C190-E043C

Access to your success
SHIMADZU

# Shimadzu HPLC Columns

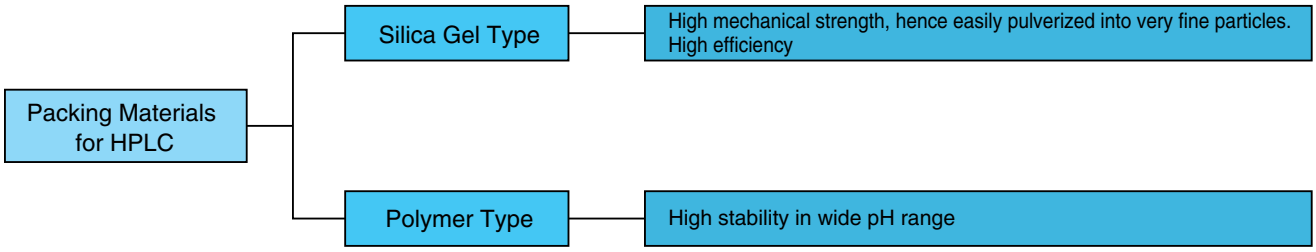
## Shimadzu
## High Performance Liquid Chromatograph

# CONTENTS

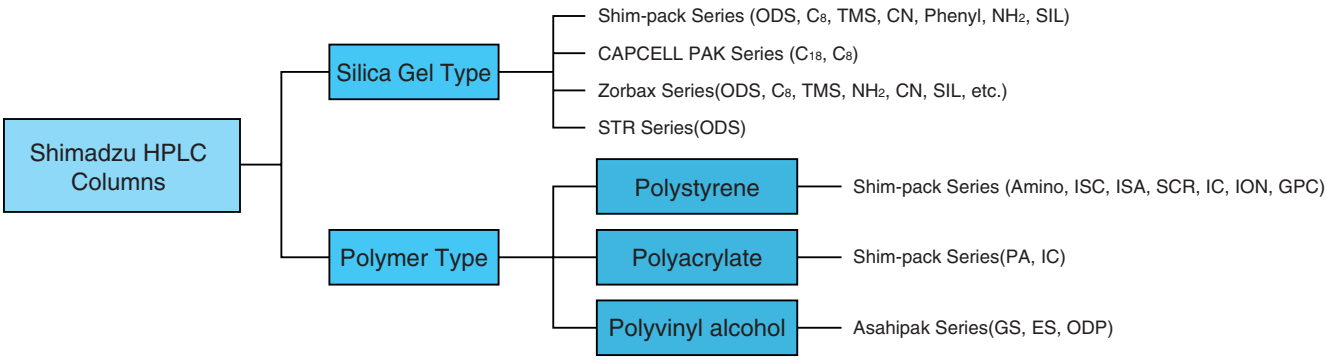
# 1 Classification of Shimadzu HPLC Columns

## Classification by Support Material

The solid supports of packing materials for HPLC are classified into the following two groups with the following features.

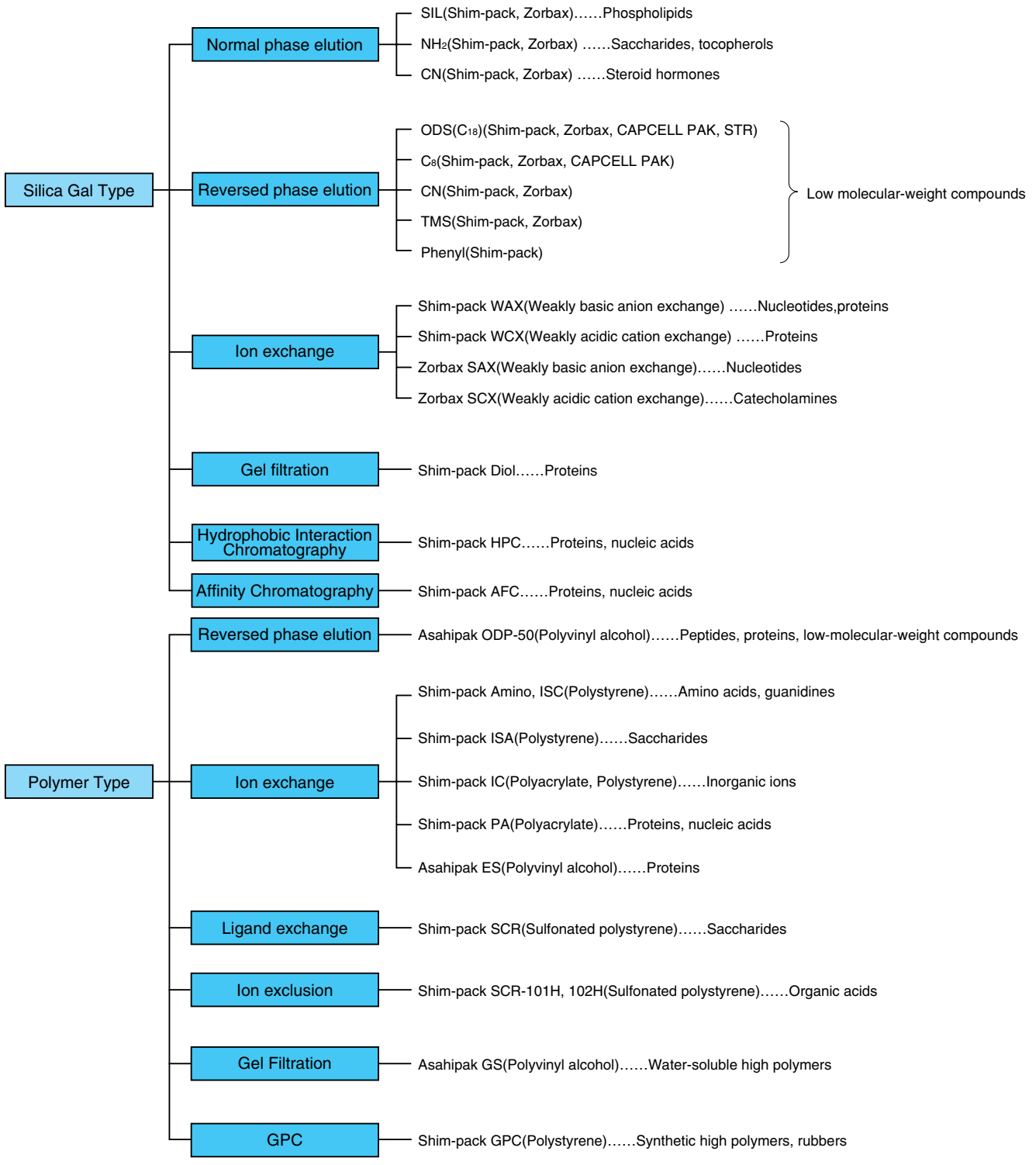



The Shimadzu HPLC columns can be classified into two groups as follows:



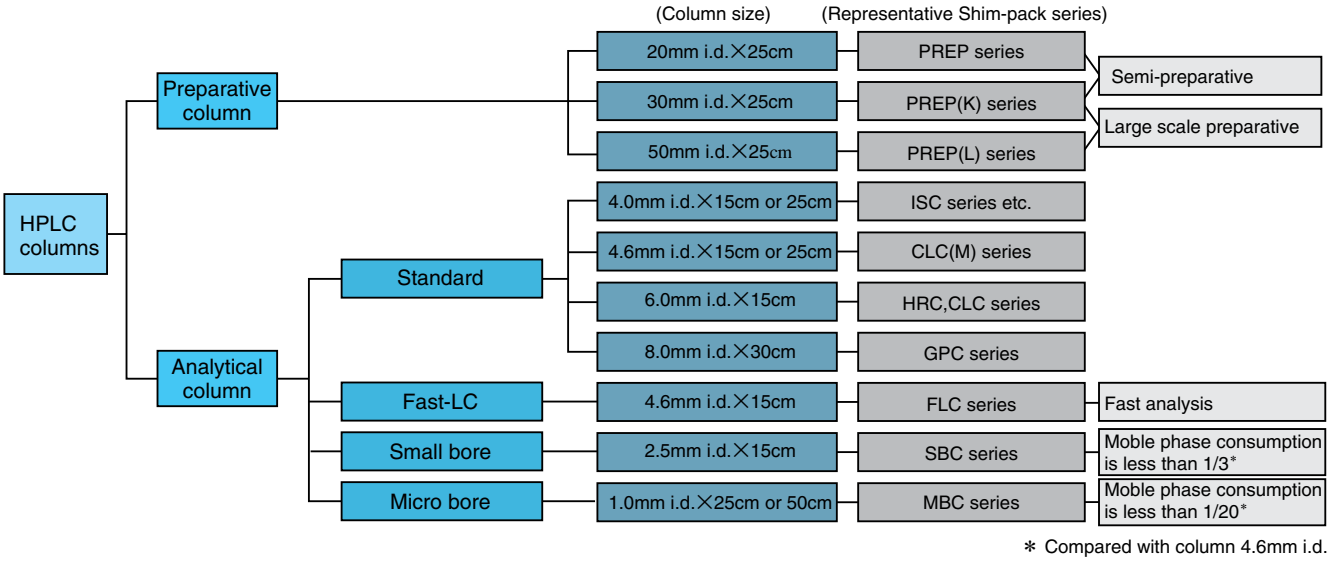
## Classification by Elution Mode

● The two groups are futher classified as follows:



## Classification by Column Dimensions

- HPLC columns are classified as analytical columns and preparative columns according to the dimensions.
- Analytical columns are further classified into several groups.




* Compared with column 4.6mm i.d.

- You can choose 20mm i.d., 30mm i.d., 50mm i.d. preparative columns in accordance with the scale of preparative. Each is 25cm long.
- As standard size analytical columns, 4～8mm i.d. and 15～30cm long columns are most widely used and are available in a wide variety.
- As other special sizes, analytical columns such as Fast-LC columns, Micro bore columns and small bore columns are available. (Refer to P.26)

### Micro bore columns

- Shimadzu MBC series micro bore columns are only 1.0mm in inner diameter.
- The mobile phase consumption is only about 1/20 that required in a 4.6mm i.d. column, because the same linear velocity can be obtained with about 1/20 flow rate.
- The sample injector, the detector flow-thru cell, and connecting pipes of a small capacity must be used.

### Small bore columns

- Shimadzu SBC series small bore columns are 2.5mm in inner diameter.
- The mobile phase consumption is about 1/3 compared with a 4.6mm i.d. column.
- Though this series columns are compatible with an ordinary HPLC, it is better to use small capacity units.

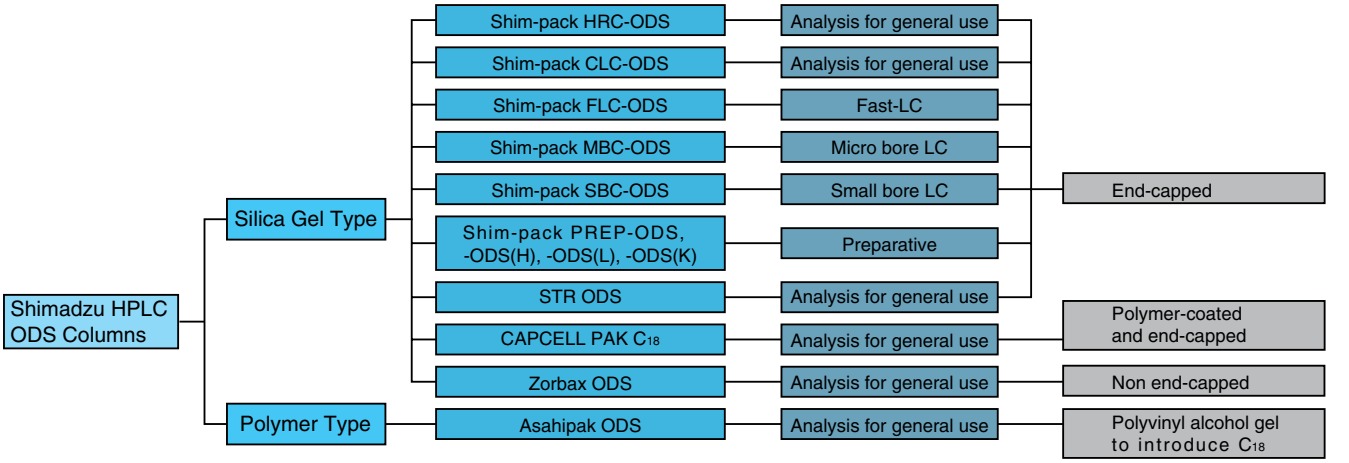
### Fast-LC columns

- Shimadzu FLC series fast LC columns are packed with 3 $\mu$m dia.
- Column packing is only 5cm long.
- They are compatible with an ordinary HPLC and permit very fast analysis.

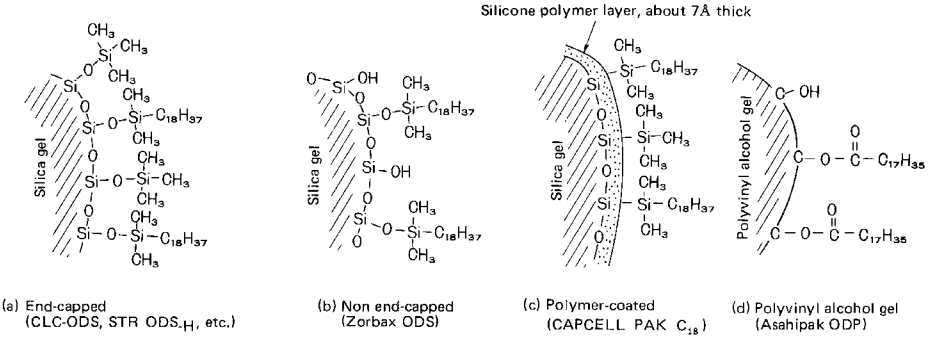
# Classification by ODS Columns

## ODS columns

ODS columns are packed with packing material having octadecyl group chemically-bonded on the surface and are most popularly used in HPLC.
ODS columns can have different separation properties, according to the state of end-capping and the characteristics of the silica gel used as the solid support. They can also be different with the brand.
The delicate differences in separation properties can be utilized to achieve some difficult analysis.
Shimadzu provides various types of ODS columns to ensure a wide field of application.




## Method to Introduce $C_{18}$ Groups




(a) End-capped (CLC-ODS, STR ODS-H, etc.)
(b) Non end-capped (Zorbax ODS)
(c) Polymer-coated (CAPCELL PAK $C_{18}$)
(d) Polyvinyl alcohol gel (Asahipak ODP)

## Selection of ODS Columns

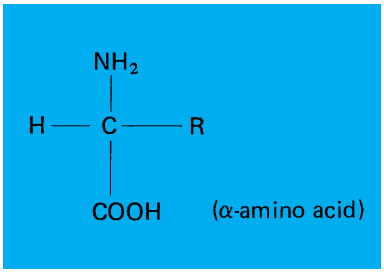
As standard analytical columns, we provide Shim-pack HRC-ODS, CLC-ODS, STR ODS, Zorbax ODS, CAPCELL PAC $C_{18}$, Asahipak ODP.
The following table is a rough guide for selecting ODS columns.

| Column name | Features | Mobile phase pH range |
|---|---|---|
| Shim-pack HRC-ODS<br>Shim-pack CLC-ODS<br>STR ODS | End-capped to minimize the influence of residual silanol groups and eliminate tailing of basic compounds. | 2～7.5 |
| Zorbax ODS | Utilizes the influence of residual silanol compounds. | 2～7.5 |
| CAPCELL PAK $C_{18}$ | Silica gel solid support is coated with silicone polymer to improve stability in basic mobile phase. | 2～10 |
| Asahipak ODP-50 | Applicable to mobile phase up to pH13.<br>The selectivity is different from that of silica gel types. | 2～13 |

# 2 Guide for Selection of Operational Conditions

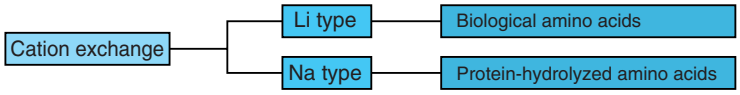
## Amino Acids

Amino acids are amphoteric compounds having carboxyl groups and amino groups. Amino acids are classified as acidic, neutral, and basic according to the number of these groups. Also they are classified as aliphatic type and aromatic type, depending on the group at the position of R.




### Separation mode

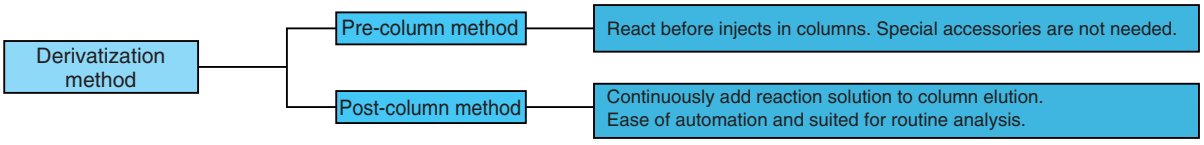
- The cation exchange chromatography is most popular.
- It is classified into two methods, Li type and Na type.




- The Li type is recommended for analysis of biological amino acids. It is also used for separating glutamine and glutamic acid.
- Reversed phase elution mode can separate particular type of amino acids but cannot separate all free amino acids.
- It is quite effective for separating amino acids derivatized by precolumn derivatization.

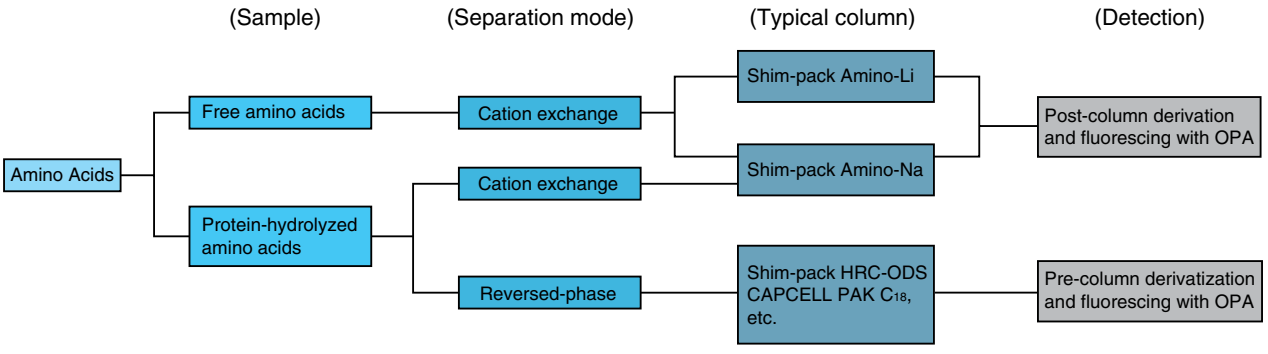
### Detection Method

- The UV absorption method which utilizes the absorption of carboxyl groups at 200～210nm is not widely used though it is useful for detecting some type of amino acids.
- Pre-column derivatization and post-column derivatization methods are often used for detecting amino acids.




- Pre-column derivatization method:
  The sample solution is derivatized before entering the analytical column. Combination of the pre-column derivatization method and the reversed phase elution mode provides rapid analysis of amino acids produced in hydrolysis of proteins. The reagents for pre-column derivatization such as OPA(ortho-phthalaldehyde) are commercially available.
- Post-column deribatization method:
  The derivatizing reagent is continuously added to the column effluent. This method has the noteworthy advantage that the entire operation can be easily automatized. Combination of the post-column derivatization method and the cation exchange method permits analysis of wide variety of amino acids ranging from free amino acids to amino acids produced in hydrolysis of proteins. The representative reagents used in the post-column derivation method are OPA (for fluorescing) and ninhydrin.

### Column




Shimadzu HPLC Amino Acid Analysis System Application Data Book (C190-E004)

# Peptides and Proteins

Peptides and proteins consist of amino acids which are combined by acid-amide bonding. Their ionic and hydrophobic properties are different depending on the type and the number of constituting amino acids.
Proteins have high-degree structures with various combinations.

## Separation mode

- Peptides and proteins are generally analyzed by one of the following methods.

| | |
|---|---|
| Gel filtration | Separation by molecular sizes |
| Ion exchange | Separation by molecular electric charge |
| Reversed phase | Separation by molecular hydrophobic properties |
| Hydrophobic | |

## Detection Method

- The UV spectrophotometric method is generally used. Detection at 280nm is effective in most cases.
- Detection at about 210nm is used for detection of peptides consisting of aliphatic amino acids and detection of low-concentration peptides and proteins.

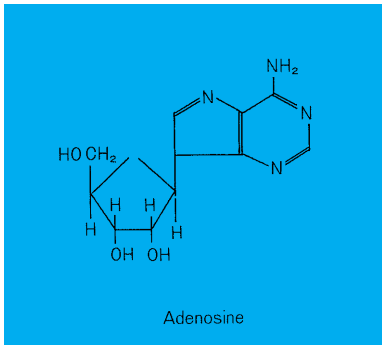
## Column

| Peptides Proteins | (Separation mode) | (Pepresentative column) | |
|---|---|---|---|
| | Gel filtration | Shim-pack Diol | (Refer to P.41) |
| | | Asahipak GS | (Refer to P.62) |
| | Cation exchange | Shim-pack WCX-1 | (Refer to P.33) |
| | | Shim-pack PA-CM | |
| | | Shim-pack PA-SP | |
| | | Asahipack ES-502C | (Refer to P.64) |
| | Anion exchange | Shim-pack WCX-2 | (Refer to P.33) |
| | | Shim-pack PA-DEAE | |
| | | Shim-pack PA-QA | |
| | | Asahipack ES-502N | (Refer to P.64) |
| | Reversed phase | Shim-pack HRC-ODS | (Refer to P.21) |
| | | Shim-pack CLC-ODS | (Refer to P.23) |
| | | Asahipack ODP-50 | (Refer to P.59) |
| | | CAPCELL PAK $C_{18}$ | (Refer to P.66) |
| | | STR ODS | (Refer to P.70) |
| | Hydrophobic | Shim-pack HPC | (Refer to P.47) |

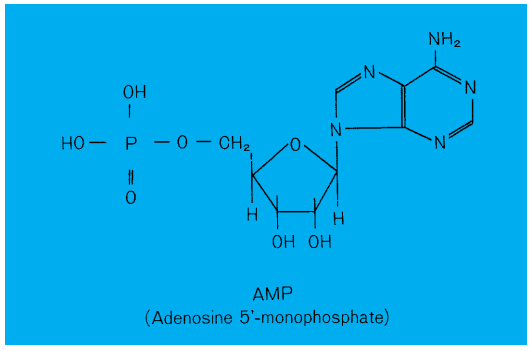
# Nucleic Acids

Nucleic acids play important roles in organism. They are classified into the following three groups:


Nucleic acid base




Nucleoside
(Nucleic acid base + sugar)




Nucleotide
(Nucleoside + phosphorus)

## Separation mode

- Nucleic acid bases and nucleosides are analyzed in the cation exchange mode or the reversed phase elution mode.
- Nucleotides are analyzed in the anion exchange mode in most cases. The reversed phase elution is also useful with suitable selection of mobile phases.
- In analysis of high molecular weight samples such as oligonucleotides, DNA, and RNA, gel filtration mode, hydrophobic mode, and ion exchange mode are selectively used.

## Detection Method

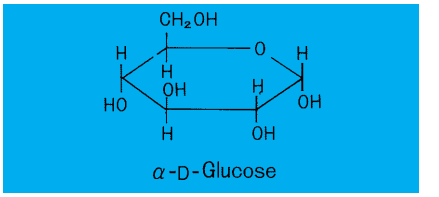
- Nucleic acids and related compounds generally have strong ultraviolet absorption, therefore UV spectrophotometric detection (250～260nm) is used in most cases.

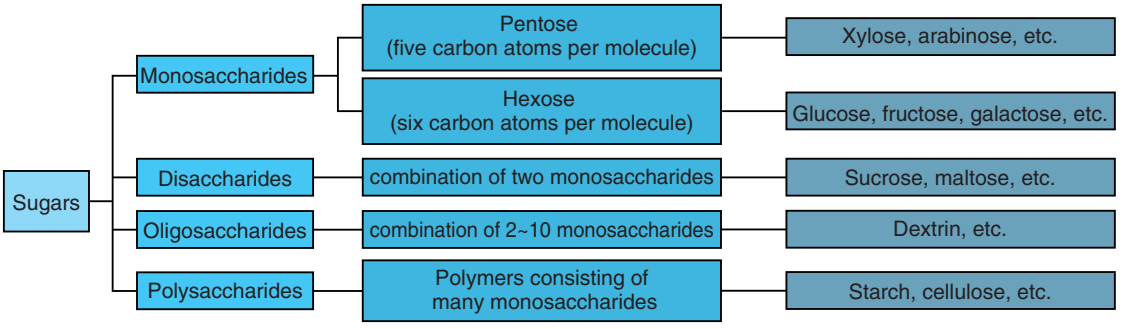
## Column

| | | (Separation mode) | (Column) | |
|---|---|---|---|---|
| Nucleic Acids | Nucleic acid bases and nucleosides | Cation exchange | Shim-pack WCX-1 | (Refer to P.24) |
| | | Reversed phase | Shim-pack HRC-ODS | (Refer to P.14) |
| | | | Shim-pack CLC-ODS | (Refer to P.16) |
| | | | Asahipak ODP-50, GS | (Refer to P.59) |
| | Nucleotides | Anion exchange | Shim-pack WAX-1 | (Refer to P.33) |
| | | Reversed phase | Shim-pack HRC-ODS | (Refer to P.14) |
| | | | Shim-pack CLC-ODS | (Refer to P.30) |
| | | | Asahipak GS | (Refer to P.62) |
| | DNA and RNA | Gel filtration | Shim-pack Diol | (Refer to P.41) |
| | | | Asahipak GS | (Refer to P.62) |
| | | Anion exchange | Shim-pack WAX-2 | (Refer to P.33) |
| | | | Shim-pack PA-DEAE | |
| | | | Shim-pack PA-QA | |
| | | | Asahipak ES-502N | (Refer to P.64) |
| | | Hydrophobic | Shim-pack HPC | (Refer to P.47) |

# Sugars

Sugars such as glucose and sucrose are very common and are available in a great variety.




## Separation mode

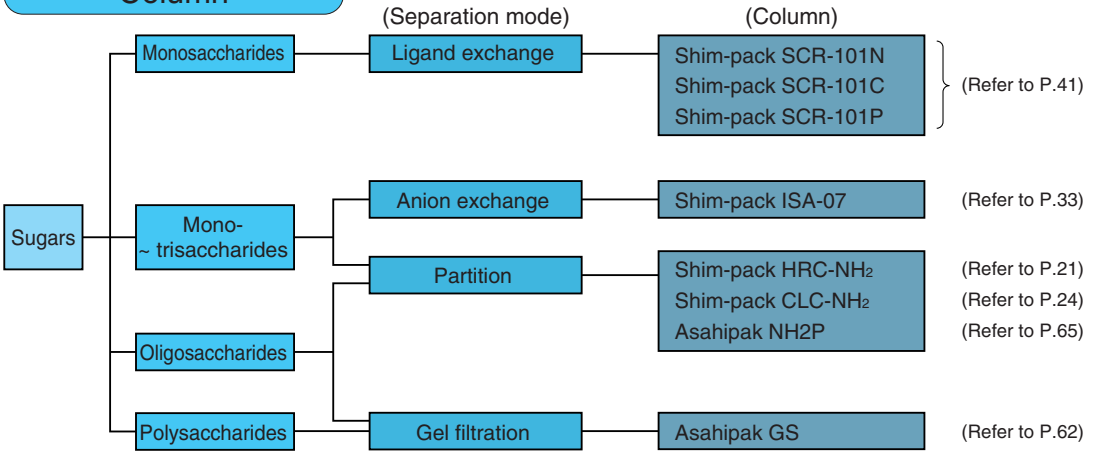
- Sugars are generally analyzed by one of the following methods.

| | | | |
|---|---|---|---|
| Partition | Separation by the interaction based on partition | Separation of mono- ~15-saccharide | Poor separation of epimers |
| Ligand exchange | Separation by the interaction between and counter-ion on sulfonic acids | Separation of monosaccharides and separation of sugars from alcohols | Poor separation of di- and higher saccharides |
| Anion exchange | Separation by the interaction based on ion exchange of sugar-borate complex | Separation of mono-~trisaccharides | Time consuming |
| Gel filtration | Separation by the size of the molecular | Measurement of molecular weight distribution | Components of the same molecula weight cannot be separated. |

## Detection Method

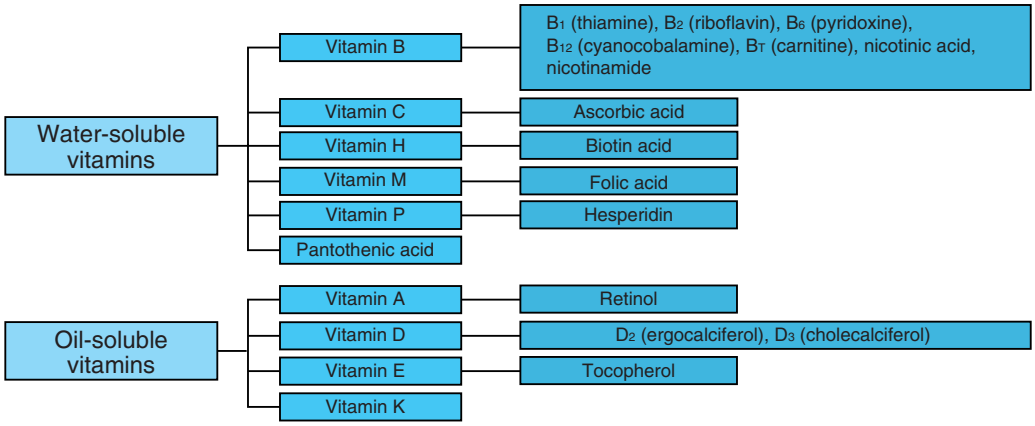
- A UV spectrophotometric detector is not used because sugars absorb radiation only around 190nm.
- A refractive index detector is generally used in the analysis of sugars.
- When sugar content is low and impurity content is high, as in the case of brewage products and natural materials, the post-column derivatization method is used.

## Column



# Vitamins

Vitamins are classified as water-soluble type and oil-soluble type.

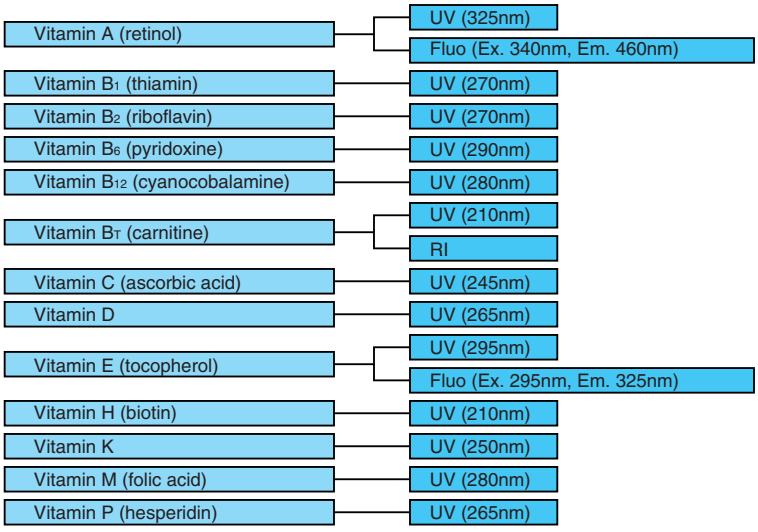



## Separation mode

- Both water-soluble and oil-soluble vitamins are analyzed in the reversed phase elution mode.
- Some oil-soluble vitamins are analyzed in the partition mode.

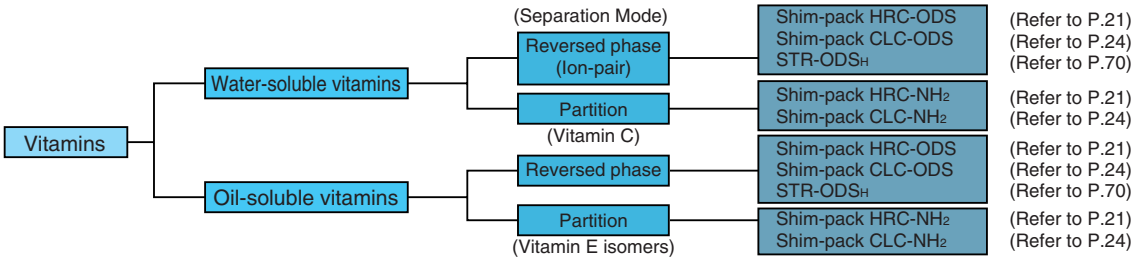
## Detection Method

- The UV spectrophotometric method is generally used: the spectrofluorometric method is used for some vitamins.



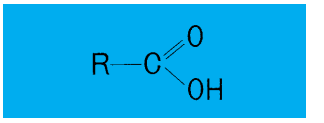

Note: The above wavelength values are approximate; they can be influenced by the state of mobile phase.

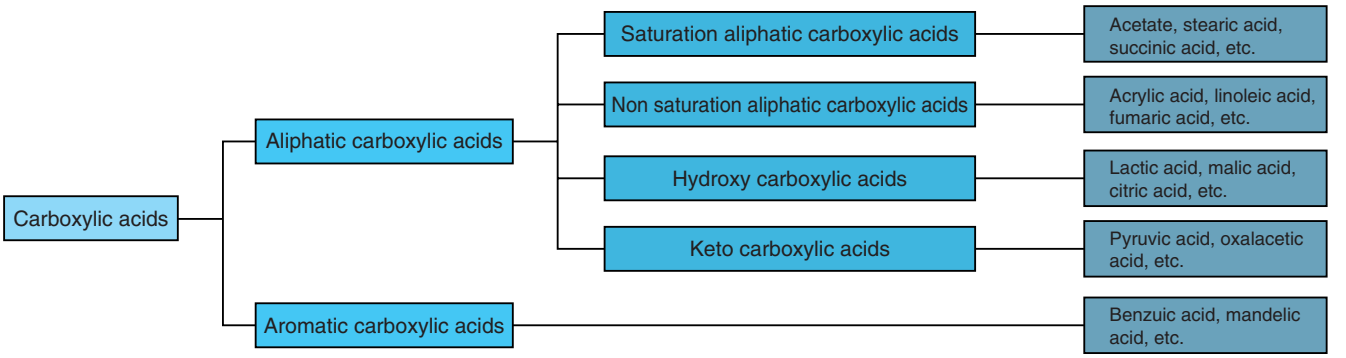
## Column



# Carboxylic acids

Carboxylic acids are organic compounds, including carboxyl group and stand for acids properties. These are classified as follows.




Carboxylic acids are also classified into mono, di, poly (more than 3) carboxylic acids in accordance with the number of carboxyl group.

## Separation mode

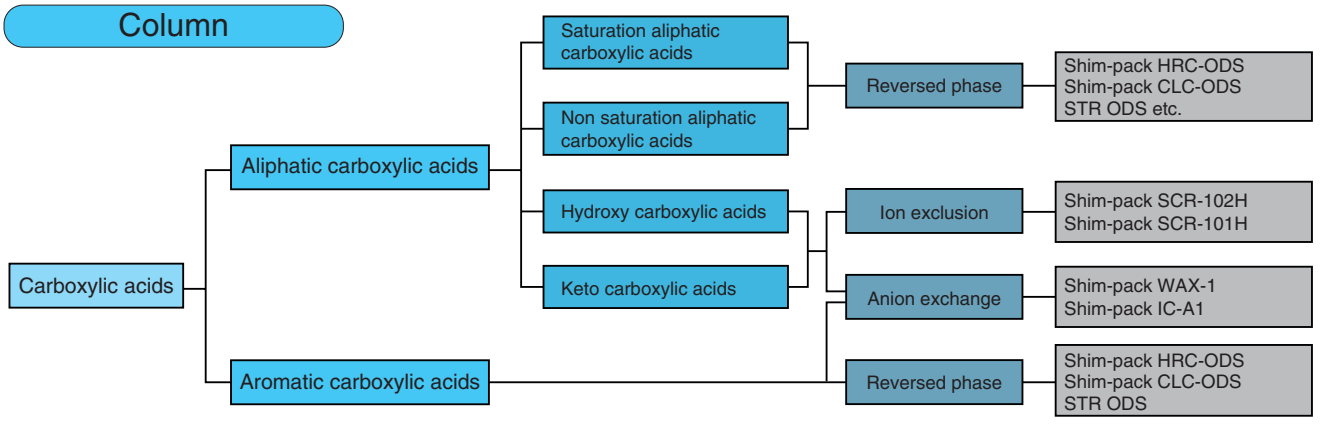
Ion exclusion chromatography, anion ion exchange chromatography and reversed phase chromatography can be used in accordance with the dissociation and the side chain of carboxylic acid.

- Ion exclusion chromatography is suitable for the analysis of high aqueous carboxylic acids and used widely to analyze food and cultivation solutions.
- Anion exchange chromatography is a basic mode of carboxylic acids having the properties of acids and has an advantage of separating from neutral components.
- Reversed phase chromatography is suitable for the separation of fatty acid and aromatic carboxylic acids.

## Detection Method

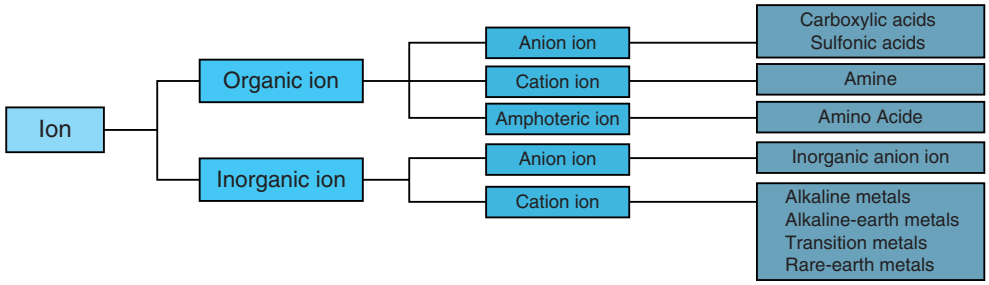
- Carboxylic acids have slight absorbency at around 205nm, therefore UV spectrophotometoric detector can be used. As far as aromatic carboxylic acids and aliphatic carboxylic acids are concerned, these absorbencies are relatively strong so that can be detected with a high sensitivity.
- However, the absorbency coefficients of carboxylic acids are generally small and the selectivity of the detection are poor. As a result, there are cases where it is difficult to analyze some samples. Therefore, pre-column derivatization using label to carboxyl group might be used.
- Post-column conductivity detector making use of separating carboxul group makeks it possible to improve selectivity.

## Column



# Ion

Ions are classified as follows. Mainly inorgainic ion and low molecale organic ion are the object of ion chromatography analysis.

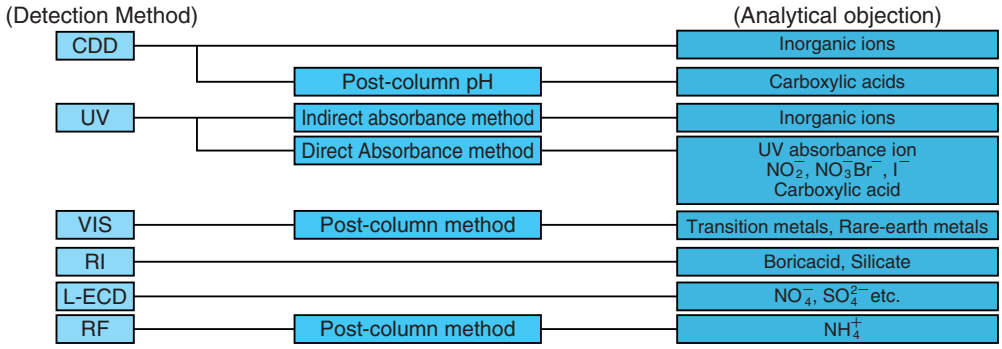



## Separation mode

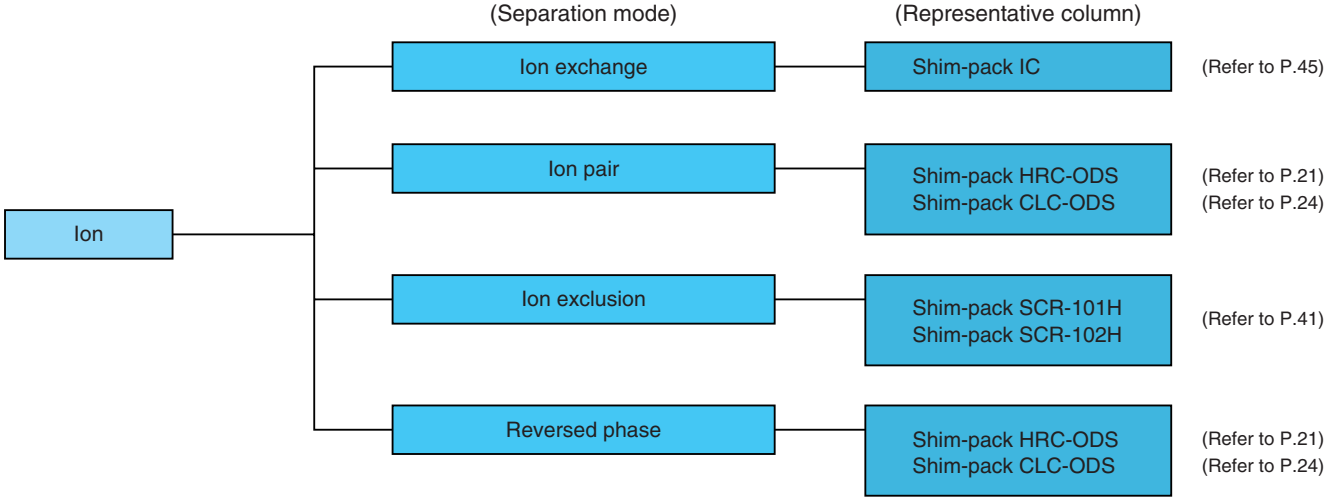
Ion exchange is a main method, but sometimes ion pair and reversed phase method are used.

## Detection Method

- In IC (Ion chromatography) analysis, generally conductivity detector can be used with a high sensitive.
- In special ions, many selectible detector can be used to make use of each chemical property.



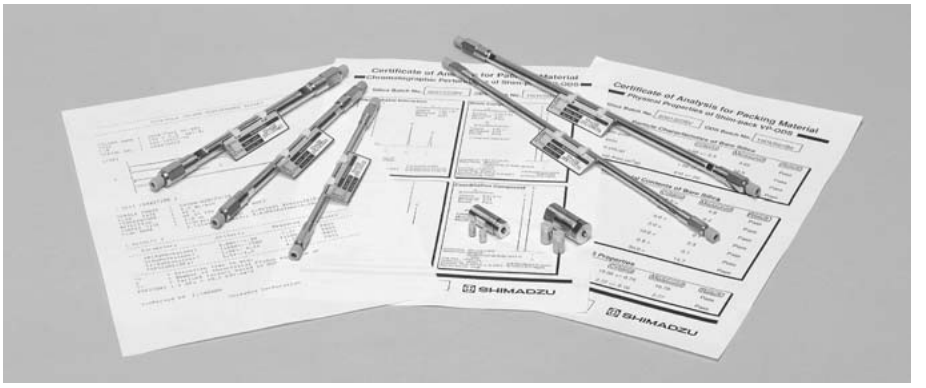

## Column



# 3 Shimadzu HPLC Columns

## Shim-pack VP-ODS *for GLP/GMP compliance*

For development or validation of analytical method, manufacturing uniformity of columns is increasing.
Shim-pack VP-ODS has been developed to meet such expectations.




〈VP-ODS Series〉

### ■Analytical Column Shim-pack VP-ODS

| Cat. No. | I.D.×length (mm) |
|---|---|
| 228-34937-91 | 4.6×150 |
| 228-34937-92 | 4.6×250 |
| 228-34937-93 | 6.0×150 |
| 228-34937-94 | 2.0×150 |
| 228-34937-95 | 2.0×250 |
| 228-34937-96 | 4.6×150, a set of 3pcs. |
| 228-34937-97 | 2.0×150, a set of 3pcs. |

＊An analytical column set consists of three columns whose packings (Silica-based) are from different production batches.

### ■Guard Column Shim-pack VP-ODS

| Cat. No. | I.D.×length (mm) |
|---|---|
| 228-34938-91 | 4.6×10<br>Incl. exchangeable cartridge 2pcs. |
| 228-34938-92 | A holder for I.D. 4.6mm |
| 228-34938-93 | 2.0×5<br>Incl. exchangeable cartridge 2pcs. |
| 228-34938-94 | A holder for I.D. 2.0mm |

＊Guard column consists of a cartridge and holder. Holders can be used repeatedly.

### ■Short Columns for Analytical/Preparative

| Cat. No. | I.D.×length (mm) | Remarks |
|---|---|---|
| 228-36849-91 | 4.6×50 | 5 μm diameter, |
| 228-36849-92 | 20×50 | 12nm (120Å) pore |
| 228-36849-93 | 20×100 | porous silica ODS |

## Excellent manufacturing uniformity

To minimize column-to-column performance deviation of ODS columns, silica-bases, surface treatment and packing procedures are strictly controlled respectively and only the products that passed the quality criteria are delivered to customers. For development or validation of method, it would be efficient to run the test with a set of three columns with packings of different batches.

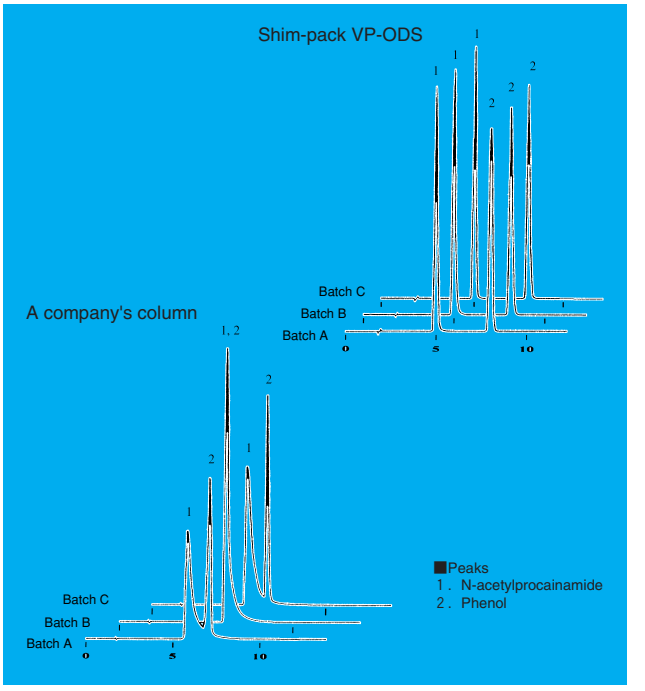



**Fig. 1 Comparison of lot-to-lot repeatability (Silica-based material)**

# 3 Shimadzu HPLC Columns

## Shim-pack VP-ODS *for GLP/GMP compliance*

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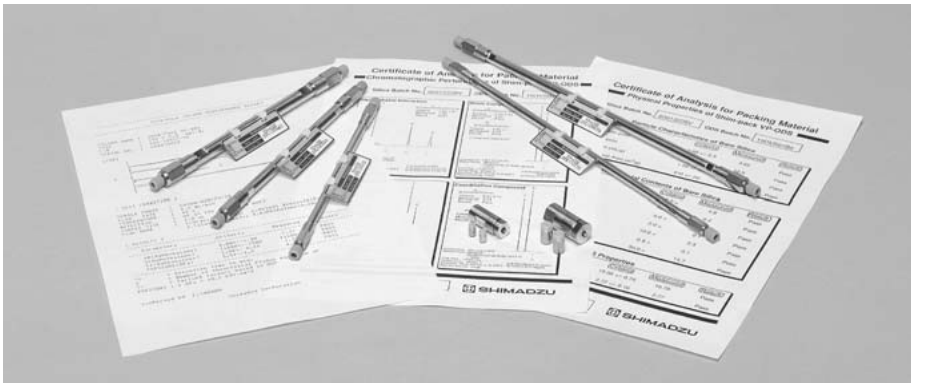



〈VP-ODS Series〉

### ■Analytical Column Shim-pack VP-ODS

| Cat. No. | I.D.×length (mm) |
|---|---|
| 228-34937-91 | 4.6×150 |
| 228-34937-92 | 4.6×250 |
| 228-34937-93 | 6.0×150 |
| 228-34937-94 | 2.0×150 |
| 228-34937-95 | 2.0×250 |
| 228-34937-96 | 4.6×150, a set of 3pcs. |
| 228-34937-97 | 2.0×150, a set of 3pcs. |

＊An analytical column set consists of three columns whose packings (Silica-based) are from different production batches.

### ■Guard Column Shim-pack VP-ODS

| Cat. No. | I.D.×length (mm) |
|---|---|
| 228-34938-91 | 4.6×10<br>Incl. exchangeable cartridge 2pcs. |
| 228-34938-92 | A holder for I.D. 4.6mm |
| 228-34938-93 | 2.0×5<br>Incl. exchangeable cartridge 2pcs. |
| 228-34938-94 | A holder for I.D. 2.0mm |

＊Guard column consists of a cartridge and holder. Holders can be used repeatedly.

### ■Short Columns for Analytical/Preparative

| Cat. No. | I.D.×length (mm) | Remarks |
|---|---|---|
| 228-36849-91 | 4.6×50 | 5 μm diameter, |
| 228-36849-92 | 20×50 | 12nm (120Å) pore |
| 228-36849-93 | 20×100 | porous silica ODS |

## Excellent manufacturing uniformity

To minimize column-to-column performance deviation of ODS columns, silica-bases, surface treatment and packing procedures are strictly controlled respectively and only the products that passed the quality criteria are delivered to customers. For development or validation of method, it would be efficient to run the test with a set of three columns with packings of different batches.

