

Packed Columns for  
Ion Chromatography

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TSKgel IC-Anion-PW<sub>xL</sub>  
TSKgel IC-Anion-PW  
TSKgel IC-Anion-SW  
TSKgel IC-Cation I / II HR  
TSKgel IC-Cation  
TSKgel IC-Cation-SW

# INSTRUCTION MANUAL



**TOSOH CORPORATION**

## Safety Precautions

To help protect you and/or your property from potential damage and ensure personal safety, please read this manual thoroughly before using the product.

### [Notational Conventions]

Notation	Explanation
 <b>WARNING</b>	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

#### **WARNING**

■ **Keep away from fire**

Not taking proper precautions when using flammable solvents could result in fire, explosion, or poisoning.

#### **CAUTION**

■ **Use only in well-ventilated areas**

In case of insufficient ventilation, flammable and toxic solvents can cause fire, explosion, or poisoning.

■ **Do not spill solvents**

Spillage and leakage can cause fire, electric shock, poisoning, injury, or corrosion.

Wear appropriate protective gear when cleaning up a spill.

■ **Wear protective eye gear and gloves**

Organic solvents and acids should not come into direct contact with the skin.

■ **Handle the package with care**

Inappropriate handling may cause rupturing and/or splattering of the product.

■ **Only use this product for its intended use**

This product is intended for the separation. Do not use it for any other purpose.

■ **Make sure compounds are safe**

Check that the target compounds and solutions after separation and purification are safe.

■ **Proper disposal**

Dispose in accordance with local laws and regulations.

#### **NOTE**

Keep this manual with the product for future reference.

## Precautions: Shipping Solvents

First Aid	Inhalation	<ul style="list-style-type: none"> <li>• Move the person to an area with fresh air and rinse the mouth with plenty of water.</li> <li>• Call immediately for medical attention.</li> </ul>
	Skin exposure	<ul style="list-style-type: none"> <li>• Wash the exposed area with plenty of soap and water.</li> </ul>
	Eye exposure	<ul style="list-style-type: none"> <li>• Open the eyes as wide as possible and rinse with clean water for at least 15 minutes.</li> <li>• Call immediately for medical attention.</li> </ul>
	Ingestion	<ul style="list-style-type: none"> <li>• Rinse the mouth with plenty of water.</li> <li>• Call immediately for medical attention.</li> </ul>
Handling and Storage	Ventilation	<ul style="list-style-type: none"> <li>• Provide adequate air ventilation to keep organic vapor concentrations below approved level.</li> </ul>
	Container handling	<ul style="list-style-type: none"> <li>• Container may break if not handled with care.</li> </ul>
	Wear appropriate protective equipment	<ul style="list-style-type: none"> <li>• Use solvent-resistant gloves and protective eye gear when using this product. Use of gas mask, additional protective clothing or rubber boots could be appropriate when handling this product.</li> </ul>
	Hazardous substance storage	<ul style="list-style-type: none"> <li>• If any flammable solvents are used for shipping or storage of this product, keep away from fire or open heat sources.</li> </ul>
Waste Disposal	Disposal methods	<ul style="list-style-type: none"> <li>• Dispose in accordance with local laws and regulations.</li> </ul>
	General considerations	<ul style="list-style-type: none"> <li>• Please pay attention to all safety precautions with respect to the handling and storage of this product.</li> </ul>
	Disposal precautions	<ul style="list-style-type: none"> <li>• Fumes produced during incineration may contain nitrogen oxides, sulfur oxides and carbon monoxide.</li> </ul>

Shipping solvent for each column : See Section 3. General Information.

