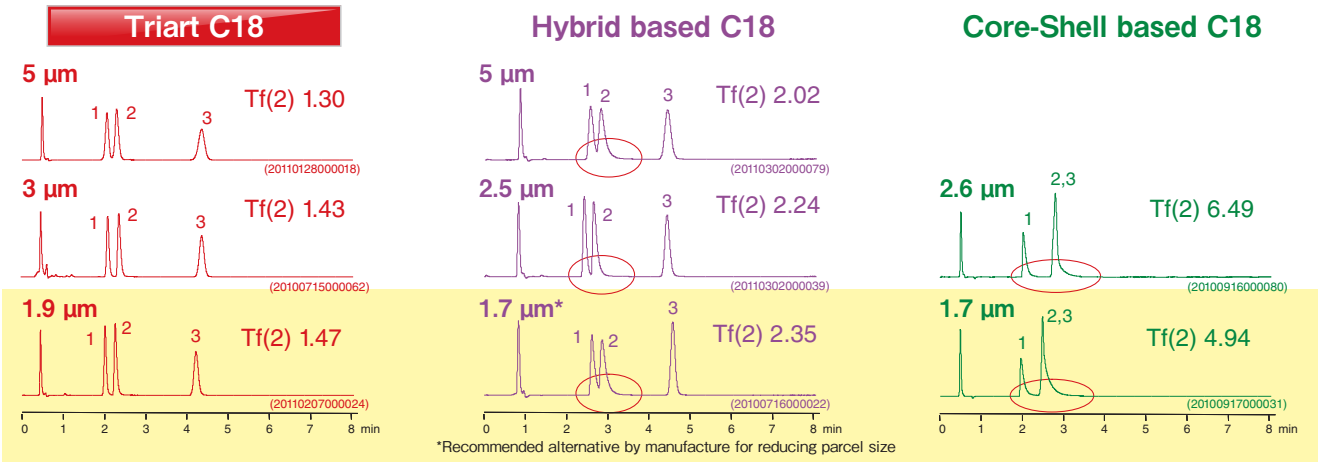
1. Hydrochlorothiazide
2. Valsartan
3. Losartan potassium
4. Amlodipine besilate
5. Atorvastatin calcium hydrate
6. Candesartan cilexetil

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]



