

# RPC

## REVERSED PHASE CHROMATOGRAPHY

### RPC PRODUCTS

#### ➤ RP COLUMNS FOR BIOMOLECULES

TSKgel Protein C4-300  
TSKgel OligoDNA RP  
TSKgel TMS-250

#### ➤ UNIVERSAL RP COLUMNS

TSKgel ODS-100V  
TSKgel ODS-100Z

#### ➤ FAST RP COLUMNS

TSKgel ODS-140HTP  
TSKgel Super-ODS  
TSKgel Super-Octyl  
TSKgel Super-Phenyl

#### ➤ TRADITIONAL RP COLUMNS

TSKgel ODS-80Ts  
TSKgel ODS-80T<sub>M</sub>  
TSKgel Octyl-80Ts  
TSKgel CN-80Ts  
TSKgel ODS-120A  
TSKgel ODS-120T

#### ➤ POLYMER BASED RP COLUMNS

TSKgel Octadecyl-NPR  
TSKgel Octadecyl-2PW  
TSKgel Octadecyl-4PW

#### ≡ TOSOH FACT

Tosoh Bioscience, part of the Specialty Group Division of Tosoh Corporation, is a leading supplier of chromatographic columns, media and sophisticated clinical diagnostic systems.

TSKgel, TOYOPEARL and our other branded chromatography products have evolved over more than three decades from the measurement and analysis of polymers and organic compounds to development in the bioscience age with the analysis, separation and purification of proteins.

Experts and knowledgeable industry observers in areas from academia, government and scientific institutions praise the achievements of Tosoh Corporation in the fields of bioanalysis and purification.





## TSKgel REVERSRED PHASE CHROMATOGRAPHY COLUMNS

Reversed phase chromatography (RPC) columns can be applied to the analysis of a wide variety of compounds, ranging from neutral polar and non-polar solutes to acidic, basic and amphoteric compounds. RPC is also an efficient technique for the analysis of derivatized amino acids, peptides and proteins, although protein structure is not always maintained due to the high concentration of organic solvent required for elution. Tosoh Bioscience offers 18 distinct RPC column types which are based on either silica or polymer particles (**TABLE I**).

The silica-based TSKgel RPC product line consists of ten stationary phases designed for the analysis of low molar mass compounds, including active pharmaceutical ingredients (API), forensic compounds, derivatized amino acids, carbohydrates, steroids, lipids, and fatty acids, as well as two stationary phases with larger pore size designed for protein analysis.

TSKgel silica packings consist of spherical particles with uniform pore sizes of 8, 10, 12, 14, 25, or 30 nm bonded with a monomeric or polymeric layer of octadecyl, octyl, cyano, trimethylsilyl, or phenyl groups. Several of the stationary phases are subsequently endcapped by derivatization with trimethylsilyl groups by a proprietary method that deactivates residual silanol groups.

Polymethacrylate-based reversed phase columns are available in a range of pore and particle sizes. Although often not as efficient as and less robust than silica-based RPC columns, key advantages of polymer-based columns are their pH stability from pH 2 to 12, which allows many basic compounds to be analyzed in their uncharged form, thus reducing secondary adsorption and improving peak shape and improving recovery for peptides and proteins due to reduced secondary interactions.

**TABLE I**

**Silica and polymer based TSKgel RPC columns**

Silica-based columns	Polymer-based columns
High purity type B silica	Hydrophilic backbone to improve recovery and reduce secondary interactions
High efficiencies	pH stable from 1 to 12
Excellent recoveries	Compatibility with organic solvents eliminates swelling
Low bleed for MS	
An excellent choice for analysis of small molecules and peptides	An excellent choice for large MW biomolecules and for analyzing small MM compounds at high pH
TSKgel Protein C4-300	TSKgel Octadecyl-2PW
High efficiency & throughput TSKgel ODS-100V and 100Z	TSKgel Octadecyl-4PW
Monomeric bonded silica	TSKgel Phenyl-5PW RP
Specialty silica columns	TSKgel Octadecyl-NPR (nonporous)

## RP COLUMNS FOR BIOMOLECULES TSKgel PROTEIN C4-300

### HIGHLIGHTS

- Ideal for the separation of proteins
- Endcapping ensures low peak tailing
- Small particle size for high theoretical plate numbers
- Short column for fast separations available

TSKgel Protein C4-300 columns are designed for the optimal recovery and resolution of proteins such as recombinant proteins, antibody fragments or PEGylated proteins. The 30 nm (300 Å) pore size of the TSKgel Protein C4-300 columns are ideal for the separation of proteins. A particle size of 3 µm and optimized ligand density and alkyl length result in better protein and peptide resolution compared to other leading RP-C4 HPLC phases.