## Precautions: Packing Material

First Aid	Inhalation	<ul style="list-style-type: none"> <li>• Move the person to an area with fresh air and rinse the mouth with plenty of water.</li> <li>• Call immediately for medical attention.</li> </ul>
	Skin exposure	<ul style="list-style-type: none"> <li>• Wash the exposed area with plenty of soap and water.</li> </ul>
	Eye exposure	<ul style="list-style-type: none"> <li>• Open the eyes as wide as possible and rinse with clean water for at least 15 minutes.</li> <li>• Call immediately for medical attention.</li> </ul>
	Ingestion	<ul style="list-style-type: none"> <li>• Rinse the mouth with plenty of water.</li> <li>• Call immediately for medical attention.</li> </ul>
Handling and Storage	Ventilation	<ul style="list-style-type: none"> <li>• Provide adequate air ventilation to keep organic vapor concentrations below approved level.</li> </ul>
	Container handling	<ul style="list-style-type: none"> <li>• Container may break if not handled with care.</li> </ul>
	Wear appropriate protective equipment	<ul style="list-style-type: none"> <li>• Use solvent-resistant gloves and protective eye gear when using this product. Use of gas mask, additional protective clothing or rubber boots could be appropriate when handling this product.</li> </ul>
	Hazardous substance storage	<ul style="list-style-type: none"> <li>• If any flammable solvents are used for shipping or storage of this product, keep away from fire or open heat sources.</li> </ul>
	Fire precautions	<ul style="list-style-type: none"> <li>• Do not expose the chromatographic resin to fire or open heat sources.</li> </ul>
Waste Disposal	Disposal methods	<ul style="list-style-type: none"> <li>• Dispose in accordance with local laws and regulations. See below for additional precautions.</li> </ul>
	General considerations	<ul style="list-style-type: none"> <li>• Please pay attention to all safety precautions with respect to the handling and storage of this product.</li> </ul>
	Disposal precautions	<ul style="list-style-type: none"> <li>• Fumes produced during incineration may contain nitrogen oxides. (TSKgel IC-Anion-PW<sub>XL</sub>, TSKgel IC-Anion-PW<sub>XL</sub> PEEK, TSKgel IC-Anion-PW, TSKgel IC-Anion-SW, TSKguardcolumn IC-AS, TSKguardcolumn IC-A)</li> <li>• Fumes produced during incineration may contain sulfur oxides. (TSKgel IC-Cation, TSKgel IC-Cation-SW, TSKguardcolumn IC-C)</li> </ul>

- TSKgel IC-Anion-PW<sub>XL</sub>, TSKgel IC-Anion-PW<sub>XL</sub> PEEK, TSKgel IC-Anion-PW, TSKgel IC-Cation I / II HR, TSKgel IC-Cation, TSKguardcolumn IC-Cation I / II HR, TSKguardcolumn IC-A, TSKguardcolumn IC-AS and TSKguardcolumn IC-C contain combustible chromatographic media bases on a co-polymer of vinyl compounds.
- TSKgel IC-Anion-SW and TSKgel IC-Cation-SW contain flame-retarded chromatographic media bases on a modified silica gel compounds.

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## 1. Introduction

TSKgel IC Series is a packed column for high performance ion chromatography using no suppressing system developed by TOSOH CORPORATION.

This column is featured by

- Short column and high performance
- Applicable to a wide range of analytical conditions

This instruction manual contains crucial information on how to care for and use these columns in a proper manner, so as to make the most effective use of their high performance capabilities.

Be sure to carefully read the instructions in this manual prior to use of these columns.

## 2. Unpacking

Be sure to inspect the packaging and closely inspect the column for any signs of damage prior to use. If any damages are evident, contact your local TOSOH sales representative at the address listed at the end of this manual.

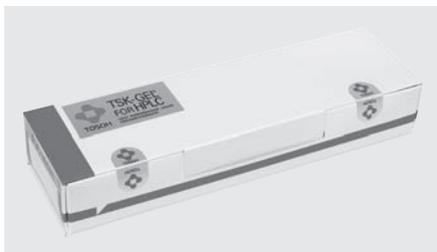


Figure 1 Appearance of the Package

Please confirm the following documents are included in the package.

- 1) INSTRUCTION MANUAL 1 copy
- 2) INSPECTION DATA 1 copy

### 3. General Information

#### 3-1 Column Grades and their Specifications

Column Grades and their Specifications are shown in Table 1.