*Recommended alternative by manufacture for reducing parcel size

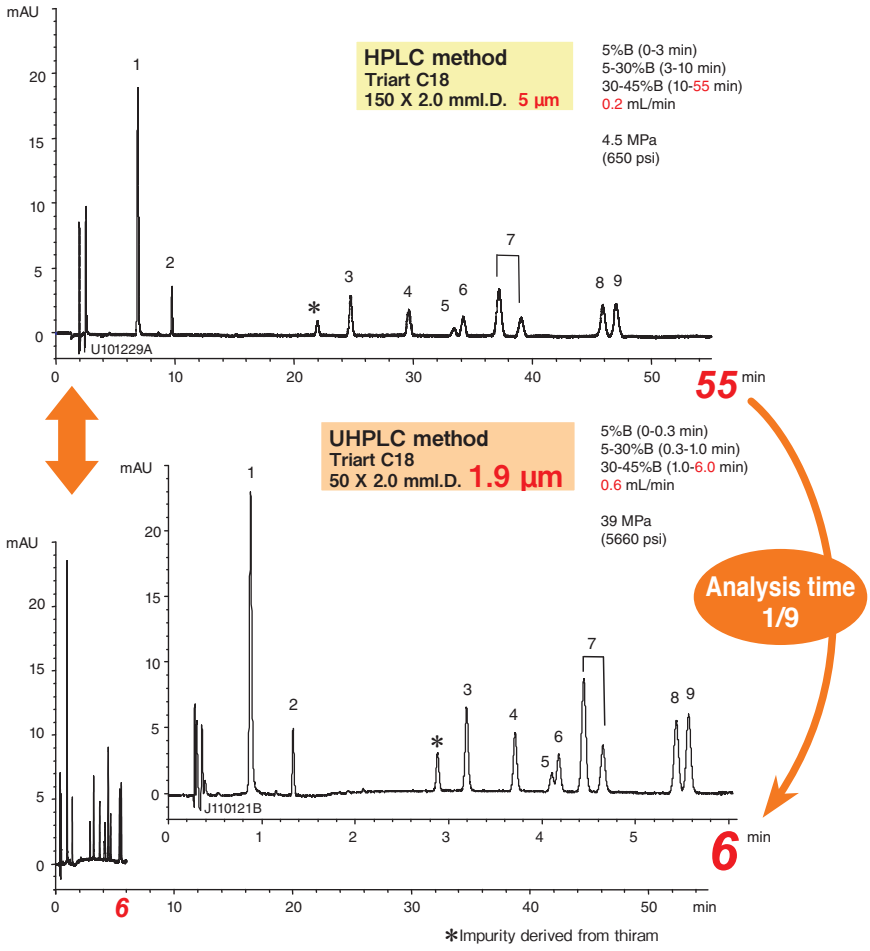
Basic drugs

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]



Agrichemicals

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

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.

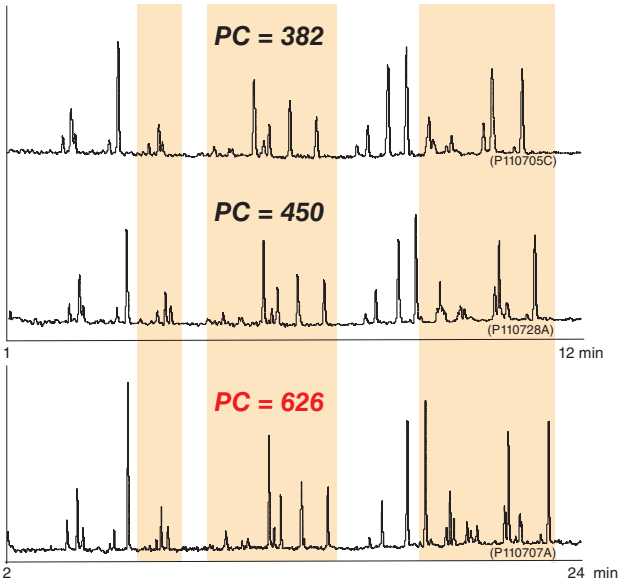
Effective as a high resolution column

[Peptide mapping]