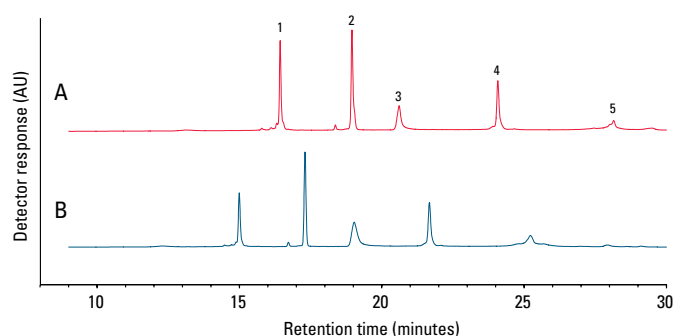
The C4 short alkyl chain ligand and its controlled bonding density provide moderate hydrophobicity to the stationary phase, which results in protein separations with high recovery and less peak tailing.

### APPLICATIONS

FIGURE 1 shows the separation of a mixture of standard proteins on the TSKgel Protein C4-300 column compared to a competitor column with 3.5 µm particle size. The resolution between cytochrome c and lysozymes reaches 24.8 on the TSKgel Protein C4-300 column compared to 18.6 on the competitor C4 column. Furthermore, the TSKgel column shows higher theoretical plates and less peak tailing, especially for BSA (Peak 3), and also a better resolution of minor peaks.

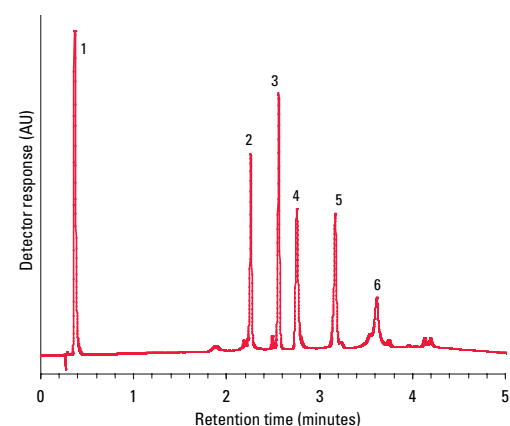
For high speed separations, the analysis time can be reduced by more than eighty percent when using the short 5 cm TSKgel Protein C4-300 column and increasing the flow rate to 3 mL/min (FIGURE 2). The backpressure remains below 15 MPa, allowing the use of standard HPLC systems. The long term stability of the new C4 phase in acidic solution was tested by flushing the column with 30% acetonitrile, 0.2% TFA (4 times the standard TFA concentration) at 40 °C. There was no change in theoretical plates even after 1,000 hours of run time under this chromatographic condition. Also retention times of standard proteins didn't have significant loss when compared to the initial values.

➤ **FIGURE 1**  
Comparison of standard protein separation



Columns: A. TSKgel Protein C4-300, 3 µm, 4.6 mm ID × 15 cm,  
B. Competitor A, 3.5 µm, 4.6 mm ID × 15 cm  
Mobile phase: A: H<sub>2</sub>O/CH<sub>3</sub>CN/TFA = 90/10/0.05 (v/v/v),  
B: H<sub>2</sub>O/CH<sub>3</sub>CN/TFA = 20/80/0.05 (v/v/v)  
Gradient: 0 min (0%B) 45 min (100%B), Flow rate: 1.0 mL/min;  
Detection: UV @ 210 nm, Temperature: 40 °C; Injection vol.: 10 µL  
Samples: 1. cytochrome C, 2. lysozyme, 3. BSA, 4. α-chymotrypsinogen A,  
5. ovalbumin (each 2 µg/10 µL)

➤ **FIGURE 2**  
High speed separation of proteins



Column: TSKgel Protein C4-300, 3 µm, 4.6 mm ID × 5 cm  
Mobile phase A: H<sub>2</sub>O/CH<sub>3</sub>CN/TFA = 90/10/0.05 (v/v/v)  
Mobile phase B: H<sub>2</sub>O/CH<sub>3</sub>CN/TFA = 20/80/0.05 (v/v/v)  
Gradient: 0 min (0%B) 5 min (100%B)  
Flow rate: 3.0 mL/min, Detection: UV @ 210 nm  
Temperature: 40 °C, Injection vol.: 10 µL  
Samples: 1. phenylalanine, 2. cytochrome C, 3. lysozyme, 4. BSA,  
5. α-chymotrypsinogen A, 6. ovalbumin (each 0.2 g/µL)