Table 1 Column Grades and their Specifications

Part No.	Type	Column Size mm(I.D.) × cm(L)	Column Material	Packing Material	Particle Size ( $\mu\text{m}$ )	Functional Group	Ion-Exchange Capacity	Counter Ion	Packed Solvent for Shipping
0006837	TSKgel IC-Anion-PW	4.6 × 5	Plastic	Polymethacrylate Gel	10	Quaternary Ammonium	30±3 *1 $\mu\text{eq/mL}$	Borate & Gluconate	Same Solvent *3 for Inspection
0014463	TSKgel IC-Anion-PW <sub>XL</sub>	4.6 × 3.5	Stainless-Steel	Polymethacrylate Gel	6	Quaternary Ammonium	30±3 *1 $\mu\text{eq/mL}$	Borate & Gluconate	Same Solvent *3 for Inspection
0018009	TSKgel	4.6 × 3.5	PEEK						
0018010	IC-Anion-PW <sub>XL</sub> PEEK	4.6 × 7.5							
0006839	TSKgel IC-Anion-SW	4.6 × 5	Plastic	Silica Gel	5	Quaternary Ammonium	0.4±0.1 *2 meq/g dry gel	Bitartrate	Methanol *4
0007171	TSKgel IC-Cation	4.6 × 5	Plastic	Polystyrene Gel	10	Sulfonate	12±2 *1 $\mu\text{eq/mL}$	Hydrogen ion	2 mmol/L Nitric Acid
0008055	TSKgel IC-Cation-SW	4.6 × 5	Plastic	Silica Gel	5	Sulfonate	0.45±0.15 *1 meq/g dry gel	Hydrogen ion	Methanol *4
0018677	TSKgel IC-Cation I / II HR	4.6 × 10	Stainless-Steel	Polystyrene Gel	5	Carboxylic Acid	>1.0 eq/L *1	Hydrogen ion	Acetonitrile
0007173	TSKguardcolumn IC-A	4.6 × 5	Plastic	Polymethacrylate Gel	13	Quaternary Ammonium	30±3 *1 $\mu\text{eq/mL}$	Borate & Gluconate	Same Solvent *3 for Inspection
0016308	TSKguardcolumn IC-AS	3.0 × 1	Plastic	Polymethacrylate Gel	17	Quaternary Ammonium	30±3 *1 $\mu\text{eq/mL}$	Borate & Gluconate	Same Solvent *3 for Inspection
0007172	TSKguardcolumn IC-C	4.6 × 5	Plastic	Polystyrene Gel	10	Sulfonate	2.0±0.2 *1 $\mu\text{eq/mL}$	Hydrogen ion	2 mmol/L Nitric Acid
0018678	TSKguardcolumn IC-Cation I / II HR	4.6 × 0.5	Stainless-Steel	Polystyrene Gel	5	Carboxylic Acid	>1.0 eq/L *1	Hydrogen ion	Acetonitrile

\*1 : Determined by titration in 0.5 mol/L NaCl aq. \*2 : Estimated by elemental analysis of nitrogen.

\*3 : 1.3 mmol/L Gluconic acid + 1.3 mmol/L Boric acid pH 8.5. \*4 : Exchange methanol into distilled water before column is connected with instrument.

### 3-2 Typical Application

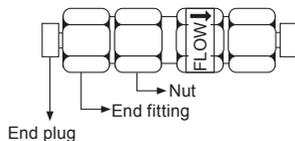
Typical applications are shown in Table 2.