100 X 2.0 mmI.D.
3 µm
9.4-9.8 MPa
(1360-1420 psi)

100 X 2.0 mmI.D.
1.9 µm
27.6-28.6 MPa
(4000-4150 psi)

200 X 2.0 mmI.D.
1.9 µm
Two coupled 1.9 µm,
100 X 2.0 mmI.D.
58.1-61.6 MPa
(8420-8930 psi)



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

Co-elution peaks on 3 µm

↓ Changing particle size to 1.9 µm

Improvement of resolution and peak capacity on 1.9 µm

↓ Changing column length to 200 mm

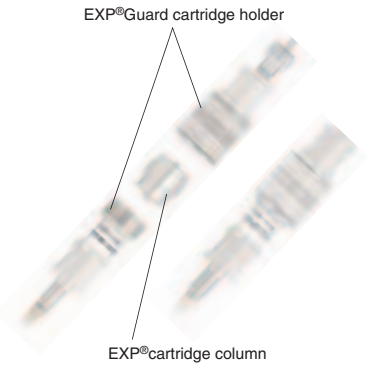
Higher resolution is achieved

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

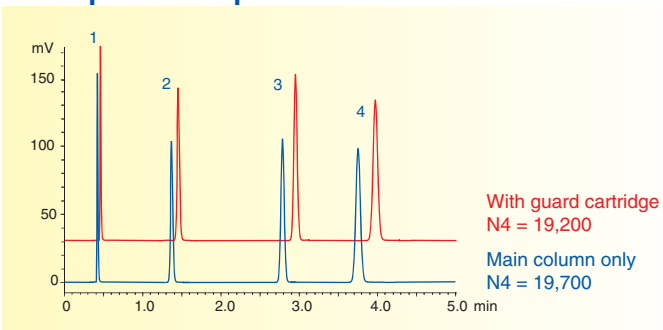
Triart 1.9 µm has superior column efficiency, and a coupling of two 100 mm length of Triart 1.9 µm columns offers outstanding separation ability. This allows the precise separation in an analysis of complicated samples, such as peptide mapping.

Guard cartridge column for UHPLC

- High Pressure resistance up to 100 MPa (15000 psi)