**➤ ORDERING INFORMATION**

<i>Part #</i>	<i>Description</i>	<i>ID (mm)</i>	<i>Length (cm)</i>	<i>Particle size (µm)</i>	<i>Number of theoretical plates</i>	<i>Maximum pressure drop (MPa)</i>
<b>TSKgel Stainless Steel Columns</b>						
0022827	TSKgel Protein C <sub>4</sub> -300	4.6	5.0	3 µm	> 6,000	10
0022828	TSKgel Protein C <sub>4</sub> -300	4.6	10.0	3 µm	> 11,500	17.5
0022829	TSKgel Protein C <sub>4</sub> -300	4.6	15.0	3 µm	> 17,000	25
0022830	TSKgel Protein C <sub>4</sub> -300	2.0	5.0	3 µm	> 4,500	15
0022831	TSKgel Protein C <sub>4</sub> -300	2.0	10.0	3 µm	> 10,000	22.5
0022832	TSKgel Protein C <sub>4</sub> -300	2.0	15.0	3 µm	> 15,500	30
0022833	Protein C <sub>4</sub> -300 Guard Cartridge, 3 p	3.2	1.5		For all 4.6 mm ID Protein C <sub>4</sub> -300 columns	
0022834	Protein C <sub>4</sub> -300 Guard Cartridge, 3 p	2.0	1.0		For all 2 mm ID Protein C <sub>4</sub> -300 columns	
0019018	Cartridge holder				For 3.2 mm ID cartridges	
0019308	Cartridge holder				For all 2 mm ID Guard columns	

# RPC

## RP COLUMNS FOR BIOMOLECULES TSKgel OligoDNA RP / TMS-250

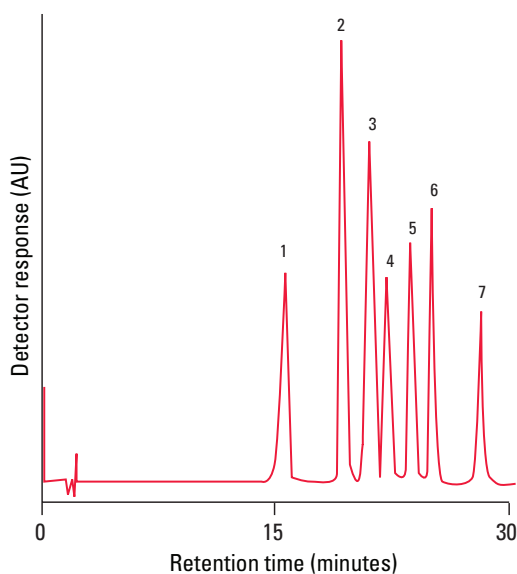
### HIGHLIGHTS

- Porous silica with 25 nm (250 Å) pore size
- C18 bonded phase in TSKgel OligoDNA RP suited for Oligonucleotides
- C1 bonded phase in TSKgel TMS-250 suited for proteins

TSKgel TMS-250 is exhaustively and repeatedly reacted with trimethyl silyl groups. Standard nomenclature designates the bonded phase as C1. This wide-pore column is recommended for the analysis of proteins.

TSKgel OligoDNA RP contains a monomeric C18 bonded phase that is not endcapped and has a relatively low carbon content of 10%. It is ideal for the purification and analysis of oligonucleotides (up to 500-mer), RNAs, and DNA fragments. It possesses high-resolving power for octamers of similar sequence.

**FIGURE 3**  
High resolution protein separation on TSKgel TMS-250



Column: TSKgel TMS-250, 4.6 mm ID x 7.5 cm L;  
 Sample: 5 µg each of: 1. ribonuclease A, 2. cytochrome C, 3. lysozyme, 4. bovine serum albumin, 5. aldolase, 6. carbonic anhydrase, 7. ovalbumin;  
 Elution: 60 min (TMS-250) linear gradient from 20% to 95% CH<sub>3</sub>CN in 0.05% TFA, pH 2.2; Flow rate: 0.61 mL/min; Detection: UV @ 220 nm