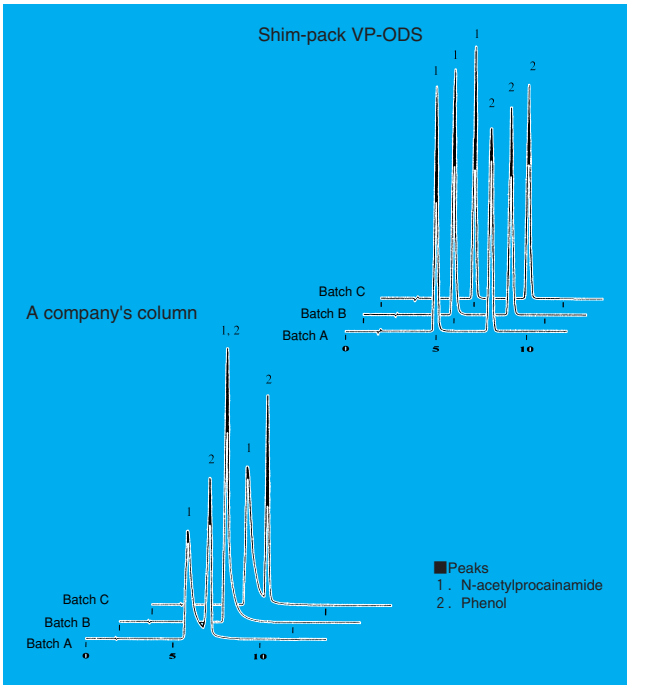
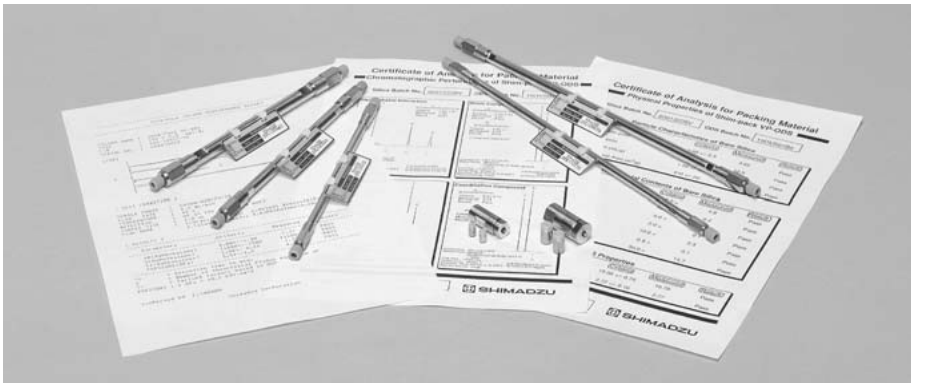



**Fig. 1 Comparison of lot-to-lot repeatability (Silica-based material)**

# 3 Shimadzu HPLC Columns

## Shim-pack VP-ODS *for GLP/GMP compliance*

For development or validation of analytical method, manufacturing uniformity of columns is increasing.
Shim-pack VP-ODS has been developed to meet such expectations.




〈VP-ODS Series〉

### ■Analytical Column Shim-pack VP-ODS

| Cat. No. | I.D.×length (mm) |
|---|---|
| 228-34937-91 | 4.6×150 |
| 228-34937-92 | 4.6×250 |
| 228-34937-93 | 6.0×150 |
| 228-34937-94 | 2.0×150 |
| 228-34937-95 | 2.0×250 |
| 228-34937-96 | 4.6×150, a set of 3pcs. |
| 228-34937-97 | 2.0×150, a set of 3pcs. |

＊An analytical column set consists of three columns whose packings (Silica-based) are from different production batches.

### ■Guard Column Shim-pack VP-ODS

| Cat. No. | I.D.×length (mm) |
|---|---|
| 228-34938-91 | 4.6×10<br>Incl. exchangeable cartridge 2pcs. |
| 228-34938-92 | A holder for I.D. 4.6mm |
| 228-34938-93 | 2.0×5<br>Incl. exchangeable cartridge 2pcs. |
| 228-34938-94 | A holder for I.D. 2.0mm |

＊Guard column consists of a cartridge and holder. Holders can be used repeatedly.

### ■Short Columns for Analytical/Preparative

| Cat. No. | I.D.×length (mm) | Remarks |
|---|---|---|
| 228-36849-91 | 4.6×50 | 5 μm diameter, |
| 228-36849-92 | 20×50 | 12nm (120Å) pore |
| 228-36849-93 | 20×100 | porous silica ODS |

## Excellent manufacturing uniformity

To minimize column-to-column performance deviation of ODS columns, silica-bases, surface treatment and packing procedures are strictly controlled respectively and only the products that passed the quality criteria are delivered to customers. For development or validation of method, it would be efficient to run the test with a set of three columns with packings of different batches.

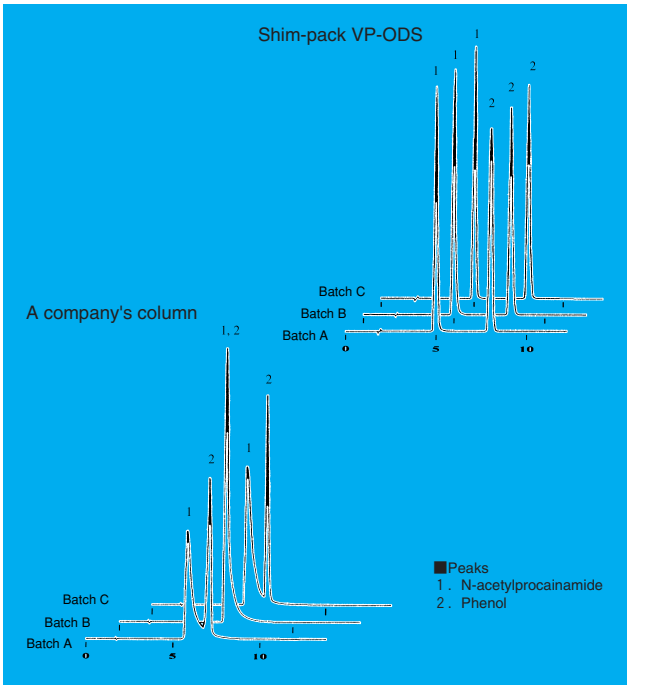


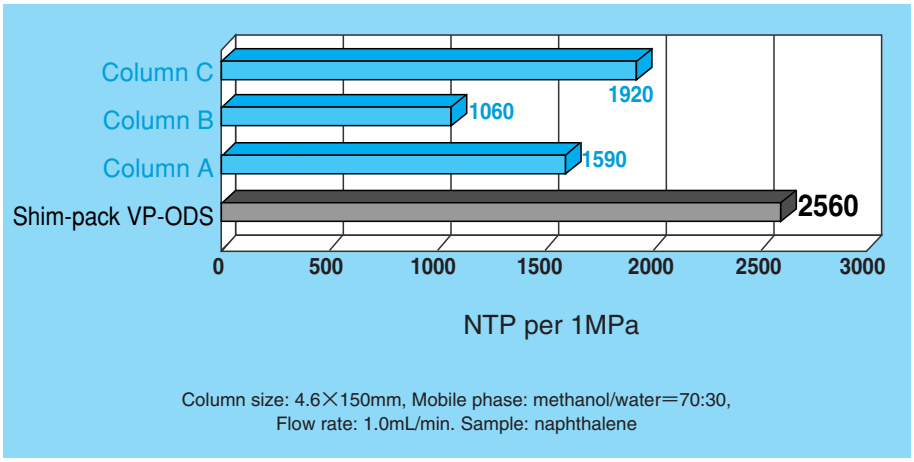

**Fig. 1 Comparison of lot-to-lot repeatability (Silica-based material)**

## 〈Packing characteristics of Shim-pack VP-ODS〉

| | |
|---|---|
| Silica particles | Entirely porous, spherical silica particles with a high purity |
| Particle size | 5 μm |
| Pore size | 12nm |
| Pore volume | 1.25mL/g |
| Specific surface area | 410m²/g |
| Trace metal content | 30ppm max |
| Percentage of ODS | 20%C |
| Carbon content | |
| ODS functional group | Mono-functional |
| End-capping | Used |

## 〈Number of theoretical plates and column pressure〉

The higher NTP is and the lower the pressure is, the easier to handle the column is. Shim-pack VP-ODS shows superior performance shown by NTP per 1MPa.




Column size: 4.6×150mm, Mobile phase: methanol/water=70:30,
Flow rate: 1.0mL/min. Sample: naphthalene

## 〈Excellent peak shapes〉

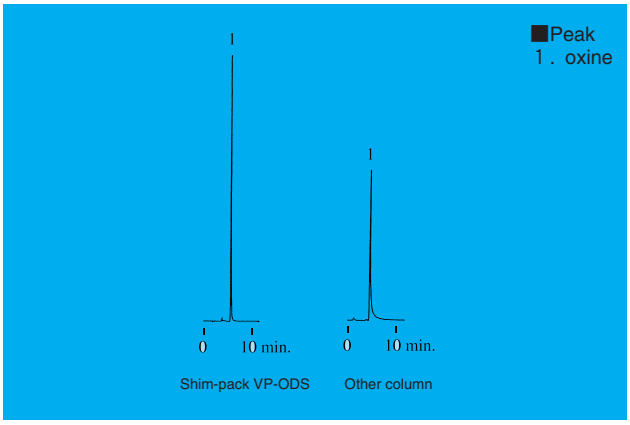



**Fig. 2**

**Excellent peak shape of coordination compounds is achieved by the packing base material with less metal impurities.**

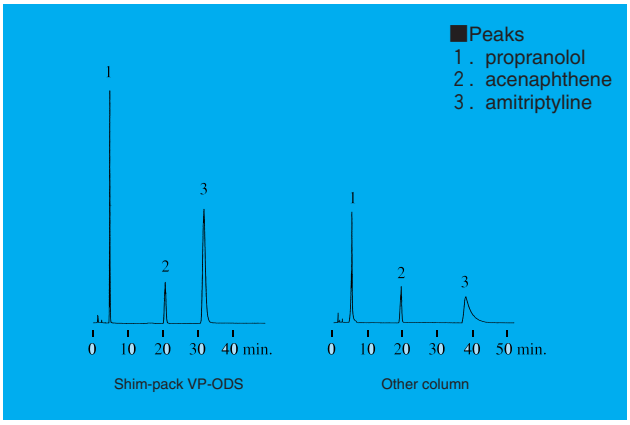


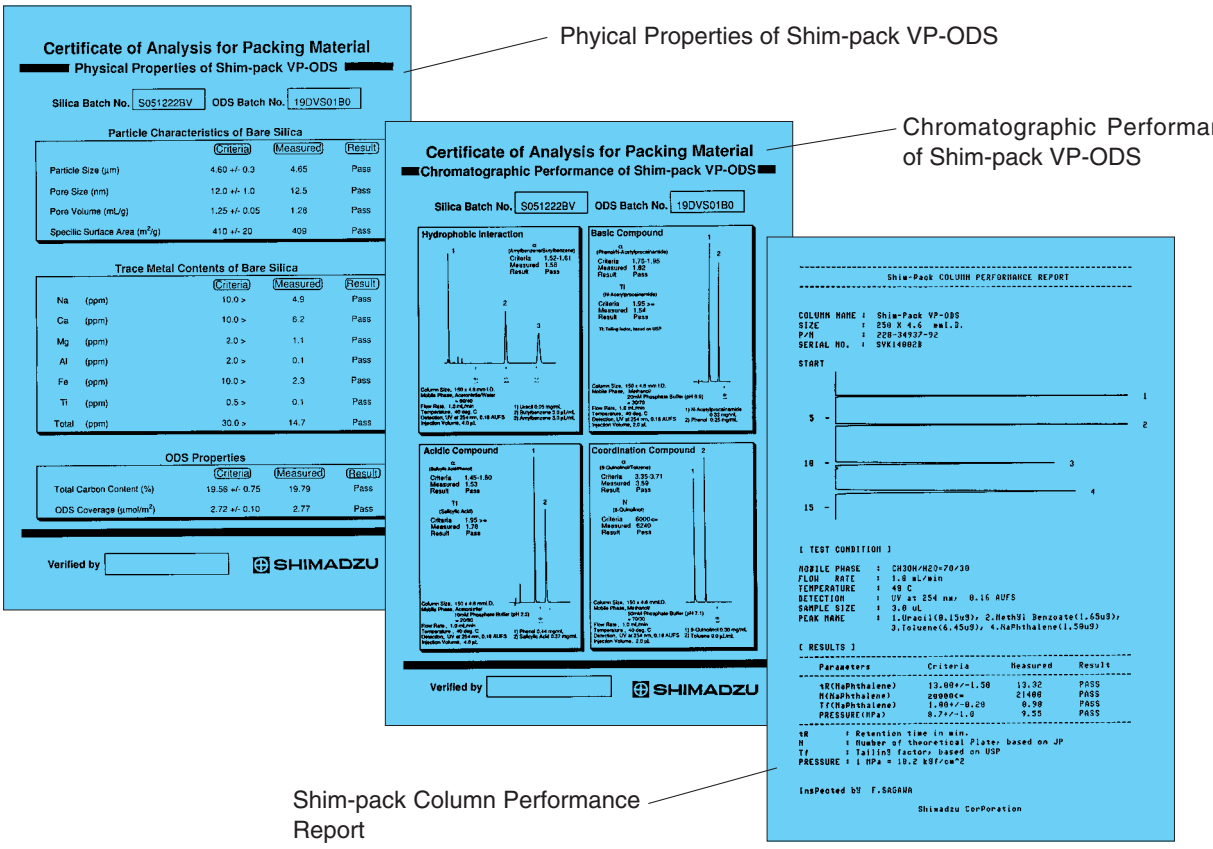

**Fig. 3**

**Excellent peak shapes of basic compounds are achieved by thorough effective end-capping of the packings.**

## 〈Certificate of Analysis (Quality certificate)〉

Shim-pack VP-ODS is shipped with three types of certificate of Analysis to support method validation for HPLC analysis.

1. Certificate of Analysis for Packing Material (Physical Properties)
2. Certificate of Analysis for Packing Material (Chromatographic Performance)
3. Shim-pack Column Performance Report




## 〈Application Data〉

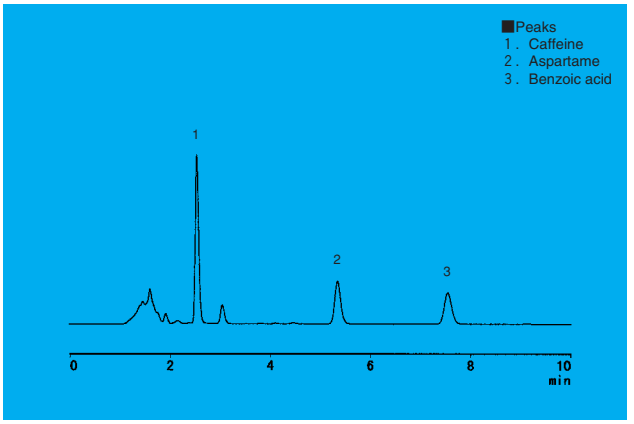



**Fig. 4 Analysis of Aspartame in Soft Drink**

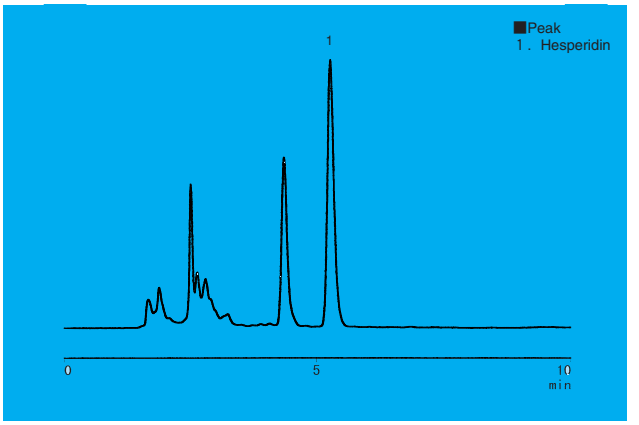



**Fig. 5 Analysis of Hesperidine in Orange Juice**

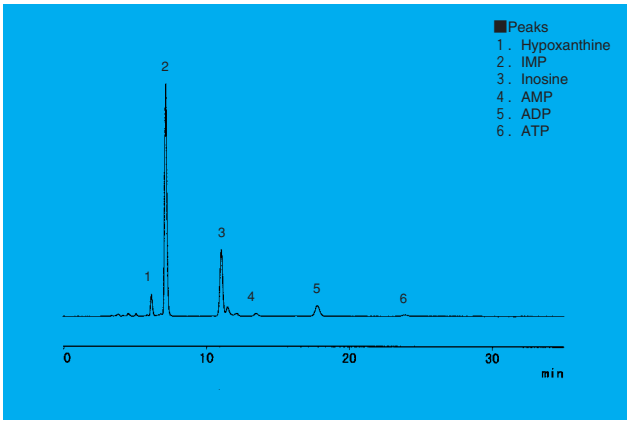



Fig. 6 Analysis of Nucleic Acid in Tuna Meet

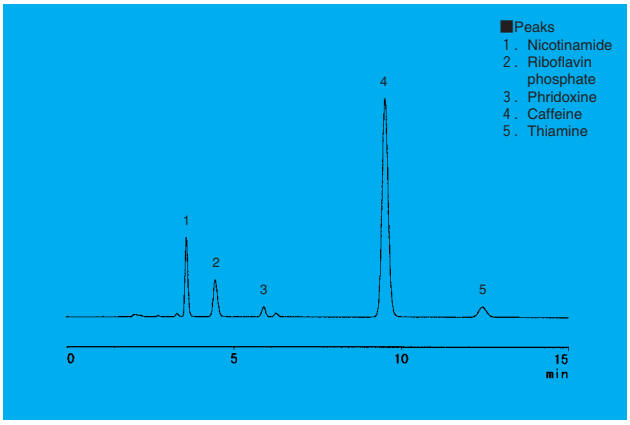



Fig. 7 Analysis of Vitamin B Group in Soft Drink

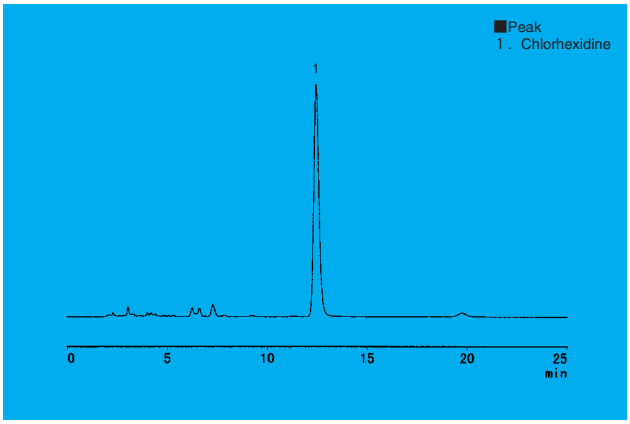



Fig. 8 Analysis of Chlorexidine in Ointment

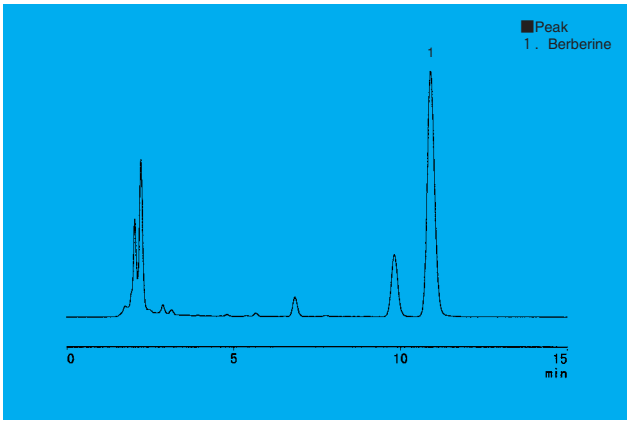



Fig. 9 Analysis of Berberine

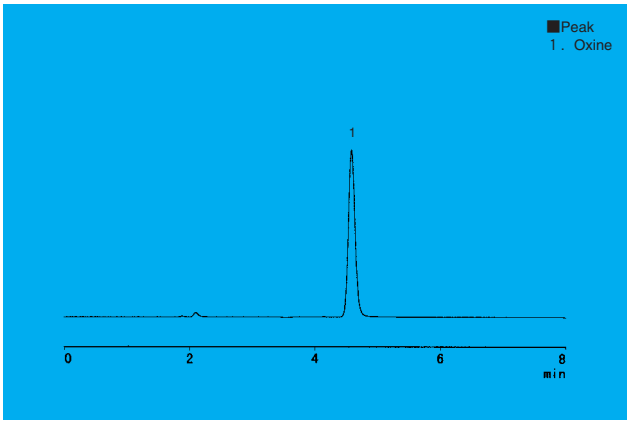



Fig. 10 Analysis of Oxine Standard

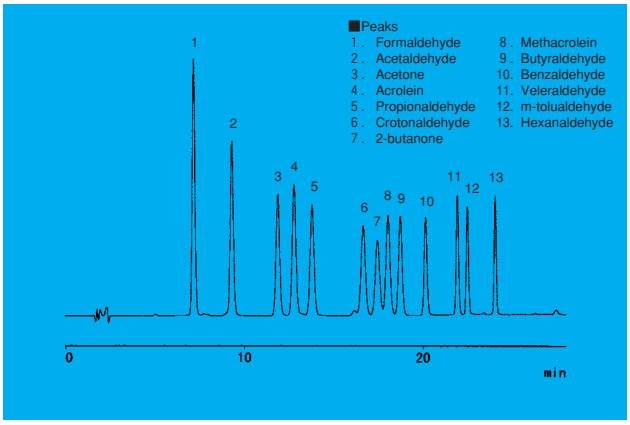
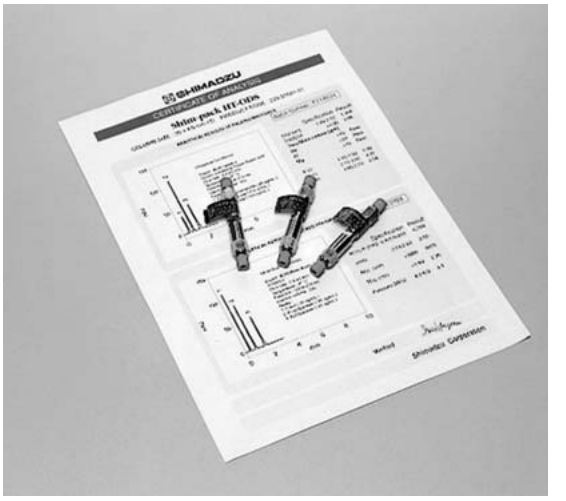



Fig. 11 Analysis of DHPH-Aldehydes, Ketones group Standard

# Shim-pack HT-ODS *High-speed HPLC columns*

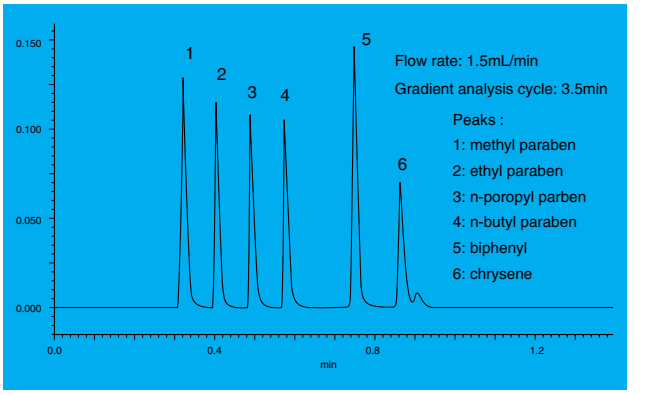
## Best Partner For High Throughput Analysis

Recently, the demand for high throughput analysis has increased. For HPLC methods, it is essential to save analysis time and to obtain reliable results. To meet such requirements, Shimadzu has developed the High Throughput (HT) column packed with very fine non-porous, high purity silica particles. With this column, it is possible to realize ultra high speed analyses (Analysis times within 1 minute.) Moreover, quality certificates for the uniformity of the packing material are provided for each column so it's easy to comply with validation requirements.
We are sure this column makes your analyses faster and more reliable.



## High speed analysis

With 2µm and non-porous packing material, it is possible to drastically reduce the gradient analysis run times while obtaining the same peak resolution. It is possible to finish an analysis within 1 minute. Shim-pack HT-ODS provides the capability of ultra high speed and high resolution analysis.




## Validation compliance

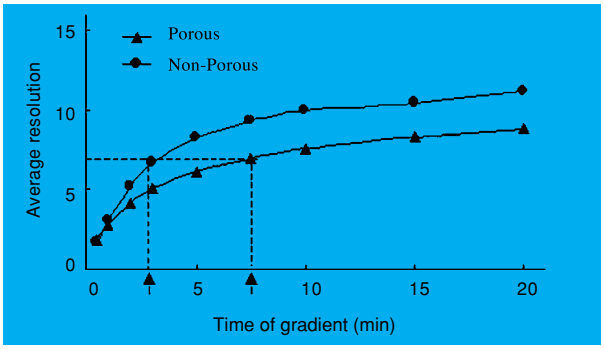
We certify the reliability of the analysis data with a 3 column set made from different lots and attach quality certificates for the uniformity of the packing material.

## The highest performance with Shimadzu LC-2010, High-throughput HPLC

The combination of the Shim-pack HT-ODS and the Shimadzu LC-2010 is sure to help you to achieve additional high throughput in your research and analyses.

## High resolution by Non-porous silica

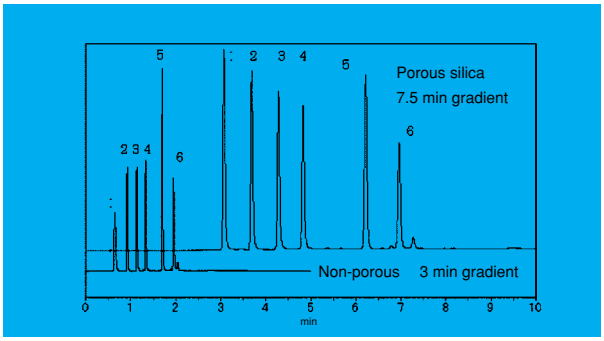
The right chart shows the time and the resolution in gradient analyses by a column packed with porous silica and one packed with non-porous silica. Non-porous silica shows higher resolution.
The time to obtain the same resolution with a non-porous column is less than the time required when using a porous silica column.




**Time of gradient and resolution**

## Benefit of non-porous silica column - High speed and reliable Analysis

The right chromatograms show gradient analyses with the same resolution by non-porous packed column and porous packed column. Non-porous column realizes high speed and reliable analysis.
Non-porous silica column can save your precious time and provide you more satisfactory performance.




**Comparison of retention time between non-porous and porous columns.**

### ■Shim-pack HT-ODS

| Cat. No. | Description | I.D.×length (mm) | Remarks |
|---|---|---|---|
| 228-37681-91 | Shim-pack HT-ODS | 4.6×30 | 2 μm non-porous silica ODS |
| 228-37681-92 | Shim-pack HT-ODS (3 column kit) | 4.6×30 | 2 μm non-porous silica ODS A kit of columns with packings from three different production lots |

## Shim-pack FC-ODS

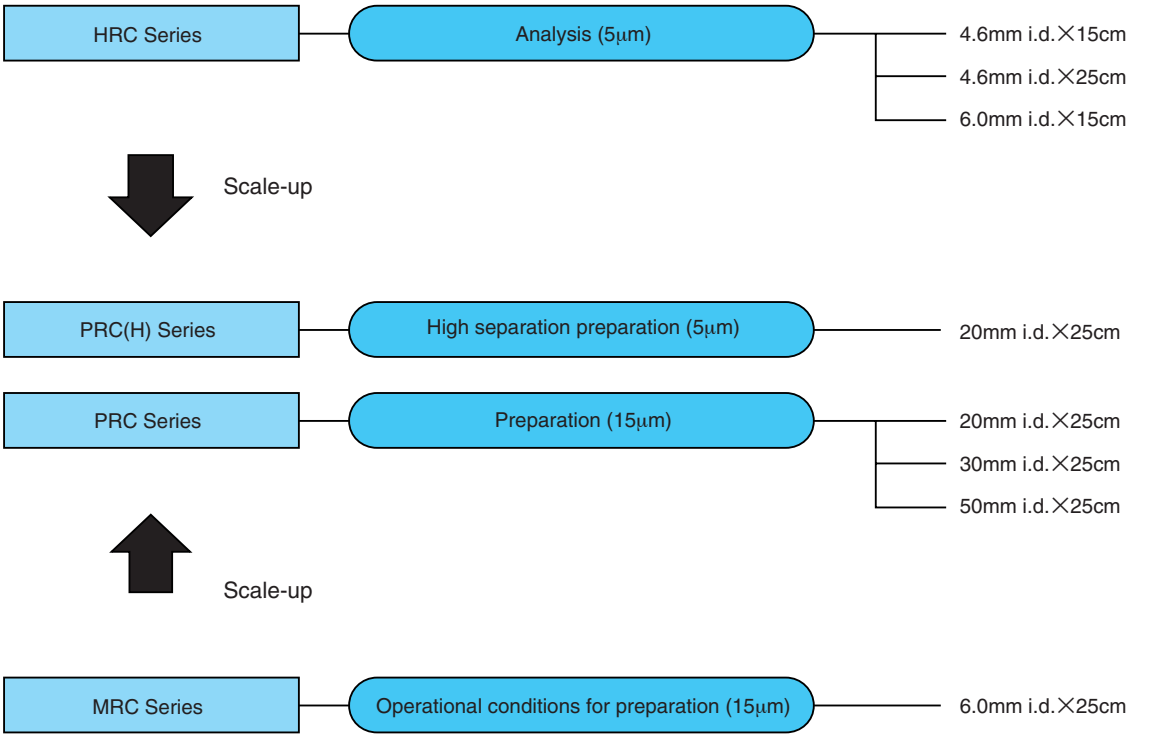
High throughput and high resolution column packed with 3 μm porous high purity silica.
Applicable to wide application range from high thoughput precisely separation analysis of complex matrix samples.

### ■Shim-pack FC-ODS

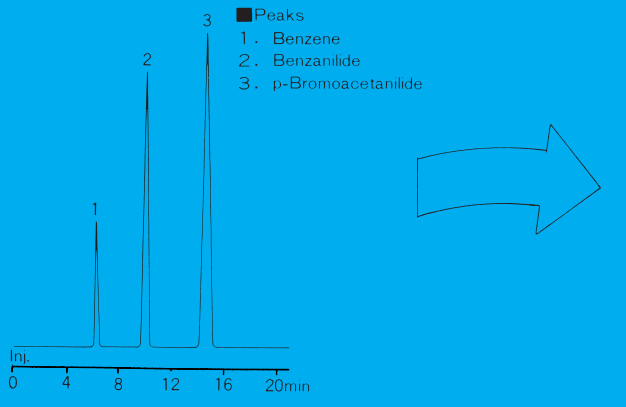
| Cat. No. | Description | I.D.×length (mm) | Remarks |
|---|---|---|---|
| 221-40511-91 | Shim-pack FC-ODS | 4.6×30 | For fast analysis |
| 221-40511-92 | Shim-pack FC-ODS | 4.6×75 | For shorter analysis time |
| 221-40511-93 | Shim-pack FC-ODS | 4.6×150 | For high separation |

## Shim-pack HRC, MRC, PRC

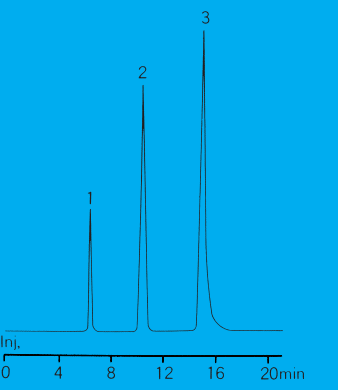
- High quality and outstanding performance ensured by stringent quality control.
- The same silica gel solid support is used in all the columns of this series.
- Adsorption even of basic compounds is completely eliminated by the Shimadzu's original secondary silylation method (except the -SIL series which is packed with silica particles without any surface treatment.
- The same packing material is used in the analytical and preparative columns, so that the operational parameters for analytical runs may be easily copied for preparative work.




■ Operational Conditions
Column: Shim-pack MRC-SIL (6.0mm i.d.×25cm)
Flow rate: 0.9mL/min.




■ Operational Conditions
Column: Shim-pack PRC-SIL (29mm i.d.×25cm)
Flow rate: 9.9mL/min



## ■Shim-pack HRC

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack HRC-SIL | Silica | 5 | Absorption | 4.6mm i.d.×15cm | 228-23460-91 |
| | | | | 4.6mm i.d.×25cm | 228-23460-92 |
| | | | | 6.0mm i.d.×15cm | 228-23460-93 |
| Shim-pack HRC-ODS | Octadecyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-23463-91 |
| | | | | 4.6mm i.d.×25cm | 228-23463-92 |
| | | | | 6.0mm i.d.×15cm | 228-23463-93 |
| Shim-pack HRC-$C_8$ | Octyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-24376-91 |
| | | | | 4.6mm i.d.×25cm | 228-24376-92 |
| | | | | 6.0mm i.d.×15cm | 228-24376-93 |
| Shim-pack HRC-TMS | Trimethyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-24377-91 |
| | | | | 4.6mm i.d.×25cm | 228-24377-92 |
| | | | | 6.0mm i.d.×15cm | 228-24377-93 |
| Shim-pack HRC-$NH_2$ | Aminopropyl group | 5 | Reversed, normal, ion exchange | 4.6mm i.d.×15cm | 228-24378-91 |
| | | | | 4.6mm i.d.×25cm | 228-24378-92 |
| | | | | 6.0mm i.d.×15cm | 228-24378-93 |
| Shim-pack HRC-CN | Cyanopropyl group | 5 | Reversed phase, Normal phase | 4.6mm i.d.×15cm | 228-24379-91 |
| | | | | 4.6mm i.d.×25cm | 228-24379-92 |
| | | | | 6.0mm i.d.×15cm | 228-24379-93 |

## ■Guard Column for HRC

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack GHRC-SIL | Silica | 5 | 4.0mm i.d.×1cm | 228-23462-91 |
| Shim-pack GHRC-ODS | Octadecyl group | 5 | 4.0mm i.d.×1cm | 228-23465-91 |
| Shim-pack GHRC-$C_8$ | Octyl group | 5 | 4.0mm i.d.×1cm | 228-24386-91 |
| Shim-pack GHRC-TMS | Trimethyl group | 5 | 4.0mm i.d.×1cm | 228-24387-91 |
| Shim-pack GHRC-$NH_2$ | Aminopropyl group | 5 | 4.0mm i.d.×1cm | 228-24388-91 |
| Shim-pack GHRC-CN | Cyanopropyl group | 5 | 4.0mm i.d.×1cm | 228-24389-91 |

## ■Shim-pack PRC

| Column name | Stationary phase | Particle dia. ( μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PRC-SIL | Silica | 15 | Adsorption | 20mm i.d.×25cm | 228-23461-93 |
| Shim-pack PRC-SIL(K) | | | | 30mm i.d.×25cm | 228-23461-94 |
| Shim-pack PRC-SIL(L) | | | | 50mm i.d.×25cm | 228-23461-95 |
| Shim-pack PRC-SIL(H) | | 5 | | 20mm i.d.×25cm | 228-23461-91 |
| Shim-pack PRC-ODS | Octadecyl group | 15 | Reversed phase | 20mm i.d.×25cm | 228-23464-93 |
| Shim-pack PRC-ODS(K) | | | | 30mm i.d.×25cm | 228-23464-94 |
| Shim-pack PRC-ODS(L) | | | | 50mm i.d.×25cm | 228-23464-95 |
| Shim-pack PRC-ODS(H) | | 5 | | 20mm i.d.×25cm | 228-23464-91 |
| Shim-pack PRC-$C_8$ | Octyl group | 15 | Reversed phase | 20mm i.d.×25cm | 228-24381-93 |
| Shim-pack PRC-$C_8$(H) | | 5 | | 20mm i.d.×25cm | 228-24381-91 |
| Shim-pack PRC-TMS | Trimethyl group | 15 | Reversed phase | 20mm i.d.×25cm | 228-24382-93 |
| Shim-pack PRC-TMS(H) | | 5 | | 20mm i.d.×25cm | 228-24382-91 |
| Shim-pack PRC-$NH_2$ | Aminopropyl group | 15 | Reversed, normal, ion exchange | 20mm i.d.×25cm | 228-24383-93 |
| Shim-pack PRC-$NH_2$(H) | | 5 | | 20mm i.d.×25cm | 228-24383-91 |
| Shim-pack PRC-CN | Cyanopropyl group | 15 | Reversed phase, normal phase | 20mm i.d.×25cm | 228-24384-93 |
| Shim-pack PRC-CN(H) | | 5 | | 20mm i.d.×25cm | 228-24384-91 |

## ■Guard Column for PRC

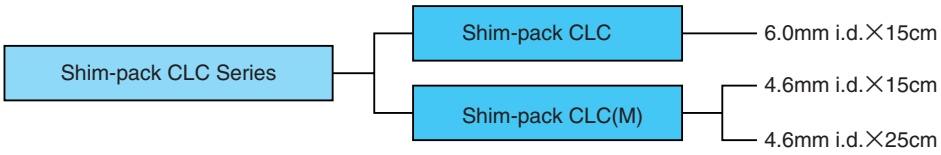
| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack GPRC-SIL | Silica | 5 | 8mm i.d.×1.5cm | 228-23462-92 |
| Shim-pack GPRC-ODS | Octadecyl group | 5 | 8mm i.d.×1.5cm | 228-23465-92 |
| Shim-pack GPRC-$C_8$ | Octyl group | 5 | 8mm i.d.×1.5cm | 228-24386-92 |
| Shim-pack GPRC-TMS | Trimethyl group | 5 | 8mm i.d.×1.5cm | 228-24387-92 |
| Shim-pack GPRC-$NH_2$ | Aminopropyl group | 5 | 8mm i.d.×1.5cm | 228-24388-92 |
| Shim-pack GPRC-CN | Cyanopropyl group | 5 | 8mm i.d.×1.5cm | 228-24389-92 |
| Shim-pack GPRC-SIL(K) | Silica | 15 | 30mm i.d.×7.5cm | 228-23462-93 |
| Shim-pack GPRC-SIL(L) | Silica | 15 | 50mm i.d.×5cm | 228-23462-94 |
| Shim-pack GPRC-ODS(K) | Octadecyl group | 15 | 30mm i.d.×7.5cm | 228-23465-93 |
| Shim-pack GPRC-ODS(L) | Octadecyl group | 15 | 50mm i.d.×5cm | 228-23465-94 |

## ■Shim-pack MRC

| Column name | Stationary phase | Particle dia. ( μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack MRC-SIL | Silica | 15 | Adsorption | 6.0mm i.d.×25cm | 228-23461-92 |
| Shim-pack MRC-ODS | Octadecyl group | 15 | Reversed phase | 6.0mm i.d.×25cm | 228-23464-92 |
| Shim-pack MRC-$C_8$ | Octyl group | 15 | Reversed phase | 6.0mm i.d.×25cm | 228-24381-92 |
| Shim-pack MRC-TMS | Trimethyl group | 15 | Reversed phase | 6.0mm i.d.×25cm | 228-24382-92 |
| Shim-pack MRC-$NH_2$ | Aminopropyl group | 15 | Reversed, normal, ion, exchange | 6.0mm i.d.×25cm | 228-24383-92 |
| Shim-pack MRC-CN | Cyanopropyl group | 15 | Reversed phase, normal phase | 6.0mm i.d.×25cm | 228-24384-92 |

# Shim-pack CLC

● Low cost, high-performance columns for wide field of applications.




## ■Shim-pack CLC (6.0mm $\phi$)

| Column name | Stationary phase | Particle dia. ($\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack CLC-SIL | Silica | 5 | Adsorption | 6.0mm i.d.×15cm | 228-00807-91 |
| Shim-pack CLC-ODS | Octadecyl group | 5 | Reversed phase | 6.0mm i.d.×15cm | 228-00808-91 |
| Shim-pack CLC-$C_8$ | Octyl group | 5 | Reversed phase | 6.0mm i.d.×15cm | 228-00809-91 |
| Shim-pack CLC-TMS | Trimethyl group | 5 | Reversed phase | 6.0mm i.d.×15cm | 228-00810-91 |
| Shim-pack CLC-CN | Cyanopropyl group | 5 | Reversed-phase, normal phase | 6.0mm i.d.×15cm | 228-00811-91 |
| Shim-pack CLC-Phenyl | Phenyl group | 5 | Reversed phase | 6.0mm i.d.×15cm | 228-00812-91 |
| Shim-pack CLC-$NH_2$ | Aminopropyl group | 5 | Reversed, normal, ion, exchange | 6.0mm i.d.×15cm | 228-16725-91 |

＊Also the Shim-pack VMA which is dedicated to the analysis of HVA and VMA is available.

## ■Shim-pack CLC(M) (4.6mm $\phi$)

| Column name | Stationary phase | Particle dia. ($\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack CLC-SIL(M) | Silica | 5 | Adsorption | 4.6mm i.d.×15cm | 228-17872-91 |
| | | | | 4.6mm i.d.×25cm | 228-17872-92 |
| Shim-pack CLC-ODS(M) | Octadecyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-17873-91 |
| | | | | 4.6mm i.d.×25cm | 228-17873-92 |
| Shim-pack CLC-$C_8$(M) | Octyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-17874-91 |
| | | | | 4.6mm i.d.×25cm | 228-17874-92 |
| Shim-pack CLC-TMS(M) | Trimethyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-17875-91 |
| | | | | 4.6mm i.d.×25cm | 228-17875-92 |
| Shim-pack CLC-CN(M) | Cyanopropyl group | 5 | Reversed-phase, normal phase | 4.6mm i.d.×15cm | 228-17876-91 |
| | | | | 4.6mm i.d.×25cm | 228-17876-92 |
| Shim-pack CLC-Phenyl(M) | Phenyl group | 5 | Reversed phase | 4.6mm i.d.×15cm | 228-17877-91 |
| | | | | 4.6mm i.d.×25cm | 228-17877-92 |
| Shim-pack CLC-$NH_2$(M) | Aminopropyl group | 5 | Reversed, normal, ion, exchange | 4.6mm i.d.×15cm | 228-17878-91 |
| | | | | 4.6mm i.d.×25cm | 228-17878-92 |

＊Also the Shim-pack VMA which is dedicated to the analysis of HVA and VMA is available.

## ■Shim-pack G(4) Series (Guard Column for CLC series)

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack G-SIL(4) | 4.0mm i.d.×1cm | 228-18270-91 |
| Shim-pack G-ODS | 4.0mm i.d.×1cm | 228-18246-91 |
| Shim-pack G-$C_8$(4) | 4.0mm i.d.×1cm | 228-18248-91 |
| Shim-pack G-TMS(4) | 4.0mm i.d.×1cm | 228-18262-91 |
| Shim-pack G-CN(4) | 4.0mm i.d.×1cm | 228-18266-91 |
| Shim-pack G-Phenyl(4) | 4.0mm i.d.×1cm | 228-18264-91 |
| Shim-pack G-$NH_2$(4) | 4.0mm i.d.×1cm | 228-18268-91 |

## Shim-pack HRC, CLC

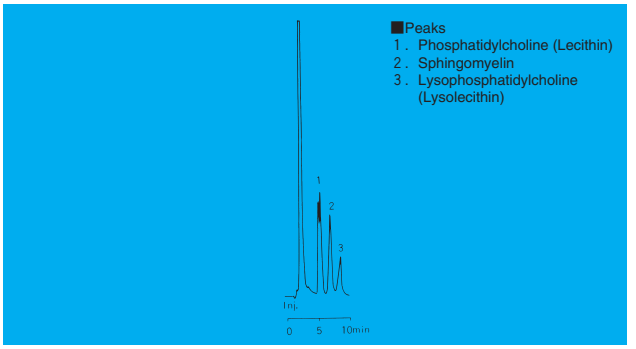



**Fig. 12 Analysis of Phospholipids**

**■Operational Conditions**
**Column:** Shim-pack CLC-SIL (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitrile/methanol/water (3/1/1)
**Flow rate:** 1.5mL/min.
**Column temperature:** 45℃
**Detector:** UV spectrophotometric detector (205nm)

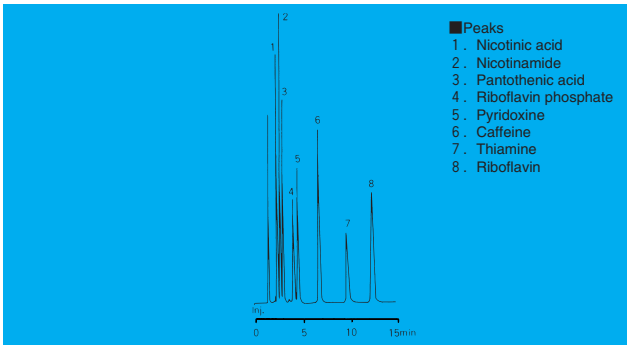



**Fig. 13 Analysis of Vitamin B**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** [100mM phosphate buffer solution (pH 2.1) and 1.2mM sodium octane sulfonate] /acetonitrile (9/1)
**Flow rate:** 1.2mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

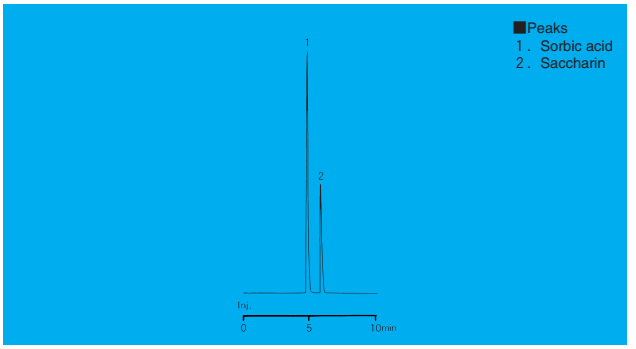



**Fig. 14 Determination of Sorbic Acid and Saccharin**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Precolumn:** Shim-pack GRD-ODS
**Mobile phase:** 10mM phosphoric acid buffer solution/acetonitrile (15/1)
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (265nm)

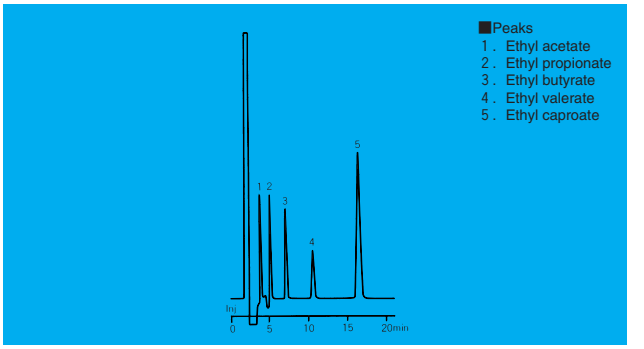



**Fig. 15 Analysis of Fatty Acid Ethyl Esters**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitrile/water (1/1)
**Flow rate:** 1.2mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

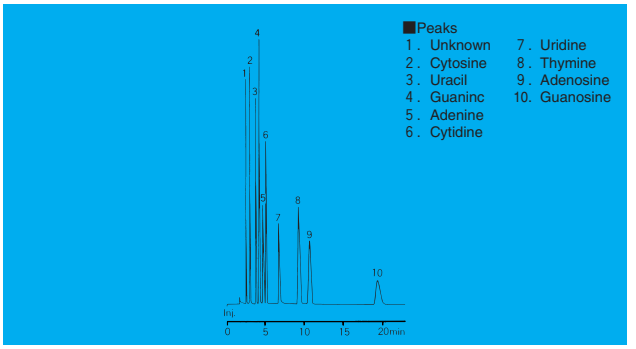



**Fig. 16 Analysis of Nucleic Acid Related Compounds**

**■Operational Conditions**
**Column:** Shim-pack HRC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1) and 0.2M sodium perchlorate
**Flow rate:** 1.5mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (260nm)

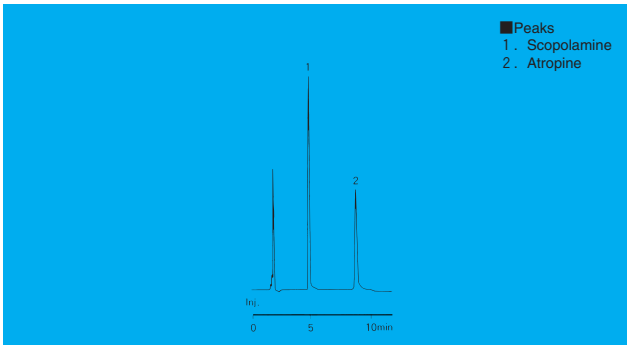



**Fig. 17 Determination of Atropine and Scopolamine**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) /acetonitrile (5/1)
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

## Shim-pack HRC, CLC

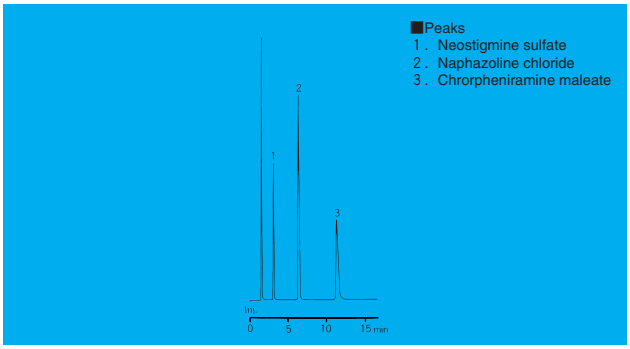



**Fig. 18 Analysis of Eyewash**

**■Operational Conditions**
**Column:** Shim-pack HRC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM Potassium dihydrogen phosphate /acetonitrile/phosphoric and (70/30/0.05) with 0.1% sodium sulfonic octanate added)
**Flow rate:** 1.5mL/min.
**Detector:** UV spectrophotometric detector (210nm)

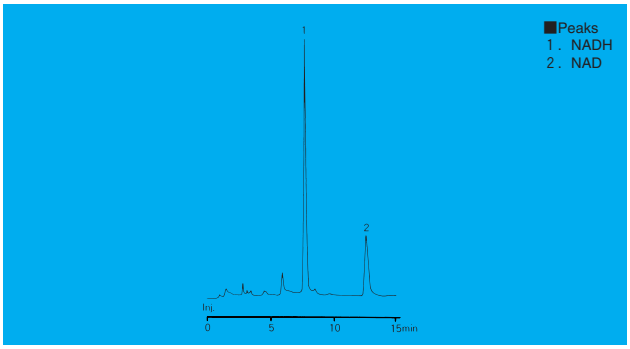



**Fig. 19 Determination of NAD and NADH**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6)
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (260nm)