Table 2 Typical Applications

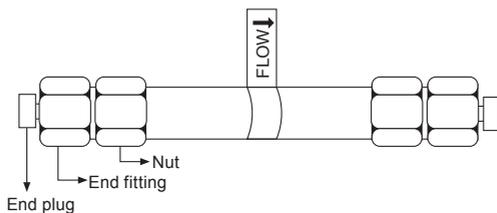
Type	Typical Applications
TSKgel IC-Anion-PW	Analysis of Anions such as F <sup>-</sup> , Cl <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , Br <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , SO <sub>4</sub> <sup>2-</sup> etc.
TSKgel IC-Anion-PW <sub>XL</sub>	Analysis of Anions such as F <sup>-</sup> , Cl <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , Br <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , SO <sub>4</sub> <sup>2-</sup> etc.
TSKgel IC-Anion-PW <sub>XL</sub> PEEK	Analysis of Anions such as F <sup>-</sup> , Cl <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , Br <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , SO <sub>4</sub> <sup>2-</sup> etc.
TSKgel IC-Anion-SW	Analysis of relatively strong Hydrophobic Anions such as SCN <sup>-</sup> , S <sub>2</sub> O <sub>3</sub> <sup>2-</sup> , BrO <sub>3</sub> <sup>-</sup> etc.
TSKgel IC-Cation	Analysis of Cations (Measure with metal free system)
TSKgel IC-Cation-SW	1) Analysis of Heavy Metal Ions which contain transition metal ions such as Fe <sup>2+</sup> , Cu <sup>2+</sup> , Ni <sup>2+</sup> , Zn <sup>2+</sup> , Mn <sup>2+</sup> etc. (For the eluent, ethylene-diamine/citric acid or ethylene-diamine/tartaric acid is recommended) 2) Analysis of Amine Compounds which have strong hydrophobic group such as R <sub>4</sub> N <sup>+</sup> or R <sub>3</sub> N (R : Alkyl group such as Butyl group, Octyl group etc.) (For the eluent, HNO <sub>3</sub> aq./acetonitrile is recommended)
TSKgel IC-Cation I / II HR	Analysis of Cations such as Li <sup>+</sup> , Na <sup>+</sup> , NH <sub>4</sub> <sup>+</sup> , K <sup>+</sup> , Mg <sup>2+</sup> , Ca <sup>2+</sup> etc.
TSKguardcolumn IC-A	Guard Column for TSKgel IC-Anion-PW and TSKgel IC-Anion-SW.
TSKguardcolumn IC-AS	Guard Column for TSKgel IC-Anion-PW and TSKgel IC-Anion-SW.
TSKguardcolumn IC-C	On cation analysis, eliminate the slight amount of polyvalent cations in the eluent. (Pretreatment of the eluent for TSKgel IC-Cation and TSKgel IC-Cation-SW.)
TSKguardcolumn IC-Cation I / II HR	Guard Column for TSKgel IC-Cation I / II HR.

## 4. Configuration and Parts of Columns

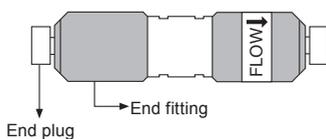
\* For TSKgel IC-Anion-PW<sub>XL</sub> (Stainless-Steel)



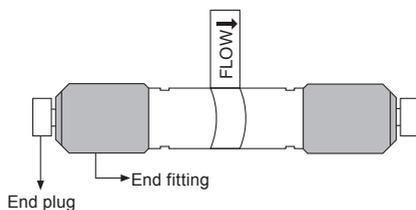
\* For TSKgel IC-Cation I / II HR



\* For TSKgel IC-Anion-PW<sub>XL</sub> PEEK (4.6 mm (I.D.)×3.5 cm (L))



\* For TSKgel IC-Anion-PW<sub>XL</sub> PEEK (4.6 mm (I.D.)×7.5 cm (L))



\* For TSKgel IC-Anion-PW, TSKgel IC-Anion-SW, TSKgel IC-Cation, TSKgel IC-Cation-SW

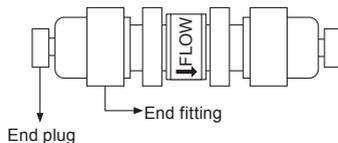


Figure 2 Column Parts

## 5. Maintenance

### 5-1 Conditions of Measurement

#### 1) pH Range of Eluent and Sample Solution

Keep pH of eluent and sample solution within the following range.

pH 2.0~12.0 ..... for TSKgel IC-Anion-PW, TSKgel IC-Anion-PW<sub>XL</sub>,  
TSKgel IC-Anion-PW<sub>XL</sub> PEEK, TSKgel IC-Cation,  
and TSKguardcolumn IC-A, TSKguardcolumn IC-AS,  
TSKguardcolumn IC-C

pH 2.0~10.0 ..... for TSKgel IC-Cation I / II HR  
and TSKguardcolumn IC-Cation I / II HR

pH 2.0~7.5 ..... for TSKgel IC-Anion-SW and TSKgel IC-Cation-SW

The pH range should be determined from the chemical stability of packing materials.

A chemically modified silica gel like TSKgel IC-Anion-SW and TSKgel IC-Cation-SW are easily dissolved by the eluent at pH level above 7.5 and under pH 2.0.

#### 2) Flow Rate

The maximum flow rate for all grades of TSKgel IC Series is under 1.2 mL/min (25 °C).

For analysis with aqueous solvent, the flow rate of 0.5 mL/min~1.0 mL/min is recommended.

In case the solvent of higher viscosity is used, the flow rate must be set to be smaller.

#### 3) Pressure

Maximum operating pressure should be determined by the withstanding pressures of the column piping and joint.