### APPLICATIONS

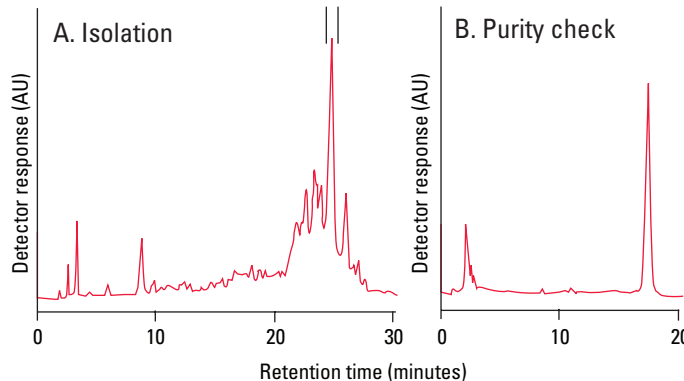
#### ➤ TSKgel TMS-250

TSKgel TMS-250 is ideal for the separation of proteins which exhibit sharp peaks relative to wide-pore C8 or C18 columns. It can accommodate even large proteins, such as aldolase (158 kDa). The resolution of proteins on TSKgel TMS-250 columns is shown in Figure 3.

#### ➤ TSKgel OligoDNA RP

The semi-preparative isolation of a 49-mer oligonucleotide from the crude synthetic reaction mixture using a 7.8 mm ID TSKgel OligoDNA-RP column is shown in Figure 4. The purity of the isolated oligonucleotide was subsequently verified on an analytical 4.6 mm ID TSKgel OligoDNA-RP column.

**FIGURE 4**  
High resolution protein separation on TSKgel OligoDNA-RP



Columns: A. TSKgel OligoDNA-RP, 5 µm, 7.8 mm ID x 15 cm, B. TSKgel OligoDNA-RP, 5 µm, 4.6 mm ID x 15 cm  
 Mobile phase: A. 120 min linear gradient from 6.25% to 25% CH<sub>3</sub>CN (7.8 mm ID) column; B. 90 min linear gradient from 7.5% to 25% CH<sub>3</sub>CN (4.6 mm ID) column, both in 0.1 mol/L ammonium acetate, pH 7.0,  
 Flow rate: A. 2.8 mL/min (7.8 mm ID) B. 1.0 mL/min (4.6 mm ID),  
 Detection: UV @ 260 m, Sample: synthetic 49-mer oligonucleotide, d(AGCTTGGGCTGCAGGTCGTCTCTAGAGGATCCCCGGGCGAGCTCGAATT)

### ➤ ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size (µm)	Number theoretical plates	Flow rate (mL/min) range	Maximum pressure drop (MPa)
<b>TSKgel stainless steel columns</b>							
0013352	OligoDNA RP, 25 nm	4.6	15.0	5	7,000	0.6 - 1.0	12.0
0013353	OligoDNA RP, 25 nm	7.8	15.0	5	7,000	2.0 - 3.0	12.0
0007190	TMS-250, 25 nm	4.6	7.5	10	1,500	0.5 - 0.8	2.0

## UNIVERSAL RP COLUMNS TSKgel ODS-100V / ODS-100Z

### HIGHLIGHTS

- Ultra-pure silica minimizes sample adsorption
- High surface area (450 m<sup>2</sup>/g) silica
- Spherical 3 and 5 μm particles with 10 nm (100 Å) pores
- Very high column efficiency
- Moderate column back pressure
- Two levels of hydrophobicity:
  - 15% carbon (100V)
  - 20% carbon (100Z)
- Monomeric bonding chemistry
- Low residual silanol content

TSKgel ODS-100V & TSKgel ODS-100Z columns incorporate the best-in-class surface properties to limit secondary interactions of basic, acidic and chelating compounds. The ultra high purity Type B base silica contains negligible amounts of metal ion impurities.

TSKgel ODS-100V provides strong retention for polar compounds due to its lower C18 ligand density (15% carbon content). Proprietary monomeric bonded phase chemistry provides complete wetting and retention stability in 100% aqueous mobile phases.

The TSKgel ODS-100V and TSKgel ODS-100Z column lines were expanded to include 3 μm packed columns. These columns are well suited for high throughput LC/MS applications, providing fast and efficient separations.

TSKgel ODS-100Z contains a high density (20% carbon content) monomeric C18 bonded phase for maximum retention and selectivity of small molecular weight compounds. Exhaustive endcapping prevents secondary interaction with residual silanol groups.