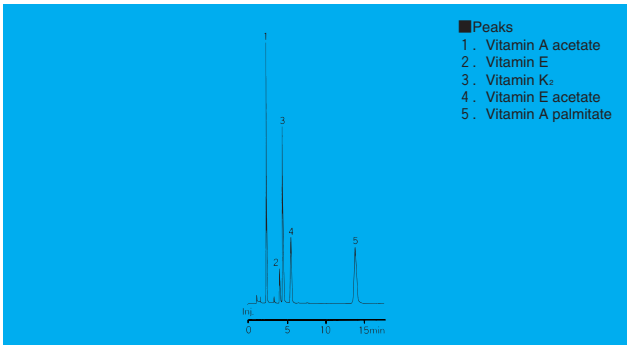



**Fig. 20 Analysis of Oil Soluble Vitamines**

**■Operational Conditions**
**Column:** Shim-pack HRC-ODS (4.6mm i.d.×15cm)
**Mobile phase:** Methanol
**Flow rate:** 1.5mL/min.
**Column temperature:** 55℃
**Detector:** UV spectrophotometric detector (254nm)

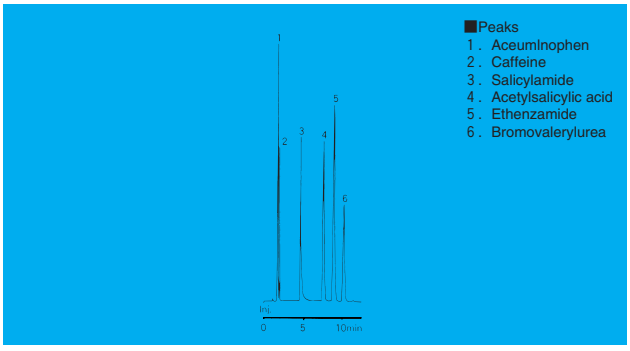



**Fig. 21 Analysis of Analgesics/Antipyretics**

**■Operational Conditions**
**Column:** Shim-pack HRC-ODS.(4.6mm i.d.×15cm)
**Mobile phase:** 10mM Ammonium dihydrogen phosphate (pH 2.5) /acetonitrile (4/1)
**Flow rate:** 1.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

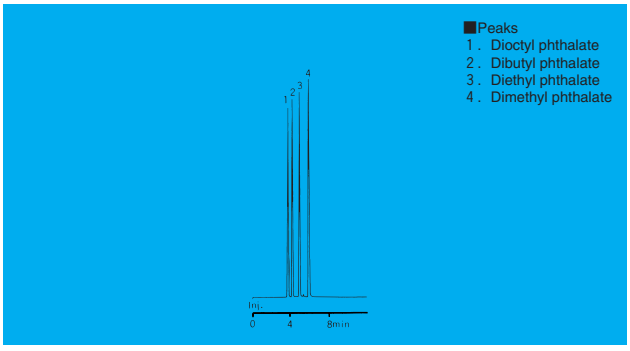



**Fig. 22 Analysis of Phthalate Esters**

**■Operational Conditions**
**Column:** Shim-pack HRC-SIL (4.6mm i.d.×25cm)
**Mobile phase:** n-Hexane/ethanol (98/2)
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

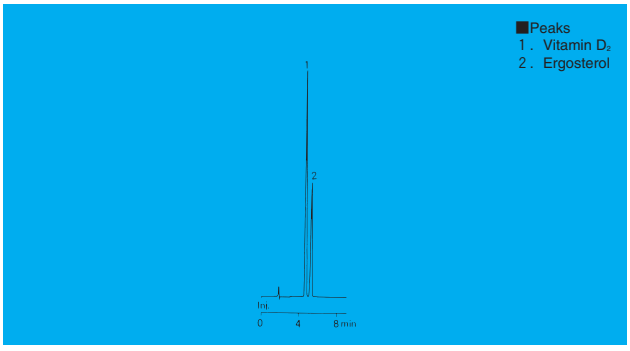



**Fig. 23 Analysis of Vitamine $D_2$ and Ergosterol**

**■Operational Conditions**
**Column:** Shim-pack HRC-SIL (4.6mm i.d.×25cm)
**Mobile phase:** n-Hexane/ethanol (98/2)
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

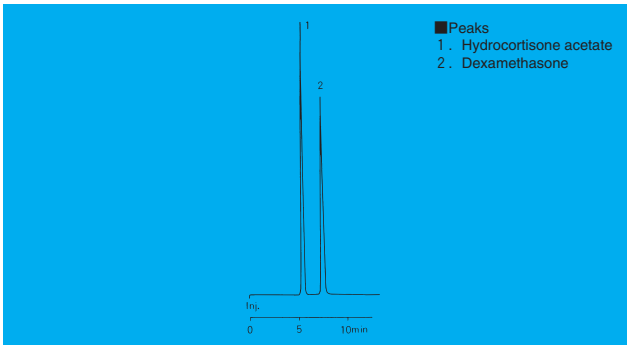



**Fig. 24 Analysis of Steroid Hormones**

**■Operational Conditions**

**Column:** Shim-pack CLC-CN (6.0mm i.d.×15cm)
**Mobile phase:** Hexane/methanol (4/1)
**Flow rate:** 1.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

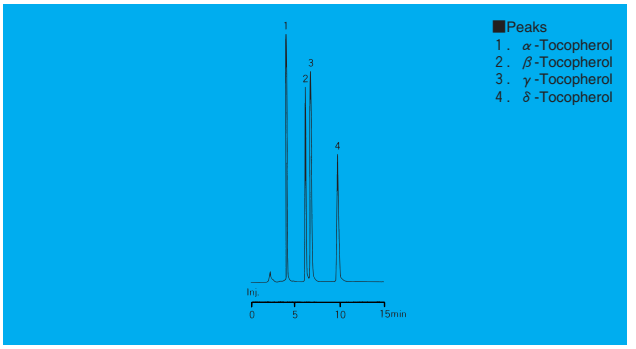



**Fig. 25 Analysis of Tocopherols**

**■Operational Conditions**

**Column:** Shim-pack CNC-$NH_2$ (6.0mm i.d.×15cm)
**Mobile phase:** n-Hexane/isopropanol (25/1)
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (297nm)

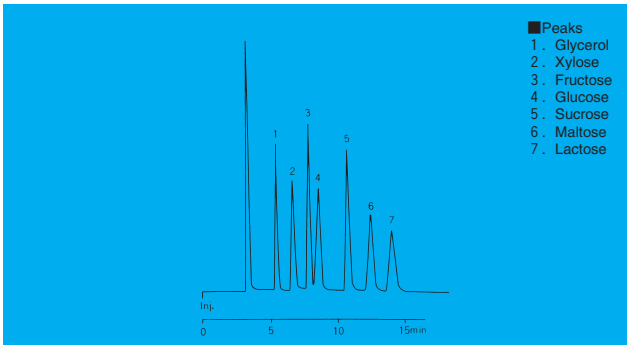



**Fig. 26 Analysis of Sugars**

**■Operational Conditions**

**Column:** Shim-pack CLC-$NH_2$ (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitrile/water (7/3)
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** Refractive index detector

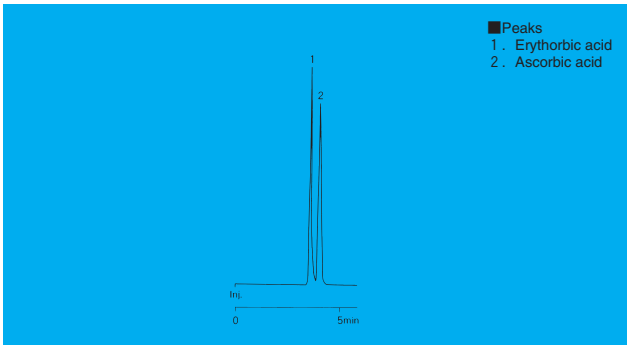


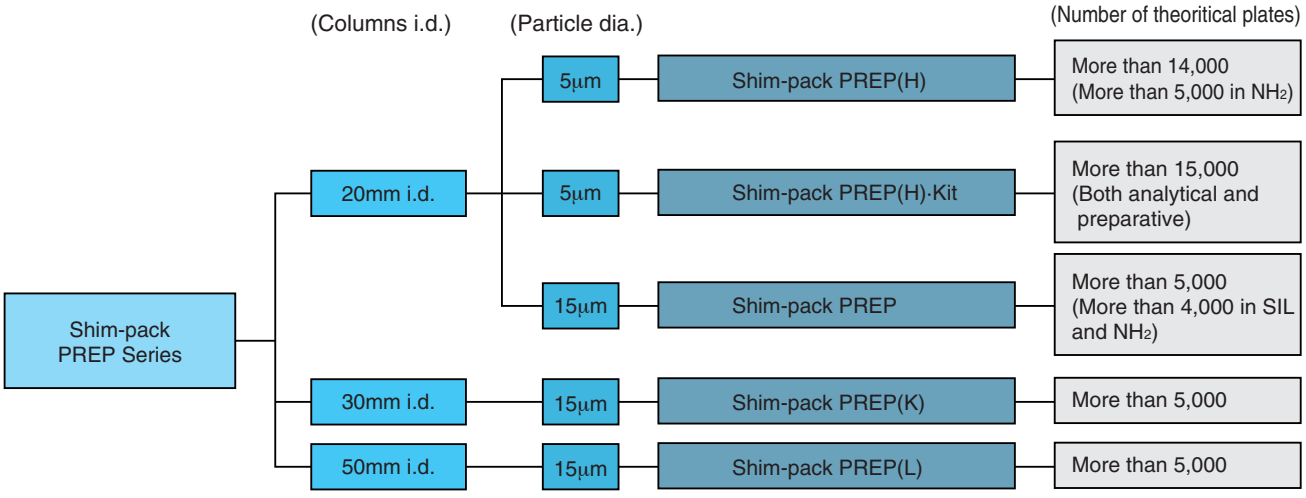

**Fig. 27 Determination of Ascorbic Acid and Erythorbic Acid**

**■Operational Conditions**

**Column:** Shim-pack CLC-$NH_2$ (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitrile/10mM phosphate buffer solution (pH 2.6) (3/1)
**Column temperature:** 40℃
**Flow rate:** 1.5mL/min
**Detector:** UV spectrophotometric detector (245nm)

# Shim-pack PREP

- Shim-pack PREP Series are economical, high-performance columns for preparative LC.
- The columns are packed with fully porous spherical silica particles on which respective stationary phases are chemically bonded. (Except the PREP-SIL which is packed with silica particles without any surface treatment.)
- The residual silanol groups are end-capped by the unique silylation method. (Except the PREP-SIL)
- The PREP(H) series columns are packed with 5 μm diameter particles (same as those used in the CLC series columns) to permit preparative LC with high resolution.
- The PREP(H) Kit is a set of an analytical and a preparative columns which are packed with packing material (5 μm dia.) of the same lot.
- The PREP, PREP(K), and PREP(L) columns are universal LC columns, having an inner diameter of 20mm, 30mm, and 50mm, respectively.




## ■Shim-pack PREP(H) (5 μm) (20mm φ)

| Column name | Stationary phase | Particle dia. (μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PREP-$C_8$(H) | Octyl group | 5 | Reversed | 20mm i.d.×25cm | 228-17882-91 |
| Shim-pack PREP-TMS(H) | Trimethyl group | 5 | Reversed | 20mm i.d.×25cm | 228-17883-91 |
| Shim-pack PREP-CN(H) | Cyanopropyl group | 5 | Normal, reversed | 20mm i.d.×25cm | 228-17884-91 |
| Shim-pack PREP-Phenyl(H) | Phenyl group | 5 | Reversed | 20mm i.d.×25cm | 228-17885-91 |
| Shim-pack PREP-$NH_2$(H) | Aminopropyl group | 5 | Normal, reversed, ion exchange | 20mm i.d.×25cm | 228-17886-91 |

## ■Shim-pack PREP(H)・Kit (5 μm) (20mm φ)

| Column name | Stationary phase | Particle dia. (μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PREP-SIL(H)・Kit | Silica | 5 | Adsorption | 4.6mm i.d.×25cm | 228-17887-91 |
| | | | | 20mm i.d.×25cm | |
| Shim-pack PREP-ODS(H)・Kit | Octadecyl group | 5 | Reversed | 4.6mm i.d.×25cm | 228-17888-91 |
| | | | | 20mm i.d.×25cm | |

## Shim-pack PREP (15 μm) (20mm ϕ)

| Column name | Stationary phase | Particle dia. (μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PREP-SIL | Silica | 15 | Adsorption | 20mm i.d.×25cm | 228-00814-91 |
| Shim-pack PREP-ODS | Octadecyl group | 15 | Reversed | 20mm i.d.×25cm | 228-00815-91 |
| Shim-pack PREP-$C_8$ | Octyl group | 15 | Reversed | 20mm i.d.×25cm | 228-00816-91 |
| Shim-pack PREP-TMS | Trimethyl group | 15 | Reversed | 20mm i.d.×25cm | 228-00817-91 |
| Shim-pack PREP-CN | Cyanopropyl group | 15 | Normal, reversed | 20mm i.d.×25cm | 228-00818-91 |
| Shim-pack PREP-Phenyl | Phenyl group | 15 | Reversed | 20mm i.d.×25cm | 228-00819-91 |
| Shim-pack PREP-$NH_2$ | Aminopropyl group | 15 | Normal, reversed, ion, exchange | 20mm i.d.×25cm | 228-17879-91 |

## Shim-pack PREP(K) (15 μm) (30mm ϕ)

| Column name | Stationary phase | Particle dia. (μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PREP-SIL(K) | Silica | 15 | Adsorption | 30mm i.d.×25cm | 228-18273-91 |
| Shim-pack PREP-ODS(K) | Octadecyl group | 15 | Reversed | 30mm i.d.×25cm | 228-18319-91 |

## Shim-pack PREP(L) (15 μm) (50mm ϕ)

| Column name | Stationary phase | Particle dia. (μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PREP-SIL(L) | Silica | 15 | Adsorption | 50mm i.d.×25cm | 228-18274-91 |
| Shim-pack PREP-ODS(L) | Octadecyl group | 15 | Reversed | 50mm i.d.×25cm | 228-18320-91 |

## Shim-pack G(8), GK, and GL Guard columns

| Column name | Use | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack G-SIL(8) | Guard column for Shim-pack PREP and PREP(H) | 8.0mm i.d.×1.5cm | 228-18270-92 |
| Shim-pack G-ODS(8) | | 8.0mm i.d.×1.5cm | 228-18246-92 |
| Shim-pack G-$C_8$(8) | | 8.0mm i.d.×1.5cm | 228-18248-92 |
| Shim-pack G-TMS(8) | | 8.0mm i.d.×1.5cm | 228-18262-92 |
| Shim-pack G-CN(8) | | 8.0mm i.d.×1.5cm | 228-18266-92 |
| Shim-pack G-Phenyl(8) | | 8.0mm i.d.×1.5cm | 228-18264-92 |
| Shim-pack G-$NH_2$(8) | | 8.0mm i.d.×1.5cm | 228-18268-92 |
| Shim-pack GK-SIL | Guard column for Shim-pack PREP(K) | 30mm i.d.×7.5cm | 228-18338-91 |
| Shim-pack GK-ODS | | 30mm i.d.×7.5cm | 228-18321-91 |
| Shim-pack GL-SIL | Guard column for Shim-pack PREP(L) | 50mm i.d.×5cm | 228-18339-91 |
| Shim-pack GL-ODS | | 50mm i.d.×5cm | 228-18322-91 |

# Shim-pack FLC,SBC, MBC

● The Shim-pack FLC series, SBC series, and MBC series ensure higher speeds, higher sensitivity and lower mobile phase consumption than the Shim-pack CLC series.

| | (Column i.d.) | (Particle dia.) | |
|---|---|---|---|
| Shim-pack CLC | 6mm i.d.,4.6mm i.d. | 5μm | Universal use |
| Shim-pack FLC | 4.6mm i.d. | 3μm | Fast analysis |
| Shim-pack SBC | 2.5mm i.d. | 5μm | Mobile phase consumption is less than 1/3 compared with the Shim-pack CLC series. Applicable to ordinary HPLC systems. |
| Shim-pack MBC | 1.0mm i.d. | 10μm | Mobile phase consumption is less than 1/20 compared with the Shim-pack CLC series. Dedicated HPLC systems are required. |

## Comparison of Shim-pack CLC and FLC

The Shim-pack FLC series columns use 3 μm-diameter packing materials; the linear velocity of mobile phase can be increased without much lowering the column efficiency. This feature provide very fast analyses, which are quite useful for process control, for example.
Figure 28 shows a comparison data.

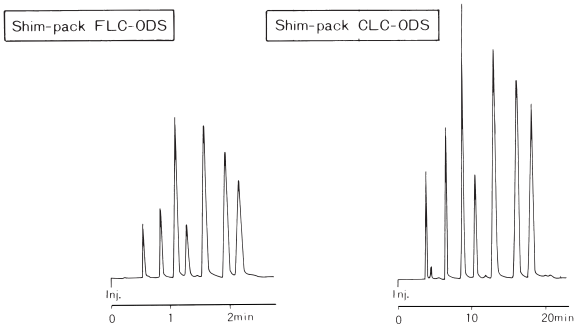



Fig. 28 Comparison Data of Shim-pack FLC and CLC

## Comparison of Shim-pack CLC, SBC, and MBC

These columns have different inner diameters. A smaller diameter column can provide a higher sensitivity, as shown in Fig. 29.Use of a small-diameter column, however, requires use of small-capacity sample injector and flow-thru cell; otherwise high sensitivity will not be provided. The Shim-pack SBC (2.5mm ida.) is applicable to ordinary HPLC systems, while the Shim-pack MBC (1.0mm i.d.) must be used in a dedicated HPLC system.

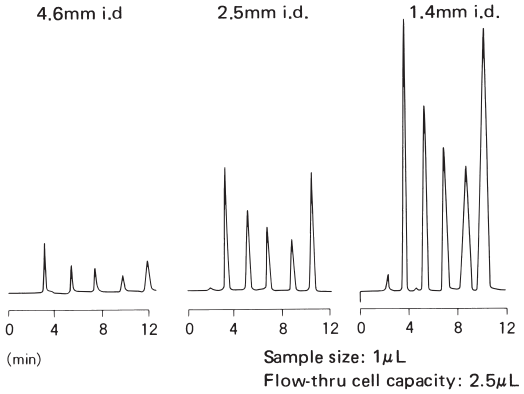



Fig. 29 Column Diameter and Peak Height

## Advantage of Pre-heater

In very fast LC using a Shim-pack FLC series column, a high mobile phase flow rate can result in broadened peaks due to a temperature gradient within the column.
A pre-heater connected between the sample injector and the column will solve this problem as demonstrated in Fig.30.

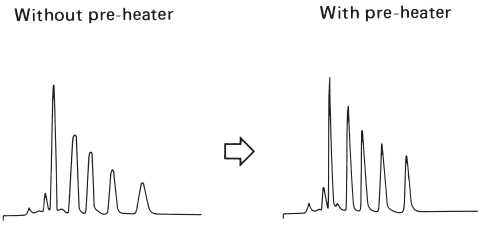



Fig. 30 Merit of Pre-heater

## ■Shim-pack FLC for fast LC

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack FLC-ODS | Octadecyl group | 3 | Reversed | 4.6mm i.d.×5cm | 228-13375-91 |
| Shim-pack FLC-SIL | Silica | 3 | Adsorption | 4.6mm i.d.×5cm | 228-13375-92 |
| Shim-pack FLC-CN | Cyanopropyl group | 3 | Normal, reversed | 4.6mm i.d.×5cm | 228-13694-91 |
| Shim-pack FLC-$C_8$ | Octyl group | 3 | reversed | 4.6mm i.d.×5cm | 228-13695-91 |
| Shim-pack FLC-$NH_2$ | Aminopropyl group | 3 | Normal, reversed, ion exchange | 4.6mm i.d.×5cm | 228-13696-91 |

## ■Shim-pack SBC small-bore columns

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack SBC-ODS | Octadecyl group | 5 | Reversed | 2.5mm i.d.×15cm | 228-17268-91 |
| Shim-pack SBC-$C_8$ | Octyl group | 5 | Reversed | 2.5mm i.d.×15cm | 228-17269-91 |
| Shim-pack SBC-SIL | Silica | 5 | Adsorption | 2.5mm i.d.×15cm | 228-17270-91 |

## ■Shim-pack MBC micro-bore columns

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack MBC-ODS | Octadecyl group | 10 | Reversed | 1.0mm i.d.×25cm | 228-12812-02 |
| | | | | 1.0mm i.d.×50cm | 228-12812-05 |
| Shim-pack MBC-SIL | Silica | 10 | Adsorption | 1.0mm i.d.×50cm | 228-12811-05 |
| | | | | 1.0mm i.d.×100cm | 228-12811-10 |
| Shim-pack MBC-ACN | Aminopropyl group | 10 | Normal, reversed | 1.0mm i.d.×25cm | 228-12813-02 |
| | | | | 1.0mm i.d.×50cm | 228-12813-05 |
| Shim-pack MBC-$C_8$ | Octyl group | 10 | Reversed | 1.0mm i.d.×25cm | 228-12814-02 |
| | | | | 1.0mm i.d.×50cm | 228-12814-05 |

*Shim-pack MBC requires dedicated HPL system.

## Shim-pack FLC

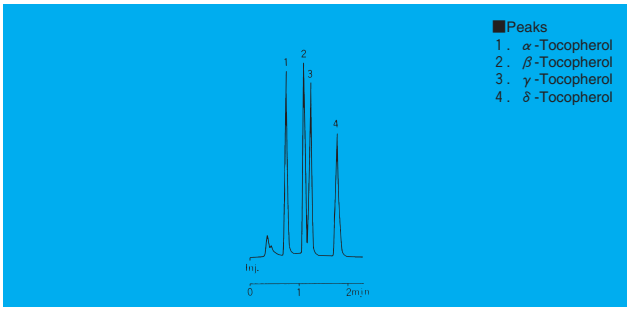



**Fig. 31 Analysis of Tocopherols**

**■Operational Conditions**
**Column:** Shim-pack FLC-SIL (4.6mm i.d.×5cm)
**Mobile phase:** n-Hexane/dioxane/ethanol (98/2/0.2)
**Flow rate:** 2.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (295nm)

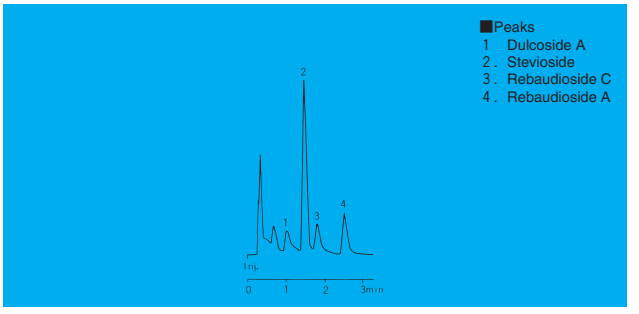



**Fig. 32 Analysis of Sweet Components in Stevia Leaf**

**■Operational Conditions**
**Column:** Shim-pack FLC-$NH_2$ (4.6mm i.d.×5cm)
**Mobile phase:** Acetonitrile/water (8/2)
**Flow rate:** 2.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (210nm)

## Shim-pack SBC

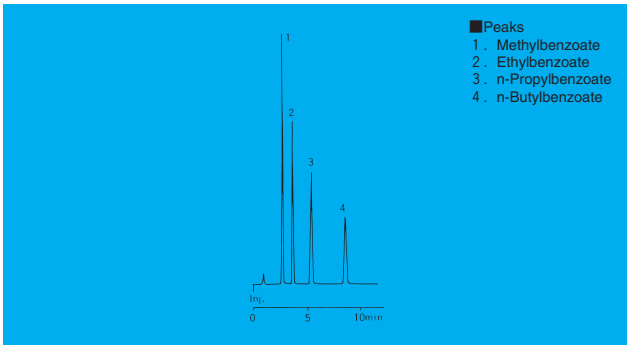



**Fig. 33 Analysis of Benzoic Acid Esters**

**■Operational Conditions**
**Column:** Shim-pack SBC-ODS (2.5mm i.d.×15cm)
**Mobile phase:** Methanol/water (7/3)
**Flow rate:** 0.4mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (250nm)

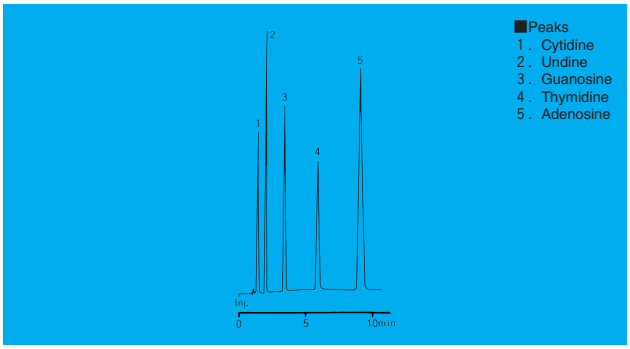



**Fig. 34 Analysis of Nucleosides**

**■Operational Conditions**
**Column:** Shim-pack SBC-$C_8$ (2.5mm i.d.×15cm)
**Mobile phase:** 50mM potassium dihydrogenphosphate methanol (93/7)
**Flow rate:** 0.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (260nm)

## Shim-pack SBC

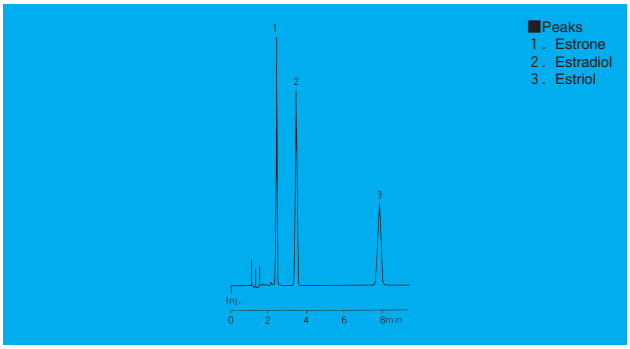



**Fig. 35 Analysis of Estrogens**

**■Operational Conditions**
**Column:** Shim-pack SBC-SIL (2.5mm i.d.×15cm)
**Mobile phase:** Heptane/ethanol/methanol (90/80/2)
**Flow rate:** 0.6mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (250nm)

## Shim-pack MBC

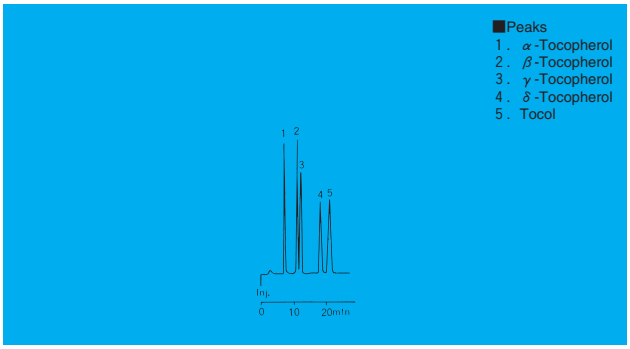



**Fig. 36 Analysis of Tocopherols**

**■Operational Conditions**
**Column:** Shim-pack MBC-SIL (1.0mm i.d.×50cm)
**Mobile phase:** Hexane/dioxane/ethanol(98/2/0.2)
**Flow rate:** 50 μL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (295nm)
(Micro flow-thru cell was used.)

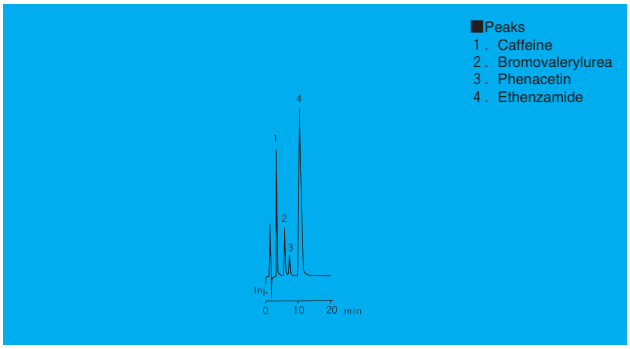
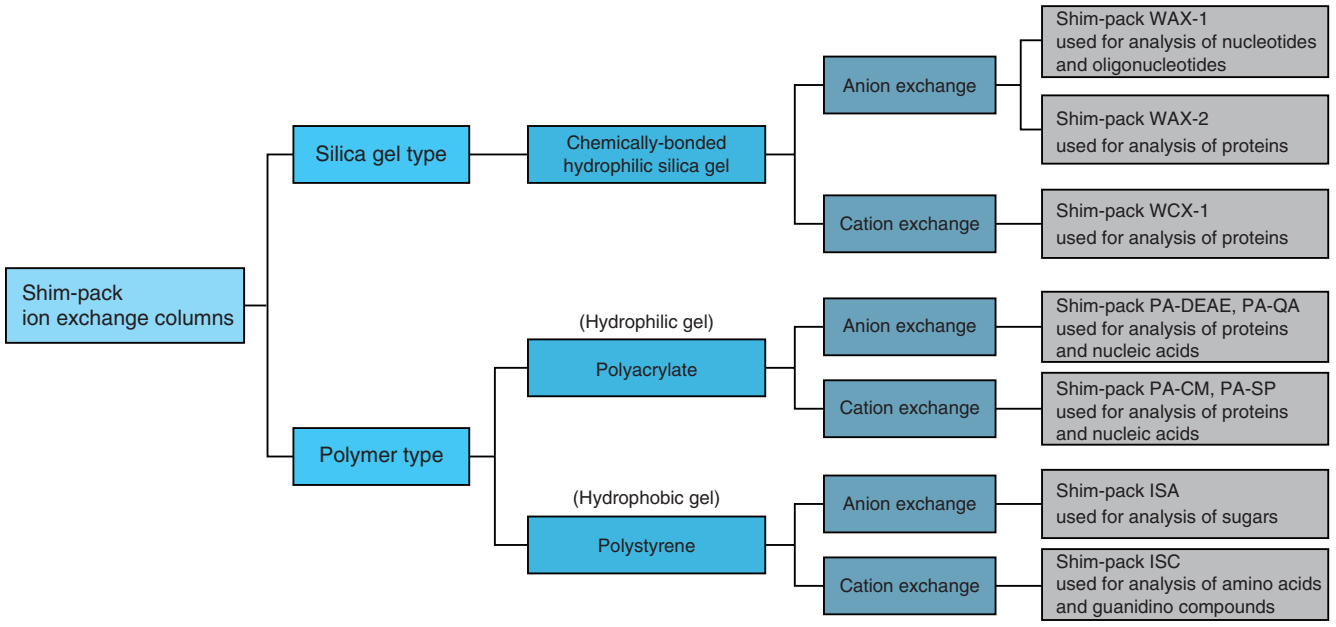



**Fig. 37 Analysis of Febrifuge/Analgesics**

**■Operational Conditions**
**Column:** Shim-pack MBC-ODS (1.0mm i.d.×25cm)
**Mobile phase:** 10mM phosphoric acid buffer solution/acetonitrile (3/1)
**Flow rate:** 100 μL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (210nm)
(Micro flow-thru cell was used.)

## Shim-pack Ion Exchange Columns

● The Shim-pack ion exchange columns are available in various types as shown below.




● Shim-pack ion exchange column series are classified into silica gel type and polymer type.

● The silica gel type columns ensure higher number of theoretical plates than the polymer type, because they use 5 $\mu$m or 3 $\mu$m diameter packing materials in contrast to 10 $\mu$m diameter packing materials used in the latter.

● The polymer type columns ensure better pH stability than the silica gel type and so they are applicable to wider pH range mobile phases.

● Polymer types are classified into polyacrylate type having hydrophilic gel and polystyrene type having hydrophobic gel. Therefore it is possible to use each depending on objecting samples.

● The Shim-pack WAX/WCX series columns are suitable for analysis of nucleotides, oligonucleotides, and proteins.

● The Shim-pack PA series columns use hydrophilic polymers as the solid support. They are especially suitable for the preparative LC of biological substances such as proteins and nucleic acids. The columns are available in two diameters, 8mm i.d. for determining the preparation conditions and 20mm i.d. for preparative work.

● The Shim-pack ISA/ISC series columns, which use polystyrene gel as the solid support, utilize electrostatic reaction and hydrophobic reaction. These columns are suitable for the analysis of sugars (ISA), amino acids (ISC-07), and guanidiono compounds (ISC-05).

## ■Shim-pack WAX, WCX: Silica Gel Type Ion Exchange Column

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack WAX-1 | Tertiary amino group | 3 | 4.0mm i.d.×5cm | 228-16225-91 |
| Shim-pack WAX-2 | Tertiary amino group | 5 | 4.0mm i.d.×5cm | 228-16365-91 |
| Shim-pack WCX-1 | Corboxyl group | 5 | 4.0mm i.d.×5cm | 228-16366-91 |

＊It is necessary to connect a precolumn (Cat. No. 228-16367-91) between the liquid pump and the sample injector.

## ■Shim-pack PA: Polyacrylate Type Ion Exchange Column

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack PA-DEAE | Diethyl amino ethyl group | 10 | 8.0mm i.d.×10cm | 228-20758-91 |
| | | | 20mm i.d.×10cm | 228-20758-92 |
| Shim-pack PA-QA | Tetramethyl ammonium group | 10 | 8.0mm i.d.×10cm | 228-20759-91 |
| | | | 20mm i.d.×10cm | 228-20759-92 |
| Shim-pack PA-CM | Carboxy methyl group | 10 | 8.0mm i.d.×10cm | 228-20760-91 |
| | | | 20mm i.d.×10cm | 228-20760-92 |
| Shim-pack PA-SP | Surforpropyl group | 10 | 8.0mm i.d.×10cm | 228-20761-91 |
| | | | 20mm i.d.×10cm | 228-20761-92 |

## ■Shim-pack PAG: Guard Column for Shim-pack PA

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack PAG-DEAE | Diethyl amino ethyl group | 10 | 8.0mm i.d.×1cm | 228-20762-91 |
| Shim-pack PAG-QA | Tetramethyl ammonium group | 10 | 8.0mm i.d.×1cm | 228-20763-91 |
| Shim-pack PAG-CM | Carboxy methyl group | 10 | 8.0mm i.d.×1cm | 228-20764-91 |
| Shim-pack PAG-SP | Surforpropyl group | 10 | 8.0mm i.d.×1cm | 228-20765-91 |

＊The Shim-pack PAG columns are also used for analysis. (See Fig. 46.)

## ■Shim-pack ISC, ISA: Polystyrene Type Ion Exchange Column

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack Amino-Na | Na type sulfone group | 5 | 6.0mm i.d.×10cm | 228-18837-91 |
| Shim-pack Amino-Li | Li type sulfone group | 5 | 6.0mm i.d.×10cm | 228-18337-92 |
| Shim-pack ISC-05/S0504 | Na type sulfone group | 5 | 4.6mm i.d.×3.8cm | 228-09700-91 |
| Shim-pack ISC-07/S1504 | Na type sulfone group | 7 | 4.0mm i.d.×15cm | 228-09328-91 |
| Shim-pack ISC-07/S1504Li | Li type sulfone group | 7 | 4.0mm i.d.×15cm | 228-00796-91 |
| Shim-pack ISC-07/S2504 | Quaternery ammonium group | 7 | 4.0mm i.d.×25cm | 228-09699-91 |

## ■Ammonia Trap Column

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack ISC-30/S0504 (For trapping Na type ammonia) | 4.0mm i.d.×5cm | 228-14206-91 |
| Shim-pack ISC-30/S0504Li (For trapping Li type ammonia) | 4.0mm i.d.×5cm | 228-00821-91 |

＊It is necessary to use one of the columns, in analysis of amino acids.

## ■Guard Column

＊The following are dedicated guard columns.

| Column name | Dimensions | Cat. No. |
|---|---|---|
| ISA guard column | 4.0mm i.d.×5cm | 228-00823-91 |
| ISC-07 guard column (Na type) | 4.0mm i.d.×5cm | 228-00802-91 |
| ISC-07 guard column (Li type) | 4.0mm i.d.×5cm | 228-00797-91 |

## Shim-pack WCX

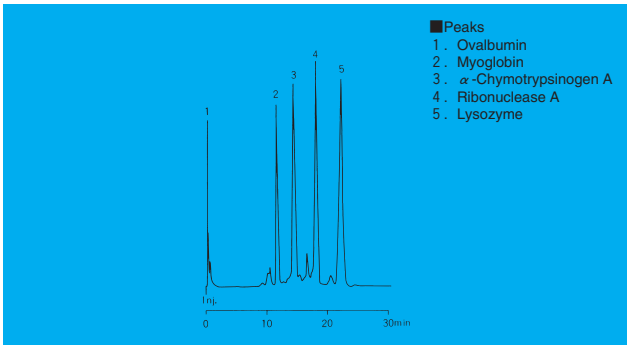



**Fig. 38 Analysis of Protein Standard**

■**Operational Conditions**
**Column:** Shim-pack WCX-1 (4.0mm i.d.×5cm)
**Mobile phase:** 20mM phosphate buffer solution (pH 6.0)/sodium sulfate, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector

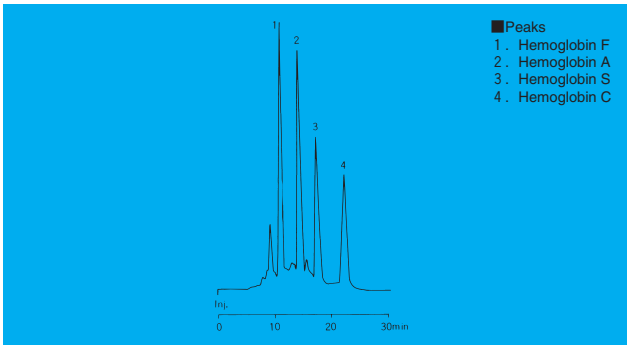



**Fig. 39 Analysis of Hemoglobins**

■**Operational Conditions**
**Column:** Shim-pack WCX-1 (4.0mm i.d.×5cm)
**Mobile phase:** 20mM phosphate buffer solution (pH 6.5)/sodium sulfate, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (415nm)

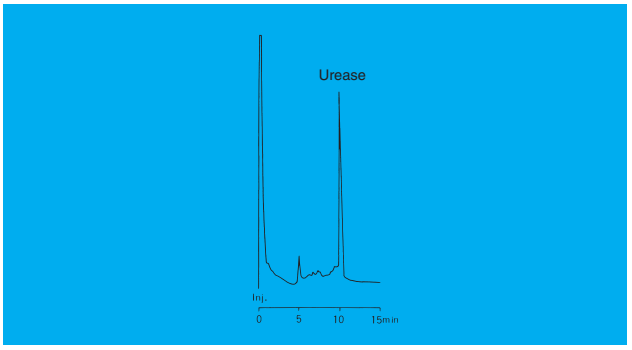



**Fig. 40 Determination of Urease**

■**Operational Conditions**
**Column:** Shim-pack WCX-1 (4.0mm i.d.×5cm)
**Mobile phase:** 20mM phosphate buffer solution (pH 6.0)/sodium sulfate, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

## Shim-pack WAX

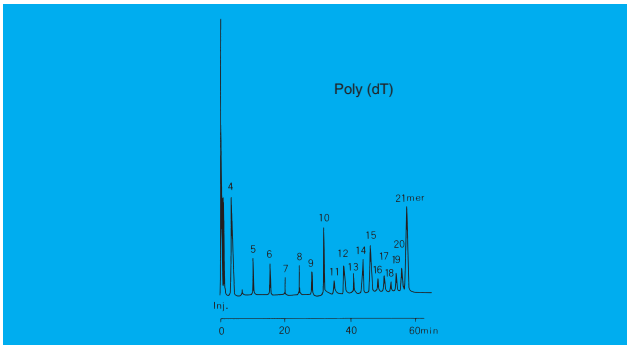



**Fig. 41 Analysis of Synthesized DNAs**

■**Operational Conditions**
**Column:** Shim-pack WAX-1 (4.0mm i.d.×5cm)
**Mobile phase:** Phosphate buffer solution (pH 6.8)/acetonitrile, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (260nm)

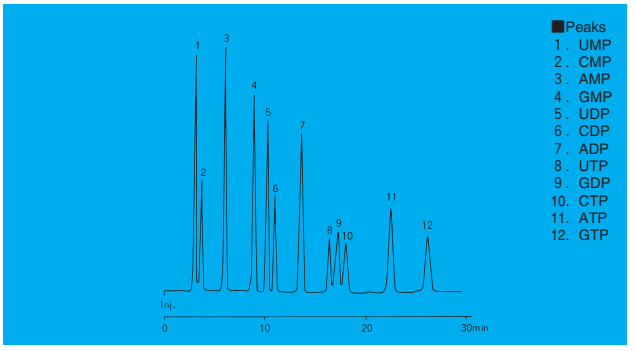



**Fig. 42 Analysis of Mononucleotides**

■**Operational Conditions**
**Column:** Shim-pack WAX-1 (4.0mm i.d.×5cm)
**Mobile phase:** 20mM phosphate buffer solution (pH 7)/480mM phosphoric acid buffer solution (pH 6.85), gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** 45℃
**Detector:** UV spectrophotometric detector (260nm)

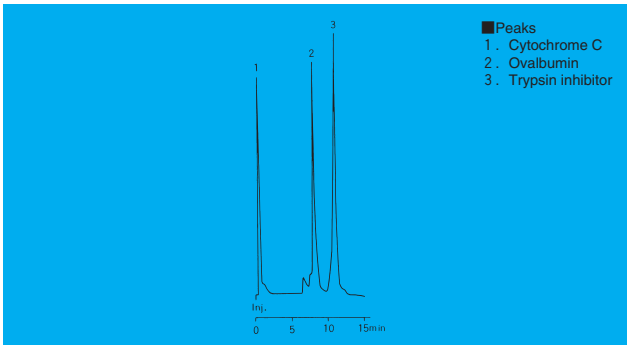



**Fig. 43　Analysis of Protein Standard**

**■Operational Conditions**
**Column:** Shim-pack WAX-2 (4.0mm i.d.×5cm)
**Mobile phase:** Tris-sulfuric acid buffer solution (pH 7.5)/sodium sulfate, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

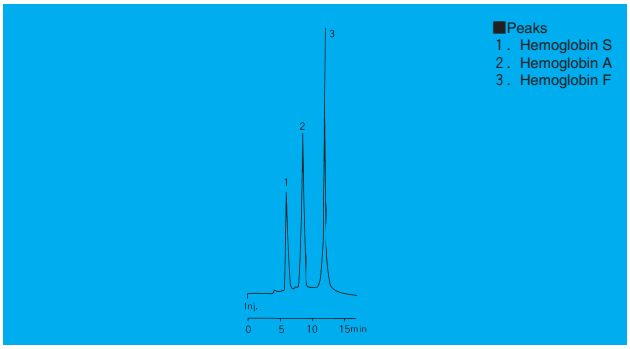



**Fig. 44　Analysis of Hemoglobins**

**■Operational Conditions**
**Column:** Shim-pack WAX-2 (4.0mm i.d.×5cm)
**Mobile phase:** Tris-acetic acid buffer solution (pH 8) /sodium sulfate, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV-VIS spectrophotometric detector (415nm)

## Shim-pack PA

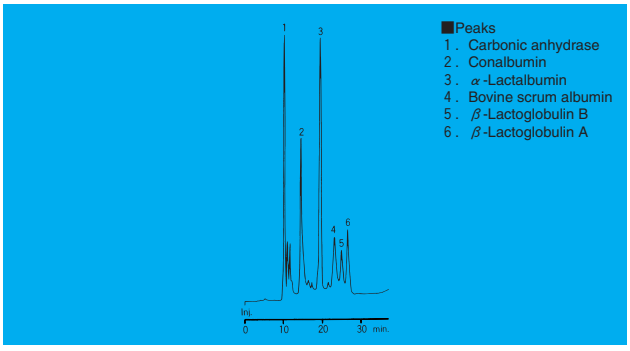



**Fig. 45　Analysis of Protein Standard**

**■Operational Conditions**
**Column:** Shim-pack PA-DEAE (8.0mm i.d.×1cm)
**Mobile phase:** Tris-hydrochloric acid buffer solution (pH 8.0) /sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

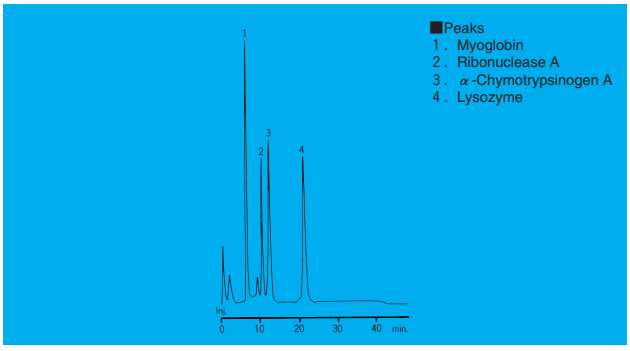



**Fig. 46　Analysis of Protein Standard**

**■Operational Conditions**
**Column:** Shim-pack PAG-CM (8.0mm i.d.×1cm)
**Mobile phase:** Phosphate buffer solution (pH 6.6) /sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

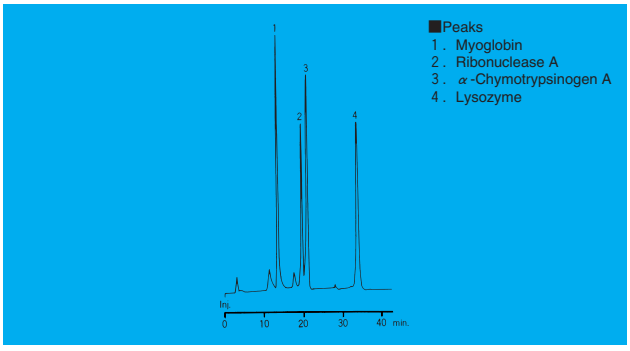



**Fig. 47　Analysis of Protein Standard**

**■Operational Conditions**
**Column:** Shim-pack PA-SP (8.0mm i.d.×1cm)
**Mobile phase:** Phosphate buffer solution (pH 6.6) /sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

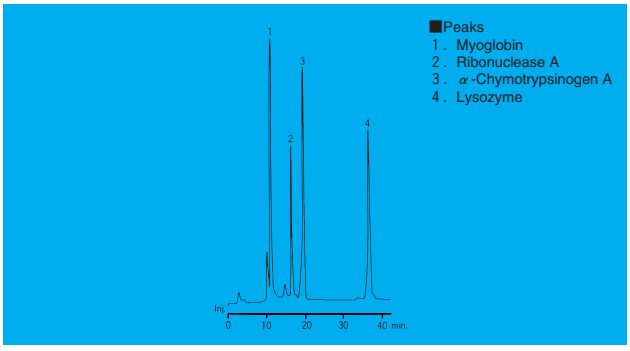



**Fig. 48　Analysis of Protein Standard**

**■Operational Conditions**
**Column:** Shim-pack PA-CM (8.0mm i.d.×1cm)
**Mobile phase:** Phosphate buffer solution (pH 6.6) /sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

## Shim-pack ISA, ISC

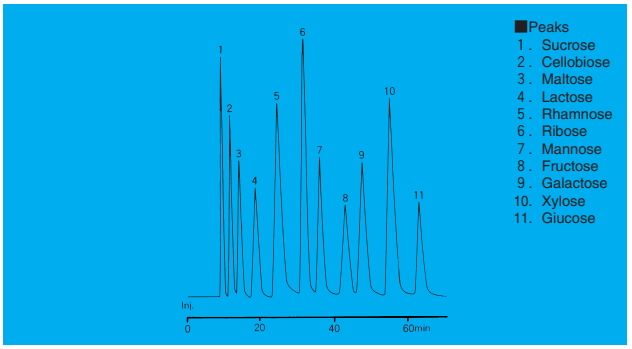



Fig. 49 Analysis of Saccharide Standard

■Operational Conditions

| | |
|---|---|
| **Column:** | Shim-pack ISA-07/S2504 (4.0mm i.d.×25cm) |
| **Mobile phase:** | Potassium borate buffer solution, gradient elution |
| **Flow rate:** | 0.6mL/min. |
| **Column temperature:** | 65℃ |
| **Detector:** | Spectrofluorophotometric detector (EX. 348nm, Em. 430nm) |
| **Method:** | Post-column derivatization with arginine |

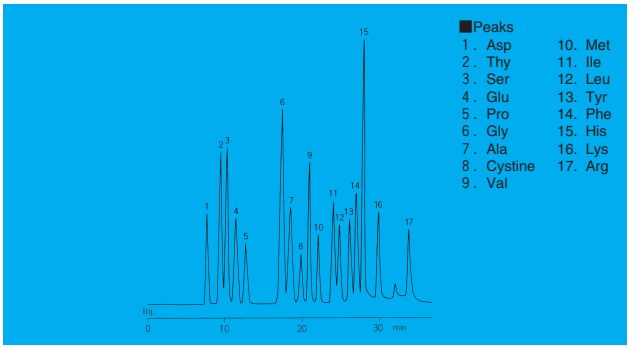



Fig. 50 Analysis of Amino Acid Standard

■Operational Conditions

| | |
|---|---|
| **Column:** | Shim-pack ISC-07/S1504 (4.0mm i.d.×15cm) |
| **Mobile phase:** | Sodium citrate buffer solution, gradient elution |
| **Flow rate:** | 0.3mL/min. |
| **Column temperature:** | 55℃ |
| **Detector:** | Spectrofluorophotometric detector (EX. 348nm, Em. 450nm) |
| **Method:** | Post-column derivatization with ortho-phthalaldehyde |

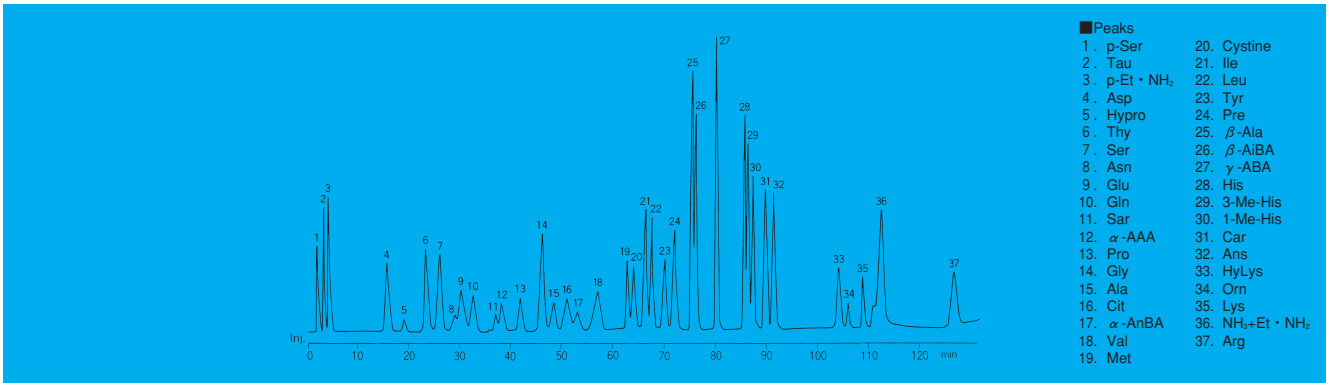



Fig. 51 Analysis of Biological Amino Acids

■Operational Conditions

| | |
|---|---|
| **Column:** | Shim-pack ISC-07/S1504Li (4.0mm i.d.×15cm) |
| **Mobile phase:** | Lithium citrate buffer solution, gradient elution |
| **Flow rate:** | 0.4mL/min. |
| **Column temperature:** | 38℃～58℃ |
| **Detector:** | Spectrofluorophotometric detector (EX. 348nm, Em. 450nm) |
| **Method:** | Post-column derivatization with ortho-phthalaldehyde |

# Shim-pack GPC

- Shim-pack GPC Series columns are used for the determination of analysis of organic solvent solution of tetrahydrofuran (800 Series), determination of chloroform (800C Series), and determination of dimethylformamide (800D series).
- The technique of GPC does not utilize such chemical reactions as partition, adsorption, and ion exchange, but a physical reaction, that is , separation based on molecular size of the sample components. Therefore, this method is suitable for the measurement of molecular weight distribution of high polymers and oligomers.
- Shim-pack GPC series columns are packed with polystyrene polymers of respective degree of cross-linking, so that you can choose a column that exactly meets your requirements, ranging from analysis of high polymers to that of oligomers.
- GPC-80M (80MC, 80MD) are mixed gel columns which get the straight of calibration curve in wide range of molecular weight.
- Shim-pack GPC-2000 Series are dedicated to preparative LC of tetrahydrofuran and chloroform. They ensure separation efficiency comparable to analytical columns as well as large preparative capacity.