Use the column at less than 7.0 MPa. Using it at more than 7.0 MPa may cause leakage in the mobile phase or damage to the column.

#### 4) Temperature

The optimal operating temperature for TSKgel IC-Anion-PW, TSKgel IC-Anion-PW<sub>XL</sub>, TSKgel IC-Anion-PW<sub>XL</sub> PEEK, TSKgel IC-Cation, TSKguardcolumn IC-A, TSKguardcolumn IC-AS and TSKguardcolumn IC-C is between room temperature to 60 °C, and that for TSKgel IC-Anion-SW, TSKgel IC-Cation-SW is between room temperature to 45 °C and that for TSKgel IC-Cation I / II HR and TSKguardcolumn

IC-Cation I / II HR is between room temperature to 40 °C.  
Below 10 °C, apply a lower flow rate to avoid the column deterioration.

### 5) Ionic Strength

When polyvalent electrolytes have accumulated to the packing material, they must be flushed and stripped from the packing material.

In this case the salt concentration of mobile phase must be under 100 mmol/L.

### 6) Organic Solvents

Organic Solvents miscible with water are often used as a modifier to reduce hydrophobic interaction between sample molecules and packing material.

Allowable concentration of organic solvents for each columns are as follows.

- 0 vol%~100 vol% ..... for TSKgel IC-Anion-SW and TSKgel IC-Cation-SW
- below 20 vol% ..... for TSKgel IC-Anion-PW, TSKgel IC-Anion-PW<sub>XL</sub>,  
TSKgel IC-Anion-PW<sub>XL</sub> PEEK,  
and TSKguardcolumn IC-A, TSKguardcolumn IC-AS
- only the acetonitrile ..... for TSKgel IC-Cation I / II HR  
and TSKguardcolumn IC-Cation I / II HR
- below 10 vol% ..... for TSKgel IC-Cation and TSKguardcolumn IC-C

The organic modifier should be premixed with the aqueous buffer to prevent the precipitation of salts. Exchange of mobile phase between an organic solvent and water containing salts should be carried out intermediately through the substitution with deionized water.

## 5-2 Preparation of Eluent

### 1) Reagents

Fresh distilled water, analytical grade of reagents and organic solvents should be used for the eluent.

### 2) Filtration

The eluent should be filtered through a 0.5 μm filter before use in order to prevent clogging of the inlet filter and column bed.

### 3) Degassing

The eluent should be degassed for stable detection.

#### 4) pH Meter

When pH meter is used for pH adjustment, you must pay attention for the contamination of the pH meter by chloride ion.

#### 5) Preventing CO<sub>2</sub> Absorption

If a high-pH eluent is used, reservoir contact with air will spoil reproducibility through absorption of CO<sub>2</sub> which necessarily causes change of pH and ionic strength.

When an eluent of pH higher than 9.0 is used, it is recommended to attach a soda-lime absorbing tube to prevent CO<sub>2</sub> absorption.

### **5-3 Installation**

#### 1) Connections

For a column of TSKgel IC-Anion-PW<sub>XL</sub> and TSKgel IC-Cation I / II HR can be connected with 1/16" Stainless-Steel lead pipe of swage lock type.

For a column of TSKgel IC-Anion-PW<sub>XL</sub> PEEK can be connected with 1/16" PEEK pipe of swage lock type.

The other columns can be connected with 1/4"-28UNF setscrews to Teflon tube.

#### 2) Flow Direction

The flow direction of the eluent is determination by the directions of the arrow show on the label attached to the column.

#### 3) Prevention of Bubbles

Be careful not to admit any bubbles into the column during its installation or removal from the equipment. Always remove all bubbles from all pipings before installing the column.

Admitting bubbles into the column will cause degradation of its performance through the occurrence of channeling, etc.

Connect the column as follows:

If solvent leaks from end fitting when the cap on the inlet side column is removed, connect the column to the equipment carefully, as mentioned above, so that no bubbles will be introduced into the column.

If no solvent leaks from the inlet side of the column, connect the outlet side to the equipment and feed solvent through the column in the reverse direction with the feed pump in order to expel the air.

Feed the solvent slowly at less than 1.0 mL/min. in this case, rapid pressurization or

solvent feeding may cause degradation of column performance.  
 After confirming bubble-free solvent leakage at the inlet side of the column, arrange the column in the direction of normal flow, and connect the inlet side to the injector.