➤ TABLE II

	TSKgel ODS-100V	TSKgel ODS-100Z
Carbon content	15%	20%
Particle size (μm)	3 and 5	3 and 5
Endcapped	Yes <sup>(1)</sup>	Yes <sup>(2)</sup>
Pore size (nm)	10	10
Preferred sample type	Polar, basic, acidic	Hydrophobic
Bonded phase structure	Monolayer	Monolayer
Specific surface area (m <sup>2</sup> /g)	450	450
*Asymmetry factor (10%)	0,90 - 1,15	0,90 - 1,15
*Theoretical plates	>14.000	>14.000

\* Specifications for 4.6 mm ID x 15 cm L columns packed with 5 μm particles. Conditions: 70% methanol, 30% water; flow rate: 1 mL/min; Temp.: 40°C, N and AF are based on naphthalene peak. Typical pressure: 6 MPa

(1) Prepared by an incomplete first reaction with a difunctional octadecylsilane reagent, which is followed by endcapping with a mixture of two difunctional dialkylsilane reagents.

(2) Prepared by bonding the surface with a difunctional octadecylsilane reagent, followed by repeated endcapping with monofunctional trimethylsilane reagent.

## APPLICATIONS OF TSKgel ODS-100V / ODS-100Z

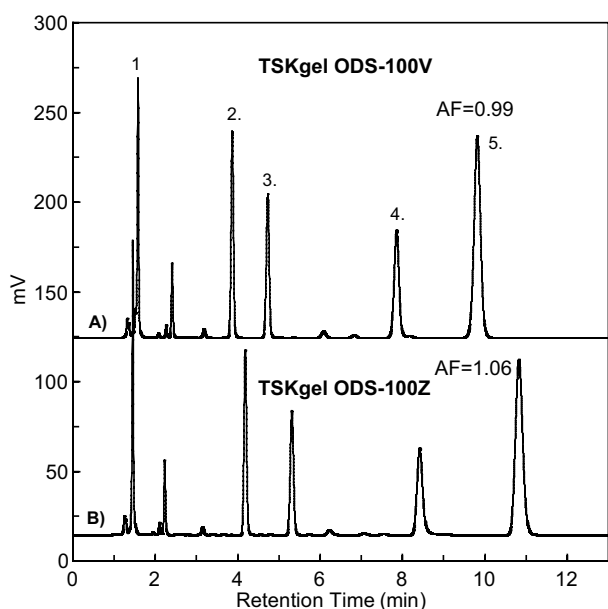
### SRM 870

Standard Reference Material SRM 870 was developed by NIST (National Institute of Standards and Technology) as a means to classify the many commercially available reversed phase columns into closely-related groups. Amitriptyline, a tertiary amine, and quinizarin, a strong chelating compound, are included in the SRM 870 mixture, together with more traditional compounds. As shown in **FIGURE 5**, symmetrical peaks are obtained on TSKgel ODS-100V and TSKgel ODS-100Z for the compounds in this test mixture, clearly demonstrating the superior performance of these columns for the analysis of basic and chelating compounds.

### VITAMINS

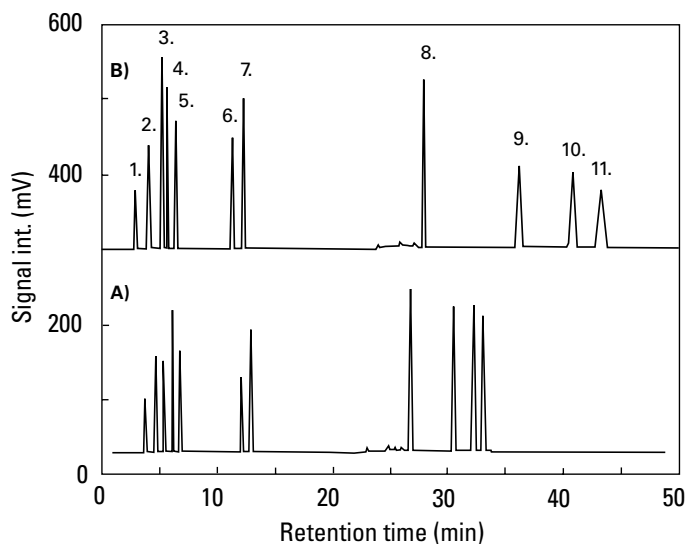
Simple and fast analysis of water- and lipid-soluble vitamins is possible on the TSKgel ODS-100V and TSKgel ODS-100Z columns, as shown in **FIGURE 6**. Clearly the TSKgel ODS-100Z column provides better overall resolution for the polar compounds in the mixture, while much shorter analysis time was obtained on TSKgel ODS-100V for the late eluting non-polar compounds.