## ■Shim-pack GPC (dedicated to determination of tetrahydrofuran)

| Column name | Exclusion limit (polystyrene) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack GPC-801 | $1.5\times10^3$ | 8.0mm i.d.×30cm | 228-20803-91 |
| Shim-pack GPC-802 | $5\times10^3$ | 8.0mm i.d.×30cm | 228-20804-91 |
| Shim-pack GPC-8025 | $2\times10^4$ | 8.0mm i.d.×30cm | 228-20805-91 |
| Shim-pack GPC-803 | $7\times10^4$ | 8.0mm i.d.×30cm | 228-20806-91 |
| Shim-pack GPC-804 | $4\times10^5$ | 8.0mm i.d.×30cm | 228-20807-91 |
| Shim-pack GPC-805 | $4\times10^6$ | 8.0mm i.d.×30cm | 228-20808-91 |
| Shim-pack GPC-806 | $4\times10^7$ | 8.0mm i.d.×30cm | 228-20809-91 |
| Shim-pack GPC-80M | $4\times10^7$, Mixed gel | 8.0mm i.d.×30cm | 228-20810-91 |
| Shim-pack GPC-807 | $2\times10^8$ | 8.0mm i.d.×30cm | 228-20811-91 |

## ■Guard Column (for the above)

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack GPC-800P | 4.6mm i.d.×1cm | 228-20812-91 |

## ■Shim-pack GPC (dedicated to determination of chloroform)

| Column name | Exclusion limit (polystyrene) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack GPC-801C | $1.5\times10^3$ | 8.0mm i.d.×30cm | 228-20803-92 |
| Shim-pack GPC-802C | $5\times10^3$ | 8.0mm i.d.×30cm | 228-20804-92 |
| Shim-pack GPC-8025C | $2\times10^4$ | 8.0mm i.d.×30cm | 228-20805-92 |
| Shim-pack GPC-803C | $7\times10^4$ | 8.0mm i.d.×30cm | 228-20806-92 |
| Shim-pack GPC-804C | $4\times10^5$ | 8.0mm i.d.×30cm | 228-20807-92 |
| Shim-pack GPC-805C | $4\times10^6$ | 8.0mm i.d.×30cm | 228-20808-92 |
| Shim-pack GPC-806C | $4\times10^7$ | 8.0mm i.d.×30cm | 228-20809-92 |
| Shim-pack GPC-80MC | $4\times10^7$, Mixed gel | 8.0mm i.d.×30cm | 228-20810-92 |
| Shim-pack GPC-807C | $2\times10^8$ | 8.0mm i.d.×30cm | 228-20811-92 |

## ■Guard Column (for the above)

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack GPC-800CP | 4.6mm i.d.×1cm | 228-20812-92 |

## ■Shim-pack GPC (dedicated to determination of dimethylformamide)

| Column name | Exclusion limit (polystyrene) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack GPC-801D | $1.5\times10^3$ | 8.0mm i.d.×30cm | 228-20803-93 |
| Shim-pack GPC-802D | $5\times10^3$ | 8.0mm i.d.×30cm | 228-20804-93 |
| Shim-pack GPC-8025D | $2\times10^4$ | 8.0mm i.d.×30cm | 228-20805-93 |
| Shim-pack GPC-803D | $7\times10^4$ | 8.0mm i.d.×30cm | 228-20806-93 |
| Shim-pack GPC-804D | $4\times10^5$ | 8.0mm i.d.×30cm | 228-20807-93 |
| Shim-pack GPC-805D | $4\times10^6$ | 8.0mm i.d.×30cm | 228-20808-93 |
| Shim-pack GPC-806D | $4\times10^7$ | 8.0mm i.d.×30cm | 228-20809-93 |
| Shim-pack GPC-80MD | $4\times10^7$, Mixed gel | 8.0mm i.d.×30cm | 228-20810-93 |
| Shim-pack GPC-807D | $2\times10^8$ | 8.0mm i.d.×30cm | 228-20811-93 |

## ■Guard Column (for the above)

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack GPC-800DP | 4.6mm i.d.×1cm | 228-20812-93 |

## ■Shim-pack GPC-2000 Series

| Column name | Exclusion limit (polystyrene) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack GPC-2001* | $1.5\times10^3$ | 20mm i.d.×30cm | 228-23342-91 |
| Shim-pack GPC-2002* | $5\times10^3$ | 20mm i.d.×30cm | 228-23342-92 |
| Shim-pack GPC-20025* | $2\times10^4$ | 20mm i.d.×30cm | 228-23342-93 |
| Shim-pack GPC-2003* | $7\times10^4$ | 20mm i.d.×30cm | 228-23342-94 |
| Shim-pack GPC-2001C** | $1.5\times10^3$ | 20mm i.d.×30cm | 228-23343-91 |
| Shim-pack GPC-2002C** | $5\times10^3$ | 20mm i.d.×30cm | 228-23343-92 |
| Shim-pack GPC-20025C** | $2\times10^4$ | 20mm i.d.×30cm | 228-23343-93 |
| Shim-pack GPC-2003C** | $7\times10^4$ | 20mm i.d.×30cm | 228-23343-94 |

*For preparative LC of tetrahydrofuran. **For preparative LC of chloroform.

## ■Guard Column (for the above)

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack GPC-2000P (For preparative LC of tetrahydrofuran.) | 8mm×5cm | 228-20812-94 |
| Shim-pack GPC-2000CP (For preparative LC of chloroform.) | 8mm×5cm | 228-20812-95 |

## Shim-pack GPC

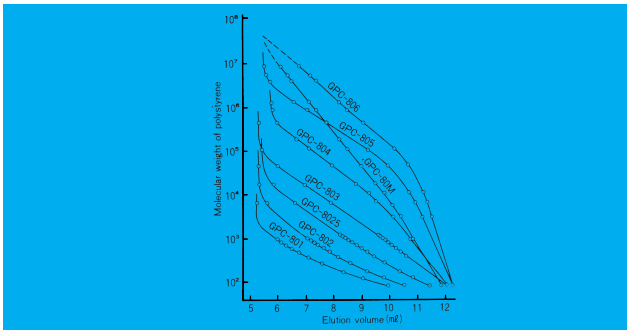



**Fig. 52 Calibration Curves**

**■Operational Conditions**
**Mobile phase:** Tetrahydrofuran
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

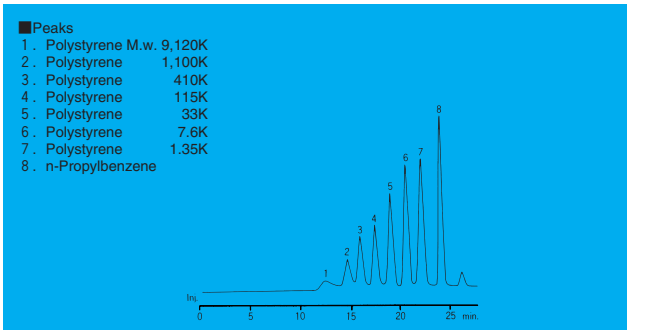



**Fig. 53 Analysis of Polystyrene Standard**

**■Operational Conditions**
**Column:** Shim-pack GPC-80M (2 columns in series)
**Mobile phase:** Tetrahydrofuran
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

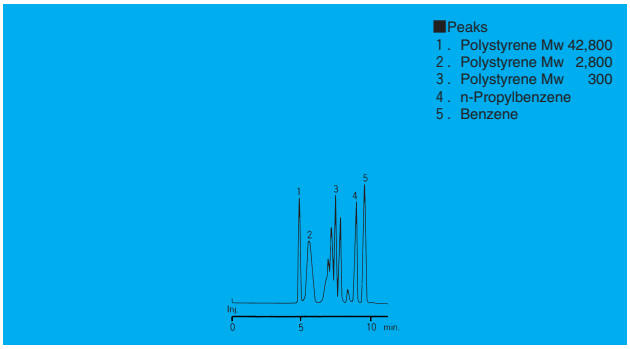



**Fig. 54 Analysis of Polystyrene Standard**

**■Operational Conditions**
**Column:** Shim-pack GPC-802
**Mobile phase:** Tetrahydrofuran
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (254nm)

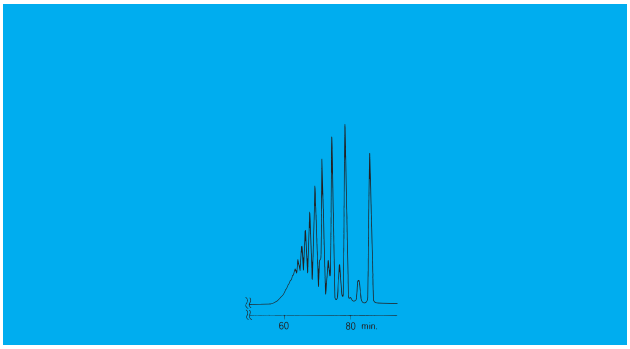



**Fig. 55 Analysis of Epoxy Resin**

**■Operational Conditions**
**Column:** Shim-pack GPC-803 (4 pcs.) and Shim-pack GPC-8025 (4 pcs.)
**Mobile phase:** Tetrahydrofuran
**Flow rate:** 1.0mL/min.
**Column temperature:** 55℃
**Detector:** UV spectrophotometric detector (254nm)

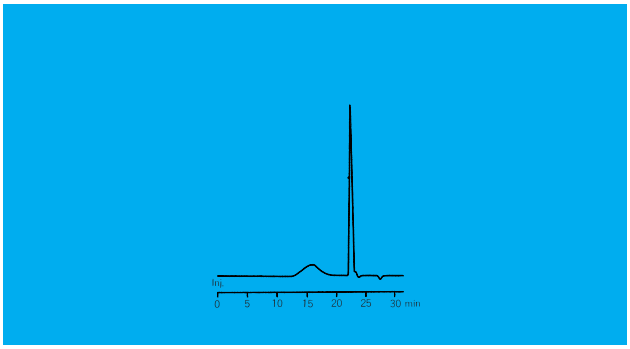



**Fig. 56 Analysis of Polymethylbenzene**

**■Operational Conditions**
**Column:** Shim-pack GPC-80MC (2pcs.) (8mm i.d.×300mm)
**Mobile phase:** Chloroform/Trichlorotrifluoroethane (8/2)
**Flow rate:** 1.0mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

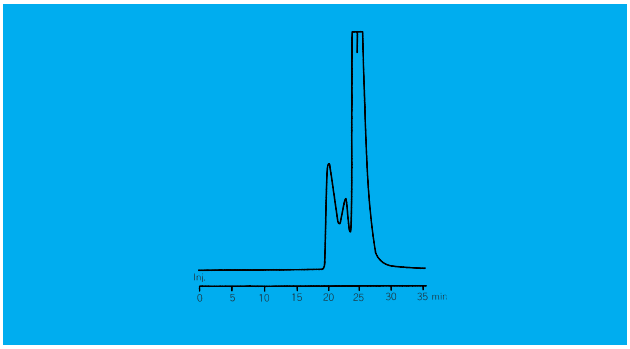



**Fig. 57 Analysis of Polythioethersulfone**

**■Operational Conditions**
**Column:** Shim-pack GPC-80MC (8mm i.d.×300mm)
**Mobile phase:** Chloroform
**Flow rate:** 0.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (270nm)

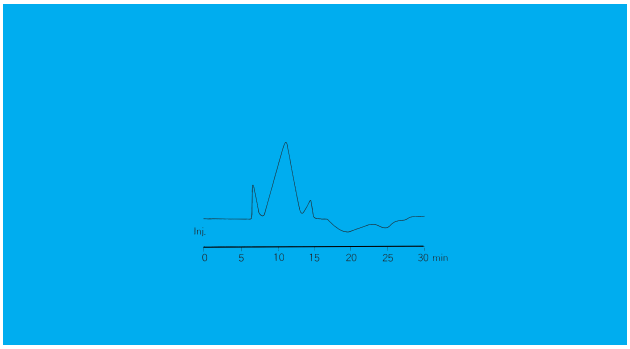



**Fig. 58 Analysis of Vinyleden Poly fluoride**

**■Operational Conditions**
**Column:** Shim-pack GPC-80MD (8mm i.d.×300mm)
**Mobile phase:** DMF (including 10mM LiCL)
**Flow rate:** 0.8mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

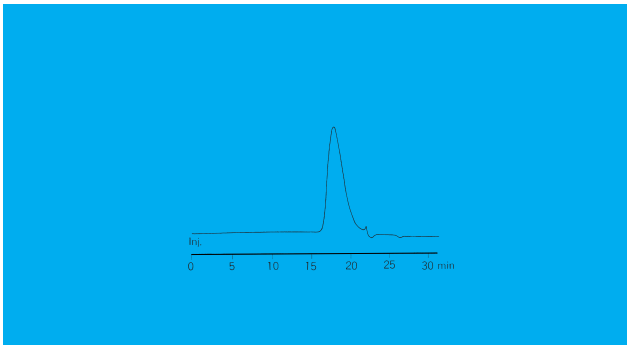
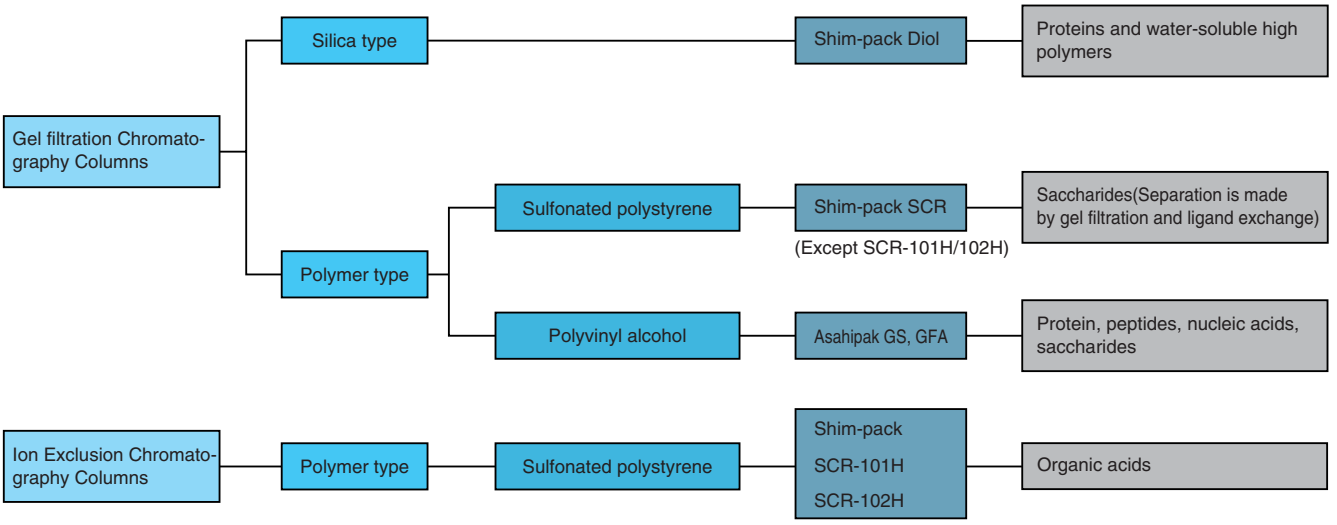



**Fig. 59 Analysis of Polyetherimide**

**■Operational Conditions**
**Column:** Shim-pack GPC-80MD (2 pcs.) (8mm i.d.×300mm)
**Mobile phase:** DMF (including 10mM LiCL)
**Flow rate:** 1.0mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

# Shim-pack Columns for Gel Filtration / Ion Exclusion Chromatography

- Gel filtration chromatography (GFC) is used to separate water-soluble high polymers such as polysaccharides, proteins, and nucleic acids, according to the molecular sizes.
- Shimadzu HPLC columns for gel filtration chromatography and ion exclusion chromatography may be classified as follows.




- Analysis of polysaccharides and oligosaccharides · · · · Asahipak GS series are recommended.
- Analysis of monosaccharides · · · · · · · · · · · · · · Shim-pack SCR series is recommended. Since the separation is made by a combination of gel filtration and ligand exchange, the selectivity differs with the type of cation.
- Analysis of proteins · · · · · · · · · · · · · · · · · · · Shim-pack Diol series, and Asahipak GS series are recommended. The silica type provides sharper peaks while the polymer type ensures better alkali resistancy.
- Analysis of organic acids · · · · · · · · · · · · · · · · Ion exclusion chromatography using Shim-pack SCR-101H and SCR-102H is recommended. An acidic aqueous solution (e.g. aqueous solution of perchloric acid) is used as mobile phase and the H type sulfonated styrene polymer as stationary phase.

## ■Shim-pack SCR

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack SCR-101N | Na type sulfone group | 10 | 7.9mm i.d.×30cm | 228-07730-92 |
| Shim-pack SCR-101C | Ca type sulfone group | 10 | 7.9mm i.d.×30cm | 228-17889-91 |
| Shim-pack SCR-101P | Pb type sulfone group | 10 | 7.9mm i.d.×30cm | 228-17890-91 |
| Shim-pack SCR-101H | H type sulfone group | 10 | 7.9mm i.d.×30cm | 228-07730-93 |
| Shim-pack SCR-102H | H type sulfone group | 7 | 8.0mm i.d.×30cm | 228-17893-91 |

## ■Guard Column for Shim-pack SCR

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Guard column SCR(N) (Dedicated to SCR-101N) | 4.0mm i.d.×5cm | 228-09619-92 |
| Guard column SCR(H) (Dedicated to SCR-101H) | 4.0mm i.d.×5cm | 228-09619-93 |
| Guard column SCR(C) (Dedicated to SCR-101C) | 4.0mm i.d.×5cm | 228-17891-91 |
| Guard column SCR(P) (Dedicated to SCR-101P) | 4.0mm i.d.×5cm | 228-17892-91 |
| Guard column SCR-102H (Dedicated to SCR-102H) | 6.0mm i.d.×5cm | 228-17924-91 |

＊Use a guard column without fail.

## ■Shim-pack Diol

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack Diol-150 | Diol group | 5 | 7.9mm i.d.×25cm | 228-14775-91 |
| | | | 7.9mm i.d.×50cm | 228-14775-92 |
| Shim-pack Diol-300 | Diol group | 5 | 7.9mm i.d.×25cm | 228-14776-91 |
| | | | 7.9mm i.d.×50cm | 228-14776-92 |

＊Install a precolumn (Cat. No. 228-16367-91) between the liquid pump and the sample injector.

## Shim-pack ION KS

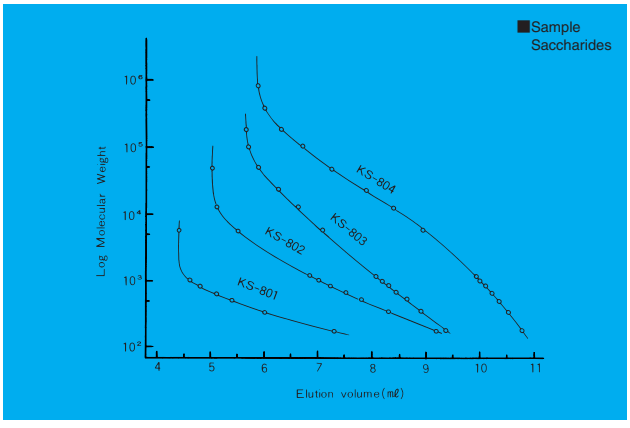



**Fig. 60 Calibration Curves for ION KS Series Columns**

**■Operational Conditions**

**Column:** Shim-pack ION KS (8.0mm i.d.×30cm)
**Mobile phase:** Water
**Flow rate:** 1.0mL/min.
**Column temperature:** 80℃
**Detector:** Refractive index detector

## Shim-pack SCR

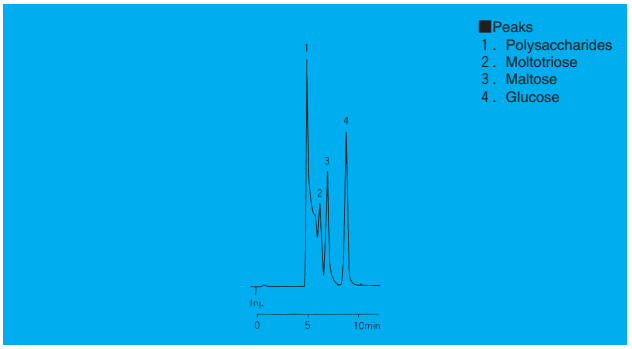



**Fig. 61 Analysis of Dextrin**

**■Operational Conditions**
**Column:** Shim-pack SCR-101N (7.9mm i.d.×30cm)
**Mobile phase:** Water
**Flow rate:** 0.8mL/min.
**Column temperature:** 60℃
**Detector:** Refractive index detector

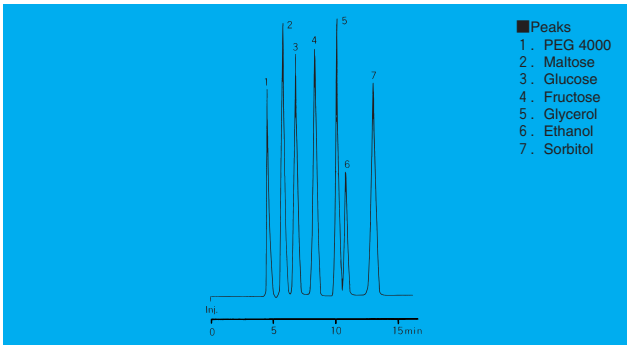



**Fig. 62 Analysis of Saccharide Standard**

**■Operational Conditions**
**Column:** Shim-pack SCR-101C (7.9mm i.d.×30cm)
**Mobile phase:** Water
**Flow rate:** 1.0mL/min.
**Column temperature:** 80℃
**Detector:** Refractive index detector

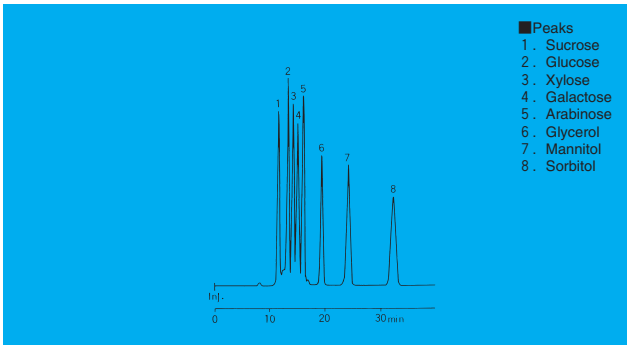



**Fig. 63 Analysis of Saccharide Standard**

**■Operational Conditions**
**Column:** Shim-pack SCR-101p (7.9mm i.d.×30cm)
**Mobile phase:** Water
**Flow rate:** 0.6mL/min.
**Column temperature:** 80℃
**Detector:** Refractive index detector

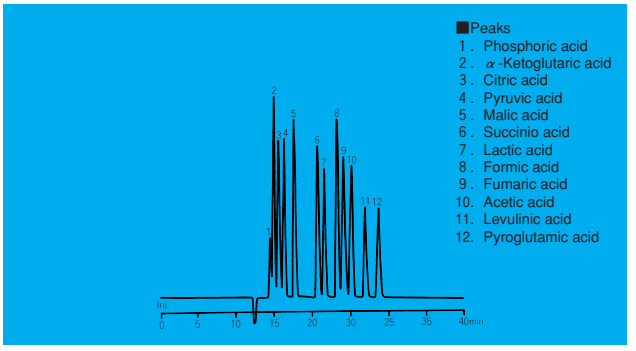



**Fig. 64 Analysis of Organic Acids**

**■Operational Conditions**
**Column:** Shim-pack SCR-102H (7.9mm i.d.×30cm) (2 pcs.)
**Mobile phase:** 5mM p-Toluene sulfonic acids aqueous solution
**Flow rate:** 0.8mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector (pH buffer organic acids analysis system)

## Shim-pack Diol

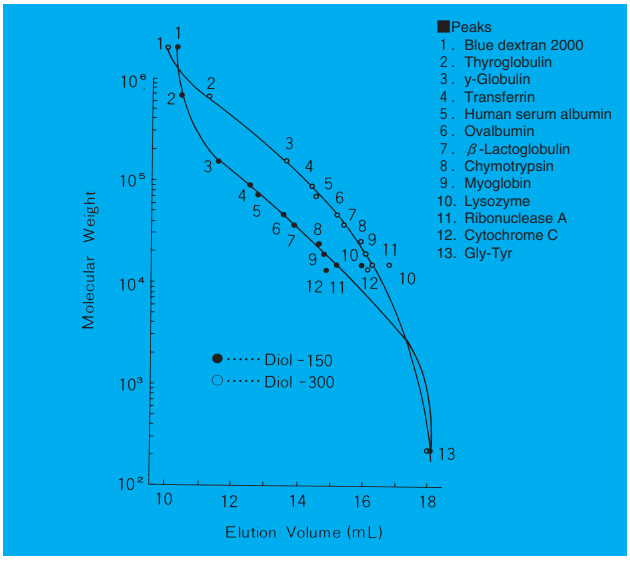



**Fig. 65 Calibration Curve for Shim-pack Diol Columns**

■**Operational Conditions**
**Column:** Shim-pack Diol (7.9mm i.d.×50cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 7) and 0.2M sodium sulfate
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

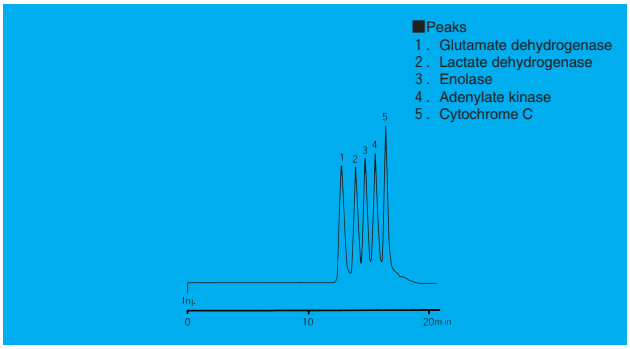



**Fig. 66 Analysis of Protein Standard**

■**Operational Conditions**
**Column:** Shim-pack Diol-300 (7.9mm i.d.×50cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 7) and 0.1M sodium chloride
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

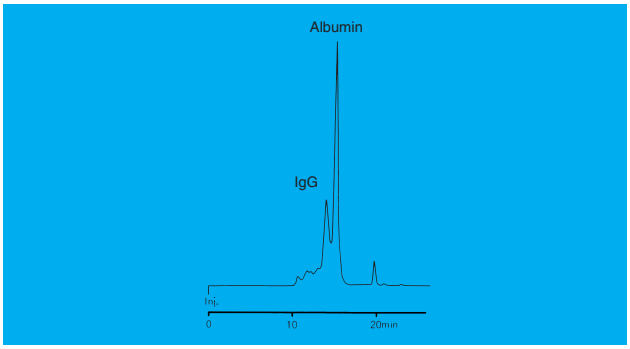



**Fig. 67 Analysis of Human Serum**

■**Operational Conditions**
**Column:** Shim-pack Diol-300 (7.9mm i.d.×50cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 7) and 0.2M sodium sulfate
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

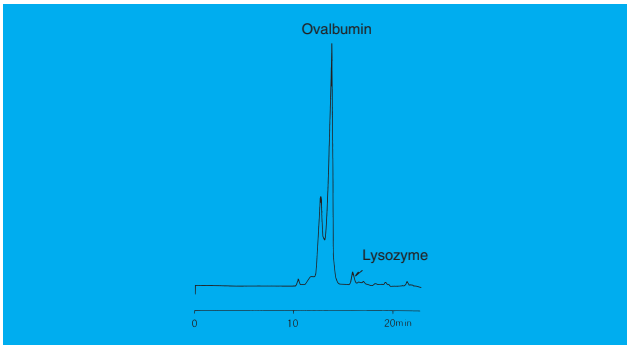



**Fig. 68 Analysis of Albumin**

■**Operational Conditions**
**Column:** Shim-pack Diol-150 (7.9mm i.d.×50cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 7) and 0.2M sodium sulfate
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

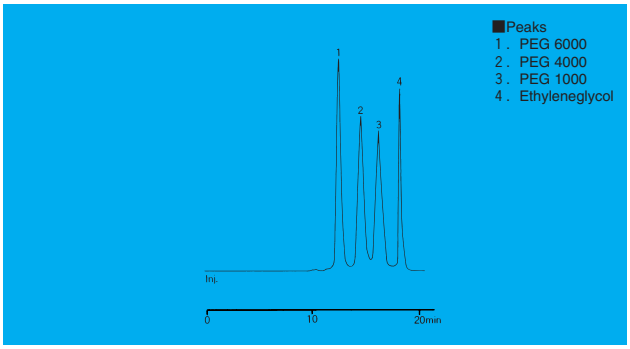
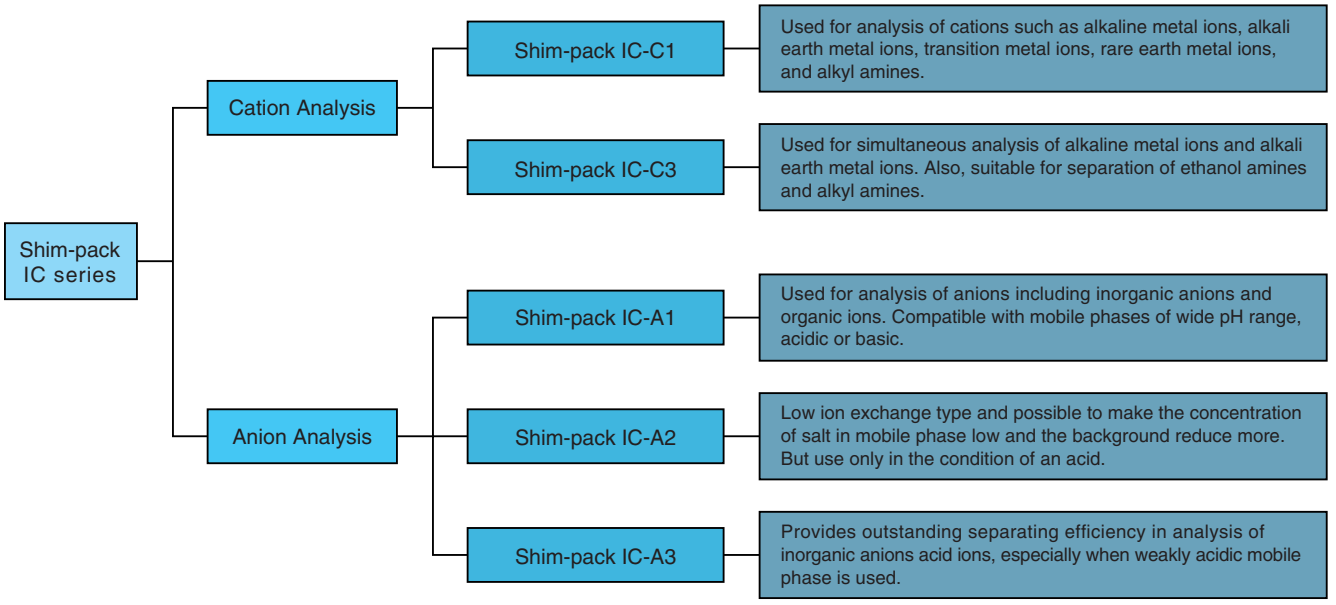



**Fig. 69 Analysis of Polyethylene Glycol**

■**Operational Conditions**
**Column:** Shim-pack Diol-150 (7.9mm i.d.×50cm)
**Mobile phase:** Water
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** Refractive index detector

# Shim-pack IC

- Shim-pack IC series is ion exchange columns developed for ion chromatography.
- The Shim-pack IC series columns are classified as follows.




## ■Shim-pack IC

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack IC-A1 | Quaternary ammonium group | 12.5 | 4.6mm i.d.×10cm | 228-17733-91 |
| Shim-pack IC-A1(S) | Quaternary ammonium group | 10 | 2.0mm i.d.×15cm | 228-33400-91 |
| Shim-pack IC-A2 | Quaternary ammonium group | 10 | 4.6mm i.d.×5cm | 228-17735-91 |
| Shim-pack IC-A3 | Quaternary ammonium group | 5 | 4.6mm i.d.×15cm | 228-31076-91 |
| Shim-pack IC-A3(S) | Quaternary ammonium group | 5 | 2.0mm i.d.×15cm | 228-33366-91 |
| Shim-pack IC-C1 | Sulfone group | 10 | 5.0mm i.d.×15cm | 228-17737-91 |
| Shim-pack IC-C1 PEEK | Sulfone group | 10 | 4.6mm i.d.×10cm | 228-33497-91 |
| Shim-pack IC-C3 | Carboxylic group | 7 | 4.6mm i.d.×10cm | 228-32329-91 |
| Shim-pack IC-C3(S) | Carboxylic group | 7 | 2.0mm i.d.×10cm | 228-33367-91 |

*Shim-pack IC(S) series are for semi-micro LC. The use of this with PIA-1000 is recommended.

## ■Shim-pack IC-G

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack IC-GA1 (Dedicated to IC-A1) | 4.6mm i.d.×1cm | 228-17734-91 |
| Shim-pack IC-GA2 (Dedicated to IC-A2) | 4.0mm i.d.×1cm | 228-17736-91 |
| Shim-pack IC-GA3 (Dedicated to IC-A3) | 4.6mm i.d.×1cm | 228-31076-92 |
| Shim-pack IC-GC1 (Dedicated to IC-C1) | 4.0mm i.d.×1cm | 228-17738-91 |
| Shim-pack IC-GC1 PEEK (Dedicated to IC-C1 PEEK) | 4.6mm i.d.×1cm | 228-33497-92 |
| Shim-pack IC-GC3 Ⅱ (Dedicated to IC-C3) | 4.6mm i.d.×7.5mm | 228-41176-91 |

## ■Precolumn

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack IC-PC1 (Dedicated to IC-C1) | 8.0mm i.d.×5cm | 228-17744-91 |

In analysis of alkali metal ions with the Shim-pack IC-C1, the use of the pre-column is recommended.

## Shim-pack IC

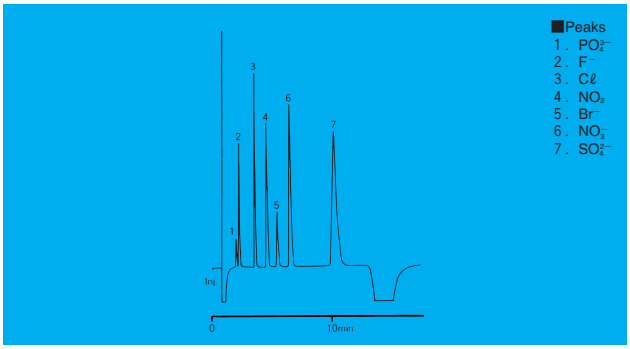



**Fig. 70 Analysis of Inorganic Anions**

**■Operational Conditions**

**Column:** Shim-pack IC-A3 (4.6mm i.d.×15cm)
**Mobile phase:** 8.0mM p-Hydroxybenzoic acid and 3.2 mM Bis-Tris*
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

*Bis(2-hydroxyethyl) iminotris (hydroxymethyl) methane

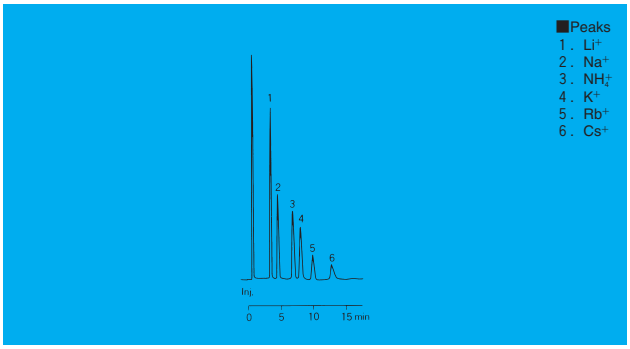



**Fig. 71 Analysis of Alkali Metal Ions**

**■Operational Conditions**

**Column:** Shim-pack IC-C1 (5.0mm i.d.×15cm)
**Mobile phase:** 5mM nitric acid
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

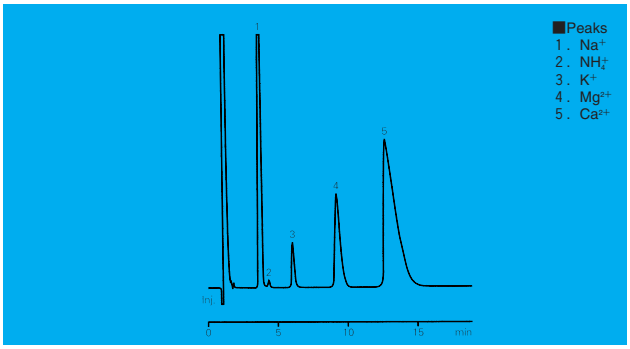



**Fig. 72 Analysis of Cations in Water (includes ammonia)**

**■Operational Conditions**

**Column:** Shim-pack IC-C3 (4.6mm i.d.×10cm)
**Mobile phase:** 2.5mM oxalic acid
**Flow rate:** 1.0mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

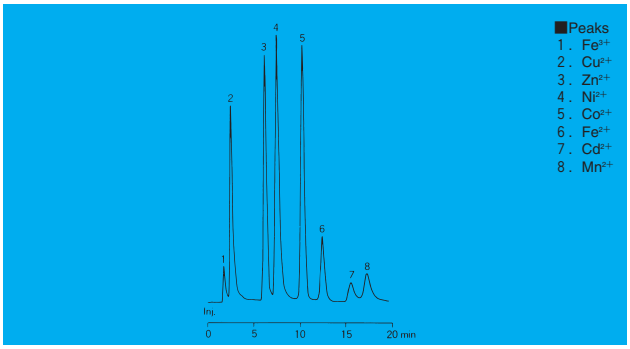



**Fig. 73 Analysis of Transition Metal Ions**

**■Operational Conditions**

**Column:** Shim-pack IC-C1 (5mm i.d.×15cm)
**Mobile phase:** 0.3M lactic acid
**Flow rate:** 1.0mL/min.
**Column temperature:** 40℃
**Detector:** UV・VIS spectrophotometric detector
**Method:** Post-column derivatization with 4- (2-pyridilazo resorcinol)

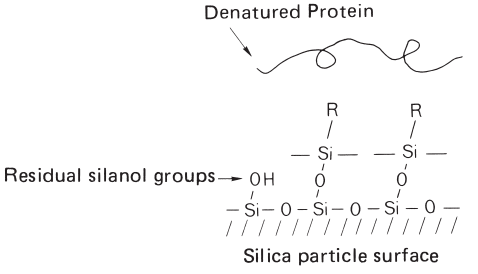
# Shim-pack HPC

- Shim-pack HPC columns have been specifically developed for the hydrophobic LC of biological high polymers such as proteins and nucleic acids.
- The columns are packed with fully-porous spherical particles, 5 μm in diameter and 300 Å in pore diameter. The effect of the residual silanol groups is minimized by the unique chemical treatment technique.
- Ethyl groups or n-propyl groups are chemically bonded as stationary phase.

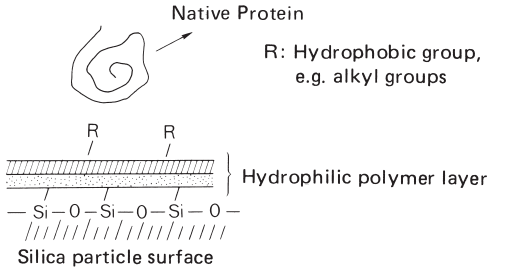
## Hydrophobic LC and Reversed Phase LC

Both of these techniques use hydrophobic column packings, but are different in the following points.

- The column packings for reversed phase LC are more hydrophobic than those for hydrophobic LC.
- In reversed phase LC, since organic solvent is generally used as mobile phase, the high-degree structures of proteins are often transmuted and the enzymes deactivated. In hydrophobic LC, on the other hand, since buffer solutions containing some salt are generally used, the high-degree structures of proteins are hardly transmuted.
- The retention of sample components is more dependent on the degree of hydrophobicity of the stationary phase in hydrophobic LC than in reversed phase LC. It is, therefore, more important to select the stationary phase, HPC-C2 or HPC-C3, in hydrophobic LC.




(a) Chemically-Bonded Packing Material for Ordinary Reversed Phase LC




(b) Shim-pack HPC Column Packing for Hydrophobic LC

## ■Shim-pack HPC

| Column name | Stationary phase | Particle dia. (μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack HPC-C2 | Ethyl group | 5 | 4.0mm i.d.×5cm | 228-17792-91 |
| Shim-pack HPC-C3 | n-Propyl group | 5 | 4.0mm i.d.×5cm | 228-17793-91 |

*It is necessary to install a pre-column between the liquid pump and the sample injector, to protect the Shim-pack HPC column.

## Shim-pack HPC

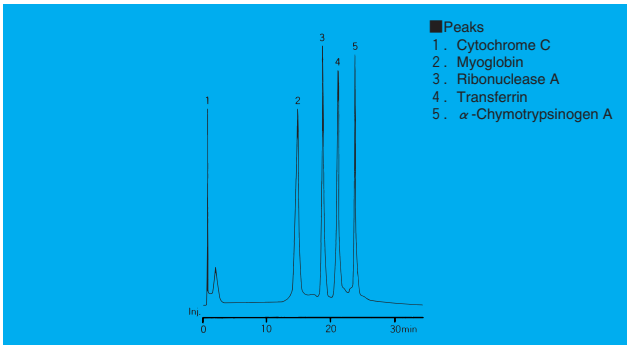



**Fig. 74 Analysis of Protein Standard**

**■Operational Conditions**

**Column:** Shim-pack HPC-C2 (4.0mm i.d.×5cm)
**Mobile phase:** Ammonium sulfate/phosphate buffer solution (pH 7), gradient elution
**Flow rate:** 0.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (220nm)

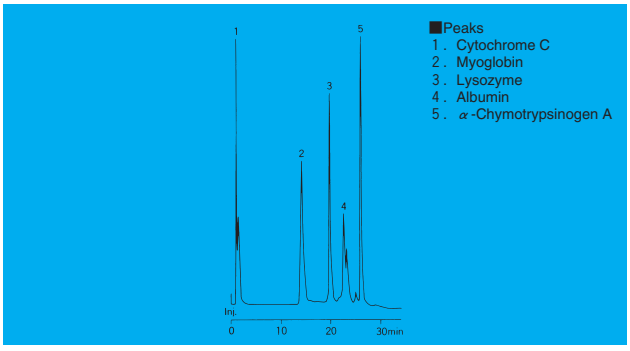



**Fig. 76 Analysis of Glucosidase**

**■Operational Conditions**

**Column:** Shim-pack HPC-C3 (4.0mm i.d.×5cm)
**Mobile phase:** Ammonium sulfate/phosphate buffer solution (pH 7), gradient elution
**Flow rate:** 0.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (220nm)

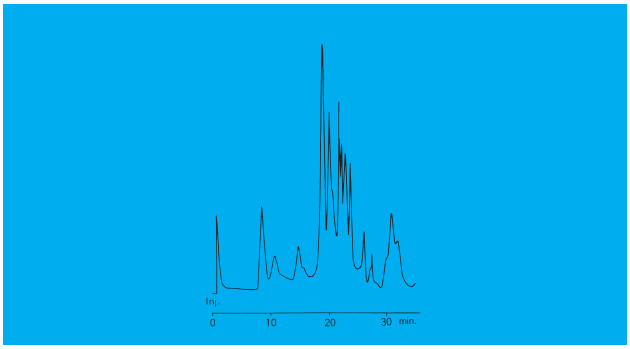



**Fig. 75 Analysis of Snake Venom**

**■Operational Conditions**

**Column:** Shim-pack HPC-C2 (4.0mm i.d.×5cm)
**Mobile phase:** Ammonium sulfate/phosphate buffer solution (pH 7), gradient elution
**Flow rate:** 0.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (220nm)

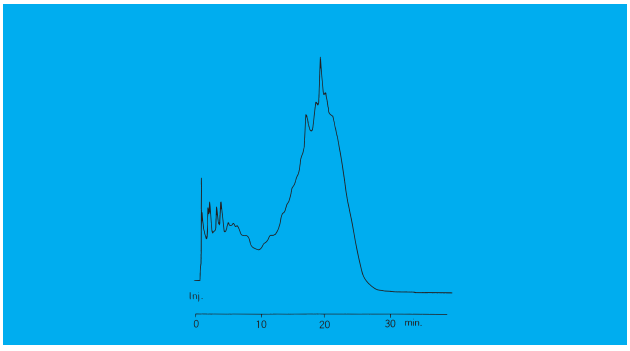



**Fig. 77 Analysis of Ribonucleic Acids**

**■Operational Conditions**

**Column:** Shim-pack HPC-C3 (4.0mm i.d.×5cm)
**Mobile phase:** Ammonium sulfate/phosphate buffer solution (pH 7), gradient elution
**Flow rate:** 0.5mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (260nm)

# Shim-pack SPC

- The Shim-pack SPC has specifically developed for automatic sample pretreatment and concentration by the column switching method.
- The Shim-pack SPC-RP3 column is packed with polymer particles and used for reversed phase LC.
- The Shim-pack SPC-AE1 column is packed with fully porous silica gel particles on which weakly basic anion exchange functions are chemically bonded.
- The Shimadzu Automatic Sample Pretreatment HPLC System is recommended.

## HPLC System with Automatic Sample Pretreatment Functions

This system is used for analysis of samples that contain many interfering compounds. In the first step, the sample is roughly separated in the pretreating column. Then, only the fraction that contains the target compounds is made to enter the analytical column, the switching being done with a valve. The sample pretreatment is carried out in a completely automated sequence.

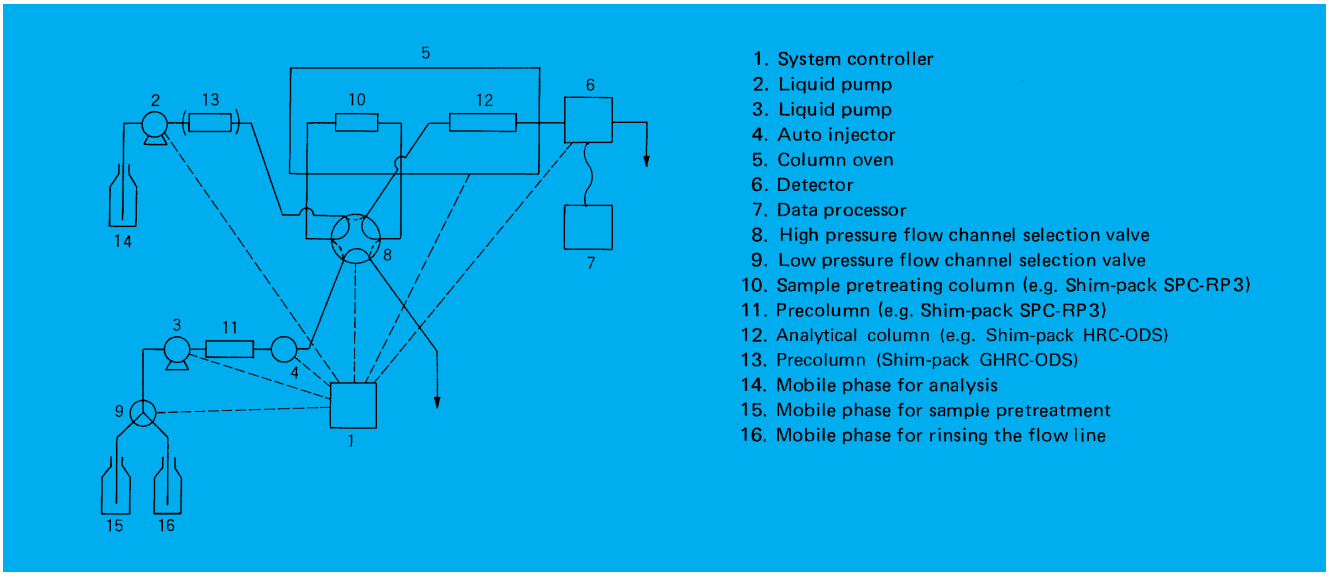



**Fig. 78 Shimadzu Automatic Sample Pretreatment HPLC System**

## ■Shim-pack SPC

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack SPC-RP3 | Polymer | 9 | Reversed phase | 4.0mm i.d.×3cm | 228-33713-91 |
| Shim-pack SPC-RP2 | Polymer | 10 | Reversed phase | 4.6mm i.d.×1cm | 228-18838-91 |
| Shim-pack SPC-AE1 | Tertiary amino group | 10 | Anion exchange | 4.0mm i.d.×1cm | 228-17990-91 |

# Shim-pack GRD, Pre-column

- Undissolved materials in mobile phase is the cause of stuffing analytical column and consuming packing materials. Installing Shim-pack GRD-ODS, you can escape from these causes above. Connect this between the liquid pump and the sample injector bellow.
- Using GRD, Pre-column makes the life of analytical columns long.