#### 4) Flow Diagram

Flow diagrams for the analytical purpose are shown in Figure. 3 and 4.

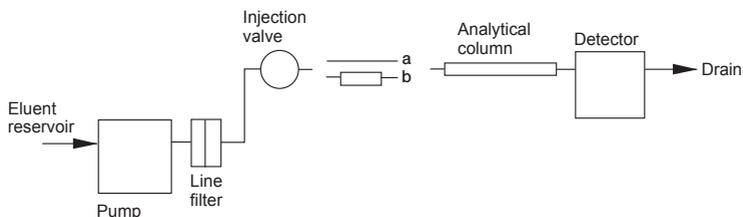


Figure 3 Flow Diagram for Anions Analysis

TSKguardcolumn IC-A

TSKguardcolumn IC-AS

TSKguardcolumn IC-Cation I / II HR

a : without a guard column

b : a guard column in use

For TSKgel IC-Anion-PW<sub>XL</sub>, use a Filter Assembly (NPR) (Part No.0014594) attached with the micro-filter less than 0.45 μm instead of a guard column.

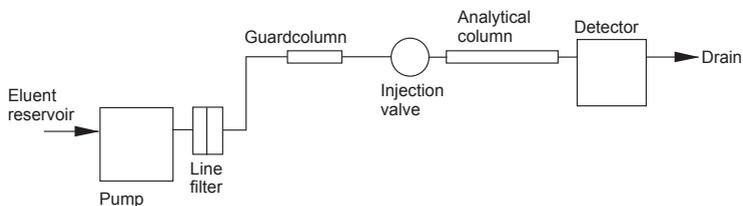


Figure 4 Flow Diagram for Cations Analysis

Caution : Whenever TSKgel IC-Cation and TSKgel IC-Cation-SW are used, TSKguardcolumn IC-C is installed in front of the injection valve.

#### 5-4 Exchange of Solvents (Counter Ions)

The counter ions of each grade are shown in Table 1.

If you want to change the counter ions according to the analytical sample, you can change the counter ions by eluting the solvent used for analysis.

## 5-5 Preparation of Sample Solution

### 1) Elimination of Insoluble Matter

Even if nothing can be seen in the sample solution, insoluble matter may be present.

So remove the insoluble matter from the sample solution by micro-pore filtration (of eg. 0.45  $\mu$ m pore size) but to avoid the contamination by the filter, the removal of the insoluble matter by centrifugation may be recommended.

### 2) Elimination of Hydrophobic Compounds

To prevent accumulation of hydrophobic compounds in the packing material, it is recommended to eliminate such compounds from the sample by preliminary treatment using commercially available disposable ODS column, etc.

### 3) Dilution of Sample Solution

In case ionic strength of the sample solution is too high (over 100 ppm per ion) overloading may be occurred and reduce the accuracy of quantitative analysis.

In this case the sample solution must be diluted by the using solvent or deionized water.

### 4) Concentration of Sample Solution

On the contrary ionic strength of the sample solution is too low, the detection of sample ion becomes difficult. So the sample solution must be concentrated to appropriate level by using "TSKprecolumn IC-Conc-A". (See Table 3.)

Table 3 TSKprecolumn Grades and Properties

Part No.	Type	Functional Group	Application
0008700	TSKprecolumn IC-Conc-A	Quaternary Ammonium	Inorganic Anions

## 6. Storage of Column

### 6-1 Protection from Drying and Freezing

Always keep the columns filled with the solvent and tighten the end plugs in order to keep the packing materials from drying and store them at room temperature.

Drying or freezing of column can cause fatal deterioration of column efficiency.

## 6-2 Storage Conditions

### 1) Solvent

For TSKgel IC-Anion-PW, TSKgel IC-Anion-PW<sub>XL</sub>, TSKgel IC-Anion-PW<sub>XL</sub> PEEK, TSKgel IC-Cation, TSKguardcolumn IC-A, TSKguardcolumn IC-AS and TSKguardcolumn IC-C, the solvent is not necessary to replace for storage.

For TSKgel IC-Anion-SW and TSKgel IC-Cation-SW, methanol or acetonitrile should be used as the solvent for long-term storage (more than one week). However it is not necessary to replace the solvent for routine use.