- Low-volume, low-dispersion cartridges minimize the impact on separation
- Zero-dead-volume direct connection to column
- Hand-tight guard replacement (No tools required)



Low-volume, low-dispersion cartridges minimize the impact on separation



Column	: YMC-Triart C18 1.9 µm 100 X 2.0 mmI.D.
Eluent	: acetonitrile/water (60/40)
Flow rate	: 0.4 mL/min
Temperature	: 25°C
Detection	: UV at 270 nm
Injection	: 1 µL
Sample	: 1. Uracil 2. Methyl benzoate 3. Naphthalene 4. Butyl benzoate

EXP® guard cartridge column with low-volume and low-dispersion column minimize the impact on separation. EXP® guard cartridge column provides less than 3% decrease in theoretical plate count.

Hand-tight EXP® fitting

● Fitting for connecting system and main column/guard cartridge is also available.

EXP is a registered trademark of Optimize Technologies, Inc.

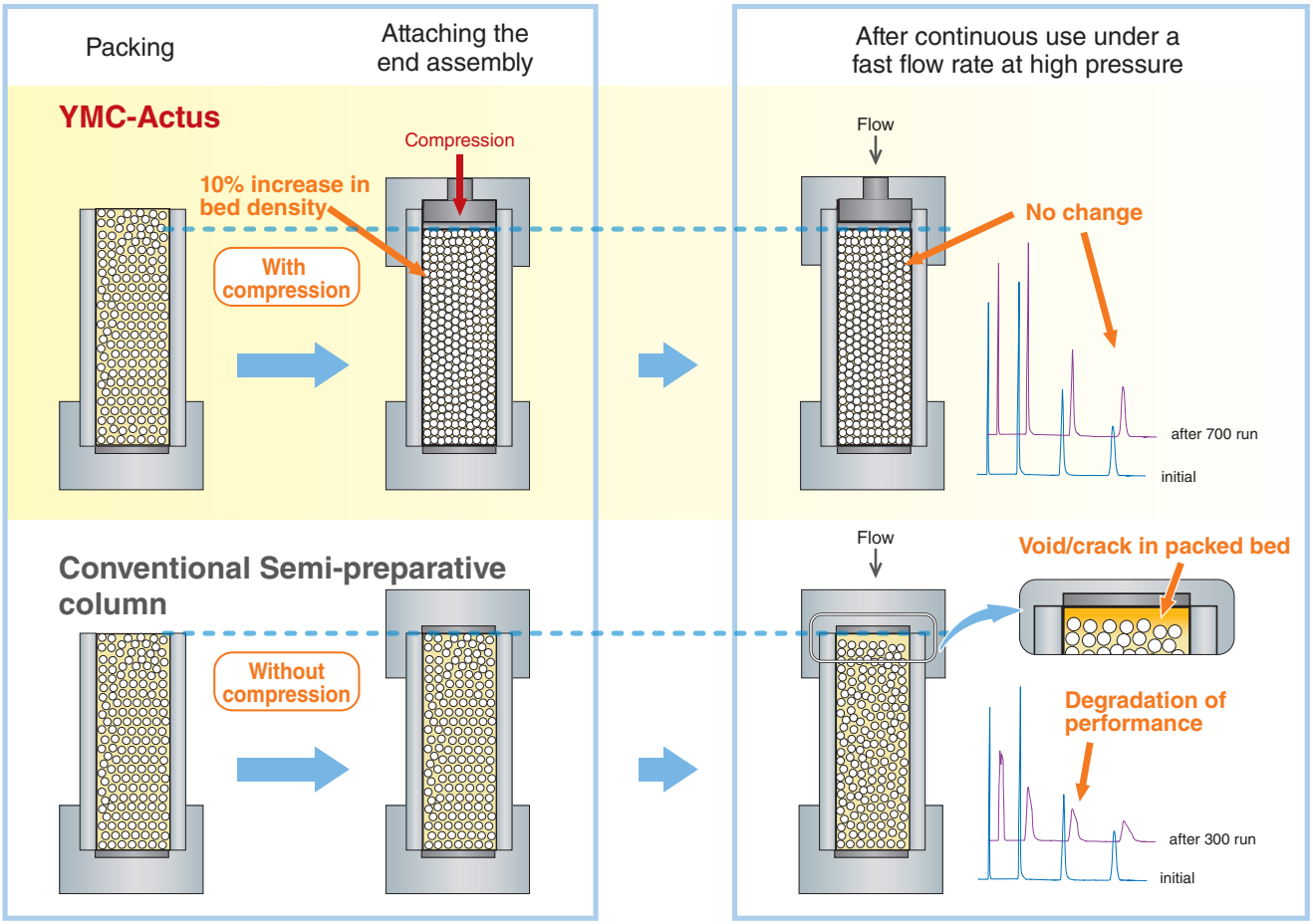
Semi-preparative HPLC columns with outstanding column durability