## Shim-pack GRD-ODS

Effective particuraly when reversed phase column is used and both mobile phase pH is higher than neutral and ion pair reagent involving ritrogen such as tetrabutyl ammonium is used.

## Pre-column Diol

The use of pre-column is recommended when using Shim-pack Diol, Shim-pack WAX, WCX, Shim-pack HPC series. Particurely when the concentration of the salt is high, it is available to eliminate un-dissolved materials in salt.

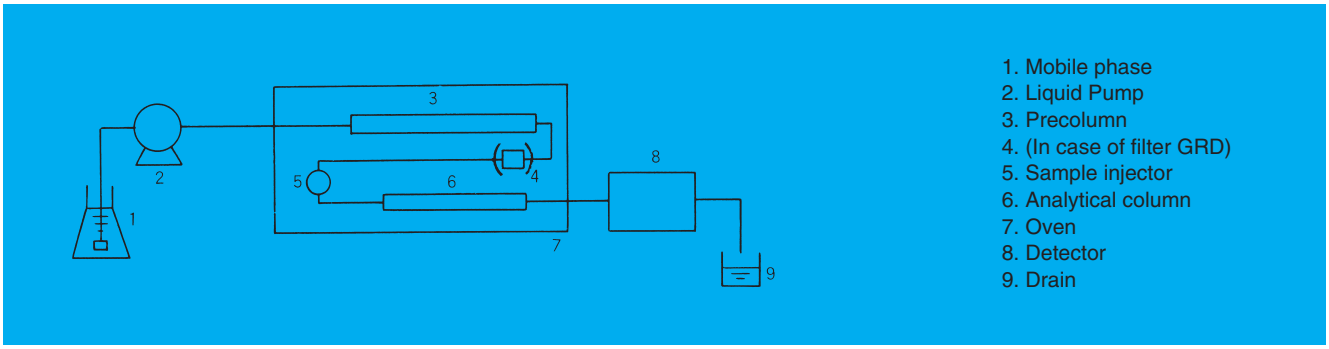



**Fig. 79 Flow line having Pre-column**

### ■Shim-pack GRD, Pre-column (It is necessary to install a pre-column between the liquid pump and the sample injector.)

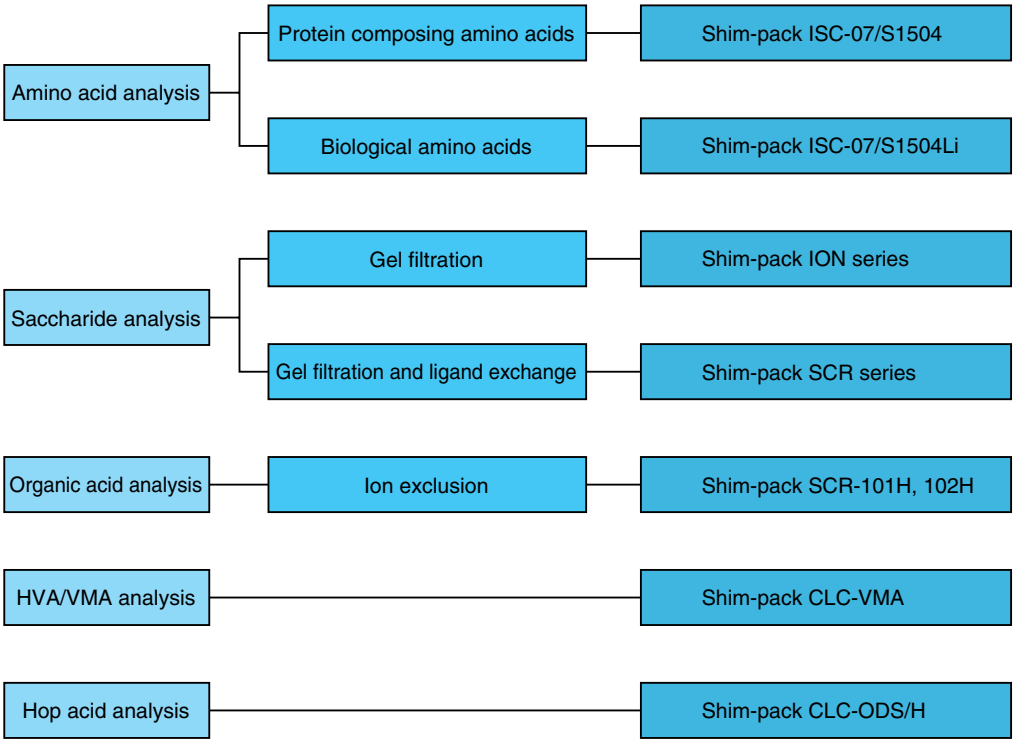
| Column name | Stationary phase | Particle dia. ( $\mu$m) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack GRD-ODS | Octadecyl group | 30～50 | 4.0mm i.d.×25cm | 228-16557-91 |
| Pre-column Diol | Diol group | 10 | 4.0mm i.d.×5cm | 228-16367-91 |

### Packing materials of GRD-ODS

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Weight | Cat. No. |
|---|---|---|---|---|
| Gel GRD-ODS | Octadecyl group | 30～50 | 10g | 228-16831-91 |

## Dedicated Shim-pack Columns

● The Shim-pack Series columns may be classified as follows, according to the applicable type of samples.




Applications of the Shim-pack CLC-VMA column and the Shim-pack CLC-ODS/H column

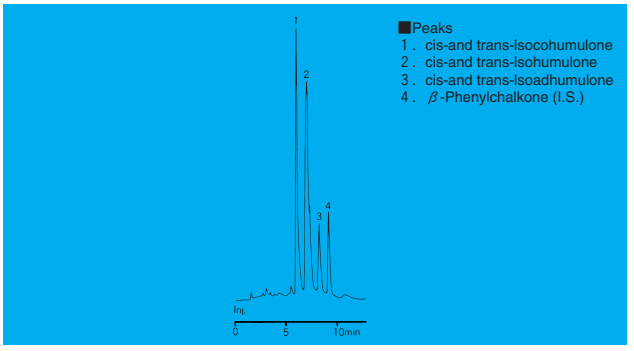



**Fig. 80 Analysis of Hop Acids**

**■Operational Conditions**

**Column:** Shim-pack CLC-ODS/H (4.6mm i.d.×25cm)
**Mobile phase:** Methanol/water/phosphoric acid/10% tetra ethyl ammonium (77.5/22.5/1.1/3)
**Flow rate:** 1.5mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (270nm)

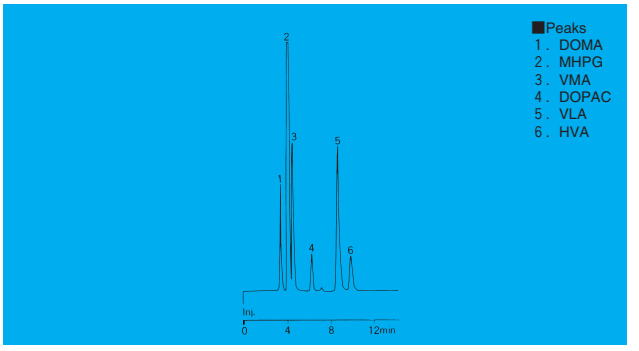



**Fig. 81 Analysis of Catecholamine Metabolites**

**■Operational Conditions**

**Column:** Shim-pack CLC-VMA (6.0mm i.d.×15cm)
**Mobile phase:** 3mM tartaric acid/acetonitrile (7/3)
**Flow rate:** 1.0mL/min.
**Column temperature:** 40℃
**Detector:** Fluorescence HPLC monitor (Ex. 280nm, Em. 320nm)

## ■Columns for Amino Acid Analysis

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack Amino-Na | Na type sulfone group | 5 | 6.0mm i.d.×10cm | 228-18837-91 |
| Shim-pack Amino-Li | Li type sulfone group | 5 | 6.0mm i.d.×10cm | 228-18837-92 |
| Shim-pack ISC-07/S1504Na | Na type sulfone group | 7 | 4.0mm i.d.×15cm | 228-09328-91 |
| Shim-pack ISC-07/S1504Li | Li type sulfone group | 7 | 4.0mm i.d.×15cm | 228-00796-91 |

＊The following guard columns are available for amino acid analysis.

| Column name | Dimensions | Cat. No. |
|---|---|---|
| ISC-07 guard column (Na type) | 4.0mm i.d.×5cm | 228-00802-91 |
| ISC-07 guard column (Li type) | 4.0mm i.d.×5cm | 228-00797-91 |

＊The following column must be used in amino acid analysis.

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack ISC-30/S0504Na (for trapping Na type ammonia) | 4.0mm i.d.×5cm | 228-14206-91 |
| Shim-pack ISC-30/S0504Li (for trapping Li type ammonia) | 4.0mm i.d.×5cm | 228-00821-91 |

## ■Columns for Saccharide Analysis

| Column name | Exclusion limit (dextran) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack ION KS-801 | $1\times10^3$ | 8.0mm i.d.×30cm | 228-17894-91 |
| Shim-pack ION KS-802 | $1\times10^4$ | 8.0mm i.d.×30cm | 228-17895-91 |
| Shim-pack ION KS-803 | $5\times10^4$ | 8.0mm i.d.×30cm | 228-17896-91 |
| Shim-pack ION KS-804 | $4\times10^5$ | 8.0mm i.d.×30cm | 228-17897-91 |

＊The following dedicated guard column is available

| Column name | Dimensions | Cat. No. |
|---|---|---|
| Shim-pack ION KS-800P (Common to ION KS series) | 6.0mm i.d.×5cm | 228-17898-91 |

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack SCR-101N | Na type sulfone group | 10 | 7.9mm i.d.×30cm | 228-07730-92 |
| Shim-pack SCR-101C | Ca type sulfone group | 10 | 7.9mm i.d.×30cm | 228-17889-91 |
| Shim-pack SCR-101P | Pb type sulfone group | 10 | 7.9mm i.d.×30cm | 228-17890-91 |

＊The following guard column must be used.

| Column name | Dimensions | Cat. No. |
|---|---|---|
| SCR(N) guard column, dedicated to SCR-101N | 4.0mm i.d.×5cm | 228-09619-92 |
| SCR(C) guard column, dedicated to SCR-101C | 4.0mm i.d.×5cm | 228-17891-91 |
| SCR(P) guard column, dedicated to SCR-101P | 4.0mm i.d.×5cm | 228-17892-91 |

## ■Columns for Organic Acid Analysis

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack SCR-101H | H type sulfone group | 10 | 7.9mm i.d.×30cm | 228-07730-93 |
| Shim-pack SCR-102H | H type sulfone group | 7 | 8.0mm i.d.×30cm | 228-17893-91 |

| Column name | Dimensions | Cat. No. |
|---|---|---|
| SCR(H) guard column, dedicated to SCR-101H | 4.0mm i.d.×5cm | 228-09619-93 |
| SCR-102H guard column, dedicated to SCR-102H | 6.0mm i.d.×5cm | 228-17924-91 |

## ■Columns for VMA/HVA Analysis

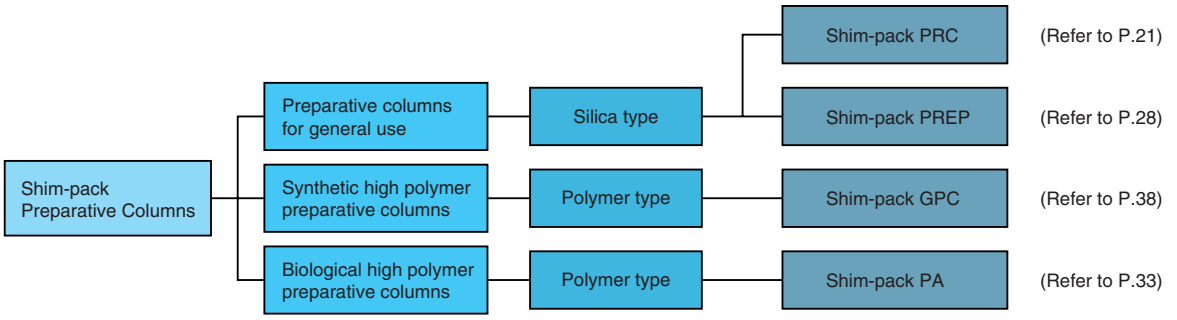
| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack CLC-VMA | Polar group | 5 | Reversed | 6.0mm i.d.×15cm | 228-17255-91 |

## ■Columns for Hop Acid Analysis

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack CLC-ODS/H | Octadecyl group | 5 | Reversed | 4.6mm i.d.×25cm | 228-00808-92 |

# Shim-pack Preparative Columns

● The Shim-pack preparative columns are available as follows.




Also STR (refer to P.70), Asahipak (refer to P.59) and CAPCELL PAK (refer to P.66) preparative columns are available.

## Standard values for maximum sample loads

When the sample load is increased beyond some maximum, extreme peak distortions can occur; the upper limit is the maximum acceptable sample load based on this peak distortion. The table below shows standard values of maximum sample loads for a semi-preparative column and preparative column each having a length of 250mm, in comparison with an ordinary analytical column. It shoud be noted that these standard values are applicable on condition that various requirements are satisfied: ion suppression for the desired component is achieved, the desired component is sufficiently soluble in the mobile phase, the type of sample injection solvent is considered, and other components do not elute near the target peak.

### ■Standard Values of Maximum Sample Loads (column length is 250mm)

| Column internal diameter (mm) | Sectional area ($cm^2$) | Flow rate (ml $min^{-1}$) | Maximum sample load (mg) |
|---|---|---|---|
| 4.6 | 0.17 | 0.8 | 17 |
| 20.0 | 3.1 | 15 | 300 |
| 50.0 | 20 | 90 | 2000 |

### ■Polymer type GPC Preparative Columns

■Shim-pack GPC-2000 series
Preparative columns of Shim-pack GPC-800 series (Tetrahydrofuran)

| Column name | Exclusion limit (polystyrene) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack GPC-2001 | $1.5\times10^3$ | 20mm i.d.×30cm | 228-23342-91 |
| Shim-pack GPC-2002 | $5\times10^3$ | 20mm i.d.×30cm | 228-23342-92 |
| Shim-pack GPC-20025 | $2\times10^4$ | 20mm i.d.×30cm | 228-23342-93 |
| Shim-pack GPC-2003 | $7\times10^4$ | 20mm i.d.×30cm | 228-23342-94 |
| Shim-pack GPC-2000P | (guard column) | 8.0mm i.d.×5cm | 228-20812-94 |

■Shim-pack GPC-2000 series
Preparative columns of Shim-pack GPC-800C series (Chloroform)

| Column name | Exclusion limit (polystyrene) | Dimensions | Cat. No. |
|---|---|---|---|
| Shim-pack GPC-2001C | $1.5\times10^3$ | 20mm i.d.×30cm | 228-23343-91 |
| Shim-pack GPC-2002C | $5\times10^3$ | 20mm i.d.×30cm | 228-23343-92 |
| Shim-pack GPC-20025C | $2\times10^4$ | 20mm i.d.×30cm | 228-23343-93 |
| Shim-pack GPC-2003C | $7\times10^4$ | 20mm i.d.×30cm | 228-23343-94 |
| Shim-pack GPC-2000CP | (guard column) | 8.0mm i.d.×5cm | 228-20812-95 |

## ■Polymer Type Ion Exchange Preparative Column

### ■Shim-pack PA

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack PA-DEAE | Diethylaminoethyl group | 10 | 20mm i.d.×10cm | 228-20758-92 |
| Shim-pack PA-QA | Tetramethyl ammonium group | 10 | 20mm i.d.×10cm | 228-20759-92 |
| Shim-pack PA-CM | Carboxymethyl group | 10 | 20mm i.d.×10cm | 228-20760-92 |
| Shim-pack PA-SP | Sulfopropyl group | 10 | 20mm i.d.×10cm | 228-20761-92 |

### ■Guard Column for Shim-pack PA

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack PAG-DEAE | Diethylaminoethyl group | 10 | 8.0mm i.d.×1cm | 228-20762-91 |
| Shim-pack PAG-QA | Tetramethyl ammonium group | 10 | 8.0mm i.d.×1cm | 228-20763-91 |
| Shim-pack PAG-CM | Carboxymethyl group | 10 | 8.0mm i.d.×1cm | 228-20764-91 |
| Shim-pack PAG-SP | Sulfopropyl group | 10 | 8.0mm i.d.×1cm | 228-20765-91 |

## ■Preparative column for general use

### ■Shim-pack PRC

| Column name | Stationary phase | Particle dia. ( μm) | Separation mode | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack PRC-SIL | Silica | 15 | Adsorption | 20mm i.d.×25cm | 228-23461-93 |
| Shim-pack PRC-SIL(K) | | | | 30mm i.d.×25cm | 228-23461-94 |
| Shim-pack PRC-SIL(L) | | | | 50mm i.d.×25cm | 228-23461-95 |
| Shim-pack PRC-SIL(H) | | 5 | | 20mm i.d.×25cm | 228-23461-91 |
| Shim-pack PRC-ODS | Octadecyl group | 15 | Reversed | 20mm i.d.×25cm | 228-23464-93 |
| Shim-pack PRC-ODS(K) | | | | 30mm i.d.×25cm | 228-23464-94 |
| Shim-pack PRC-ODS(L) | | | | 50mm i.d.×25cm | 228-23464-95 |
| Shim-pack PRC-ODS(H) | | 5 | | 20mm i.d.×25cm | 228-23464-91 |
| Shim-pack PRC-$C_8$ | Octyl group | 15 | Reversed | 20mm i.d.×25cm | 228-24381-93 |
| Shim-pack PRC-$C_8$(H) | | 5 | | 20mm i.d.×25cm | 228-24381-91 |
| Shim-pack PRC-TMS | Trimethyl group | 15 | Reversed | 20mm i.d.×25cm | 228-24382-93 |
| Shim-pack PRC-TMS(H) | | 5 | | 20mm i.d.×25cm | 228-24382-91 |
| Shim-pack PRC-TMS | Aminopropyl group | 15 | Reversed, normal, ion exchange | 20mm i.d.×25cm | 228-24383-93 |
| Shim-pack PRC-$NH_2$(H) | | 5 | | 20mm i.d.×25cm | 228-24383-91 |
| Shim-pack PRC-CN | Cyanopropyl group | 15 | Reversed-phase, normal phase | 20mm i.d.×25cm | 228-24384-93 |
| Shim-pack PRC-CN(H) | | 5 | | 20mm i.d.×25cm | 228-24384-91 |

### ■PRC guard column

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | Cat. No. |
|---|---|---|---|---|
| Shim-pack GPRC-SIL | Silica | 5 | 8mm i.d.×1.5cm | 228-23462-92 |
| Shim-pack GPRC-ODS | Octadecyl group | 5 | 8mm i.d.×1.5cm | 228-23465-92 |
| Shim-pack GPRC-$C_8$ | Octyl group | 5 | 8mm i.d.×1.5cm | 228-24386-92 |
| Shim-pack GPRC-TMS | Trimethyl group | 5 | 8mm i.d.×1.5cm | 228-24387-92 |
| Shim-pack GPRC-$NH_2$ | Aminopropyl group | 5 | 8mm i.d.×1.5cm | 228-24388-92 |
| Shim-pack GPRC-CN | Cyanopropyl group | 5 | 8mm i.d.×1.5cm | 228-24389-92 |
| Shim-pack GPRC-SIL(K) | Silica | 15 | 30mm i.d.×7.5cm | 228-23462-93 |
| Shim-pack GPRC-SIL(L) | Silica | 15 | 50mm i.d.×5cm | 228-23462-94 |
| Shim-pack GPRC-ODS(K) | Octadecyl group | 15 | 30mm i.d.×7.5cm | 228-23465-93 |
| Shim-pack GPRC-ODS(L) | Octadecyl group | 15 | 50mm i.d.×5cm | 228-23465-94 |

## ■Preparative purification of Paeoniflorin in paeony root

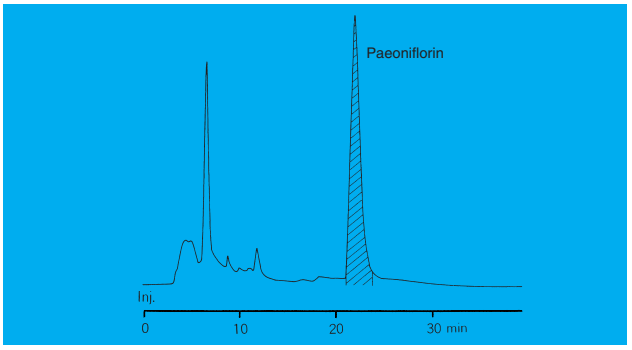



Fig. 82

**■Large scale preparative conditions**
**Sample:** Paeonyroot etract, 200mL, pumped-injection
**Column:** Shim-pack PREP-ODS (L) (50mm i.d.×25cm)
**Mobile phase:** Acetonitriles/water (1/6)
**Flow rate:** 100mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (230nm, 0.5mmL. cell)

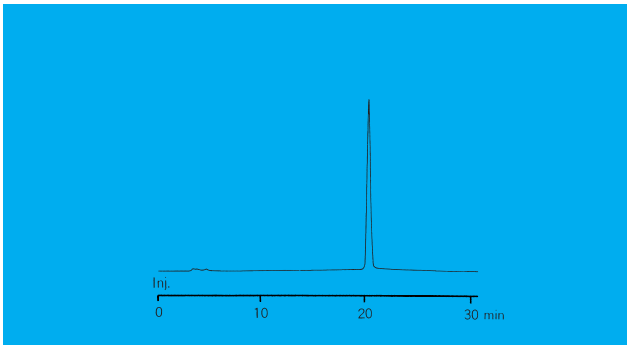



Fig. 83

**■Fraction purity test condition**
**Sample:** Fraction 5 μL
**Column:** Shim-pack CLC-ODS (M) (4.6mm i.d.×25cm)
**Mobile phase:** Acetonitriles/water (1/6)
**Flow rate:** 0.8mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (230nm, 10mmL. cell)

## ■Preparative purification of Paeonol in Moutan Bark

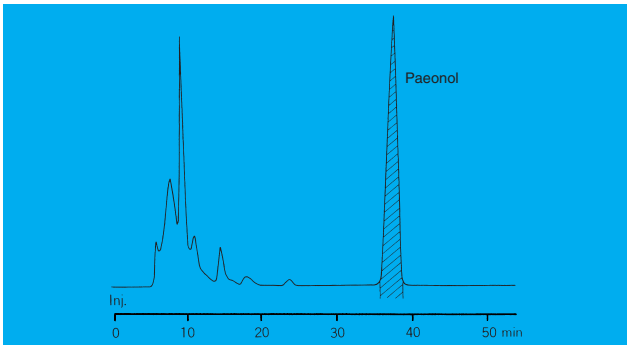



Fig. 84

**■Large scale preparative conditions**
**Sample:** Moutan bark extract, 200mL, pumped-injection
**Column:** Shim-pack PREP-ODS (L) (50mm i.d.×25cm, 15 μm)
**Mobile phase:** 0.1%(v/v)Acetate water/Acetonitriles (3/2)
**Flow rate:** 60mL/min.
**Detector:** UV spectrophotometric detector (254nm, 0.2mmL. cell)

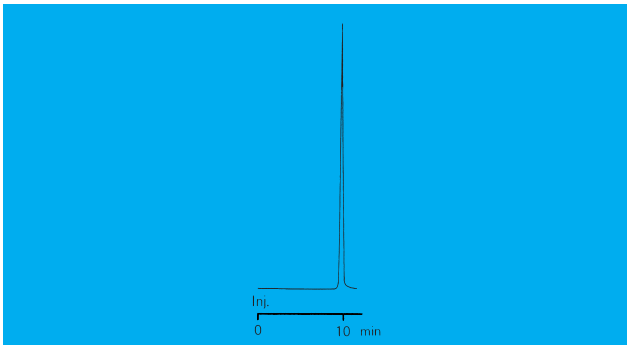



Fig. 85

**■Fraction purity test condition**
**Sample:** Fraction 10 μL
**Column:** STR ODS-H (4mm i.d.×15cm, 5 μm)
**Mobile phase:** 0.1%(v/v)Acetate water/Acetonitriles (3/2)
**Flow rate:** 0.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (254nm)

## ■Preparative purification of Peptides

When separating peptides in reversed phase chromatography, changing mobile phase into acidic makes it possible to restrain the sticking of peptides to the surface of the silica gel. In case of preparative purification, the point is that evaporating a fraction easily to make the mobile phase acidic using trifluoroacetic acid and acetate

Preparative Scale Purification of Peptides

| | |
|---|---|
| Column | Reversed phase TMS($C_1$), $C_4$, $C_8$, ODS($C_{18}$) (size-exclusion or ion exchange column, as required) |
| Mobile phase | Acetonitrile/water (or 2-propanol), in the presence of 0.1 to 1%(v/v) trifluoreacetic acid, formic acid or acetic acid. |
| Detector | 210-230nm |
| Fraction concentration | Evaporator (organic solvent) → freeze-drying (water) → storage at −20℃ |

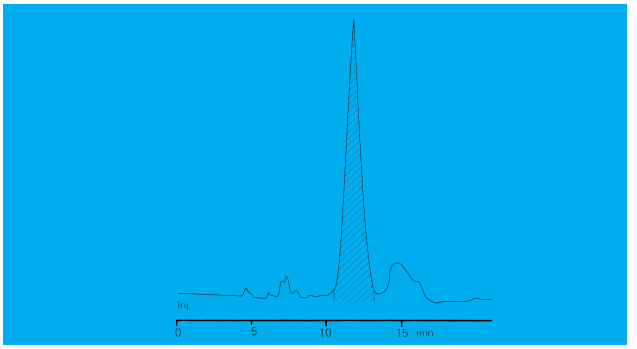



**Fig. 86 Preparative purification of synthetic Peptides**

**Sample:** Synthetic peptide (10 amino acids) 100mg/10mL aqueous solution
**Column:** Shim-pack PREP-ODS(H)kit (20mm i.d.×250mm L.)
**Mobile phase:** A: 0.1%(v/v) aqueous trifluoroacetic acid
B: 0.1%(v/v) sloution of trifluoroacetic acid in acetonitrile
Gradient B 8 → 18% (20 min)
**Flow rate:** 15mL/min.
**Column temperature:** Ambient
**Detector:** 220nm

## ■Preparative in using GPC column

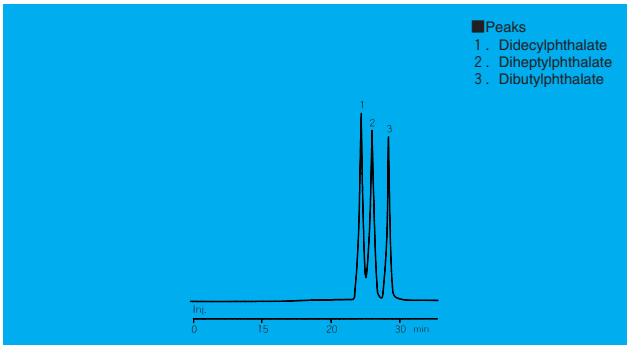



**Fig. 87 Separation of Esters phthalate in using GPC column**

**Column:** Shim-pack GPC 2001C (20mm i.d.×30cm)×2
**Mobile phase:** Chloroform
**Flow rate:** 3mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (260nm, 0.5mmL. cell)

Various HPLC conditions must be accepted to increase the sample load. One of these conditions, mobile phase that has high sample solubilities should be used. In this point, GPC using chloroform as mobile phase has an advantage rather than reversed phase chromatography. With reference to the separation of low molecular, GPC is inferior to reversed phase chromatography. However, recycling method might be used to improve separations when the difference of the molecular size can be noticed and peak top is separated.

## ■Recycling in preparative purification

Since preparative purification columns become more expensive as their size increases, it may be inevitable to use a column of such length that high resolution is not ensured. In these cases, an enhanced separating effect can be obtained as if the column length were increased by re-introducing the eluate band containing the desired component eluted from the column back into the column inlet. Figure 88 shows a flow chart for the recycling procedure. Switching the recycle valve permits choice of the out flow path leading to the fraction collector and the recycling path leading to the pump inlet. In the recycling mode, no additional mobile phase is consumed at all.

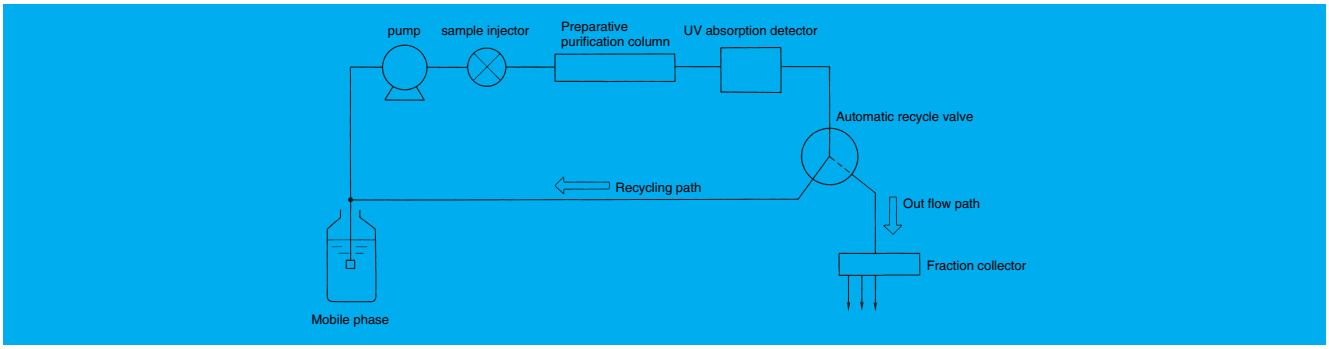



**Fig. 88 Flow Chart of Recycling System**

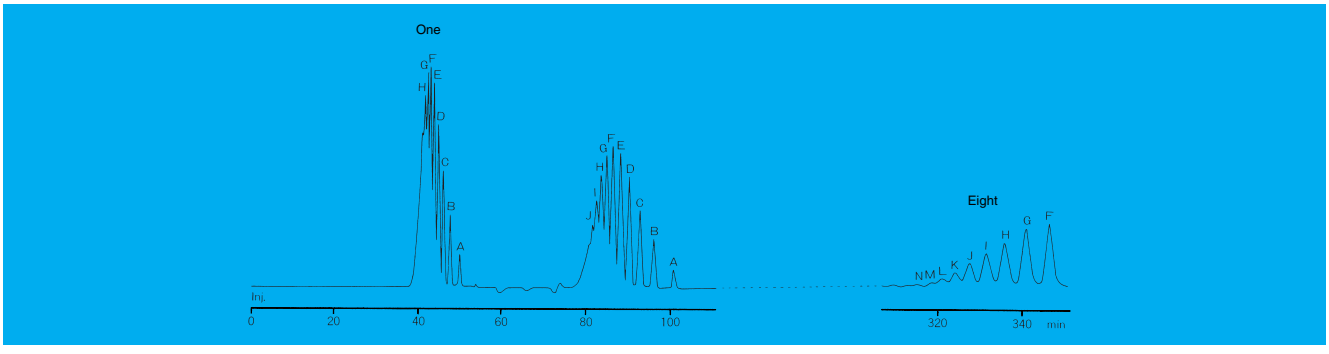



**Fig. 89 Recycle separation chromatogram of Styrene oligama**

**Sample:** Polystyrene molecular weight marker (molecular weight 760) 1%(W/V) chloroform solution 0.5mL injection
**Column:** Shim-pack GPC-20025C+2002C+2001C
**Mobile phase:** Chloroform
**Column temperature:** Ambient
**Detector:** Refractive index detector ($128\times12^{-6}$RIUFS)

# Shim-pack BIO(T)

- The Shim-pack BIO(T) series columns, using titanium column tubing, have been developed for biocompatible HPLC system, e.g. the Shimadzu LC-7A System.
- The Shim-pack BIO(T) series columns are available in three types: reversed phase, ion exchange, and hydrophobic.

## Merits of Titanium Column

In the HPLC of biological samples, corrosive liquids such as sodium chloride solution and hydrochloric acid are often used as the mobile phase.

Titanium is far more resistant against corrosion by sodium chloride solution and hydrochloric acid, especially against that by halogen ions, than the 316 stainless steel which is generally used in HPLC systems.

The Shim-pack BIO(T) series is recommended for such cases.

〈Corrosion Resistancy Comparison of Titanium and Stainless Steel〉

| Solvent | Concentration (%) | Temperature (℃) | 316 stainless steel | Pure titanium |
|---|---|---|---|---|
| Hydrochloric acid | 1 | 25 | ◎ | ◎ |
| | 10 | 25 | × | ○ |
| Sulfuric acid | 1 | 25 | ◎ | ◎ |
| | 10 | 25 | ○ | ○ |
| Nitric acid | 25 | boiling | ◎ | ◎ |
| | 65 | boiling | ○ | ◎ |
| Acetic acid | 10 | boiling | ◎ | ◎ |
| | 60 | boiling | ○ | ◎ |
| Formic acid | 10 | 25 | ○ | ◎ |
| Sodium chloride | 25 | 25 | ○ | ◎ |
| Ammonium chloride | 40 | 25 | ○ | ◎ |
| Zinc chloride | 20 | 25 | ○ | ◎ |
| Ferrous chloride | 30 | 25 | × | ◎ |
| Sodium hypochlorite | 5 | 25 | △ | ◎ |

◎ : Less than 0.125mm/year　○ : 0.125 ～ 0.5m/year
△ : 0.5 ～ 1.25mm/year　× : More than 1.25mm/year

## ■Shim-pack BIO(T) Series

| Column name | Separation mode | Particle dia. (μm) | Pore diameter (Å) | Dimensions | Cat. No. |
|---|---|---|---|---|---|
| Shim-pack CLC-ODS(T) | Reversed | 5 | 100 | 4.6mm i.d.×15cm | 228-18062-91 |
| Shim-pack WAX-1T | Anion exchange | 3 | 100 | 4.6mm i.d.×5cm | 228-18257-91 |
| Shim-pack WAX-2T | Anion exchange | 5 | 300 | 4.6mm i.d.×5cm | 228-18258-91 |
| Shim-pack WCX-1T | Cation exchange | 5 | 300 | 4.6mm i.d.×5cm | 228-18259-91 |
| Shim-pack HPC-C2T | Hydrophobic | 5 | 300 | 4.6mm i.d.×5cm | 228-18260-91 |
| Shim-pack HPC-C3T | Hydrophobic | 5 | 300 | 4.6mm i.d.×5cm | 228-18261-91 |

## Shim-pack BIO(T)

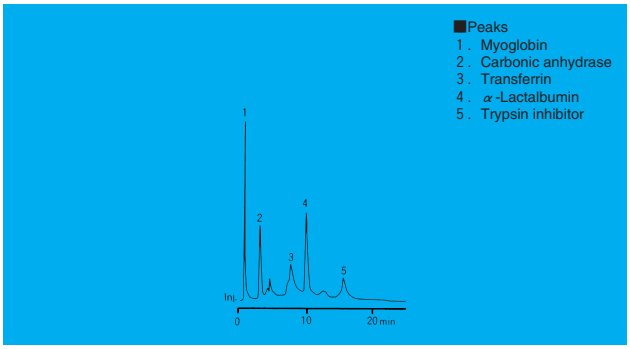



**Fig. 90 Analysis of Protein Standards**

**■Operational Conditions**

**Column:** Shim-pack WAX-2T (4.6mm i.d.×5cm)
**Mobile phase:** Tris-hydrochloric acid buffer solution (pH 8.0) /sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

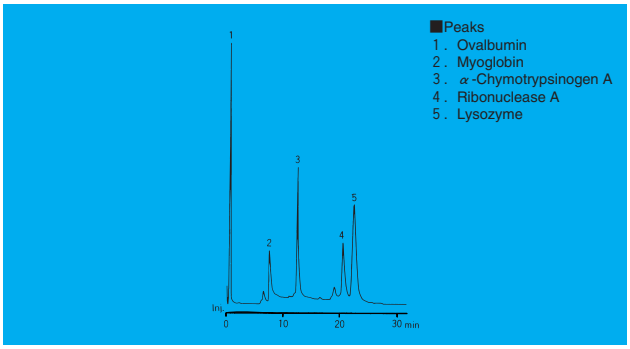



**Fig. 91 Analysis of Protein Standards**

**■Operational Conditions**

**Column:** Shim-pack WCX-1T (4.6mm i.d.×5cm)
**Mobile phase:** Phosphate buffer solution (pH 6.0)/sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (280nm)

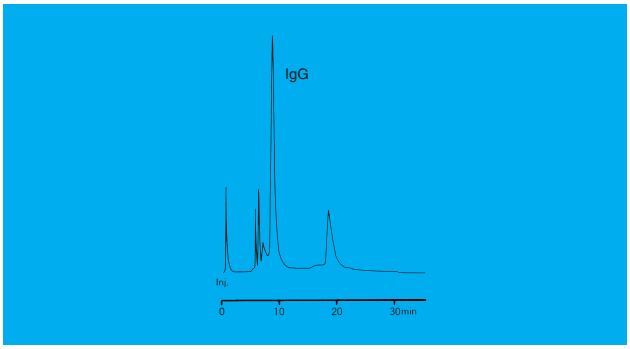



**Fig. 92 Determination of IgG Monoclonal Antibody in Mouse Ascites Fluid**

**■Operational Conditions**

**Column:** Shim-pack WAX-2T (4.6mm i.d.×5cm)
**Mobile phase:** Tris-hydrochloric acid buffer solution (pH 8.0) /sodium chloride, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (280nm)

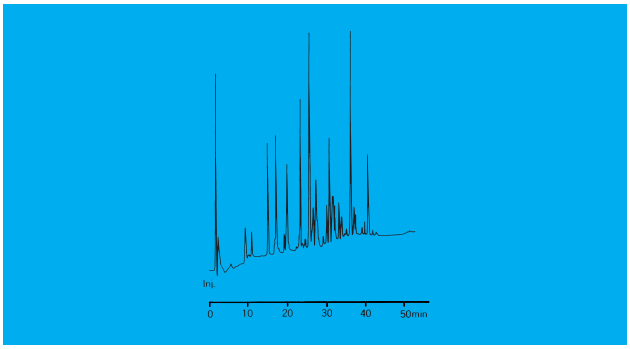



**Fig. 93 Analysis of Decomposition Products of Trypsin in Cytoch C**

**■Operational Conditions**

**Column:** Shim-pack CLC-ODS(T) (4.6mm i.d.×5cm)
**Mobile phase:** 0.1% aqueous solution of TFA/0.1% acetonitrile solution of TFA, gradient elution
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (215nm)

# Asahipak® ODP

- The Asahipak ODP column is packed with synthetic hard polymer particles on which octadecyl groups are chemically bonded and is used for reversed phase LC.
- Having no silanol groups, this column is especially effective for the HPLC of basic compounds, e.g. some drugs.
- The column is stable in a pH range of 2～13. It can be washed with an alkaline solution.
- The gel has a minimum swelling and contraction, and so the column can be used in a wide mobile phase condition, from 100% water to 100% water-soluble organic solvent.
- High repeatability in gradient LC.

## ■Asahipak® ODP

| Column name | | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|---|
| Asahipak ODP-50 | 4D | $C_{18}$ group | 5 | 4.6mm i.d.×15cm | 406-020 |
| | 4E | | | 4.6mm i.d.×25cm | 406-021 |
| | 6D | | | 6.0mm i.d.×15cm | 406-017 |
| | 6E | | | 6.0mm i.d.×25cm | 406-018 |

## ■Guard Column (Analytical)

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|
| Asahipak ODP-50G | $C_{18}$ group | 5 | 4.6mm i.d.×1cm | 406-022 |
| | | | 6.0mm i.d.×1cm | 406-019 |

## ■Guard Column (Analytical)

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|
| Asahipak C8P-50 | $C_8$ group | 5 | 4.6mm i.d.×15cm | 406-023 |
| | | | 4.6mm i.d.×25cm | 406-024 |
| Asahipak C8P-50G | | | 4.6mm i.d.× 1cm | 406-025 |

## ■Asahipak® C4P

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|
| Asahipak C4P-50 | $C_4$ group | 5 | 4.6mm i.d.×15cm | 406-026 |
| | | | 4.6mm i.d.×25cm | 406-027 |

## ■Guard Column (Analytical)

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|
| Asahipak C4P-50G | $C_4$ group | 5 | 4.6mm i.d.×1cm | 406-028 |

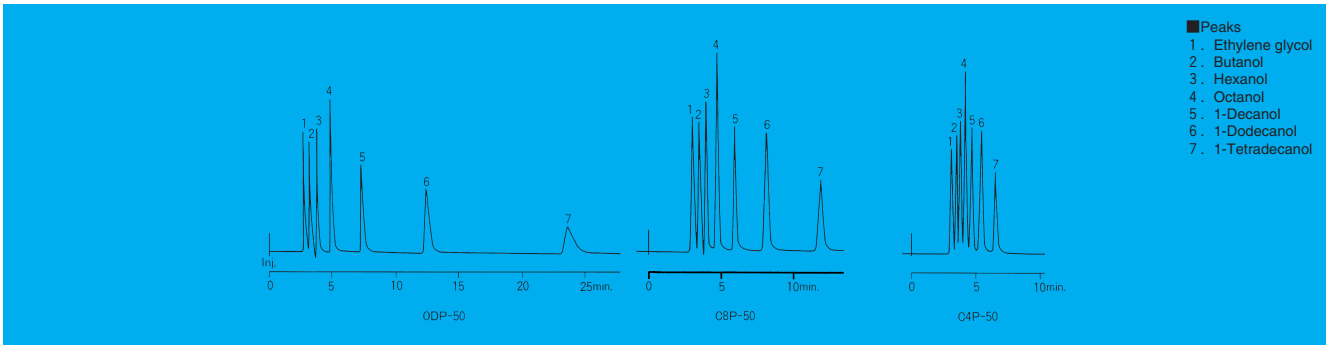



**Fig. 94 Separation of Alkylalcohols Group**

**■Operational Conditions**
**Column:** Asahipak ODP-50, C8P-50, C4P-50 (4.6mm i.d.×15cm)
**Mobile phase:** Methanol 80/water 20
**Flow rate:** 0.6mL/min.
**Column temperature:** 30℃
**Detector:** Refractive index detector

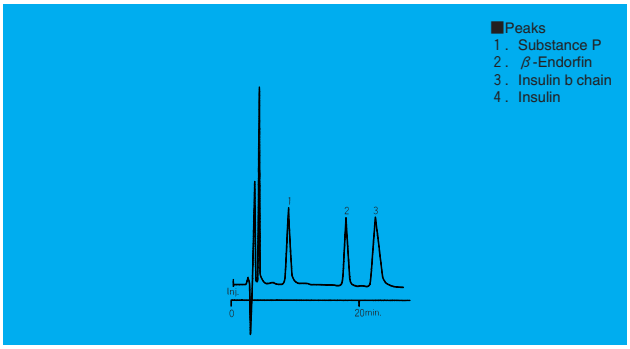



**Fig. 95 Separeation of Macromolecule Peptide**

**■Operational Conditions**
**Column:** Asahipak C8P-50, (4.6mm i.d.×15cm)
**Mobile phase:** 0.05%TFA (pH=2.3) 73/Acetonitriles 27
**Flow rate:** 0.6mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (220nm)

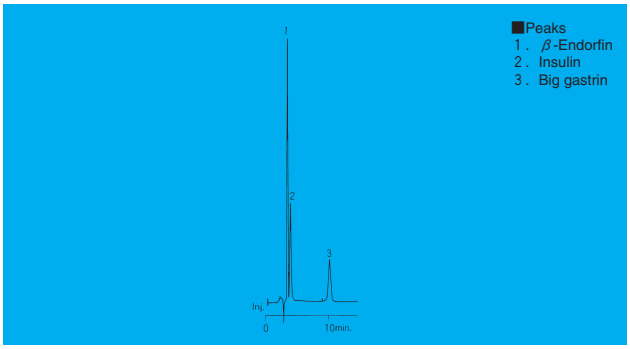



**Fig. 96 Separeation of Macromolecule Peptide**

**■Operational Conditions**
**Column:** Asahipak C4P-50, (4.6mm i.d.×15cm)
**Mobile phase:** 0.05%TFA (pH=2.3) 72/Acetonitriles 28
**Flow rate:** 0.6mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (220nm)

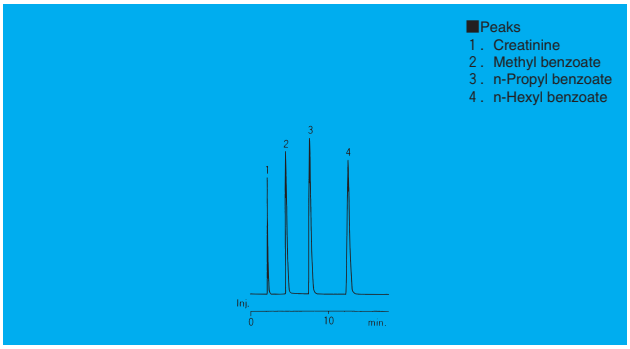



**Fig. 97 Analysis of Standard Samples**

**■Operational Conditions**
**Column:** Asahipack ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitrile/water (7/3)
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (254nm)

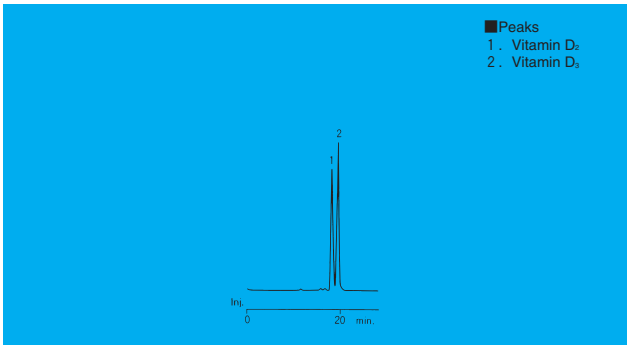



**Fig. 98 Separation of Vitamin $D_2$ and $D_3$**

**■Operational Conditions**
**Column:** Asahipak ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitrile/water (95/5)
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (260nm)

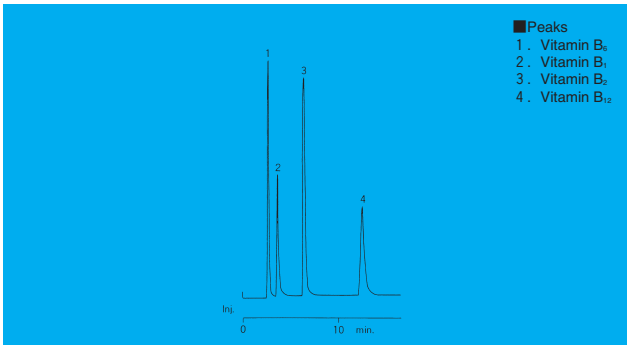



**Fig. 99 Separation of Vitamins B Group**

**■Operational Conditions**
**Column:** Asahipak ODP-50, (6.0mm i.d.×15cm)
**Mobile phase:** Acetonitriles 1/50mM phosphoric acid sodium
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (254nm)

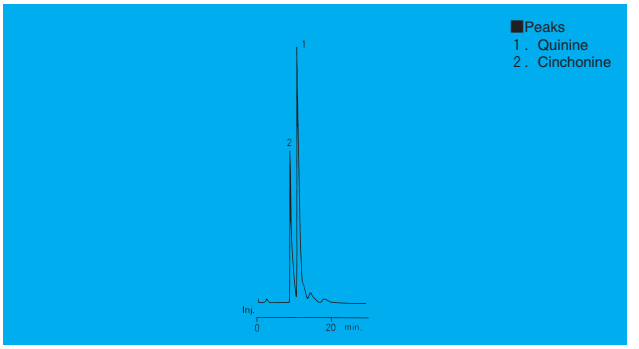



**Fig. 100 Separation of Quinine and Cinchonine**

**■Operational Conditions**
**Column:** Asahipak ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** Methanol/acetonitrile/10mM sodium phosphate (2/1/1) (pH 9)
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (250nm)

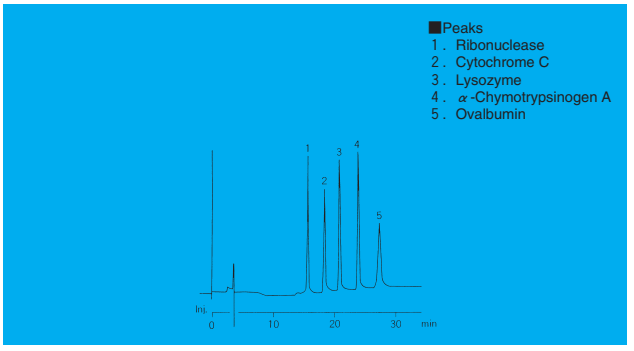



**Fig. 101 Separation of Protein Standard**

**■Operational Conditions**
**Column:** Asahipak ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** Solvent A: Water and 0.05% TFA
Solvent B: Acetonitrile and 0.05% TFA
A/B=Linear gradient from 90/10 to 40/60, 30minutes
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (280nm)

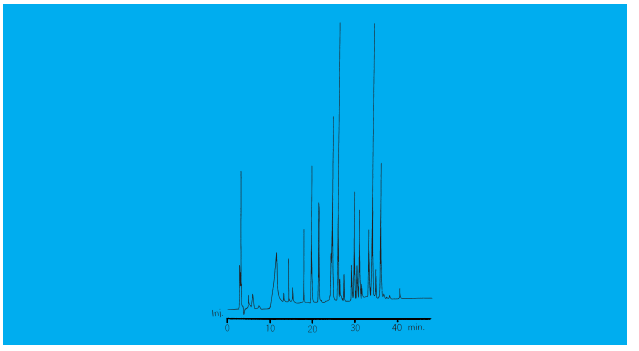



**Fig. 102 Analysis of Decomposition Products of Trypsin in Cytochrome C**

**■Operational Conditions**
**Column:** Asahipak ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** Solvent A: Water and 0.1% TFA
Solvent B: Acetonitrile and 0.1% TFA
Linear gradient from solvent A to solvent B in 100minutes.
**Flow rate:** 1.0mL/min.
**Column temperature:** 25℃
**Detector:** UV spectrophotometric detector (215nm)

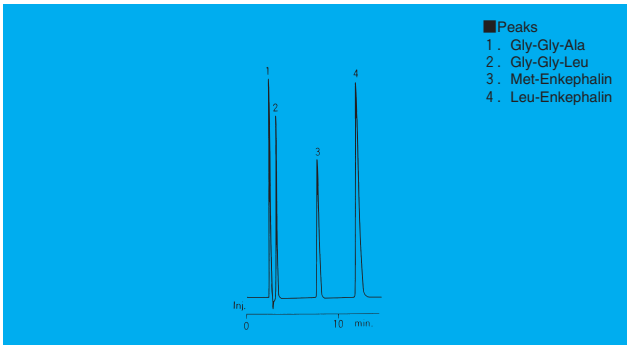



**Fig. 103 Analysis of Peptide Mixture**

**■Operational Conditions**
**Column:** Asahipak ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** 0.05% TFA/acetonitrile (4/1)
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (210nm)

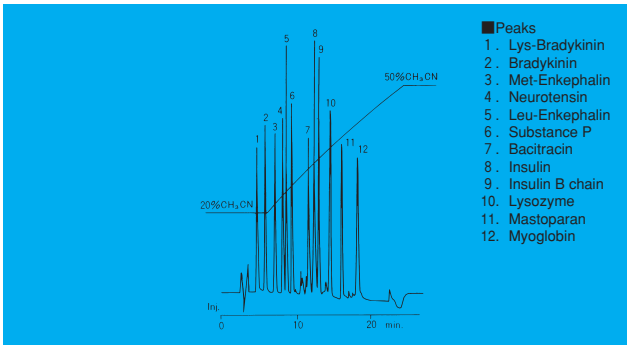



**Fig. 104 Analysis of Peptide Mixture**

**■Operational Conditions**
**Column:** Asahipak ODP-50 (6.0mm i.d.×15cm)
**Mobile phase:** Solvent A: 0.05% TFA/acetonitrile (4/1)
Solvent B: 0.05% TFA/acetonitrile (1/1)
Linear gradient from solvent A to solvent B in 20 minutes
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** UV spectrophotometric detector (220nm)

# Asahipak® GS

- The Asahipak GS series columns are packed with hard gel particles made of vinyl alcohol polymer.
- The allowable pH range of mobile phase is 2～12 for the GS-320 and GS-520, and 2～9 for the other columns.
- Various organic solvents can be used.
- Aqueous solutions of salts and buffer solutions can be used as mobile phase. (It is recommended that the concentration is below 0.5M.) Mobile phases that contain urea, guanidine HCl, or SDS (sodium dodecyl sulfate) are also applicable.