For TSKgel IC-Cation I / II HR and TSKguardcolumn IC-Cation I / II HR acetonitrile should be used as the solvent for long-term storage (more than one week). However it is not necessary to replace the solvent for routine use.

### 2) Temperature

Store the column at 15 °C~30 °C. The columns may freeze and their efficiency may degrade if they are left where the temperature is below 0 °C.

## 7. Regeneration of Column

### 7-1 Clogging of Filter

Insoluble matters in the solvent and the sample solution may cause the clogging of inlet-filter and increases the backpressure of the column and lowers the column efficiency.

If the damage is slight, the column can be regenerated by flushing the column in the reverse flow direction or by replacing the inlet-filter.

### 7-2 Removal of Polyvalent Electrolytes

Prolonged operation with complex mixture may lead to the gradual accumulation of polyvalent electrolytes compounds.

This is evidenced by changes in chromatography behavior and apparent loss of ion exchange capacity.

Adsorbed material can be stripped from the column by flushing with the following solvents.

#### Typical cleaning solvents

Buffer containing 100 mmol/L of the salt using for the eluent

..... for TSKgel IC-Anion-PW, TSKgel IC-Anion-PW<sub>XL</sub>,  
TSKgel IC-Anion-PW<sub>XL</sub> PEEK, TSKgel IC-Anion-SW,  
TSKguardcolumn IC-A and TSKguardcolumn IC-AS

Nitric acid (100 mmol/L)

..... for TSKgel IC-Cation, TSKgel IC-Cation-SW  
and TSKGuardcolumn IC-C

Nitric acid (10 mmol/L)

..... for TSKgel IC-Cation I / II HR  
and TSKGuardcolumn IC-Cation I / II HR

### 7-3 Removal of Hydrophobic Compounds

Flush the packing material in the column with a buffer containing organic solvents.  
(Refer the allowable concentration of organic solvents to section 5-16.)

The ionic surfactants have hydrophobic section and ionic section, and there is the interaction of static electricity between the packing material and the surfactants. So you have better to operate in the condition of reducing the interaction.

## 8. Calculation of Theoretical Plate Number and Asymmetry Factor

The theoretical plate number (N) and the asymmetry factor (As) as well as their chromatographic conditions for each columns are as shown on the INSPECTION DATA sheet.

### 8-1 Method of Calculating Theoretical Plate Number

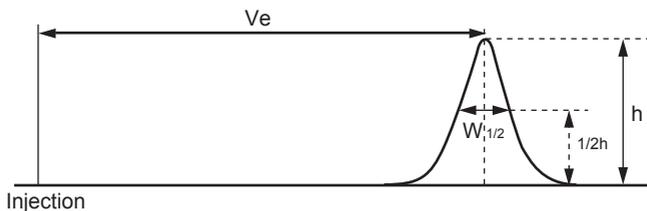


Figure 5 Method of Calculating Theoretical Plate Number

The theoretical plate number (N) of a column is calculated by the half width method shown in Figure 5 and the following equation.

$$N=5.54 (Ve/W_{1/2})^2$$

Ve : Elution time (min)

W<sub>1/2</sub> : Peak width (min) at one-half the peak height

h : Peak height

## 8-2 Method of Calculating Asymmetry Factor

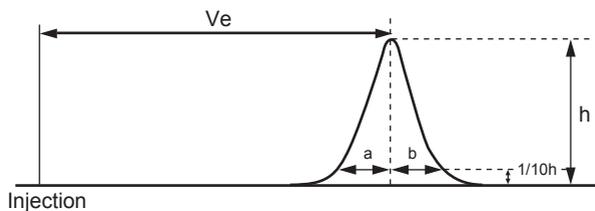


Figure 6 Method of Calculating Asymmetry Factor

The asymmetry factor ( $A_s$ ) of a column is calculated by the 1/10h method.

$$A_s = b/a$$

## 9. Quality Specification and Warranty

### 9-1 INSPECTION DATA

The results of each inspection are described in the INSPECTION DATA enclosed in the column package.

In the INSPECTION DATA, N is expressed as that per column.