YMC-Actus Triart

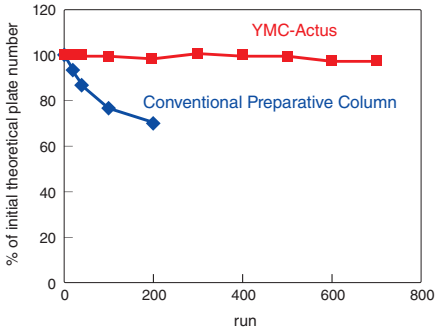
- Improved durability by applying axial compression technology
- Prepacked column for milligram scale preparative HPLC
- Excellent resolution

Great durability achieved by applying axial compression technology

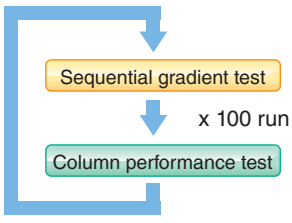
【Excellent durability provided by improved bed density】



Column durability study



Test condition



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. or 50 X 19 mmI.D.
Eluent : methanol/water (60/40)
Flow rate : 10 mL/min
Sample : naphthalene

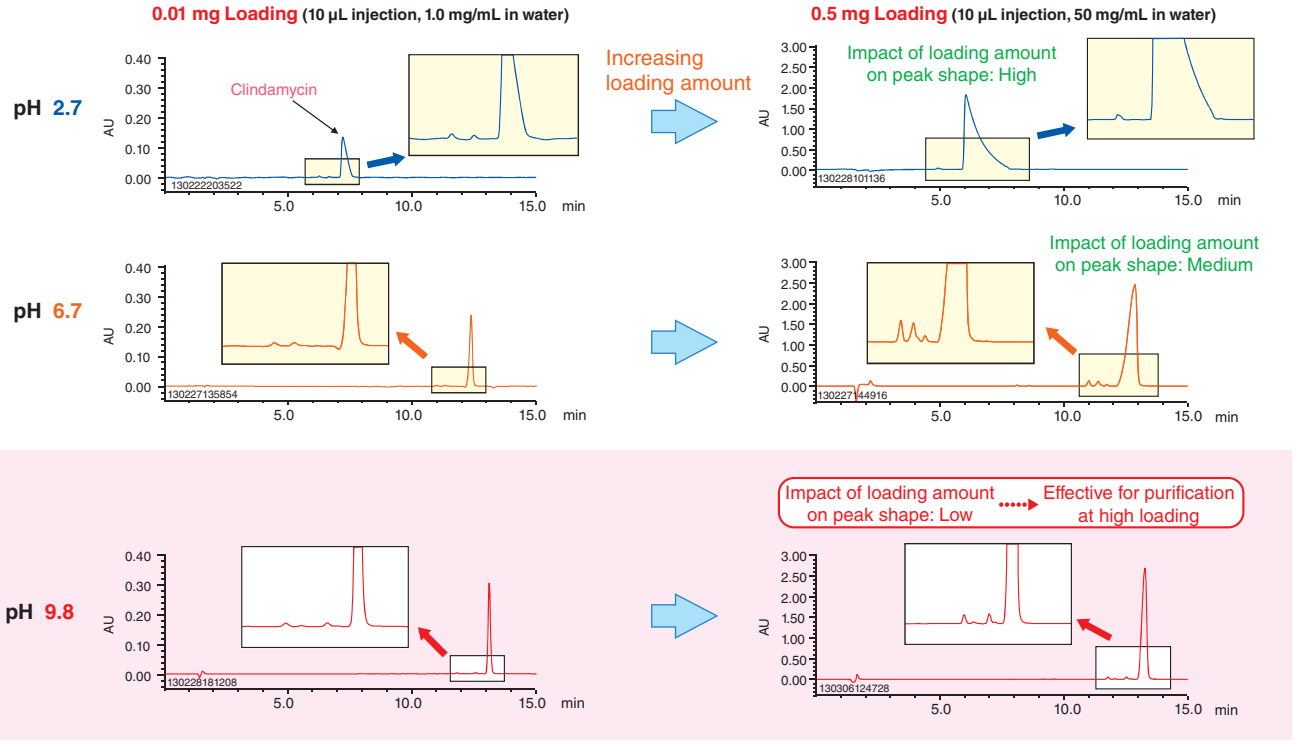
Uniformly high density packing is necessary for high performance HPLC column. DAC (Dynamic Axial Compression) column is widely used for preparative separation in pilot or production scale. It allows uniformly high density packing and prevents formation of voids during use by applying continuous compression.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

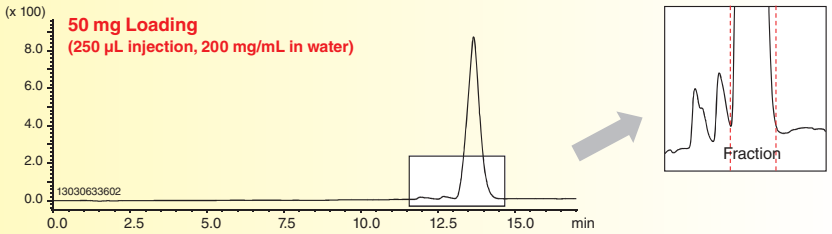
Purification method development

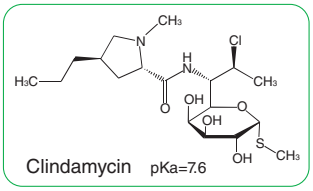
YMC-Triart C18 5 µm, 150 X 4.6 mmI.D.



Purification at pH 9.8

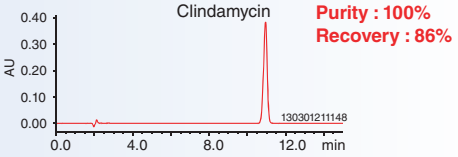
YMC-Actus Triart C18 5 µm, 150 X 20 mmI.D.





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.