## ■High-Resolution Type (7.6mm i.d.×30cm)

| Type | Column name | Average particle diameter (μm) | Exclusion limit (molecular weight) (Pullulan) | Number of theoritical plates | GLC Cat. No. |
|---|---|---|---|---|---|
| Applicable both to aqueous solutions and organic solvent | GF-310HQ | 5 | 40,000 | >16,000 | 406-323 |
| | GF-510HQ | 5 | 300,000 | >16,000 | 406-324 |
| | GF-710HQ | 9 | 1,000,000 | >10,000 | 406-325 |
| | GF-7MHQ | 7 | 1,000,000 | >11,000 | 406-326 |
| Applicable to aqueous solutions | GS-220HQ | 6 | 3,000 | >16,000 | 406-318 |
| | GS-320HQ | 6 | 40,000 | >16,000 | 406-319 |
| | GS-520HQ | 7 | 300,000 | >15,000 | 406-320 |
| | GS-620HQ | 7 | 2,000,000 | >15,000 | 406-321 |

## ■Guard Columns

| Column name | Dimensions | Grade | GLC Cat. No. |
|---|---|---|---|
| GF-1G 7B | 7.6mm i.d.×10mm | 310, 310HQ, 510, 510HQ 710, 710HQ, 700, 710HQ | 406-327 |
| GS-2G 7B | 7.6mm i.d.×10mm | 220, 220HQ, 320, 320HQ 520, 520HQ, 620, 620HQ | 406-322 |

## ■Applicable Organic Solvents

| Solvent conditions | | Applicability | | | |
|---|---|---|---|---|---|
| Solvent | Concentration | 310, 510 710, 7M | 320 520 | 220 620 | GS-710 |
| Aqueous solution | 0~0.5M | ● | ● | ● | ● |
| Methanol | 0~100% | ● | ● | Below 20% | ● |
| Ethanol | 0~100% | ● | ● | Below 20% | |
| Acetonitrile | 0~50% | ● | ● | ● | |
| | 51~100% | ● | Not applicable | | |
| THF | 0~100% | ● | | | |
| DMF | 0~100% | ● | | | |
| Acetone | 0~100% | ● | | | |
| Chloroform | 0~100% | ● | | | |
| DMSO | 0~50% | ● | | | |
| | 51~100% | × | | | |

## ■Applications

| | |
|---|---|
| 310 | Hydrophobic polymer, oligomers, monomers, surfactants, steroids, hydrophilic polymers |
| 510 | Proteins, nucleic acids, sugars, gelatins, hydrophobic/hydrophilic polymers |
| 220 | Oligosaccharides, peptides, hydrophilic, oligomers, monomers |
| 320 | Peptides, nucleic acid constituents, sugars, vitamines, blood metabolites |
| 520 | Plasma proteins, albumins, globulin, sugars, hydrophilic polymers, nucleic acids |
| 620 | Highly polymerated proteins, nucleic acids, gelatins |
| 710 | Polysaccharides, dextran, hydrophilic polymers |

## ■Calibration Curves

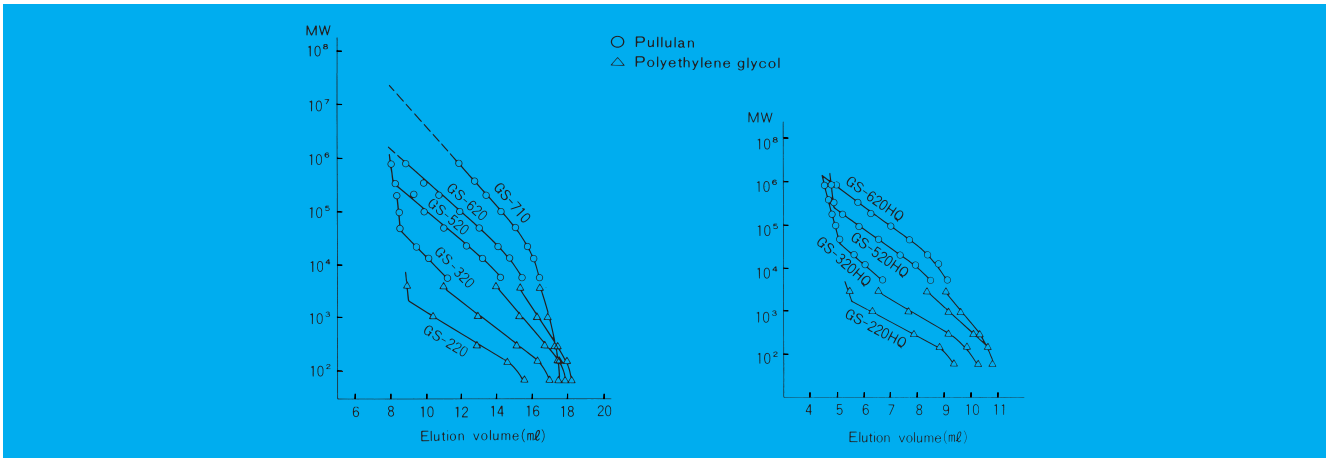



**Fig. 105 Columns for Aqueous Mobile Phases**

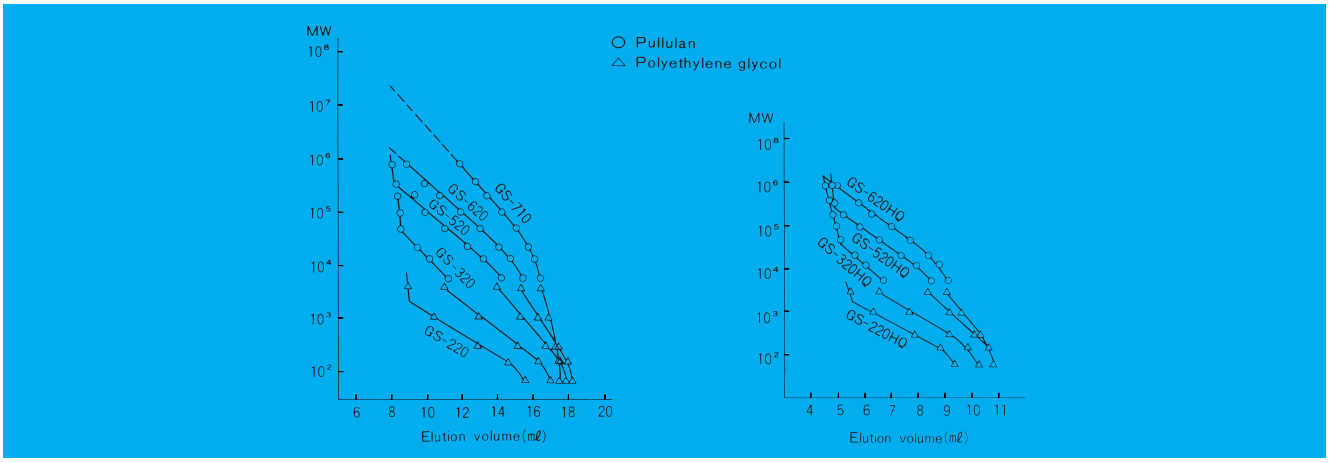



**Fig. 106 Columns for Aqueous/Organic Solvent Mobile Phases**

# Asahipak® ES

- The Asahipak ES series columns, developed for high-speed ion exchange chromatography, are packed with vinyl alcohol polymer particles into which ion exchange groups have been introduced.
- Since the gel particles have many ion exchange groups and alcoholic hydroxyl groups, hence have little hydrophobic adsorption, the columns are suitable for the separation of ionic biological compounds.
- The columns ensure high yield for proteins, enzymes, and nucleic acids.
- The allowable pH range of mobile phase is 2～12.
- The columns are available in two types, anion exchange type and cation exchange type.

## ■Analytical Column (7.6mm i.d.×10cm)

| Column name | Average particle diameter (μm) | Ion exchange group | Ion exchange capacity (meq/g) | Number of theoritical plates | GLC Cat. No. |
|---|---|---|---|---|---|
| ES-502C | 9±0.5 | Carboxyl group | 0.55±0.02 | ＞3,000 | 406-109 |
| ES-502N | 9±0.5 | Diethylamino ethyl group | 0.55±0.02 | ＞3,000 | 406-108 |

The use of preparative guard column GS-20G (228-18754-02) is recommended.

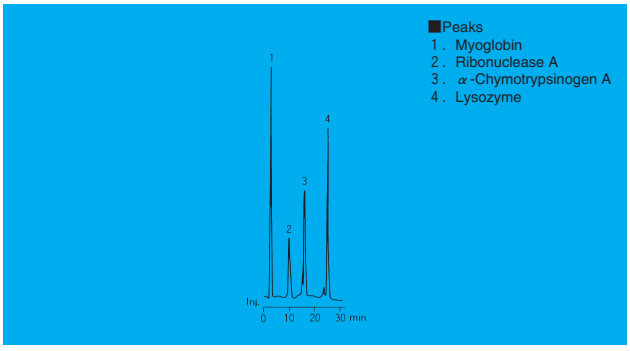



**Fig. 107 Analysis of Protein Standard**

**■Operational Conditions**

**Column:** Asahipak ES-502C (7.6mm i.d.×10cm)
**Mobile phase:** Solvent A: Sodium phosphate (pH 7.0)
Solvent B: 50mM sodium phosphate and 500mM sodium chloride (pH 7.0)
Linear gradient from solvent A to solvent B in 20 minutes
**Flow rate:** 1.0mL/min.
**Detector:** UV spectrophotometric detector (280nm)

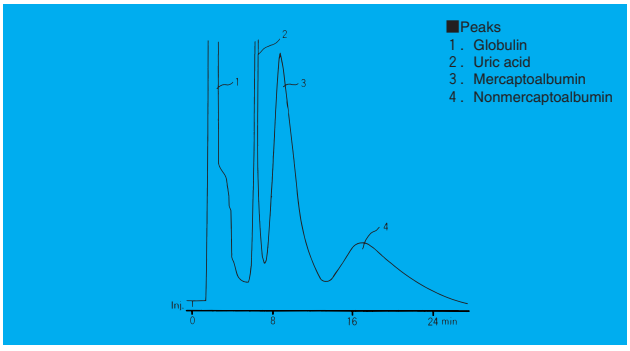



**Fig. 108 Determination of Mercaptoalbumine and Nonmercaptoalbumine in Control Serum**

**■Operational Conditions**

**Column:** Asahipak ES-502N (7.6mm i.d.×10cm)
**Mobile phase:** 50mM N-methyl piperazine, 400mM sodium sulfate, and 0.3% ethanol (pH 4.8)
**Flow rate:** 1.0mL/min.
**Column temperature:** 35℃
**Detector:** UV spectrophotometric detector (280nm)

# Asahipak® NH2P

- The Asahipak NH2P series columns are for sugar analysis, packed with vinylalcoholcopolymer with polyamines chemicaly-bonded.
- High number of theoritical plates and symmetrical peak can be aquired between monosaccharides and origosacharides.
- Available under the condition of the alkali (less than pH=13) and you can wash the column easily as well as getting high separation.
- The column is stable in a pH range of 2～13.

## ■Asahipak NH2P

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|
| Asahipak NH2P-50 4E | $NH_2$ group | 5 | 4.6mm i.d.×25cm | 406-030 |

## ■Guard Column (Analytical)

| Column name | Stationary phase | Particle dia. ( μm) | Dimensions | GLC Cat. No. |
|---|---|---|---|---|
| Asahipak NH2P-50G 4A | $NH_2$ group | 5 | 4.6mm i.d.×1cm | 406-031 |

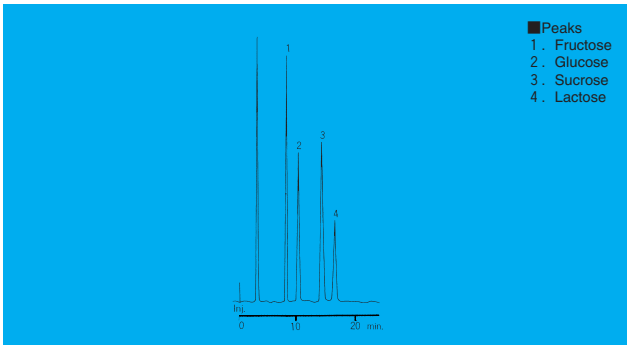



**Fig. 109 Separation of Monosaccharides and Disaccharides**

**■Operational Conditions**
**Column:** Asahipak NH2P-50, (4.6mm i.d.×25cm)
**Mobile phase:** Acetonitriles 75/Water 25
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** Refractive index detector

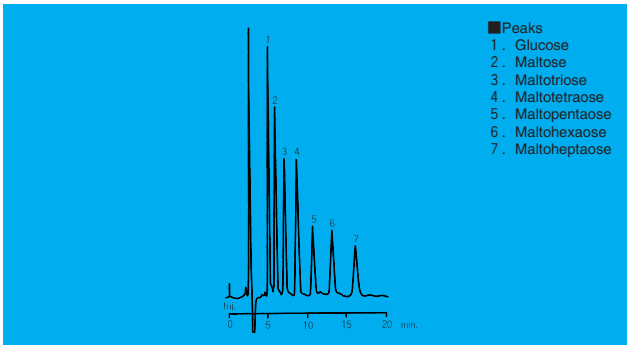



**Fig. 110 Separation of Oligosaccharides**

**■Operational Conditions**
**Column:** Asahipak NH2P-50, (4.6mm i.d.×25cm)
**Mobile phase:** Acetonitriles 60/Water 40
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** Refractive index detector

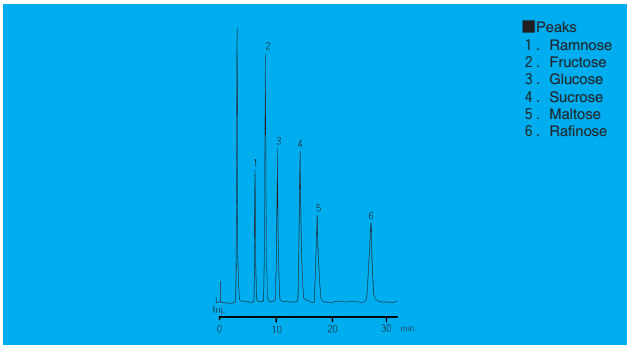



**Fig. 111 Separation of Monosaccharides, Disaccharides and Trisaccharides**

**■Operational Conditions**
**Column:** Asahipak NH2P-50, (4.6mm i.d.×25cm)
**Mobile phase:** Acetonitriles 75/Water 25
**Flow rate:** 1.0mL/min.
**Column temperature:** 30℃
**Detector:** Refractive index detector

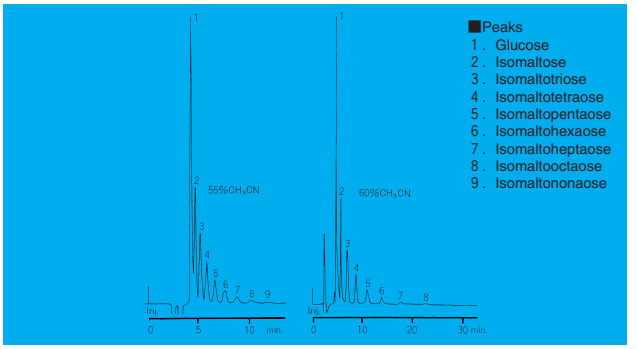



**Fig. 112 Separation of Dextran hydrolysis substances**

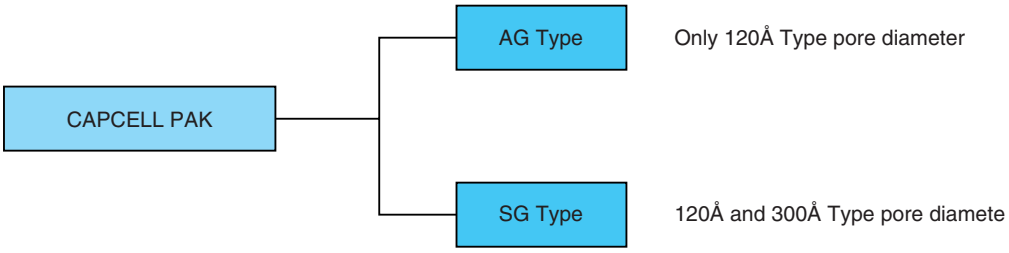
**■Operational Conditions**
**Column:** Asahipak NH2P-50, (4.6mm i.d.×25cm)
**Mobile phase:** Acetonitriles/Water
**Flow rate:** 1.0mL/min.
**Detector:** Refractive index detector

# CAPCELL PAK

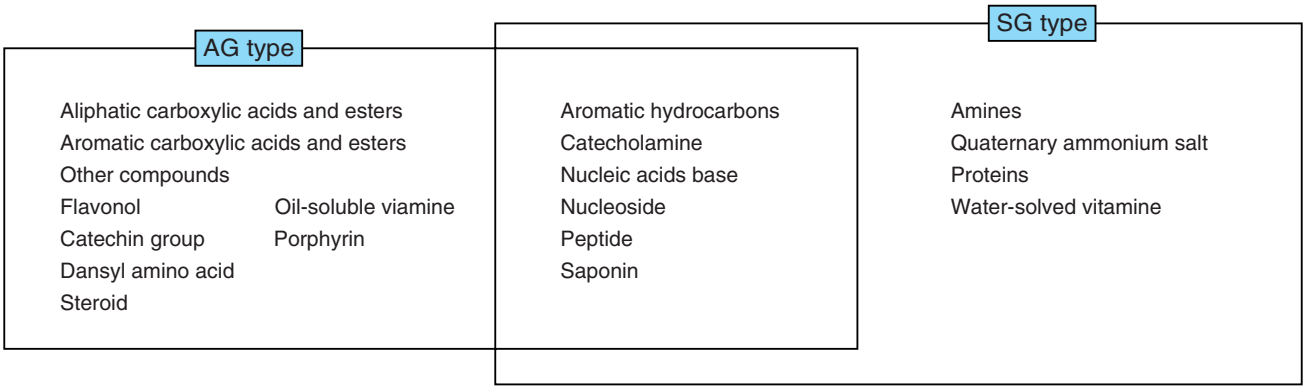
(1) Features of CAPCELL PAK

As covered with silicones polymer on the surface of silica, superior in chemical stability rather than silica type materials.

(2) CAPCELL PAK is classified as follows.




(3) Selection of CAPCELL PAK columns




As for the amount of micro-metal involved in silica, SG type has fewer than AG type.

## ■CAPCELL PAK AGType (C18 Type)

| Stationary phase | Pore diameter (Å) | Particle dia. (μm) | Column i.d. | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| C18 | 120 | 5 | 4.6 | 35 | 12501 |
| | | | | 150 | 12503 |
| | | | | 250 | 12504 |
| | | | 6.0 | 35 | 12506 |
| | | | | 150 | 12508 |
| | | | 20 | 50 | 15501 |
| | | | | 250 | 15504 |
| | | | 30 | 250 | 16501 |

## ■CAPCELL PAK AGType (C8 Type)

| Stationary phase | Pore diameter (Å) | Particle dia. (μm) | Column i.d. | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| C8 | 120 | 5 | 4.6 | 35 | 21501 |
| | | | | 150 | 21503 |
| | | | | 250 | 21504 |
| | | | 6.0 | 35 | 21506 |
| | | | | 150 | 21508 |
| | | | 20 | 50 | 25501 |
| | | | | 250 | 25503 |

## ■CAPCELL PAK SGType (C18 Type)

| Stationary phase | Pore diameter (Å) | Particle dia. (μm) | Column i.d. | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| C18 | 120 | 5 | 4.6 | 35 | 12510 |
| | | | | 150 | 12512 |
| | | | | 250 | 12513 |
| | | | 6.0 | 35 | 13510 |
| | | | | 150 | 13512 |
| | | | 20 | 50 | 16510 |
| | | | | 250 | 16513 |
| | | | 30 | 250 | 16501 |
| C18 | 300 | 5 | 4.6 | 35 | 12520 |
| | | | | 150 | 12522 |
| | | | | 250 | 12523 |
| | | | 6.0 | 35 | 13520 |
| | | | | 150 | 13522 |
| | | | 20 | 50 | 16520 |
| | | | | 250 | 16523 |

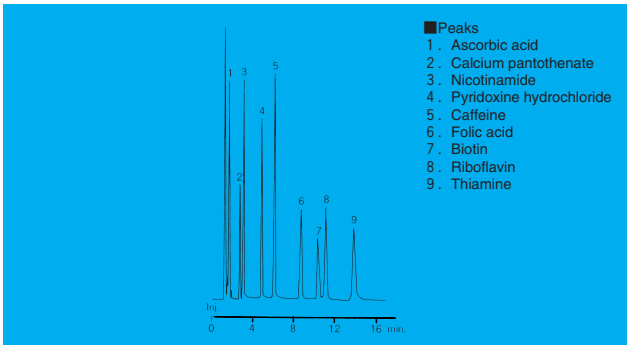



**Fig. 113 Separation of Aqueous Vitamine Group**

**■Operational Conditions**

**Column:** $C_{18}$ SG120 (4.6mm i.d.×25cm)
**Mobile phase:** Water (pH2.1, $H_3PO_4$)/$CH_3CN$ =9/1, 1.5mM heptanesulfonic acid
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

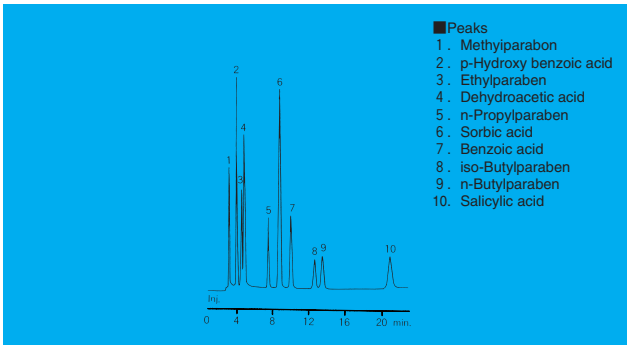



**Fig. 114 Separation of an Antiseptic Component**

**■Operational Conditions**

**Column:** $C_{18}$ SG120 (4.6mm i.d.×25cm)
**Mobile phase:** 0.05M $NaH_2PO_4$(pH4.5)/MeOH/$CH_3CN$=50/35/15, 4mM cetyltrimethylammonium chloride
**Flow rate:** 1mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (235nm)
**Injection volume:** 10 μL (5 μg/mL)

## ■CAPCELL PAK SG Type (C8 Type)

| Stationary phase | Pore diameter (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| C8 | 120 | 5 | 4.6 | 35 | 21511 |
| | | | | 150 | 21513 |
| | | | | 250 | 21514 |
| | | | 6.0 | 35 | 21516 |
| | | | | 150 | 21518 |
| | | | 20 | 50 | 25511 |
| | | | | 250 | 25513 |
| C8 | 300 | 5 | 4.6 | 35 | 21521 |
| | | | | 150 | 21523 |
| | | | | 250 | 21524 |
| | | | 6.0 | 35 | 21526 |
| | | | | 150 | 21528 |
| | | | 20 | 50 | 25521 |
| | | | | 250 | 25523 |

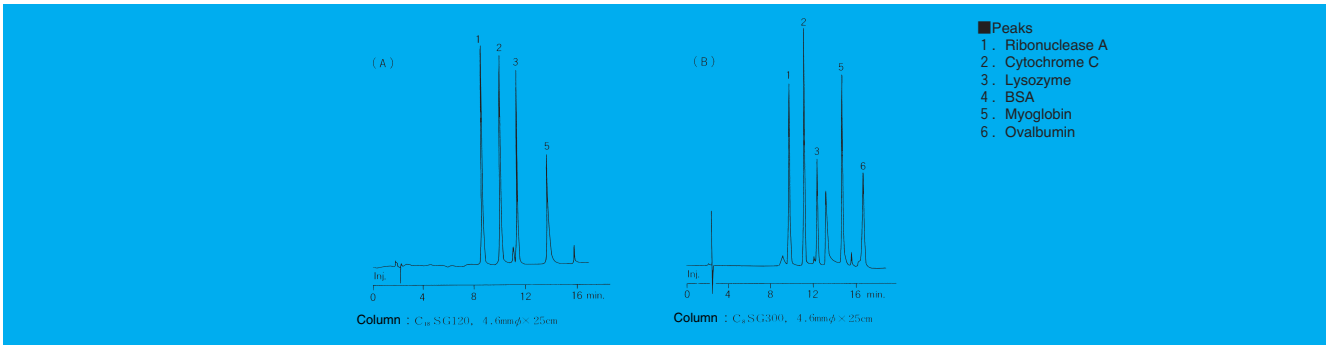



**Fig. 115 Separation of Protein with SG type columns**

**■Operational Conditions**

**Mobile phase:** (A) 0.1% TFA/$H_2O$ (B) 0.1% TFA/$CH_3CN$
(B) 15% → 60% (15min) Gradient
**Flow rate:** 1.5mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (214nm)

# Zorbax

- The Zorbax columns are high-performance columns developed by DuPont, the pioneer in HPLC.
- The columns are packed with fully-porous, spherical silica particles on which the respective stationary phases are chemically bonded. (Except Zorbax SIL)

## ■Zorbax

| Column name | Stationary phase | Particle dia. ( $\mu$m) | Separation mode | Dimensions | GLC Cat. No. |
|---|---|---|---|---|---|
| Zorbax SIL | Silica | 5 | Adsorption | 4.6mm i.d.×15cm | 883952-701 |
| | | | | 4.6mm i.d.×25cm | 880952-701 |
| Zorbax ODS | Octadecyi group | 5 | Reversed | 4.6mm i.d.×15cm | 883952-702 |
| | | | | 4.6mm i.d.×25cm | 880952-702 |
| Zorbax $C_8$ | Octyl group | 5 | Reversed | 4.6mm i.d.×15cm | 883952-706 |
| | | | | 4.6mm i.d.×25cm | 880952-706 |
| Zorbax TMS | Trimethyl group | 5 | Reversed | 4.6mm i.d.×15cm | 883952-710 |
| | | | | 4.6mm i.d.×25cm | 880952-710 |
| Zorbax $NH_2$ | Aminopropyl group | 5 | Reversed, normal, anion, exchange | 4.6mm i.d.×15cm | 883952-708 |
| | | | | 4.6mm i.d.×25cm | 880952-708 |
| Zorbax CN | Cyanopropyl group | 5 | Reversed, normal | 4.6mm i.d.×15cm | 883952-705 |
| | | | | 4.6mm i.d.×25cm | 880952-705 |
| Zorbax SAX | Quaternary ammonium group | 5 | Anion exchange | 4.6mm i.d.×15cm | 883952-703 |
| | | | | 4.6mm i.d.×25cm | 880952-703 |
| Zorbax SCX-300 | Sulfonic group | 7 | Cation exchange | 4.6mm i.d.×15cm | 883952-704 |
| | | | | 4.6mm i.d.×25cm | 880952-704 |

## Guard Column Pre-column Kit

In analyses with a Zorbax column, it is recommended to use a guard column or a pre-column so that a longer service life is expected of the Zorbax column.
The kit consists of an empty column, packing material, and a filter.

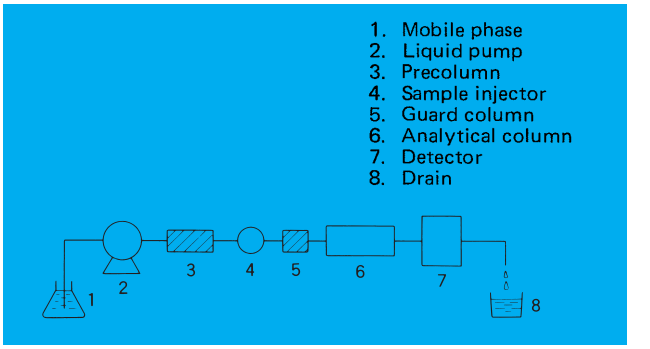


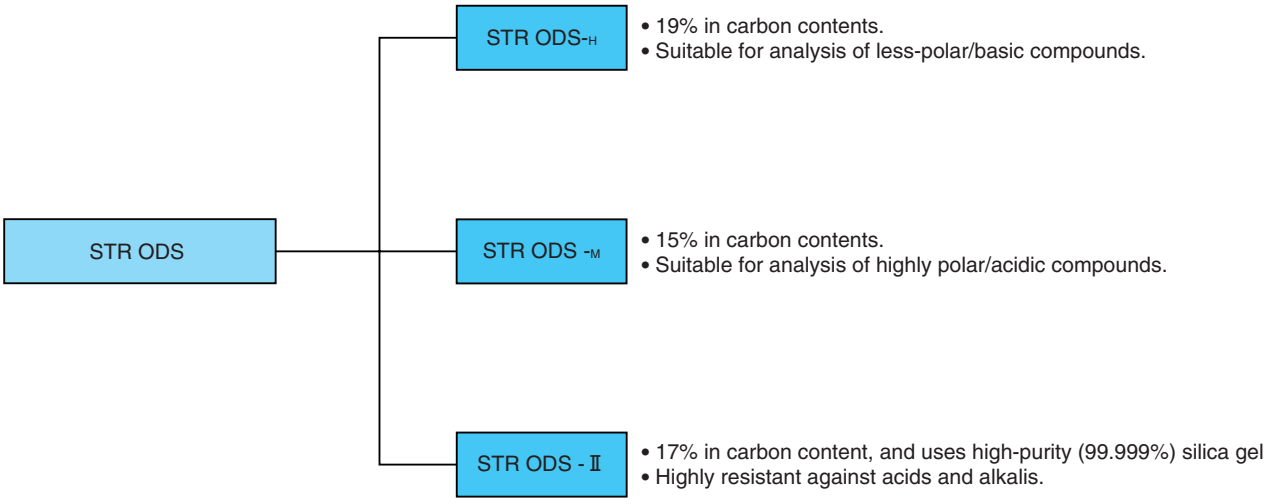

**Fig. 116 Flow Line Having Guard Column and Pre-column**

## STR ODS Series

(STR : Shimadzu Techno Research)

● STR ODS Series columns using octadedecyl group as the stationary phase feature low cost and wide field of applications.

### ■The STR ODS Series is available in the following three types:




### ■The STR ODS-Ⅱ Columns

#### ■STR ODS Column for Analytical HPLC

| Column name | Pore dia. (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| STR ODS-Ⅱ | 120 | 5 | 4.0 | 150 | 404-019 |
| | | | | 250 | 404-018 |
| | | | 4.6 | 150 | 404-021 |
| | | | | 250 | 404-020 |
| | | | 6.0 | 150 | 404-022 |
| STR ODS-Ⅱ PEEK | 120 | 5 | 4.6 | 150 | 404-027 |
| | | | | 250 | 404-026 |

#### ■STR ODS Column for Preparative HPLC

| Column name | Pore dia. (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| STR ODS-Ⅱ | 120 | 5 | 20.0 | 250 | 404-030 |

#### ■Guard Column for Analytical HPLC

| Column name | Pore dia. (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| STR ODS-Ⅱ | 120 | 5 | 4.0 | 10 | 404-023 |
| | | | 4.6 | 10 | 404-024 |
| | | | 6.0 | 10 | 404-025 |
| STR ODS-Ⅱ PEEK | 120 | 5 | 4.6 | 10 | 404-028 |

#### ■Guard Column for Preparative HPLC

| Column name | Pore dia. (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | GLC Cat. No. |
|---|---|---|---|---|---|
| STR ODS-Ⅱ | 120 | 5 | 20.0 | 50 | 404-031 |

## ■STR ODS Columns

### 1. Analytical HPLC

| Column name | Pore dia. (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | Cat. No. |
|---|---|---|---|---|---|
| ODS-H | 100 | 5 | 4 | 50 | 228-21336-02 |
| | | | | 150 | 228-21336-01 |
| | | | | 250 | 228-21336-03 |
| | | | 4.6 | 150 | 228-21336-04 |
| | | | | 250 | 228-21336-05 |
| ODS-M | 100 | 5 | 4 | 150 | 228-21830-01 |
| | | | | 250 | 228-21830-02 |
| | | | 4.6 | 150 | 228-21830-03 |
| | | | | 250 | 228-21830-04 |

### 2. Preparative HPLC

| Column name | Pore dia. (Å) | Particle dia. (μm) | Column i.d. (mm) | Column length (mm) | Cat. No. |
|---|---|---|---|---|---|
| PREP ODS-H | 120 | 5 | 20 | 250 | 228-21831-01 |
| | | | | 50 | 228-21831-02 |
| | | | 4.6 | 250 | 228-21831-03 |
| PREP ODS-M | 120 | 5 | 20 | 250 | 228-21832-01 |
| | | | | 50 | 228-21832-02 |
| | | | 4.6 | 250 | 228-21832-03 |

## ■STR ODS-H

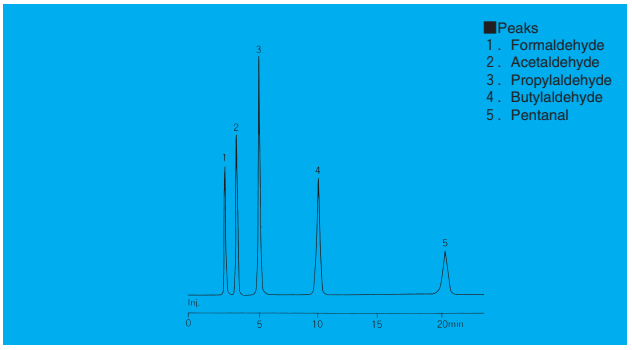



**Fig. 117 Analysis of Aldehydes**

**■Operational Conditions**
**Column:** ODS-H (4.0 mm i.d.×15 cm)
**Mobile phase:** Methanol/water (40/60)
**Column temperature:** 40℃
**Flow rate:** 0.8 mL/min.
**Detector:** Fluorophotometric detector (Ex: 360 nm, Em: 440nm)

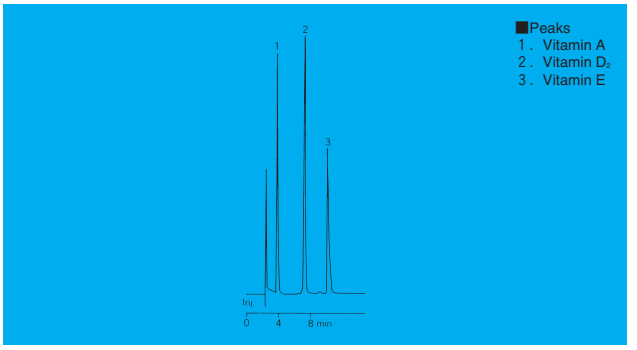



**Fig. 118 Analysis of Oil-Soluble Vitamines**

**■Operational Conditions**
**Column:** ODS-H (4.0 mm i.d.×15 cm)
**Mobile phase:** Methanol
**Column temperature:** 40℃
**Flow rate:** 0.5 mL/min.
**Detector:** UV spectrophotometric detector (260 nm)

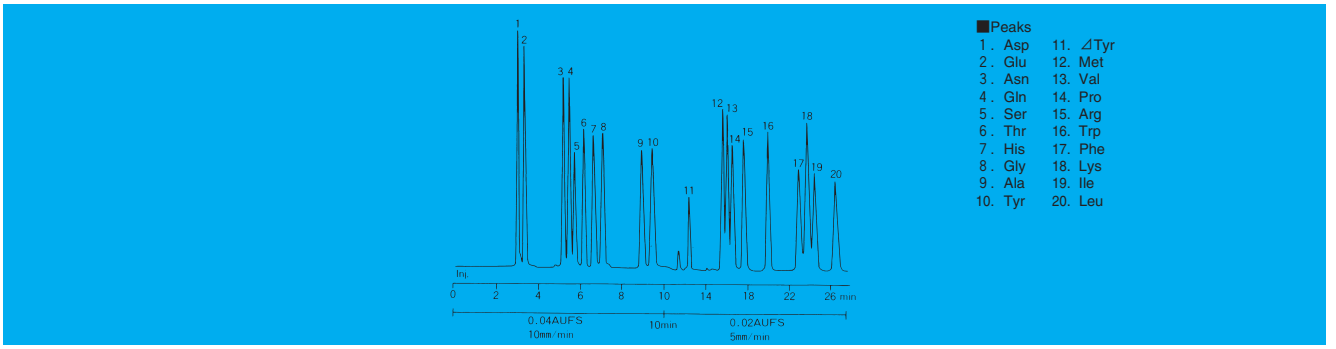



**Fig. 119 Analysis of PHT-Amino Acids**

**■Operational Conditions**
**Column:** ODS-H (4.0 mm i.d.×25 cm)
**Mobile phase:** 10mM Sodium formate buffer solution (pH 5.50 and containing 0.070% SDS)/acetonitrile (60/40)
**Column temperature:** 40℃
**Flow rate:** 0.5 mL/min.
**Detector:** UV spectrophotometric detector (269 nm)

## ■STR ODS-Ⅱ

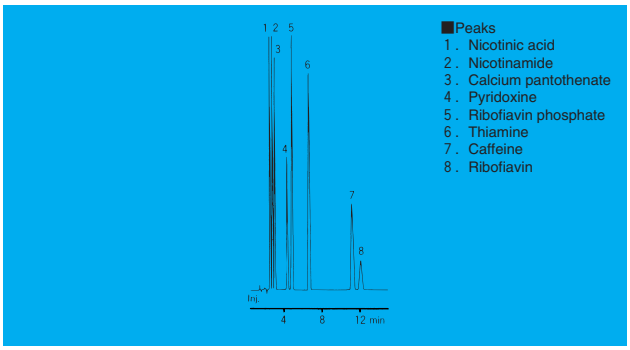



**Fig. 120 Analysis of Water Soluble Vitamines**

**■Operational Conditions**
**Column:** ODS-Ⅱ (4.0 mm i.d.×15 cm)
**Mobile phase:** 100mM phosphate buffer solution (pH 2.1) and 1.5mM Sodium octane sulfonate (9/1)
**Column temperature:** 40℃
**Flow rate:** 1.0 mL/min.
**Detector:** UV spectrophotometric detector (210 nm)

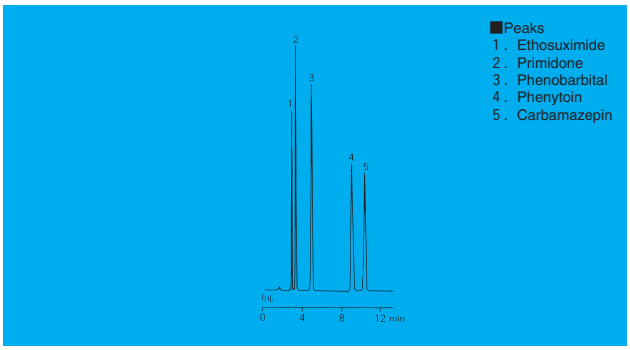



**Fig. 121 Analysis of Anticonvulsant**

**■Operational Conditions**
**Column:** ODS-Ⅱ (4.0 mm i.d.×15 cm)
**Mobile phase:** 100mM phosphate buffer solution (pH 2.1) /methanol/acetonitrile (4/2/1)
**Column temperature:** 40℃
**Flow rate:** 1.0 mL/min.
**Detector:** UV spectrophotometric detector (210 nm)

## ■STR ODS-M

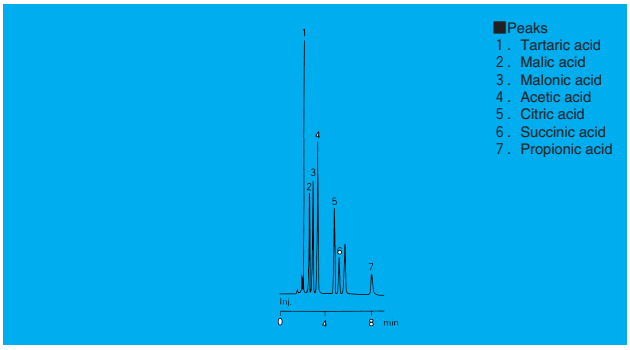



**Fig. 122 Analysis of Organic Acids**

**■Operational Conditions**
**Column:** ODS-M (4.6 mm i.d.×15 cm)
**Mobile phase:** 10mM KH2 PO4 (adjusted to pH 2.3 with phosphoric acid)
**Column temperature:** 40℃
**Flow rate:** 1.0 mL/min.
**Detector:** UV spectrophotometric detector (210 nm)

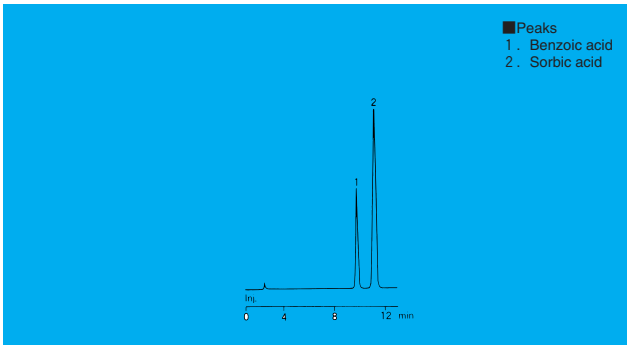



**Fig. 123 Analysis of Food Presevatives**

**■Operational Conditions**
**Column:** ODS-M (4.6 mm i.d.×15 cm)
**Mobile phase:** 25mM Phosphate buffer solution (pH 3.5)/methanol (7/3)
**Column temperature:** 50℃
**Flow rate:** 0.8 mL/min.
**Detector:** UV spectrophotometric detector (254 nm)

## ■STR PREP ODS-H

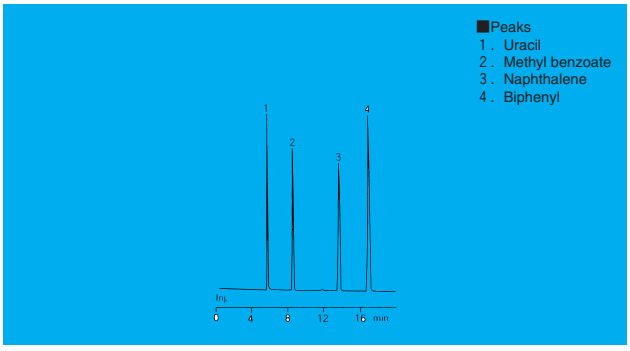



**Fig. 124 Inspection Data**

**■Operational Conditions**
**Column:** PREP ODS-H (20 mm i.d.×25 cm)
**Mobile phase:** Methanol/water (85/15)
**Column temperature:** Ambient
**Flow rate:** 8.0 mL/min.
**Detector:** 20 μL

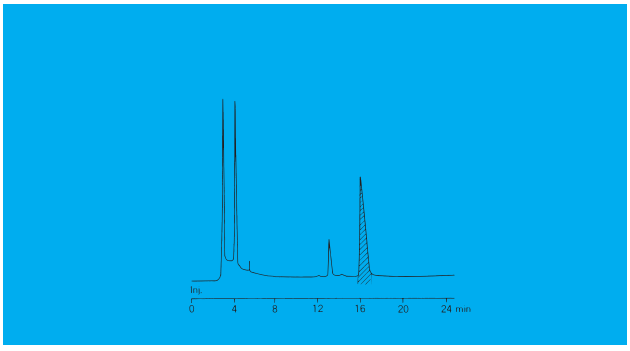



**Fig. 125 Preparative LC Chromatogram of Paeoniflorin in Peony Extract**

**■Operational Conditions**
**Column:** PREP ODS-H (20 mm i.d.×25 cm)
**Mobile phase:** Water/acetonitile (6/1)
**Column temperature:** Ambient
**Flow rate:** 15 mL/min.
**Detector:** UV spectrophotometric detector (230 nm)
**Sample size:** 100 mg of peony extract (2.0 mL of solution)

# 4 Application Data

## Food Industry

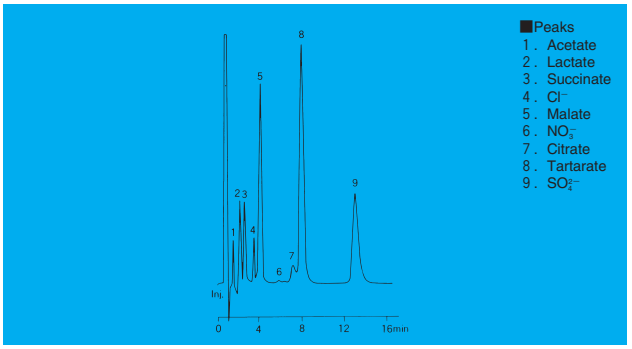



**Fig. 126 Analysis of Anions in Wine**

**■Operational Conditions**
**Column:** Shim-pack IC-A1 (4.6 mm i.d.×15 cm)
**Mobile phase:** 1.2mM potassium biphthalate (pH 4.2)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

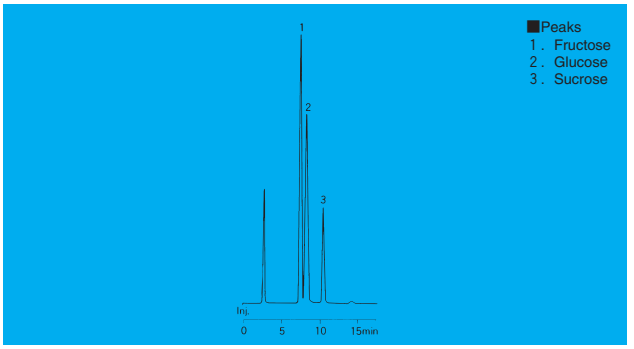



**Fig. 127 Determination of Saccharides in Soft Drink**

**■Operational Conditions**
**Column:** Shim-pack CLC-$NH_2$ (6.0 mm i.d.×15 cm)
**Mobile phase:** Actonitrile/water(7/3)
**Flow rate:** 1.2 mL/min.
**Column temperature:** Ambient
**Detector:** Refractive index detector

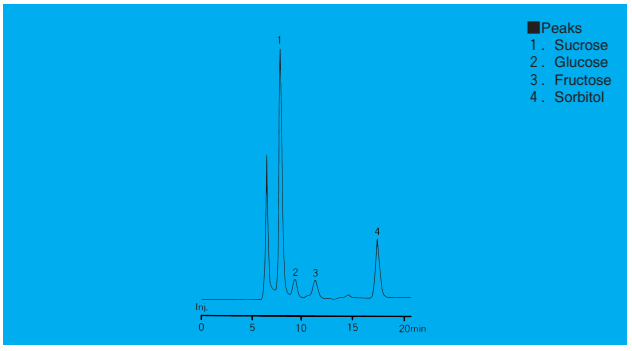



**Fig. 128 Determination of Saccharides in Pickles**

**■Operational Conditions**
**Column:** Shim-pack SCR-101C (7.9 mm i.d.×30 cm)
**Mobile phase:** Water
**Flow rate:** 1.0 mL/min.
**Column temperature:** 85℃
**Detector:** Refractive index detector

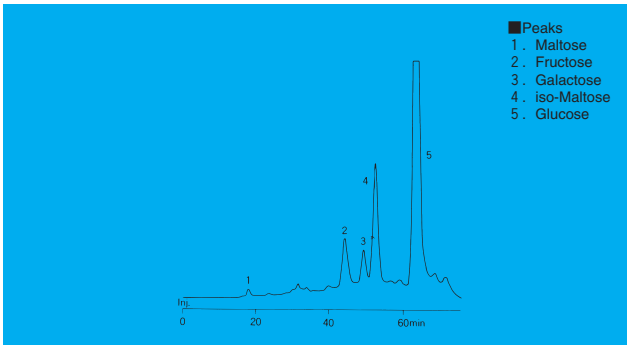



**Fig. 129 Determination of Saccharides in Miso (Bean paste)**

**■Operational Conditions**
**Column:** Shim-pack ISA-07 (4.0 mm i.d. × 25 cm)
**Mobile phase:** Potassium borate buffer solution, gradient elution
**Flow rate:** 0.6 mL/min.
**Column temperature:** 65℃
**Detector:** Fluorescence detector (Ex. 320nm, Em.430nm)
**Method:** Post-column derivatization with arginine