The conditions used in determining the INSPECTION DATA are as follows:

## 1) Solvent used for the Inspection and Shipping

Table 4 Solvent Used for the Inspection and Shipping

Type	Solvent Used for the Inspection	Solvent Used for Shipping
TSKgel IC-Anion-PW, TSKgel IC-Anion-PW <sub>XL</sub> , TSKgel IC-Anion-PW <sub>XL</sub> PEEK	Boric acid buffer (pH 8.5) <Recipe> 1) H <sub>3</sub> BO <sub>3</sub> ..... 360 mg (360 mg) 2) Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> 10H <sub>2</sub> O ..... 500 mg (575 mg) 3) Glycerin ..... 5.0 g (5.0 g) 4) Potassium Gluconate ..... 300 mg (350 mg) 5) CH <sub>3</sub> CN ..... 120 mL (40 mL) 6) n-Butyl Alcohol ..... 30 mL (30 mL) These reagents are diluted by distilled water to 1,000 mL ( )show the recipe of TSKgel IC-Anion-PW <sub>XL</sub> and TSKgel IC-Anion-PW <sub>XL</sub> PEEK	Same solvent used for the inspection
TSKgel IC-Anion-SW	Tartaric acid buffer (pH 3.2) <Recipe> 2.0 mmol/L Tartaric acid is adjusted to pH 3.2 by 1 mol/L KOH	Methanol
TSKgel IC-Cation	2.0 mmol/L HNO <sub>3</sub> aq.	Same solvent used for the inspection
TSKgel IC-Cation-SW	20 mmol/L HNO <sub>3</sub> aq./CH <sub>3</sub> CN=7/3 (V/V)	Methanol
TSKgel IC-Cation I / II HR	2.0 mmol/L HNO <sub>3</sub> aq.	Acetonitrile

## 2) Samples and their Concentrations for Inspection

Table 5 Samples for Inspection

Column Grades	Samples	Concentrations
TSKgel IC-Anion-PW	SO <sub>4</sub> <sup>2-</sup>	10 ppm
TSKgel IC-Anion-PW <sub>XL</sub>	SO <sub>4</sub> <sup>2-</sup>	10 ppm
TSKgel IC-Anion-PW <sub>XL</sub> PEEK	SO <sub>4</sub> <sup>2-</sup>	10 ppm
TSKgel IC-Anion-SW	Cl <sup>-</sup>	5 ppm
TSKgel IC-Cation	Na <sup>+</sup>	2 ppm
TSKgel IC-Cation-SW	[(C <sub>4</sub> H <sub>9</sub> ) <sub>4</sub> N]	500 ppm
TSKgel IC-Cation I / II HR	Li <sup>+</sup>	0.2 ppm

## 3) Conditions of Inspection

- Flow Rate : 1.2 mL/min
- Sample Volume : 100 μL
- Temperature : 35 °C
- Detector : Electrical conductivity

## 9-2 Quality Specifications

The shipping specifications of IC columns are shown in Table 6.

Table 6 Shipping Specifications

Part No.	Type	Column Size (mm(I.D.))×cm(L)	Number of Theoretical Plates (TP/Column)	Asymmetry Factor
0006837	TSKgel IC-Anion-PW	4.6×5	≧ 1,100	0.9 ~ 1.5
0014463	TSKgel IC-Anion-PW <sub>XL</sub>	4.6×3.5	≧ 1,000	0.8 ~ 1.5
0018009	TSKgel IC-Anion-PW <sub>XL</sub> PEEK	4.6×3.5	≧ 1,000	0.8 ~ 1.5
0018010	TSKgel IC-Anion-PW <sub>XL</sub> PEEK	4.6×7.5	≧ 2,000	0.8 ~ 1.5
0006839	TSKgel IC-Anion-SW	4.6×5	≧ 1,400	0.5 ~ 1.1
0007171	TSKgel IC-Cation	4.6×5	≧ 1,400	1.0 ~ 1.8
0008055	TSKgel IC-Cation-SW	4.6×5	≧ 2,000	1.2 ~ 2.0
0018677	TSKgel IC-Cation I / II HR	4.6×10	≧ 4,000	0.9 ~ 1.4

## 9-3 Warranty

Immediately after receipt, check the appearance of the column and test its performance according to section 9-1.

If the guaranteed specifications in Table 6 can not be obtained or the column has been damaged during the transportation, contact TOSOH CORPORATION representative within two weeks. TOSOH CORPORATION will replace the column at no cost to the purchaser.

No column should be returned to TOSOH without its prior authorization.

The specifications of these columns may change without notice for their improvement.



**TOSOH**

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