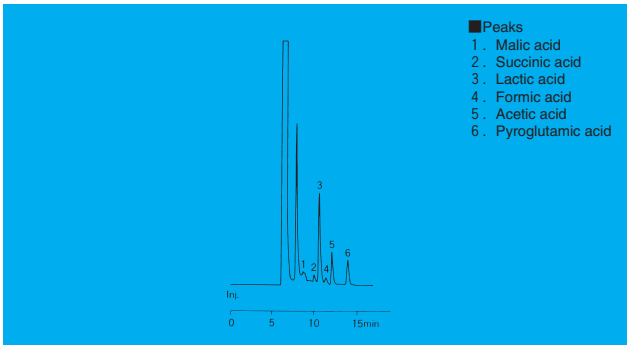



**Fig. 130 Determination of Organic Acids in Soy Sauce**

**■Operational Conditions**
**Column:** Shim-pack SCR-102H (8.0 mm i.d.×30 cm)
**Mobile phase:** 5mM p-toluenesulfonic acid
**Flow rate:** 0.8 mL/min.
**Column temperature:** 45℃
**Detector:** Conductivity detector
**Method:** Post-column derivatization with bis-tris buffer

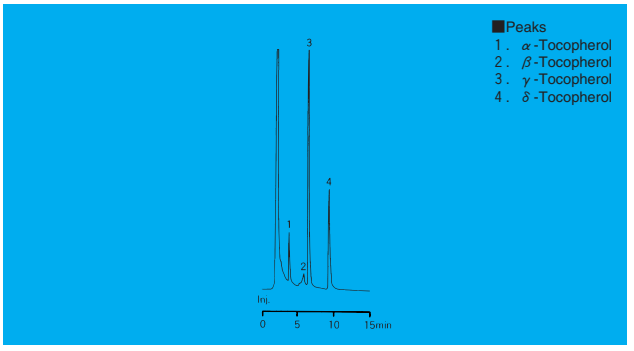



**Fig. 131 Determination of Tocopherols in Soy Bean Oil**

**■Operational Conditions**
**Column:** Shim-pack CLC-$NH_2$ (6.0mm i.d.×15 cm)
**Mobile phase:** n-Hexane/isopropanol (25/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (297nm)

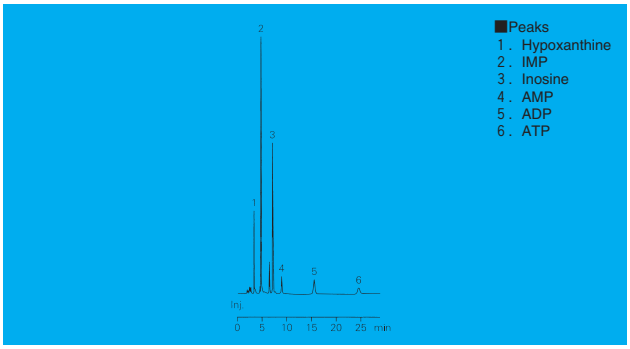



**Fig. 132 Analysis of Adenine Derivative 6 Components**

**■Operational Conditions**
**Column:** STR ODS-Ⅱ (4.6 mm i.d.×15 cm)
**Mobile phase:** 100mM phosphate (triethylammonium) buffer solution (pH 6.8) 100/acetonitrile
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (260nm)

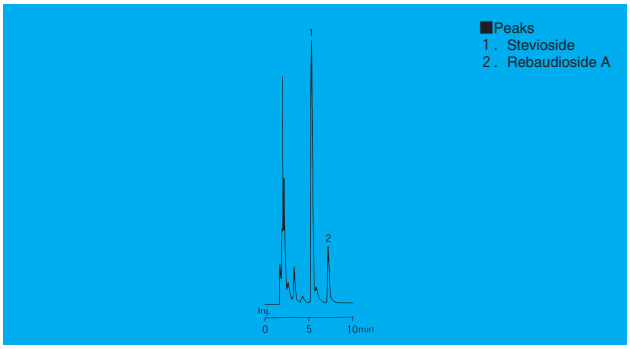



**Fig. 134 Determination of Steviosides in Pickles**

**■Operational Conditions**
**Column:** Shim-pack CLC-$NH_2$ (6.0 mm i.d.×15 cm)
**Mobile phase:** Acetonitrile/water (3/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

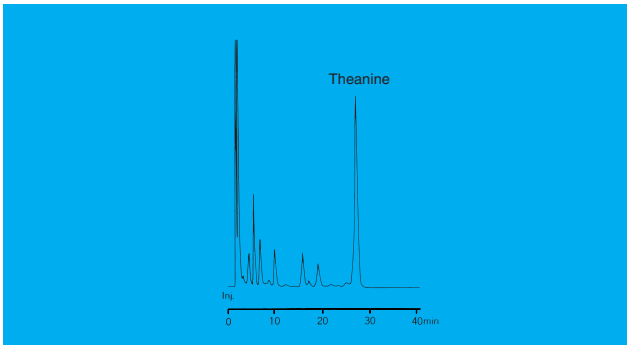



**Fig. 136 Determination of Theanine in Tea Leaf**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0 mm i.d.×15 cm)
**Precolumn:** Shim-pack GRD-ODS
**Mobile phase:** 10mM phosphate buffer solution (pH 7.1)/acetonitrile (92/8)
**Flow rate:** 1.5 mL/min.
**Column temperature:** Ambient
**Detector:** Fluorescence detector (Ex. 365nm, Em. 435nm)
**Method:** Prelabelling with OPA

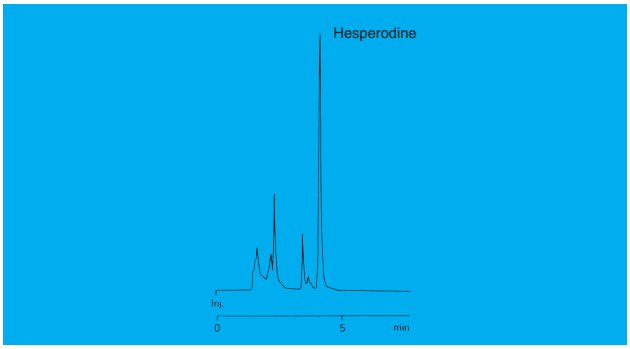



**Fig. 133 Determination of Hesperidine in Orange Juice**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0 mm i.d.×15 cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1)/acetonitrile (3/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (265nm)

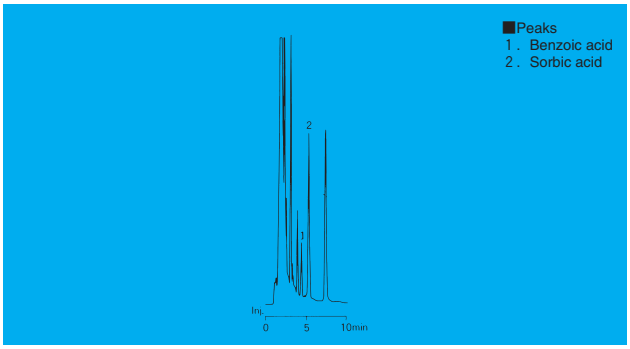



**Fig. 135 Analysis of Preservatives in Food**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0 mm i.d.×15 cm)
**Precolumn:** Shim-pack GRD-ODS
**Mobile phase:** 10mM phosphate buffer solution (pH 6.9) /acetonitrile (20/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (225nm)

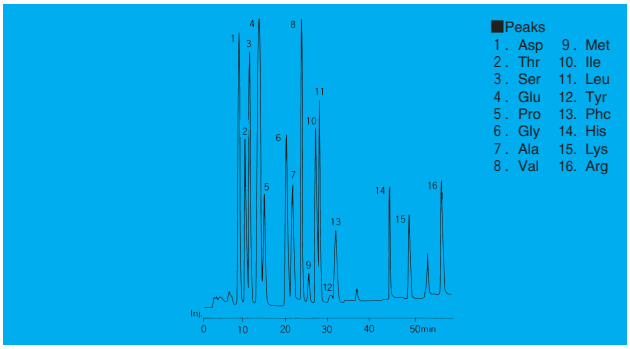



**Fig. 137 Analysis of Amino Acids in Soy Sauce**

**■Operational Conditions**
**Column:** Shim-pack ISC-07 (4.0 mm i.d.×15 cm)
**Mobile phase:** Sodium citrate buffer solution, gradient elution
**Flow rate:** 0.3 mL/min.
**Detector:** Fluorescence detector (Ex. 348nm, Em. 450nm)
**Method:** Prelabelling with OPA

# Medicines and Cosmetics

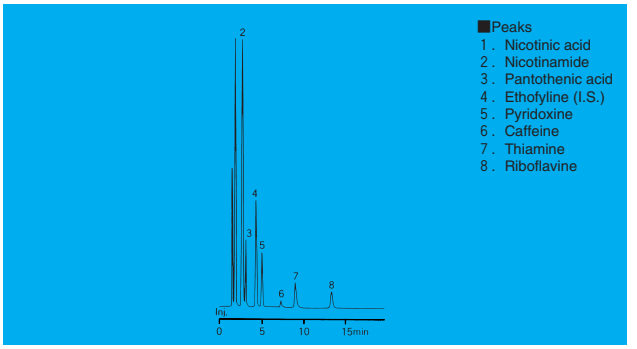



**Fig. 138 Analysis of Vitamin Tablet**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0 mm i.d.×15 cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1) and 1.2mM sodium octane sulfonate/acetonitrile (9/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

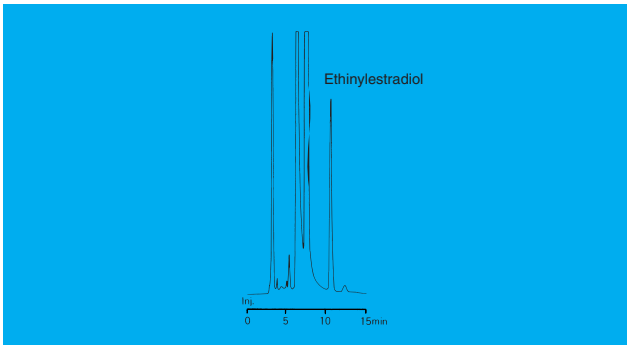



**Fig. 139 Determination of Ethinylestradiol in Cream**

**■Operational Conditions**
**Column:** Shim-pack CLC-SIL(M) (4.6mm i.d.×25cm)
**Mobile phase:** n-Hexane/ethanol (20/1)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** Fluorescence detector (Ex. 285nm, Em. 315nm)

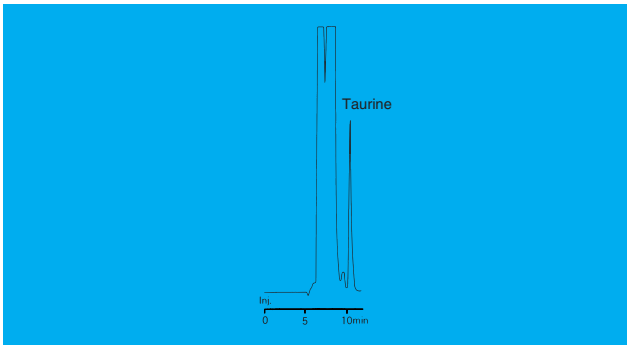



**Fig. 140 Determination of Taurine in Soft Drink**

**■Operational Conditions**
**Column:** Shim-pack SCR-101H (7.9mm i.d.×30cm)
**Mobile phase:** 10mM aqueous solution of perchloric acid
**Flow rate:** 0.8 mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

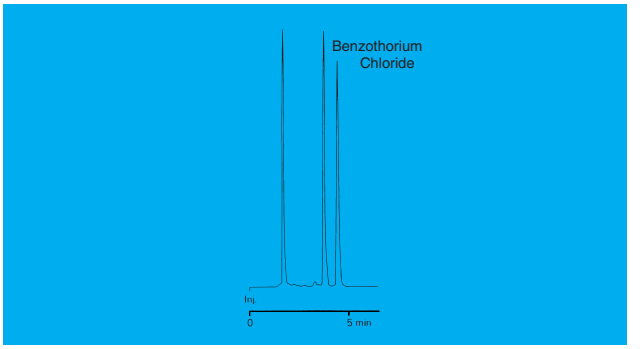



**Fig. 141 Determination of Benzethonium Chloride in Gargle**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1)/acetonitrile (1/2)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (220nm)

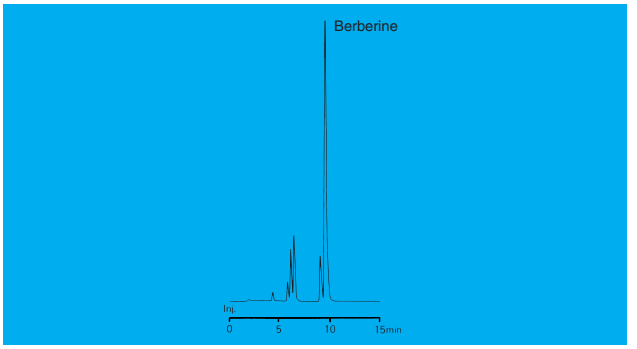



**Fig. 142 Determination of Berberine in Coptis Japonica Powder**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) and 0.1M sodium perchlorate/acetonitrile (2/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (340nm)

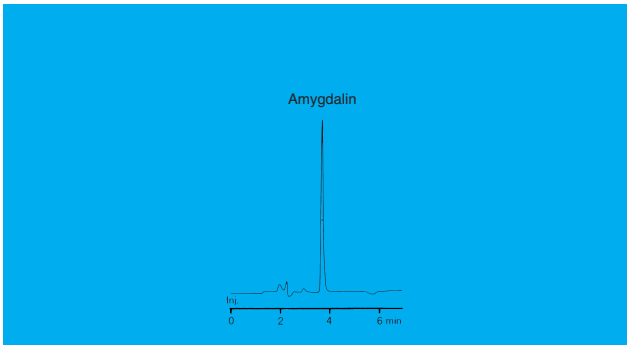



**Fig. 143 Determination of Amygdalin in Apricot Seed**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Water/acetonitrile (4/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

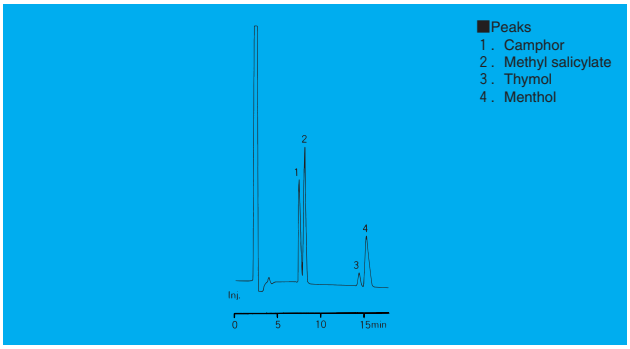



**Fig. 144 Analysis of Antiphlogistic/Analgesic Paste**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Methanol/tetrahydrofuran/water (5/1/4)
**Flow rate:** 1.2 mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

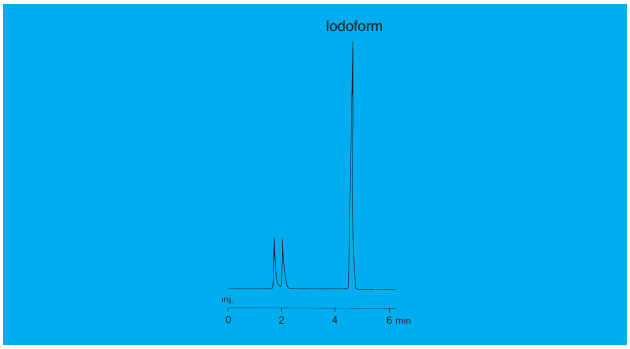



**Fig. 145 Determination of Iodoform in Pulveres**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) /acetonitrile (1/2)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (335nm)

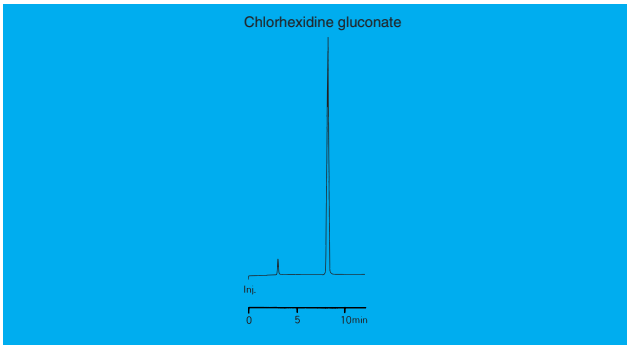



**Fig. 146 Determination of Chlorhexidine Gluconate**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) and 0.1M sodium perchlorate/acetonitrile (3/2)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (240nm)

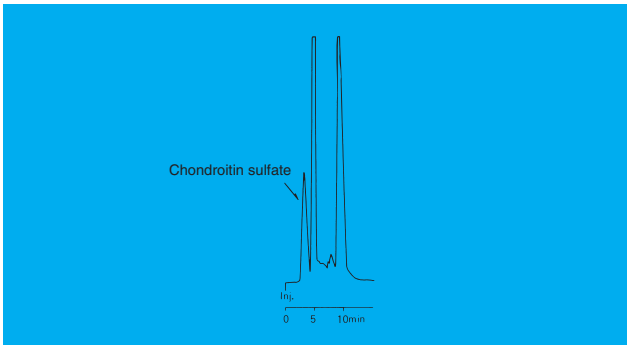



**Fig. 147 Determination of Chondroitin sulfate in Eyewash**

**■Operational Conditions**
**Column:** Shim-pack Diol-300 (7.9mm i.d.×25cm)
**Mobile phase:** 50mM phosphate buffer solution (pH 3)
**Flow rate:** 1.0 mL/min.
**Detector:** UV spectrophotometric detector (210nm)

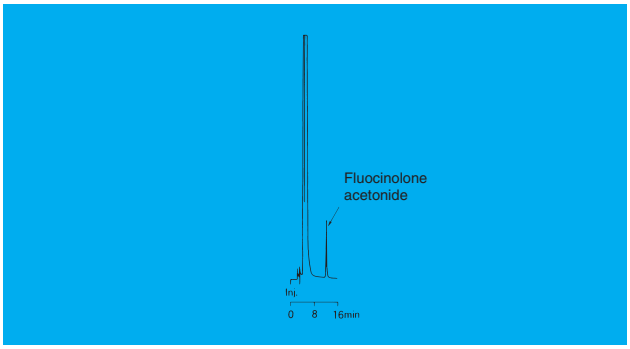



**Fig. 148 Determination of Fluocinolone Acetonide in Cream**

**■Operational Conditions**
**Column:** Zorbax CN (4.6mm i.d.×25cm)
**Mobile phase:** n-Hexane/ethanol(4/1)
**Flow rate:** 1.0mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector

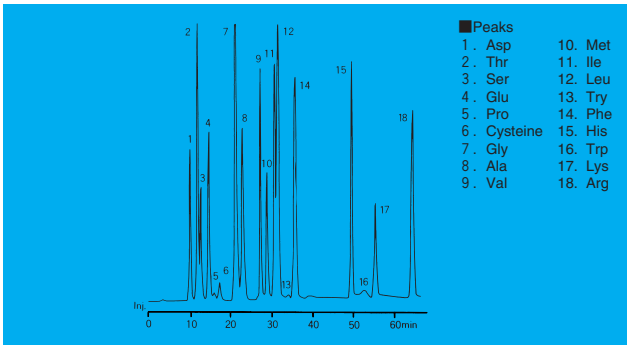



**Fig. 149 Analysis of Amino Acid in Transfusion Liquid**

**■Operational Conditions**
**Column:** Shim-pack ISC-07 (4.0mm i.d.×15cm)
**Mobile phase:** Citric acid buffer solution, gradient elution
**Flow rate:** 0.3 mL/min.
**Column temperature:** 55℃
**Detector:** Fluorescence detector (Ex. 348nm, Em. 450nm)
**Method:** Post-column derivatization with OPA

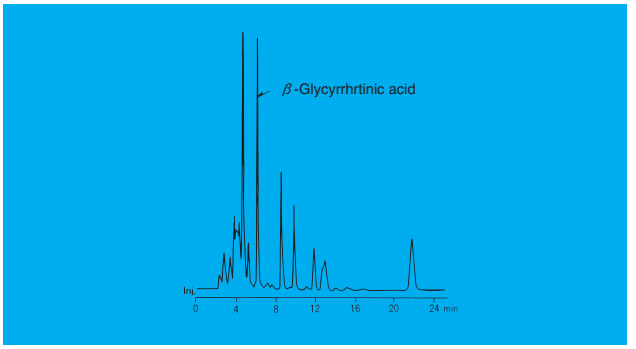



**Fig. 150 Determination of β-Glycyrrhetinic Acid in Cream**

**■Operational Conditions**

**Column:** CAPCELL PAK $C_{18}$ (5 μm) (4.6mm i.d. × 25cm)
**Mobile phase:** Acetonitrile/phosphoric acid (pH 2.5) (3/1)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (230nm)

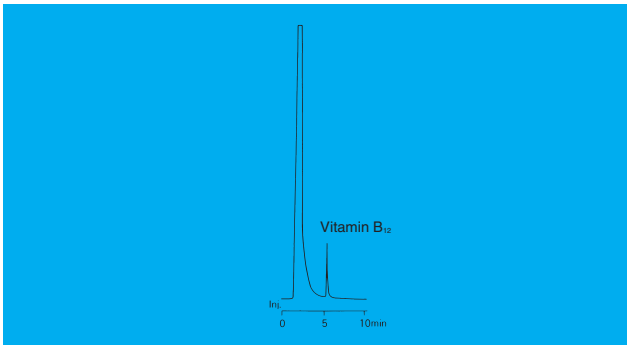



**Fig. 151 Determination of Vitamin $B_{12}$ in Injection**

**■Operational Conditions**

**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) /acetonitrile (7/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (278nm)

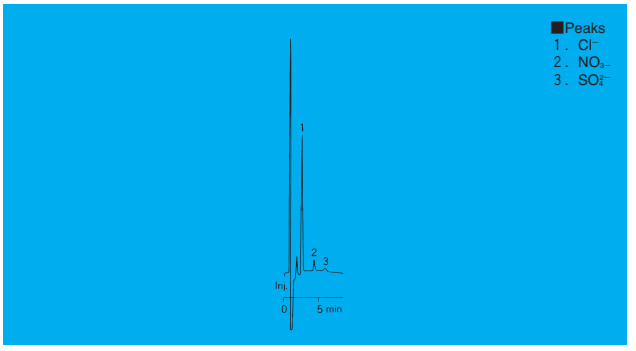



**Fig. 152 Analysis of Inorganic Anions in Injection**

**■Operational Conditions**

**Column:** Shim-pack IC-A1 (4.6mm i.d. × 15cm)
**Mobile phase:** 2.5mM phthalic acid and 2.4mM (tris) (hydroxymethyl) aminomethane (pH 4.0)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

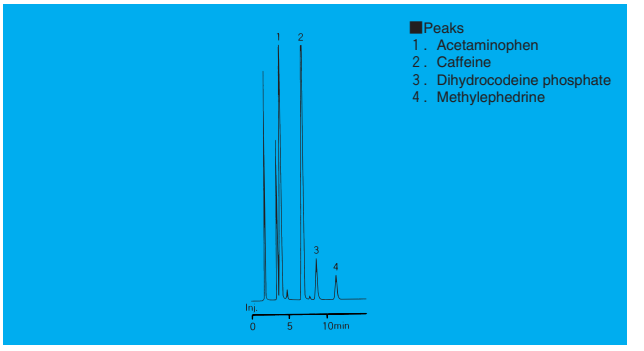



**Fig. 153 Analysis of Cold Medicine**

**■Operational Conditions**

**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) and 20mM sodium perchloric/acetonitrile (8/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

# Medical and Biochemical Field

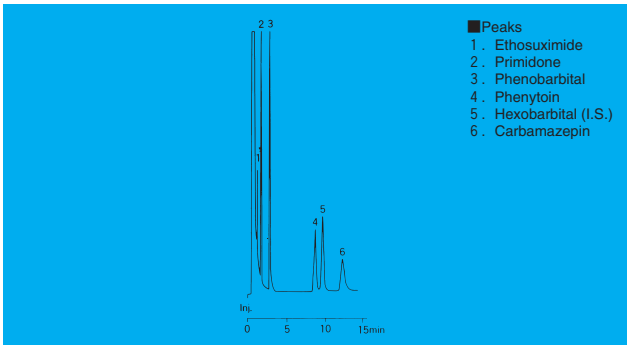



**Fig. 154 Analysis of Anticonvulsants in Serum**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 5.5) /methanol(10/9)
**Flow rate:** 1.2 mL/min.
**Column temperature:** 55℃
**Detector:** UV spectrophotometric detector (210nm)

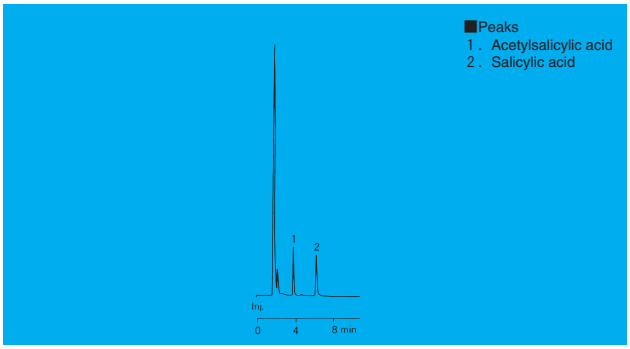



**Fig. 155 Determination of Acetylsalicylic Acid and Salicylic Acid in Serum**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1)/methanol (1/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 55℃
**Detector:** UV spectrophotometric detector (245nm)

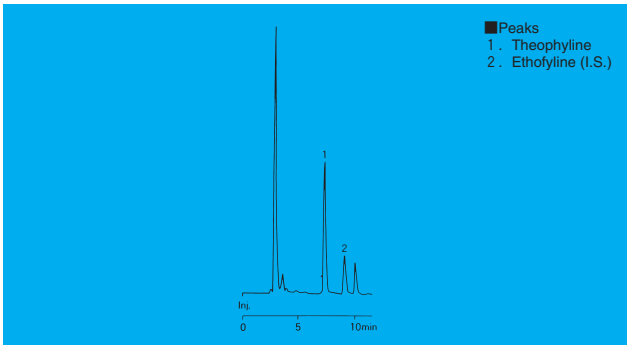



**Fig. 156 Determination of Theophylline in Blood**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1)/acetonitrile (10/1)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (270nm)

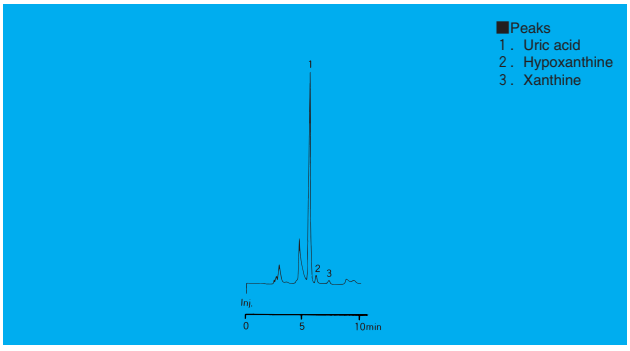



**Fig. 157 Determination of Xanthine, Hypoxanthine, and Uric Acid in Urine**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 20mM phosphate buffer solution (pH 3)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (260nm)

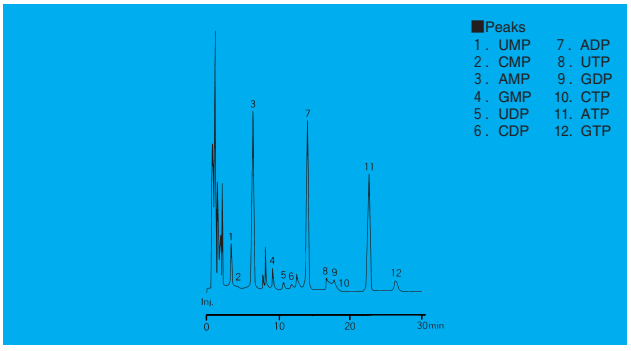



**Fig. 158 Analysis of Nucleotides in Rat Liver Oil**

**■Operational Conditions**
**Column:** Shim-pack WAX-1 (4.0mm i.d.×5cm)
**Mobile phase:** Phosphate buffer solution (pH 7), gradient elution
**Flow rate:** 1.0 mL/min.
**Column temperature:** 45℃
**Detector:** UV spectrophotometric detector (260nm)

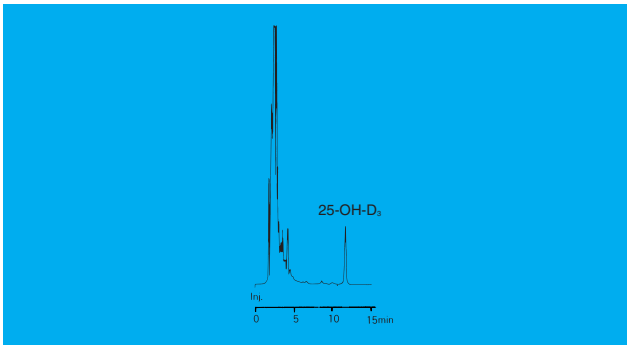



**Fig. 159 Determination of Vitamin 25-OH-$D_3$ in Blood**

**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Methanol/water (5/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (265nm)

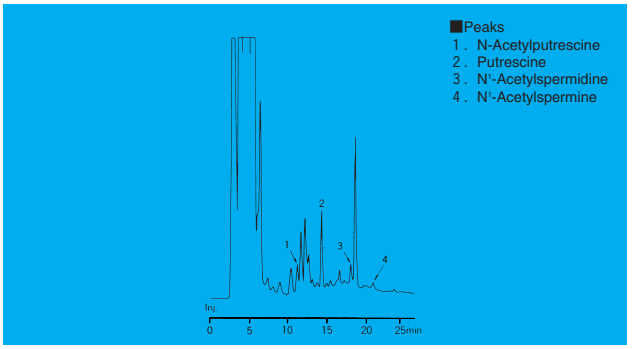



**Fig. 160 Determination of Polyamines in Urine**

**■Operational Conditions**

**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Sodium perchlorate and sodium hexane sulfonate /acetonitril, gradient elution
**Flow rate:** 1.1 mL/min.
**Column temperature:** 50℃
**Detector:** Fluorescence detector (Ex. 345nm, Em. 455nm)
**Method:** Post-column derivatization with OPA

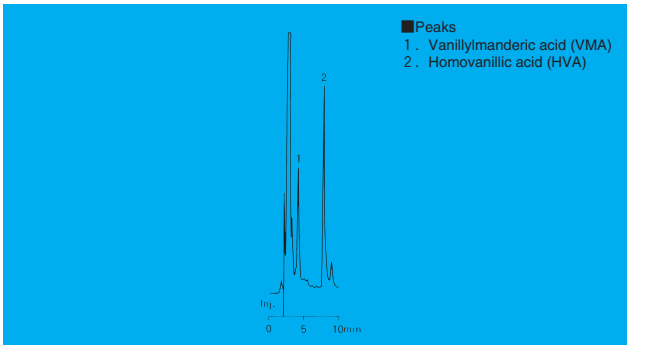



**Fig. 161 Determination of HVA and VMA in Neonate Urine**

**■Operational Conditions**

**Column:** Shim-pack CLC-VMA (6.0mm i.d.×15cm)
**Mobile phase:** Tartaric acid/acetonitrile (97/3) with a small amount of EDTA
**Flow rate:** 1.5 mL/min.
**Detector:** Conductivity detector

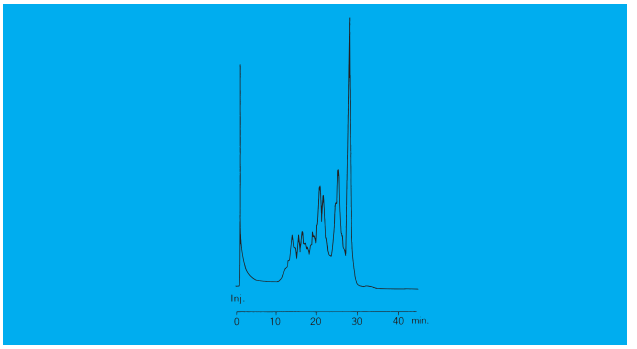



**Fig. 162 Determination of β-Glucosidase**

**■Operational Conditions**

**Column:** Shim-pack HPC-C3 (4.0mm i.d.×5cm)
**Mobile phase:** Ammonium sulfate/phosphate buffer solution (pH 7), gradient elution
**Flow rate:** 0.5 mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (220nm)

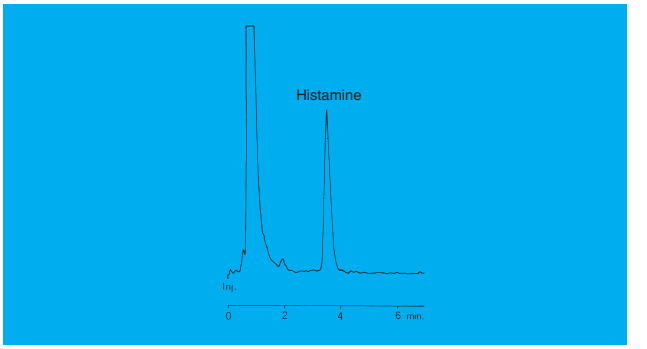



**Fig. 163 Determination of Histamine in Plasma**

**■Operational Conditions**

**Column:** Shim-pack WCX-1 (4.0mm i.d.×5cm)
**Mobile phase:** 40mM phosphate buffer solution (pH 6.9)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 50℃
**Detector:** Fluorescence detector (Ex. 348nm, Em. 440nm)
**Method:** Post-column derivatization with OPA

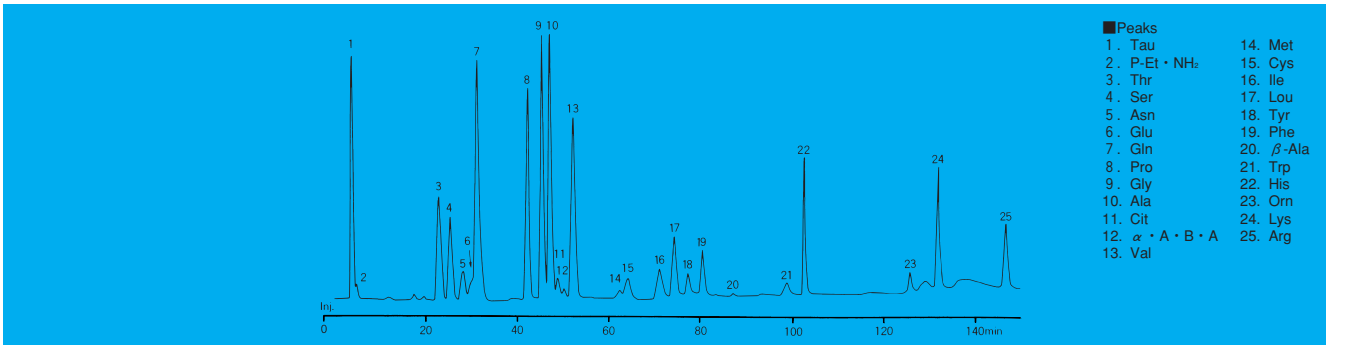



**Fig. 164 Analysis of Amino Acids in Serum**

**■Operational Conditions**

**Column:** Shim-pack ISC-07 (4.0mm i.d.×15cm)
**Mobile phase:** Lithium citrate buffer solution, gradient elution
**Flow rate:** 0.4 mL/min.
**Column temperature:** 38℃～58℃
**Detector:** Fluorescence detector (Ex. 348nm, Em. 450nm)
**Method:** Post-column derivatization with OPA

# Chemical Industry

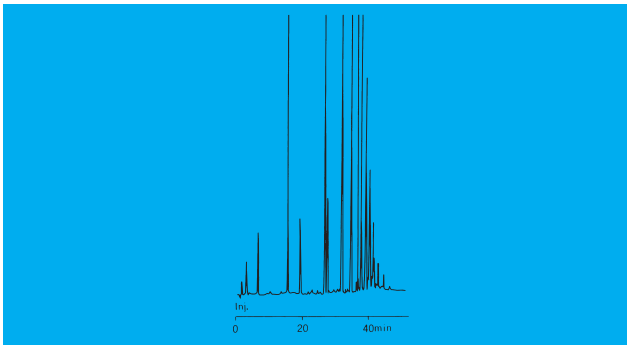



**Fig. 165 Analysis of Epoxy Resin**

■**Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Water/acetonitrile, gradient elution
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (220nm)

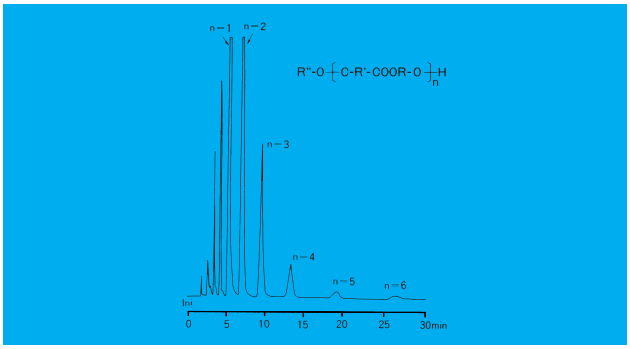



**Fig. 166 Analysis of Ester Oligomers**

■**Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Methanol/water (4/1)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 50℃
**Detector:** UV spectrophotometric detector (254nm)

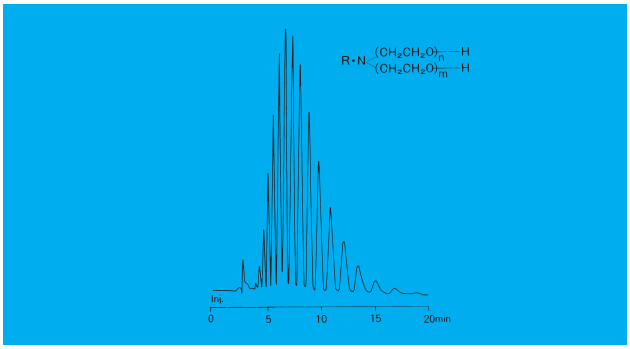



**Fig. 167 Analysis of Alkylamine-Polyethylene Aducts**

■**Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** Methanol/0.05% phosphoric acid (3/2)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

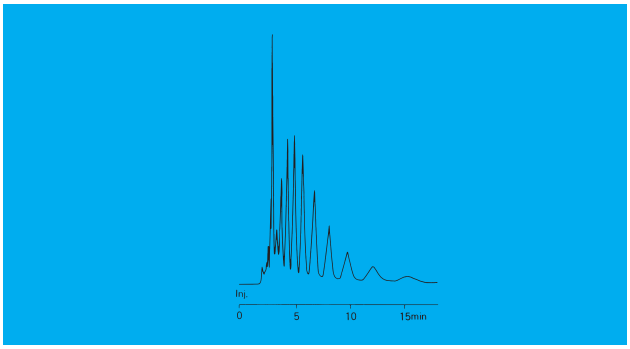



**Fig. 168 Analysis of Polyoxyethylene Octylphenyl Ether**

■**Operational Conditions**
**Column:** Shim-pack CLC-SIL (6.0mm i.d.×15cm)
**Mobile phase:** n-Hexane/ethanol (2/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** Ambient
**Detector:** UV spectrophotometric detector (250nm)

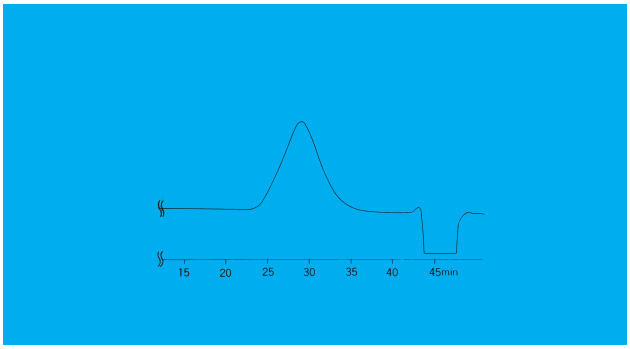



**Fig. 169 Analysis of Polyvinylacetate**

■**Operational Conditions**
**Column:** Shim-pack GPC-804, 803, and 802, (8.0mm i.d.× 30cm, each)
**Mobile phase:** Tetrahydrofuran
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

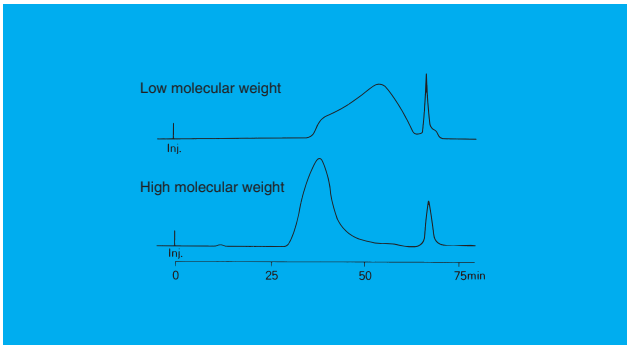



**Fig. 170 Analysis of Carboxylmethylcellulose**

■**Operational Conditions**
**Column:** Asahipak GS-710 (two columns)
**Mobile phase:** 50mM sodium nitrate
**Flow rate:** 1.0 mL/min.
**Column temperature:** 50℃
**Detector:** Refractive index detector

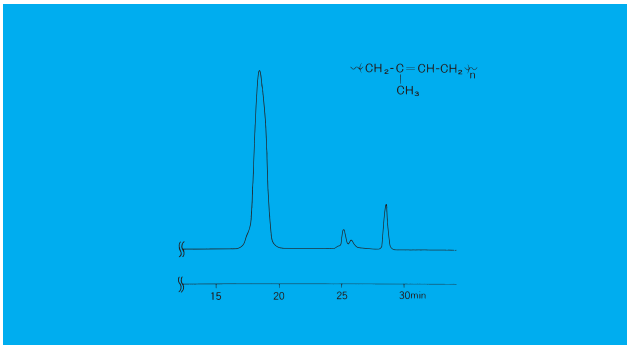



**Fig. 171 Analysis of Isoprene Rubber**

■**Operational Conditions**
**Column:** Shim-pack GPC-804, 802, and 802 (8.0mm i.d.×30cm, each)
**Mobile phase:** Tetrahydrofuran
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** Refractive index detector

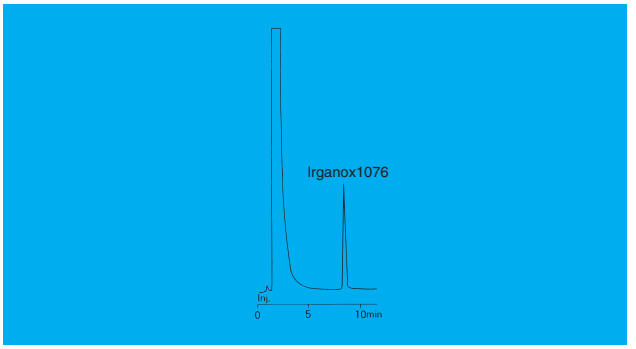



**Fig. 172 Determination of Irganox 1076 in Rubber**

■**Operational Conditions**
**Column:** Zorbax ODS (4.6mm i.d.×15cm)
**Mobile phase:** Methanol/tetrahydrofuran (9/1)
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (280nm)

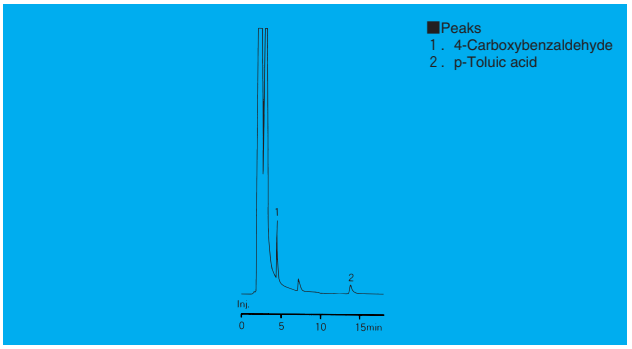



**Fig. 173 Determination of Impurities in Terephthalic acid**

■**Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 2.6) /acetonitrile (4/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 65℃
**Detector:** UV spectrophotometric detector (230nm)

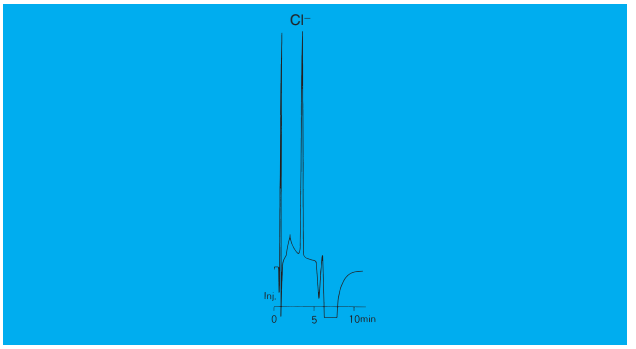



**Fig. 174 Determination of Chlorine in Concrete Additive**

■**Operational Conditions**
**Column:** Shim-pack IC-A1 (4.6mm i.d.×10cm)
**Mobile phase:** 2.0mM phthalic acid and 1.5mM tris (hydroxymethyl) aminomethane
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃

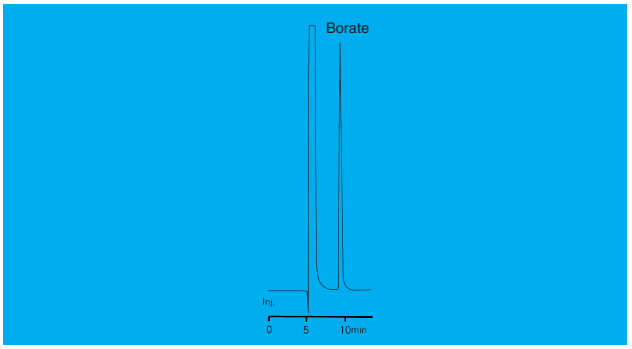



**Fig. 175 Determination of Borate in Plating Solution**

■**Operational Conditions**
**Column:** Shim-pack SCR-101H (7.9mm i.d.×30cm)
**Mobile phase:** 5mM perchloric acid aqueous solution
**Flow rate:** 0.8 mL/min.
**Column temperature:** 50℃
**Detector:** Reractive index detector

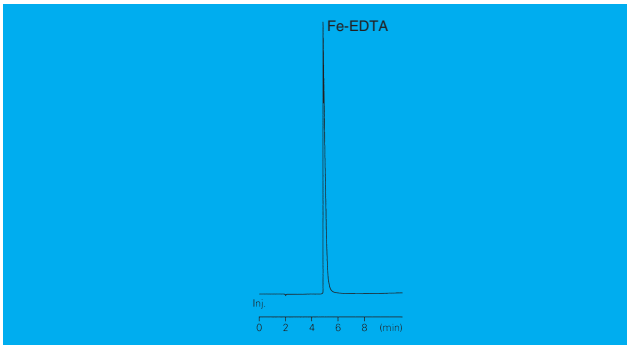



**Fig. 176 Determination of EDTA**

■**Operational Conditions**
**Column:** STR ODS-Ⅱ (4.6mm i.d.×15cm)
**Mobile phase:** 15mM inclding tributylamines 10mM phosphate aqueous solution (pH 7) 5/acetonitrile 1
**Flow rate:** 1.0 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophtometric detector (258nm)

# Environmental Pollutants

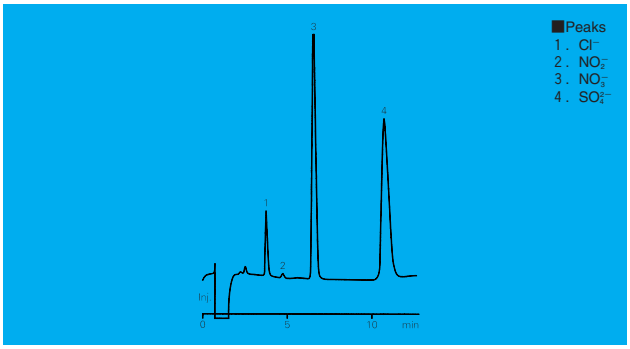



**Fig. 177 Determination of Inorganic Anion in Rain Water**

**■Operational Conditions**
**Column:** Shim-pack IC-A3
**Mobile phase:** 8.0mM Hydroxyacetic benzoate
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

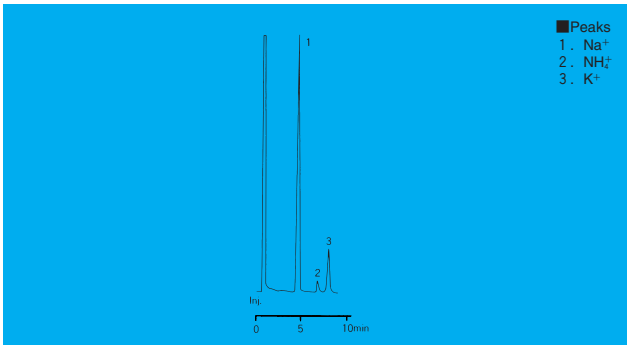



**Fig. 178 Determination of Monovalent Cations in Soil Water**

**■Operational Conditions**
**Column:** Shim-pack IC-C1 (5mm i.d.×15cm)
**Mobile phase:** 5mM nitric acid aqueous solution
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** Conductivity detector

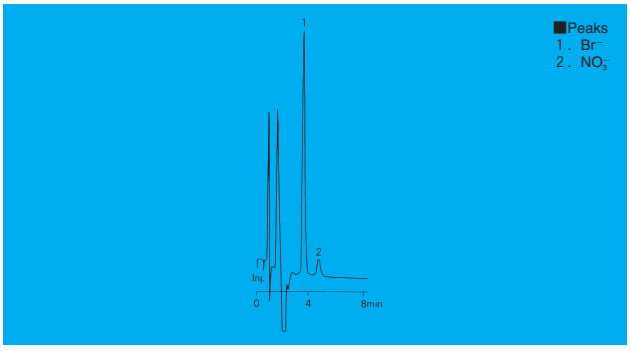



**Fig. 179 Determination of Bromine and Nitric Acid**

**■Operational Conditions**
**Column:** Shim-pack IC-A1 (4.6mm i.d.×15cm)
**Mobile phase:** 10mM phosphate buffer solution (pH 6.8)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (210nm)

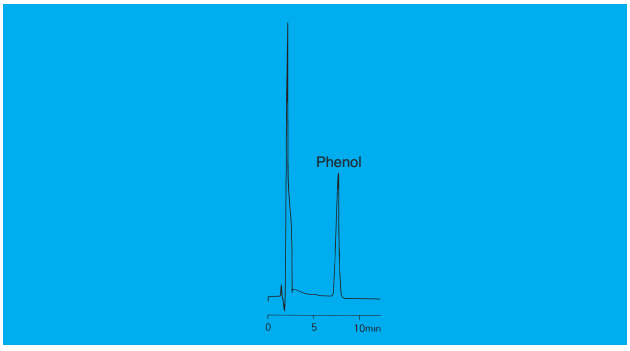



**Fig. 180 Determination of Phenol in Water**

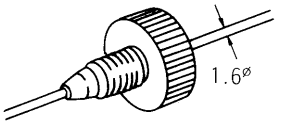
**■Operational Conditions**
**Column:** Shim-pack CLC-ODS (6.0mm i.d.×15cm)
**Mobile phase:** 0.1M phosphate buffer solution (pH 2.1)/acetonitrile (3/1)
**Flow rate:** 1.5 mL/min.
**Column temperature:** 40℃
**Detector:** UV spectrophotometric detector (265nm)
**Sample pretreatment:** Concentrated with an automatic sample pretreatment system

# 5 Parts for Flow line

## Plumbing parts (Connecting Parts)

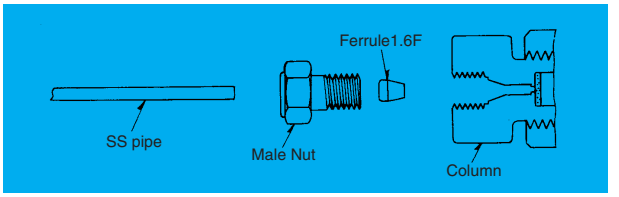
### Fingertightening connector

You can connect the column by tighening this connector, not by wrench. This PEEK connector which is superior in chemical compatibility and mechanical strength is suitable for biological LC. Available to 1.6mm i.d. pipe such as stainless, titanium, teflon, tefzel, PEEK etc. Maxium pressure is 250kgf/cm$^2$ when connecting to 0.5mm i.d. PEEK pipe.




| Description | Cat. No. |
|---|---|
| Male Nut, PEEK (Inc. 5pcs.) | 228-18565-84 |

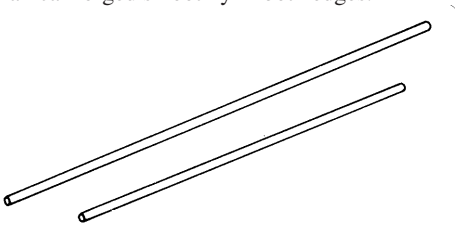
● Connecting by stainless plumbing parts




*Cut and sharpen not necessary*

### Forged pipe

This 1.6mm o.d. pipe (SS 316) is cut at the size of easily use and mechanical-forged smoothly in both edges.



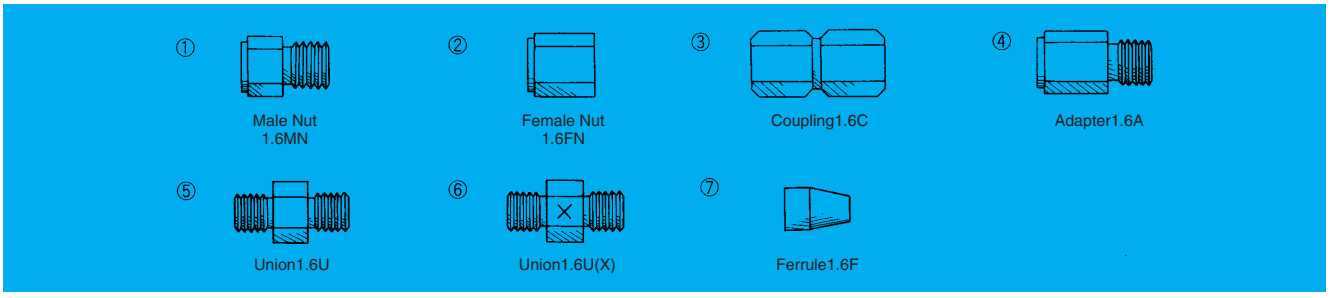
Pre-cut Stainless Pipe

| i.d.×o.d.×length (mm) | Cat. No |
|---|---|
| 0.3×1.6×100 | 228-22301-00 |
| 0.3×1.6×200 | 228-22302-00 |
| 0.3×1.6×300 | 228-22303-00 |
| 0.3×1.6×400 | 228-22304-00 |
| 0.3×1.6×500 | 228-22305-00 |
| 0.8×1.6×100 | 228-22801-00 |
| 0.8×1.6×200 | 228-22802-00 |
| 0.8×1.6×300 | 228-22803-00 |
| 0.8×1.6×400 | 228-22804-00 |
| 0.8×1.6×500 | 228-22805-00 |

To connect this type of column, use the kit below.

| Description | Cat. No. | Number |
|---|---|---|
| Column Connection Kit C ASSY<br>(For new-new type connection) | 228-16058-91 | Pipe 0.3 i.d.×1.6 o.d.×25cm 1pc.<br>Male Nut 1.6MN 2pcs.<br>Ferrule 1.6F 2pcs. |

### Connector Plumbing Parts

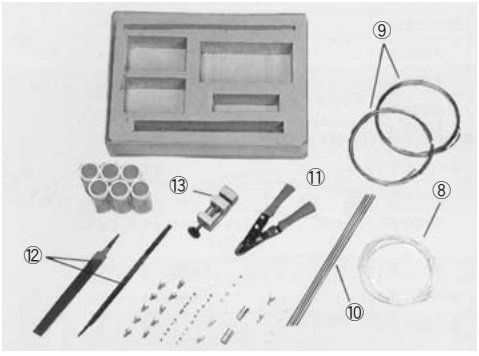



| Description | Cat. No. | Number |
|---|---|---|
| ① Male Nut 1.6MN | 228-16001-84 | 10 |
| ② Female Nut1.6FN | 228-16002-84 | 10 |
| ③ Coupling1.6C | 228-16004-03 | 1 |
| ④ Adapter1.6A | 228-16005-03 | 1 |
| ⑤ Union1.6U | 228-00034 | 1 |
| ⑥ Union1.6U(X) | 228-01356 | 1 |
| ⑦ Ferrule1.6F | 228-16000-84 | 3 |
| ⑦ Ferrule1.6F | 228-16000-85 | 10 |

## LC plumbing part kit

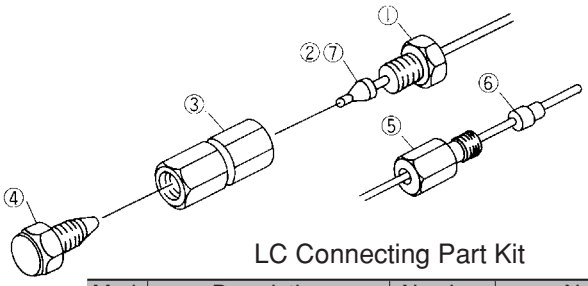
This kit put in a prastic case consists of pipes, connectors and tools needed to HPLC plumbing parts. It is possible to cut the pipe with the cutter attached as the length as you like. After cutting the pipe, hold this in the miniture vice and file the end of this smooth.

| Description | Cat. No. |
|---|---|
| LC plumbing part kit | 228-24209-91 |




〔Kit〕

| Description | Cat. No. | Products Name | | Number |
|---|---|---|---|---|
| Coupling 1.6C ASSY | 228-16051-91 | ③ Coupling | 1.6C | 1 |
| | | ⑦ Ferrule | 1.6F | 2 |
| | | ① Male Nut | 1.6MN | 2 |
| Adapter 1.6A ASSY | 228-16052-91 | ④ Adapter | 1.6A | 1 |
| | | ⑦ Ferrule | 1.6F | 2 |
| | | ① Male Nut | 1.6MN | 1 |
| | | ② Female Nut | 1.6FN | 1 |
| Union 1.6U Newtype ASSY Type | 228-16053-91 | ⑤ Union | 1.6U | 1 |
| | | ⑦ Ferrule | 1.6F | 2 |
| | | ② Female Nut | 1.6FN | 2 |
| Union 1.6U(X) Newtype ASSY | 228-16054-91 | ⑥ Union | 1.6U(X) | 1 |
| | | ⑦ Frrule | 1.6F | 2 |
| | | ② Female Nut | 1.6FN | 2 |
| Column connector kit | 228-17943-92 | ① Male Nut | 1.6MN | 2 |
| | | ⑦ Ferrule | 1.6F | 2 |



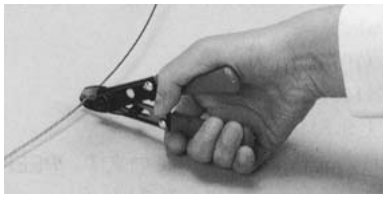

LC Connecting Part Kit

| Mark | Description | Number | Notes |
|---|---|---|---|
| ① | Male Nut, 1.6MN | 10 | |
| ② | Ferrule, 1.6F | 20 | |
| ③ | Coupling, 1.6C-0.4 | 2 | |
| ④ | Plug, 1.6P | 2 | |
| ⑤ | Longbush, 7010-011 | 2 | For Rheodyne injector |
| ⑥ | Ferrule, 7010-010 | 4 | For Rheodyne injector |
| ⑦ | PTFE ferrule, 1.6F-T | 5 | |
| ⑧ | PTFE tube, o.d. 1.6 | 2m | i.d. 0.4 |
| ⑨ | SS pipe, o.d.1.6 | Each 2m | i.d. 0.3 and 0.8 |
| ⑩ | Pre-cut pipe, o.d. 1.6 | 4 | i.d. 0.3, 250 length |
| ⑪ | Pipe cutter | 1 | |
| ⑫ | File (triangle, flat) | Each 1 | |
| ⑬ | Miniture vice | 1 | |

*As if cutting a wire by wrench*

## Cut the stainless pipe easily

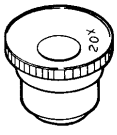
Holding and cutting the pipe like wrench by cutter in the LC plumbing part kit, we can prevent plugging the pipe. You can cut easily and the end of the pipe is smooth, comparing with the case of filing. (Do not forget to file the end of the pipe.) Possible to cut from 0.3mm i.d. to 1.6mm o.d.



| Subscription | Cat. No. |
|---|---|
| Piping cutter | 670-18802 |

## Checking the end of pipe

Use the pipe once filing the end of the stainless pipe smooth and checking with a magnifying glass carefully. We can look carefully with a High magnifying power glass made of non-colour lense.




| Description | Cat. No. |
|---|---|
| A magnifying glass, 20 times | 670-12327 |

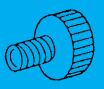
# PEEK plumbing parts

Use this parts for maintenance Non-metal LC system and system up.

| Description | Cat. No. |
|---|---|
| Plumbing parts (Connecting parts) kit for inert LC | 228-33285-91 |

## Component of Plumbing parts (Connecting parts) kit for Non-metal LC

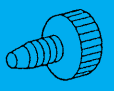
① Male Nut 1.6MN-2 PEEK*
(228-33213×5pcs.
Male Nut・Ferrule separate type)



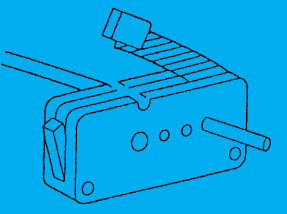
② Ferrule 1.6F PEEK*
(228-31638×10pcs.
Male Nut・Ferrule separate type)

③ Male connector 1.6C PEEK
(228-25014×2pcs.
Coupling made with PEEK)

④ Stop joint PEEK
(228-28090×2pcs. PEEK Plug)



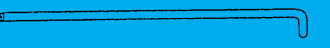
⑤ Clean cut
(228-33930×1pcs.
A pressing cutter for PEEK tube)



⑥ PEEK tube set
(228-33406×2pcs.)

⑥-1 PEEK tube 1.6×0.25×500 straight

⑥-2 PEEK tube 1.6×0.25×500 L type



⑥-3 FEP tube NFL016
(For protect PEEK tube, 1m)

* There are two types: male nut・ferrule separation type and joint type.(Refer to P.83)
When using PEEK tube with organic solvent type mobile phase, use separationtype.
When using PEEK tube with aqueous solution like IC, use joint type under normal pressure.

● The solvent when using PEEK resin

Although PEEK resin has high mechanical strength and thus is considered as optimal plastic material for HPLC, there are some restrictions to use. Make sure that particularly the solvents below are NOT used.

> Concentrated sulfuric acid, concentrated nitric acid, dichloroacetic acid, tetrahydrofuran(THF), dichloromethane, chloroform, dimethyl sulfoxide (DMSO), acetone

There is no problem of using methanol and acetonitriles, but use these solvents within the pressure below.

Methanol: Each diameter～200kgf/cm$^2$ (19.6MPa)
Acetonitriles: i.d. 0.125 $\phi$ /0.25 $\phi$ →～200kgf/cm$^2$ (19.6MPa)
i.d. 0.50 $\phi$ →～150kgf/cm$^2$ (14.7MPa)
i.d. 0.75 $\phi$ →～100kgf/cm$^2$ (9.8MPa)

● Each PEEK tube showed in this page includes FEP tube for protection. Preparing for the case of PEEK tube is broken, be sure to put FEP tube for the security.

## PEEK plumbing parts (Not included in Plumbing Parts Kits)

| Description | Cat. No. | Contents |
|---|---|---|
| Male Nut 1.6MN-2 PEEK | 228-33213 | Male nut・Ferrule separation type |
| Ferrule 1.6F PEEK (includes 3pcs.) | 228-33513-91 | Male nut・Ferrule separation type |
| Male connector 1.6C PEEK | 228-25014 | Coupling |
| 3way joint 1.6C PEEK | 228-25013 | Female T joint*1 |
| Stop joint PEEK | 228-28090 | Plug |
| Tubing cutter | 228-32930-01 | Press cutter for PEEK tube |
| Replacement blade | 228-32930-02 | |
| PEEK Tube set | 228-33406-91 | |
| Inline filter PEEK | 228-32939 | Filter for protecting a column<br>(Put between injector and column) |
| Frit (1pcs.) | 228-32744 | Spare filter for inline filter |
| Frit (5pcs.) | 228-33691-91 | Spare filter for inline filter |
| Rheflex fitting set | 228-32651-41 | Inc. nut・ferrule each 5<br>(A spare for Rheodyne 9725/i)*2 |
| PEEK tube (0.125 i.d.×1.6 o.d.×3000mm) | 228-33833-91 | |
| PEEK tube (0.25 i.d.×1.6 o.d.×3000mm) | 228-33833-92 | |
| PEEK tube (0.50 i.d.×1.6 o.d.×3000mm) | 228-33833-93 | |
| PEEK tube (0.75 i.d.×1.6 o.d.×3000mm) | 228-33833-94 | |
| Sample loop 100 μL | 228-32651-16 | Rheodyne injector for 9725/i |
| 200 μL | 228-32651-17 | Rheodyne injector for 9725/i |
| 500 μL | 228-32651-18 | Rheodyne injector for 9725/i |
| 1mL | 228-32651-19 | Rheodyne injector for 9725/i |

＊1 Use this with chemical reaction detection system etc.

＊2 Nut・Ferrule 5pcs. set for PEEK tube of Rheodyne 9725/i. Rheodyne 9725/i includes nut ・ferrule 4pcs. so that this set is not necessary when installing.
"Rheflex" stands for Fex fitting made in Rheodyne.

## Shimadzu Amino Acid Analysis kit for amino acid analytical system

- As both mobile phase and reaction solutions are prepared to be optimized of analytical conditions, dilute and pH adjusting is not necessary.
- As strictly selected grade reagent is used, suitable for high sensitive analysis.

Mobile phase kit　　Analysis kit OPA reagent

### Classification of analytical kit

| Description | Cat. No. | Bottle name | Contents | Capacity | Usage |
|---|---|---|---|---|---|
| Amino acid mobile phase kit Na type | 228-21195-94 | AA-MA(Na) | 0.2N-sodium citric acid | 1L | A solution (No.1 buffer) |
| | | AA-MB(Na) | 0.6N-sodium citric acid | 1L | B solution (No.2 buffer) |
| | | AA-MC(Na) | 0.2N-sodium hydroxide | 500mL | C solution (column clean up solution) |
| Amino acid mobile phase kit A solution | 228-21195-96 | AA-MA(Na) | 0.2N-sodium citric acid | 1L×3pcs. | A solution (No.1 buffer) |
| Amino acid mobile phase kit Li type | 228-21195-95 | AA-MA(Li) | 0.15N-lithium citric acid | 1L | A solution (No.1 buffer) |
| | | AA-MB(Li) | 0.3N-lithium citric acid | 1L | B solution (No.2 buffer) |
| | | AA-MC(Li) | 0.2N-lithium hydroxide | 500mL | C solution (column clean up solution) |
| Amino acid mobile phase Li type A solution | 228-21195-97 | AA-MA(Li) | 0.15N-lithium citric acid | 1L×3pcs. | A solution (No.1 buffer) |
| Amino acid analytical kit OPA reagent | 228-21195-93 | AA-RA | Basic buffer | 500mL | Reaction reagent A |
| | | AA-RB | O-phthalic aldehyde | 500mL | Reaction reagent B |

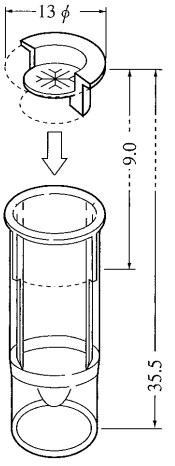
- Amino acid mobile phase kit Na type consists of mobile phase for amino acid analysis composed of protein (2 pcs.) and column clean up solution.
- Amino acid mobile phase kit Li type consists of amino acid mobile phase and column clean up solution.
- Analytical kit OPA reagent is a set of reaction reagent (2 kinds) and can be used in case of Na type and Li type.

## Disposable Vial

- Mass products made by plastic
  Suitable for the disposable of many samples
- Septa is attached in a cap
  Not necessary to set up septa
- Special patterned ditch on the septa
  The trouble such as the tears of the septa and the plugging of the syring hole doesn't occur.
- V bottom which solutions don't leave in
  The amount of the sample is available in the range of 50 μl to 1ml. Also, the shape of the bottom is arranged not to leave air bubbles.

### Specification

| | |
|---|---|
| **Injector** | SIL-10A, SIL-9A, SIL-6B, SIL-10AXL |
| **Maxium amount** | 1mL |
| **Minium amount of sample** (10 μl inject) | 50 μ |
| **Materials** | Polyethylene (Cap, Septa)<br>Polypropylene (Case) |
| **Cat. No.** | 228-31600-91 |



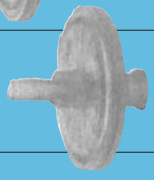

Caution) When using disposable vial with a sample of organic solvent type, be sure to check whether there are disturbing peak or not to do branktest.

# Disposable Filter

This disposable filter makes it possible to eliminates precipitate materials and minute particles in a sample. You can prevent the plugging of the column, the change of the property, and the trouble of the injector and the micro syringe. Therefore the column you use can be kept long.

## Features

- Small disk shape disposable filter.
- Ruar lock attached and you can filtrate with easily operation and no trouble.
- The amount of the liquid left in this filter is quite small.
- Filtration can be with high flow and low presure.
- There are many kinds of filter including ion chromatography as follows.

| Series | Description | Shape | Diameter (mm) | Pore Size ( $\mu$m) | Cat. No. | Features |
|---|---|---|---|---|---|---|
| Aqueous type | Filter, 4A |  | 4 | 0.45 | 670-12540-01 | ● Composed of a hydrophilic membrane and a polypropylenehousing (blue).<br>● Suitable for the pretreatment of the sample for HPLC analysis and protein analysis which are an object of aqueous and alcohol solution.<br>● Sterilization, eliminated particles. |
| | Filter,13A |  | 13 | 0.45 | 670-12540-02 | |
| | Filter,25A |  | 25 | 0.45 | 670-12540-03 | |
| Ion chromato type | Filter,4AI |  | 4 | 0.45 | 670-12540-11 | ● Composed of a de-ionized hydrophilic membrance and a polypropylenehousing (light blue)<br>● Suitable for the pretreatment of the sample for ion chromatography analysis.<br>● As divided into each 10pcs, clean can be kept. |
| | Filter,13AI |  | 13 | 0.45 | 670-12540-12 | |
| | Filter,25AI |  | 25 | 0.45 | 670-12540-13 | |
| Organic type | Filter,4N |  | 4 | 0.45 | 670-12540-21 | ● Composed of PTFE membrance and a polypropylenehousing. (half-transparent)<br>● Superiority is solvent and chemical compatibility<br>● Suitable for the pretreatment of semi-analytical sample which are an object of solvent, strong acid and strong alkarine.<br>● It is good for air vent filter. |
| | Filter,13N |  | 13 | 0.45 | 670-12540-22 | |
| | Filter,25N |  | 25 | 0.45 | 670-12540-23 | |

(Inc. each 100pcs.)

## Chemical Compatibility

○ Can use △ Can use for short time × Can NOT use

| | Chemical name | Aqueous & Ion chromato type | Organic type |
|---|---|---|---|
| Acid | Glacial acetate acid | △ | △ |
| | Acetate acid 90% | △ | △ |
| | 〃 30% | ○ | ○ |
| | 〃 10% | ○ | ○ |
| | Hydrochloric acid Conc | × | × |
| | 〃 6N | × | △ |
| | Silfuric acid Conc | × | × |
| | 〃 6N | × | △ |
| | Nitric acid Conc | × | × |
| | 〃 6N | × | △ |
| Alkaline | Ammonia water 6N | △ | △ |
| | 〃 3N | ○ | ○ |
| | Calcium hydroxide 3N | ○ | ○ |
| | Sodium hydroxide 5N | △ | ○ |
| | 〃 3N | ○ | ○ |
| Alcohols | Methanol | ○ | ○ |
| | Ethanol | ○ | ○ |
| | Propanol | ○ | ○ |
| | Isopropanol | ○ | ○ |
| | Butanol | ○ | ○ |
| | Amyl alcohol | ○ | ○ |
| | Ethylene glycol | ○ | ○ |
| | Propylene glycol | ○ | ○ |
| | Glycerine | ○ | ○ |
| Ether | Ethyl ether | ○ | ○ |
| | Isopropyl ether | ○ | ○ |
| | Dioxane | × | ○ |
| | Tetrahydrofuran | × | ○ |
| Esters | Methyl esters | × | ○ |
| | Etyl esters | × | ○ |
| | Isopropyl esters | × | ○ |
| | Butyl esters | × | ○ |
| | Amyl esters | × | ○ |
| | Serosolve esters | × | ○ |

| | Chemical name | Aqueous & Ion chromato type | Organic type |
|---|---|---|---|
| Ketones | Acetone | × | ○ |
| | Cyclohexane | × | ○ |
| | Metyl etyl ketone | × | ○ |
| | Metyl isobutyl ketone | × | ○ |
| Hydrogen carbide | Benzene | × | ○ |
| | Toluene | × | ○ |
| | Xylenes | × | ○ |
| Halogenation hydrogen carbide | Etane dichloride | × | ○ |
| | Methylene chloride | × | ○ |
| | Chloroform | × | ○ |
| | Carbon tetrachloride | × | ○ |
| | Perchloroe etylene | × | ○ |
| | Trichloro etylene | × | ○ |
| | Freon TF | × | ○ |
| | Freon TMC | × | ○ |
| Oil group | Cotton-seed oil | ○ | ○ |
| | Lubrication oil | × | ○ |
| | Peanut oil | ○ | ○ |
| | Sesame oil | ○ | ○ |
| Others | Acetnitryl | × | ○ |
| | Aniline | × | ○ |
| | Gasoline | ○ | ○ |
| | Kerosene | ○ | ○ |
| | Dimethylsulfoxide | × | ○ |
| | Dimethylsulfoxide | × | ○ |
| | Terpene oil | ○ | ○ |
| | Pyridine | × | ○ |
| | Phenols (liquid) | × | ○ |
| | Hexane (dry) | ○ | ○ |
| | Formaldehyde 37% | ○ | ○ |

## Specification

| Item \ Type | | 4mm | | | 13mm | | | 25mm | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | aqueous type | Ion chromato type | Organic type | aqueous type | Ion chromato type | Organic type | aqueous type | Ion chromato type | Organic type |
| | | 4A | 4AI | 4N | 13A | 13AI | 13N | 25A | 25AI | 25N |
| Pore size | μm | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| Stuff*1 | Filter | OP | OP | PTFE | OP | OP | PTFE | OP | OP | PTFE |
| | Housing | PP | PP | PP | PP | PP | PP | PP | PP | PP |
| Size(φ×L) | mm | 8×18 | 8×18 | 8×18 | 18×22 | 18×22 | 18×22 | 29×24 | 29×24 | 29×24 |
| Available filtration area | cm² | 0.07 | 0.07 | 0.07 | 0.8 | 0.8 | 0.8 | 4 | 4 | 4 |
| Maxium pressure | kg/cm² | 7 | 7 | 7 | 5 | 5 | 5 | 6 | 6 | 6 |
| Maxium temperature | ℃ | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Amount of the liquid left | μL | Less than 10 | Less than 10 | Less than 10 | Less than 30 | Less than 30 | Less than 30 | Less than 100 | Less than 100 | Less than 100 |
| Connecting parts | In | Ruar lock | Ruar lock | Ruar lock | Ruar lock | Ruar lock | Ruar lock | Ruar lock | Ruar lock | Ruar lock |
| | Out | Ruar slip | Ruar slip | Ruar slip | Ruar slip | Ruar slip | Ruar slip | Ruar slip | Ruar slip | Ruar slip |
| Sterilization method*2 | | E | E | A,E | E | E | A,E | E | E | A,E |
| Number(pcs.)/case | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*1 OP=Olefines type polymer, PP=Polypropylene, PTFE=Polytetrafluoroethylene
*2 S=AUTO clave, E=Ethylene oxide gas

# 6 Shim-pack Columns

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack Amino | Shim-pack Amino-Na | 6.0mm i.d.×10cm | 228-18837-91 | P.33 |
| | Shim-pack Amino-Li | 6.0mm i.d.×10cm | 228-18837-91 | |
| Shim-pack BIO （T） | Shim-pack CLC-ODS（T） | 4.6mm i.d.×15cm | 228-18062-91 | P.57 |
| | Shim-pack WAX-1（T） | 4.6mm i.d.×5cm | 228-18257-91 | |
| | Shim-pack WAX-2（T） | 4.6mm i.d.×5cm | 228-18258-91 | |
| | Shim-pack WCX-1（T） | 4.6mm i.d.×5cm | 228-18259-91 | |
| | Shim-pack HPC-C2（T） | 4.6mm i.d.×5cm | 228-18260-91 | |
| | Shim-pack HPC-C3（T） | 4.6mm i.d.×5cm | 228-18261-91 | |
| Shlm-pack CLC | Shim-pack CLC-SIL | 6.0mm i.d.×15cm | 228-00807-91 | P.24 |
| | Shlm-pack CLC-SIL（M） | 4.6mm i.d.×15cm | 228-17872-91 | |
| | Shim-pack CLC-SIL（M） | 4.6mm i.d.×25cm | 228-17872-92 | |
| | Shim-pack CLC-ODS | 6.0mm i.d.×15cm | 228-00808-91 | |
| | Shim-pack CLC-ODS（M） | 4.6mm i.d.×15cm | 228-17873-91 | |
| | Shjm-pack CLC-ODS（M） | 4.6mm i.d.×25cm | 228-17873-92 | |
| | Shim-pack CLC-$C_8$ | 6.0mm i.d.×15cm | 228-00809-91 | |
| | Shlm-pack CLC-$C_8$（M） | 4.6mm i.d.×15cm | 228-17874-91 | |
| | Shim-pack CLC-$C_8$（M） | 4.6mm i.d.×25cm | 228-17874-92 | |
| | Shim-pack CLC-TMS | 6.0mm i.d.×15cm | 228-00810-91 | |
| | Shlm-pack CLC-TMS（M） | 4.6mm i.d.×15cm | 228-17875-91 | |
| | Shim-pack CLC-TMS（M） | 4.6mm i.d.×25cm | 228-17875-92 | |
| | Shjm-pack CLC-CN | 6.0mm i.d.×15cm | 228-00810-91 | |
| | Shim-pack CLC-CN（M） | 4.6mm i.d.×15cm | 228-17876-91 | |
| | Shim-pack CLC-CN（M） | 4.6mm i.d.×25cm | 228-17876-92 | |
| | Shim-pack CLC-Phenyl | 6.0mm i.d.×15cm | 228-00812-91 | |
| | Shim-pack CLC-Phenyl（M） | 4.6mm i.d.×15cm | 228-17877-91 | |
| | Shim-pack CLC-Phenyl（M） | 4.6mm i.d.×25cm | 228-17877-92 | |
| | Shim-pack CLC-$NH_2$ | 6.0mm i.d.×15cm | 228-16725-91 | |
| | Shim-pack CLC-$NH_2$（M） | 4.6mm i.d.×15cm | 228-17878-91 | |
| | Shim-pack CLC-$NH_2$（M） | 4.6mm i.d.×25cm | 228-17878-92 | |
| | Shim-pack CLC-VMA | 6.0mm i.d.×15cm | 228-17255-91 | P.51 |
| | Shlm-pack CLC-ODS/H | 4.6mm i.d.×25cm | 228-00808-92 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shlm-pack Diol | Shim-pack Diol-150 | 7.9mm i.d.×25cm | 228-14775-91 | P.41 |
| | Shim-pack Diol-150 | 7.9mm i.d.×50cm | 228-14775-92 | |
| | Shim-pack Diol-300 | 7.9mm i.d.×25cm | 228-14776-91 | |
| | Shim-pack Diol-300 | 7.9mm i.d.×50cm | 228-14776-92 | |
| Shim-pack FLC | Shim-pack FLC-ODS | 4.6mm i.d.×5cm | 228-13375-91 | P.30 |
| | Shim-pack FLC-SIL | 4.6mm i.d.×5cm | 228-13375-92 | |
| | Shim-pack FLC-CN | 4.6mm i.d.×5cm | 228-13694-91 | |
| | Shim-pack FLC-$C_8$ | 4.6mm i.d.×5cm | 228-13695-91 | |
| | Shim-pack FLC-$NH_2$ | 4.6mm i.d.×5cm | 228-13696-91 | |
| Shim-pack G | Shim-pack G-SIL (4) | 4.0mm i.d.×1cm | 228-18270-91 | P.24, 29 |
| | Shim-pack G-SIL (8) | 8.0mm i.d.×1.5cm | 228-18270-92 | |
| | Shim-pack GK-SIL | 30mm i.d.×7.5cm | 228-18338-91 | |
| | Shrm-pack GL-SIL | 50mm i.d.×5cm | 228-18339-91 | |
| | Shim-pack G-ODS (4) | 4.0mm i.d.×1cm | 228-18246-91 | |
| | Shim-pack G-ODS (8) | 8.0mm i.d.×1.5cm | 228-18246-92 | |
| | Shim-pack GK-ODS | 30mm i.d.×7.5cm | 228-18321-91 | |
| | Shim-pack GL-ODS | 50mm i.d.×5cm | 228-18322-91 | |
| | Shim-pack G-$C_8$ (4) | 4.0mm i.d.×1cm | 228-18248-91 | |
| | Shim-pack G-$C_8$ (8) | 8.0mm i.d.×1.5cm | 228-18248-92 | |
| | Shim-pack G-TMS (4) | 4.0mm i.d.×1cm | 228-18262-91 | |
| | Shim−pack G-TMS (8) | 8.0mm i.d.×1.5cm | 228-18262-92 | |
| | Shim-pack G-CN (4) | 4.0mm i.d.×1cm | 228-18266-91 | |
| | Shim-pack G-CN (8) | 8.0mm i.d.×1.5cm | 228-18266-92 | |
| | Shim-pack G-Phenyl (4) | 4.0mm i.d.×1cm | 228-18264-91 | |
| | Shim-pack G-Phenyl (8) | 8.0mm i.d.×1.5cm | 228-18264-92 | |
| | Shim-pack G-$NH_2$ (4) | 4.0mm i.d.×1cm | 228-18268-91 | |
| | Shim-pack G-$NH_2$ (8) | 8.0mm i.d.×1.5cm | 228-18268-92 | |
| | Shim-pack GPRC-SIL | 8.0mm i.d.×1.5cm | 228-23462-92 | P.54 |
| | Shim-pack GPRC-ODS | 8.0mm i.d.×1.5cm | 228-23465-92 | |
| | Shim-pack GPRC-$C_8$ | 8.0mm i.d.×1.5cm | 228-24386-92 | |
| | Shim-pack GPRC-TMS | 8.0mm i.d.×1.5cm | 228-24387-92 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack G | Shim-pack GPRC-$NH_2$ | 8.0mm i.d.×1.5cm | 228-24388-92 | P.54 |
| | Shim-pack GPRC-CN | 8.0mm i.d.×1.5cm | 228-24389-92 | |
| | Shim-pack GPRC-SIL (K) | 3.0mm i.d.×7.5cm | 228-23462-93 | |
| | Shim-pack GPRC-SIL (L) | 50mm i.d.×5cm | 228-23462-92 | |
| | Shim-pack GPRC-ODS (K) | 30mm i.d.×7.5cm | 228-23465-93 | |
| | Shim-pack GPRC-ODS (L) | 50mm i.d.×5cm | 228-23465-94 | |
| Shim-pack GPC | Shim-pack GPC-801 | 8.0mm i.d.×30cm | 228-20803-91 | P.38 |
| | Shim-pack GPC-802 | 8.0mm i.d.×30cm | 228-20804-91 | |
| | Shim-pack GPC-8025 | 8.0mm i.d.×30cm | 228-20805-91 | |
| | Shim-pack GPC-803 | 8.0mm i.d.×30cm | 228-20806-91 | |
| | Shim-pack GPC-804 | 8.0mm i.d.×30cm | 228-20807-91 | |
| | Shim-pack GPC-805 | 8.0mm i.d.×30cm | 228-20808-91 | |
| | Shim-pack GPC-806 | 8.0mm i.d.×30cm | 228-20809-91 | |
| | Shim-pack GPC-80M | 8.0mm i.d.×30cm | 228-20810-91 | |
| | Shim-pack GPC-807 | 8.0mm i.d.×30cm | 228-20811-91 | |
| | Shim-pack GPC-800P | 4.6mm i.d.×1cm | 228-20812-91 | |
| | Shim-pack GPC-801C | 8.0mm i.d.×30cm | 228-20803-92 | |
| | Shim-pack GPC-802C | 8.0mm i.d.×30cm | 228-20804-92 | |
| | Shim-pack GPC-8025C | 8.0mm i.d.×30cm | 228-20805-92 | |
| | Shim-pack GPC-803C | 8.0mm i.d.×30cm | 228-20806-92 | |
| | Shim-pack GPC-804C | 8.0mm i.d.×30cm | 228-20807-92 | |
| | Shim-pack GPC-805C | 8.0mm i.d.×30cm | 228-20808-92 | |
| | Shim-pack GPC-806C | 8.0mm i.d.×30cm | 228-20809-92 | |
| | Shim-pack GPC-80MC | 8.0mm i.d.×30cm | 228-20810-92 | |
| | Shim-pack GPC-807C | 8.0mm i.d.×30cm | 228-20811-92 | |
| | Shim-pack GPC-800CP | 4.6mm i.d.×1cm | 228-20812-92 | |
| | Shim-pack GPC-801D | 8.0mm i.d.×30cm | 228-20803-93 | |
| | Shim-pack GPC-802D | 8.0mm i.d.×30cm | 228-20804-93 | |
| | Shim-pack GPC-8025D | 8.0mm i.d.×30cm | 228-20805-93 | |
| | Shim-pack GPC-803D | 8.0mm i.d.×30cm | 228-20806-93 | |
| | Shim-pack GPC-804D | 8.0mm i.d.×30cm | 228-20807-93 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack GPC | Shim-pack GPC-805D | 8.0mm i.d.×30cm | 228-20808-93 | P.38 |
| | Shim-pack GPC-806D | 8.0mm i.d.×30cm | 228-20809-93 | |
| | Shim-pack GPC-80MD | 8.0mm i.d.×30cm | 228-20810-93 | |
| | Shim-pack GPC-807D | 8.0mm i.d.×30cm | 228-20811-93 | |
| | Shim-pack GPC-800DP | 4.6mm i.d.×1cm | 228-20812-93 | |
| | Shim-pack GPC-2001 | 20.0mm i.d.×30cm | 228-23342-91 | |
| | Shim-pack GPC-2002 | 20.0mm i.d.×30cm | 228-23342-92 | |
| | Shim-pack GPC-20025 | 20.0mm i.d.×30cm | 228-23342-93 | |
| | Shim-pack GPC-2003 | 20.0mm i.d.×30cm | 228-23342-94 | |
| | Shim-pack GPC-2000P | 8.0mm i.d.×30cm | 228-20812-94 | |
| | Shim-pack GPC-2001C | 20.0mm i.d.×30cm | 228-23343-91 | |
| | Shim-pack GPC-2002C | 20.0mm i.d.×30cm | 228-23343-92 | |
| | Shim-pack GPC-20025C | 20.0mm i.d.×30cm | 228-23343-93 | |
| | Shim-pack GPC-2003C | 20mm i.d.×30cm | 228-23343-94 | |
| | Shim-pack GPC-2000CP | 8.0mm i.d.×30cm | 228-20812-95 | |
| Shim-pack GRD | Shim-pack GRD-ODS | 4.0mm i.d.×25cm | 228-16557-91 | P.50 |
| Shlm-pack HPC | Shim-pack HPC-C2 | 4.0mm i.d.×5cm | 228-17792-91 | P.47 |
| | Shim-pack HPC-C3 | 4.0mm i.d.×5cm | 228-17793-91 | |
| Shim-pack HRC | Shim-pack HRC-SIL | 4.6mm i.d.×15cm | 228-23460-91 | P.21 |
| | | 4.6mm i.d.×25cm | 228-23460-92 | |
| | | 6.0mm i.d.×15cm | 228-23460-93 | |
| | Shim-pack HRC-ODS | 4.6mm i.d.×15cm | 228-24463-91 | |
| | | 4.6mm i.d.×25cm | 228-23463-92 | |
| | | 6.0mm i.d.×15cm | 228-23463-93 | |
| | Shim-pack HRC-$C_8$ | 4.6mm i.d.×15cm | 228-24376-92 | |
| | | 4.6mm i.d.×25cm | 228-24376-92 | |
| | | 6.0mm i.d.×15cm | 228-24376-92 | |
| | Shim-pack HRC-TMS | 4.6mm i.d.×15cm | 228-24337-91 | |
| | | 4.6mm i.d.×25cm | 228-24377-92 | |
| | | 6.0mm i.d.×15cm | 228-24377-93 | |
| | Shim-pack HRC-$NH_2$ | 4.6mm i.d.×15cm | 228-24378-91 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack HRC | Shim-pack HRC-$NH_2$ | 4.6mm i.d.×25cm | 228-24378-92 | P.21 |
| | | 6.0mm i.d.×15cm | 228-24378-93 | |
| | Shim-pack-HRC-CN | 4.6mm i.d.×15cm | 228-24379-91 | |
| | | 4.6mm i.d.×25cm | 228-24379-92 | |
| | | 6.0mm i.d.×15cm | 228-24379-93 | |
| Shim-pack IC | Shim-pack IC-A1 | 4.6mm i.d.×10cm | 228-17733-91 | P.46 |
| | Shim-pack IC-A2 | 5.0mm i.d.×5cm | 228-17735-91 | |
| | Shim-pack IC-C1 | 5.0mm i.d.×15cm | 228-17737-91 | |
| | Shim-pack IC-GA1 | 4.6mm i.d.×1cm | 228-17734-91 | |
| | Shim-pack IC-GA2 | 4.0mm i.d.×1cm | 228-17736-91 | |
| | Shlm-pack IC-GC1 | 4.0mm i.d.×1cm | 228-17738-91 | |
| | Shim-pack IC-PCI | 8.0mm i.d.×5cm | 228-17744-91 | |
| | Shim-pack IC-A1 (S) | 2.0mm i.d.×15cm | 228-33400-91 | |
| | Shim-pack IC-A3 (S) | 2.0mm i.d.×15cm | 228-33366-91 | |
| | Shim-pack IC-C3 (S) | 2.0mm i.d.×10cm | 228-33367-91 | |
| | Shim-pack IC-CI PEEK | 4.6mm i.d.×10cm | 228-33497-91 | |
| | Shim-pack IC-GC1 PEEK | 4.6mm i.d.×9cm | 228-33497-92 | |
| Shim-pack ISA | Shim-pack ISA-07/S2504 | 4.0mm i.d.×25cm | 228-09699-91 | P.33 |
| | Guard Column ISA | 4.0mm i.d.×5cm | 228-00823-91 | |
| Shim-pack ISC | Shim-pack ISC-05/S0504 | 4.6mm i.d.×3.8cm | 228-09700-91 | P.33 |
| | Shim-pack ISC-07/S1504 | 4.0mm i.d.×15cm | 228-09328-91 | |
| | Shim-pack ISC-07/S1504Li | 4.0mm i.d.×15cm | 228-00796-91 | |
| | Shim-pack ISC-30/S0504 | 4.0mm i.d.×5cm | 228-14206-91 | |
| | Shim-pack ISC-30/S0504Li | 4.0mm i.d.×5cm | 228-00821-91 | |
| | Guard Column ISC-07 | 4.0mm i.d.×5cm | 228-00802-91 | |
| | Guard Column ISC-07Li | 4.0mm i.d.×5cm | 228-00797-91 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack MBC | Shim-pack MBC-ODS | 1.0mm i.d.×25cm | 228-12812-02 | P.29 |
| | Shim-pack MBC-ODS | 1.0mm i.d.×50cm | 228-12812-05 | |
| | Shim-pack MBC-SIL | 1.0mm i.d.×50cm | 228-12811-05 | |
| | Shim-pack MBC-SIL | 1.0mm i.d.×100cm | 228-12811-10 | |
| | Shim-pack MBC-ACN | 1.0mm i.d.×25cm | 228-12813-02 | |
| | Shim-pack MBC-ACN | 1.0mm i.d.×50cm | 228-12813-05 | |
| | Shim-pack MBC-$C_8$ | 1.0mm i.d.×25cm | 228-12814-02 | |
| | Shim-pack MBC-$C_8$ | 1.0mm i.d.×50cm | 228-12814-05 | |
| Shim-pack-MRC | Shim-pack MRC-SIL | 6.0mm i.d.×25cm | 228-23461-92 | P.21 |
| | Shim-pack MRC-ODS | 6.0mm i.d.×25cm | 228-23464-92 | |
| | Shim-pack MRC-$C_8$ | 6.0mm i.d.×25cm | 228-24381-92 | |
| | Shim-pack MRC-TMS | 6.0mm i.d.×25cm | 228-24382-92 | |
| | Shim-pack MRC-$NH_2$ | 6.0mm i.d.×25cm | 228-24383-92 | |
| | Shim-pack MRC-CN | 6.0mm i.d.×25cm | 228-24384-92 | |
| Shim-pack PA | Shim-pack PA-DEAE | 8.0mm i.d.×10cm | 228-20758-91 | P.33 |
| | Shim-pack PA-DEAE | 20mm i.d.×10cm | 228-20758-92 | |
| | Shim-pack PA-QA | 8.0mm i.d.×10cm | 228-20759-91 | |
| | Shim-pack PA-QA | 20mm i.d.×10cm | 228-20759-92 | |
| | Shim-pack PA-CM | 8.0mm i.d.×10cm | 228-20760-91 | |
| | Shim-pack PA-CM | 20mm i.d.×10cm | 228-20760-92 | |
| | Shim-pack PA-SP | 8.0mm i.d.×10cm | 228-20761-91 | |
| | Shim-pack PA-SP | 20mm i.d.×10cm | 228-20761-92 | |
| Shim-pack PAG | Shim-pack PAG-DEAE | 8.0mm i.d.×1cm | 228-20762-91 | P.33 |
| | Shim-pack PAG-QA | 8.0mm i.d.×1cm | 228-20763-91 | |
| | Shim-pack PAG-CM | 8.0mm i.d.×1cm | 228-20764-91 | |
| | Shim-pack PAG-SP | 8.0mm i.d.×1cm | 228-20765-91 | |
| Shim-pack-PRC | Shim-pack PRC-SIL | 20mm i.d.×25cm | 228-23461-93 | P.21 |
| | Shim-pack PRC-SIL（K） | 30mm i.d.×25cm | 228-23461-94 | |
| | Shim-pack PRC-SIL（L） | 50mm i.d.×25cm | 228-23461-95 | |
| | Shim-pack PRC-SIL（H） | 20mm i.d.×25cm | 228-23461-91 | |
| | Shim-pack PRC-ODS | 20mm i.d.×25cm | 228-23464-93 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack-PRC | Shim-pack PRC-ODS (K) | 30mm i.d.×25cm | 228-23464-94 | P.21 |
| | Shim-pack PRC-ODS (L) | 50mm i.d.×25cm | 228-23464-95 | |
| | Shim-pack PRC-ODS (H) | 20mm i.d.×25cm | 228-23464-91 | |
| | Shim-pack PRC-$C_8$ | 20mm i.d.×25cm | 228-24381-93 | |
| | Shim-pack PRC-$C_8$ (H) | 20mm i.d.×25cm | 228-24381-91 | |
| | Shim-pack PRC-TMS | 20mm i.d.×25cm | 228-24382-93 | |
| | Shim-pack PRC-TMS (H) | 20mm i.d.×25cm | 228-24382-91 | |
| | Shim-pack PRC-$NH_2$ | 20mm i.d.×25cm | 228-24383-93 | |
| | Shim-pack PRC-$NH_2$ (H) | 20mm i.d.×25cm | 228-24383-91 | |
| | Shim-pack PRC-CN | 20mm i.d.×25cm | 228-24384-93 | |
| | Shim-pack PRC-CN (H) | 20mm i.d.×25cm | 228-24384-91 | |
| Shim-pack PREP | Shim-pack PREP-SIL | 20mm i.d.×25cm | 228-00814-91 | P.28 |
| | Shim-pack PREP-SIL (H) | 20mm i.d.×25cm | 228-17880-91 | |
| | Shim-pack PREP-SIL (H) ・Kit | 4.6mm i.d.×25cm<br>20mm i.d.×25cm | 228-17887-91 | |
| | Shlm-pack PREP-ODS | 20mm i.d.×25cm | 228-00815-91 | |
| | Shim-pack PREP-ODS (H) | 20mm i.d.×25cm | 228-17881-91 | |
| | Shim-pack PREP・ODS (H) ・Kit | 4.6mm i.d.×25cm<br>20mm i.d.×25cm | 228-17888-91 | |
| | Shim-pack PREP-$C_8$ | 20mm i.d.×25cm | 228-00816-91 | |
| | Shim-pack PREP-$C_8$ (H) | 20mm i.d.×25cm | 228-17882-91 | |
| | Shim-pack PREP-TMS | 20mm i.d.×25cm | 228-00817-91 | |
| | Shim-pack PREP-TMS (H) | 20mm i.d.×25cm | 228-17883-91 | |
| | Shim-pack PREP-CN | 20mm i.d.×25cm | 228-00818-91 | |
| | Shim-pack PREP-CN (H) | 20mm i.d.×25cm | 228-17884-91 | |
| | Shim-pack PREP-Phenyl | 20mm i.d.×25cm | 228-00819-91 | |
| | Shim-pack PREP-Phenyl (H) | 20mm i.d.×25cm | 228-17885-91 | |
| | Shim-pack PREP-$NH_2$ | 20mm i.d.×25cm | 228-17879-91 | |
| | Shim-pack PREP-$NH_2$ (H) | 20mm i.d.×25cm | 228-17886-91 | |
| | Shim-pack PREP-SIL (K) | 30mm i.d.×25cm | 228-18273-91 | |
| | Shim-pack PREP-ODS (K) | 30mm i.d.×25cm | 228-18319-91 | |
| | Shim-pack PREP-SIL (L) | 50mm i.d.×25cm | 228-18274-91 | |
| | Shim-pack PREP-ODS (L) | 50mm i.d.×25cm | 228-18320-91 | |

| Column series | Column name | Dimension | Cat.No. | Reference |
|---|---|---|---|---|
| Shim-pack SBC | Shim-pack SBC-ODS | 2.5mm i.d.×15cm | 228-17268-91 | P.30 |
| | Shim-pack SBC-$C_8$ | 2.5mm i.d.×15cm | 228-17269-91 | |
| | Shlm-pack SBC-SIL | 2.5mm i.d.×15cm | 228-17270-91 | |
| Shim-pack SCR | Shim-pack SCR-101N | 7.9mm i.d.×30cm | 228-07730-92 | P.41 |
| | Shim-pack SCR-101C | 7.9mm i.d.×30cm | 228-17889-91 | |
| | Shim-pack SCR-101P | 7.9mm i.d.×30cm | 228-17890-91 | |
| | Shim-pack SCR-101H | 7.9mm i.d.×30cm | 228-07730-93 | |
| | Shim-pack SCR-102H | 8.0mm i.d.×30cm | 228-17893-91 | |
| | Guard Column SCR (N) | 4.0mm i.d.×5cm | 228-09619-92 | |
| | Guard Column SCR (C) | 4.0mm i.d.×5cm | 228-17891-91 | |
| | Guard Column SCR (P) | 4.0mm i.d.×5cm | 228-17892-91 | |
| | Guard Column SCR (H) | 4.0mm i.d.×5cm | 228-09619-93 | |
| | Guard Column SCR-102 (H) | 6.0mm i.d.×5cm | 228-17924-91 | |
| Shim-pack SPC | Shim-pack SPC-RP3 | 4.0mm i.d.×3cm | 228-33713-91 | P.49 |
| | Shim-pack SPC-RP2 | 4.6mm i.d.×1cm | 228-18838-91 | |
| | Shim-pack SPC-AE1 | 4.0mm i.d.×1cm | 228-17990-91 | |
| Shim-pack WAX | Shim-pack WAX-1 | 4.0mm i.d.×5cm | 228-16225-91 | P.33 |
| | Shim-pack WAX-2 | 4.0mm i.d.×5cm | 228-16365-91 | |
| Shim-pack WCX | Shim-pack WCX-1 | 4.0mm i.d.×5cm | 228-16366-91 | P.33 |

# 7 Sample and data

JQA-0376

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