**FIGURE 5**  
Standard reference material SRM 879



Columns: (A) TSKgel ODS-100V 3  $\mu$ m (4.6 mm ID x 15 cm L)  
(B) TSKgel ODS-100Z 3  $\mu$ m (4.6 mm ID x 15 cm L);  
Eluent: 20 mmol/L Phosphate buffer (pH 7.0)/MeOH (20/80);  
Flow rate: 1.0 mL/min; Detection: UV@254nm; Temp.: 40°C; Inj. volume: 10  $\mu$ L;  
Sample: 1. Uracil, 2. Toluene, 3. Ethyl benzene, 4. Quinizarin, 5. Amitriptyline

**FIGURE 6**  
Analysis of vitamins



Columns: (A) TSKgel ODS-100V (4.6 mm ID x 15 cm L)  
(B) TSKgel ODS-100Z (4.6 mm ID x 15 cm L);  
Eluent: (A) 0.1% TFA in H<sub>2</sub>O; (B) 0.1% TFA in ACN,  
Gradient: 0 min (B: 0%) - 20 min (B: 40%) - 22 min (B: 100%) - 50 min (B: 100%);  
Flow rate: 1.0 mL/min.; Temp.: 40°C; Detection: UV@280nm;  
Inj. volume: 5  $\mu$ L; Samples: 1. L-Ascorbic acid, 2. Nicotinic acid, 3. Thiamine,  
4. Pyridoxal, 5. Pyridoxine, 6. Caffeine, 7. Riboflavin, 8. Retinol, 9.  $\delta$ -Tocopherol,  
10.  $\alpha$ -Tocopherol, 11.  $\alpha$ -Tocopherol acetate)



## APPLICATIONS OF TSKgel ODS-100V /ODS-100Z

### ORGANIC ACIDS

Organic acids play an important role in many metabolic processes, fermentation and food products. **FIGURE 7** shows a baseline separation of 15 organic acids in less than 25 minutes using a simple 0.1% phosphoric acid mobile phase.

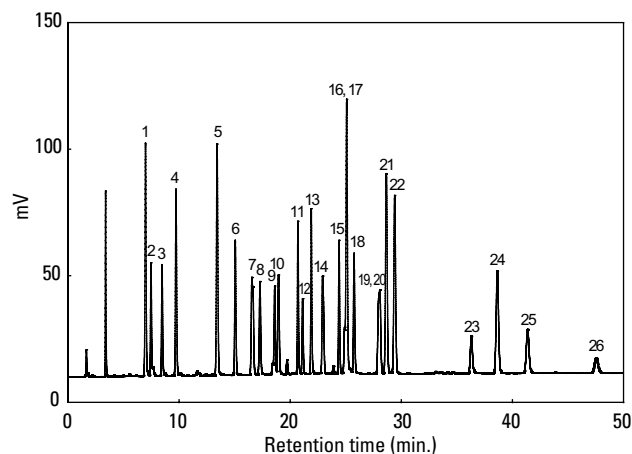
### POLYMER ADDITIVES

A baseline separation of 26 well known polymer additives is shown in **FIGURE 8**. Note that while a simple linear acetonitrile gradient was used, the column temperature was increased to 50°C to achieve the required baseline separation on a TSKgel ODS-100V column.

### NUCLEOTIDES

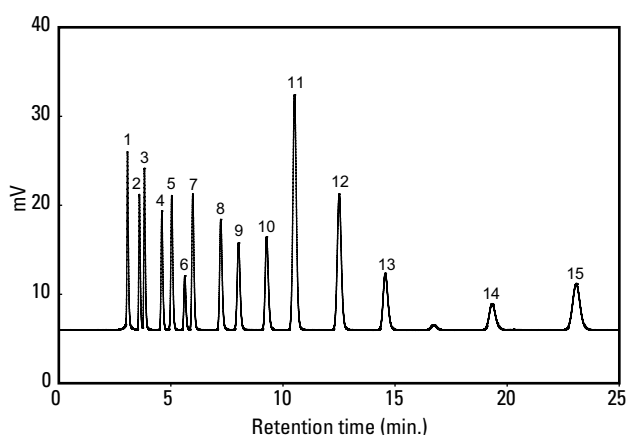
The analysis of mono-, di-, and tri-phosphorylated nucleotides on a TSKgel ODS-100V column is shown below (**FIGURE 9**). The separation is accomplished by adding a short chain ion pairing agent, *t*-butylamine, and adjusting the mobile phase pH to 6.8.

**FIGURE 8**  
Analysis of polymer additives with TSKgel ODS-100V



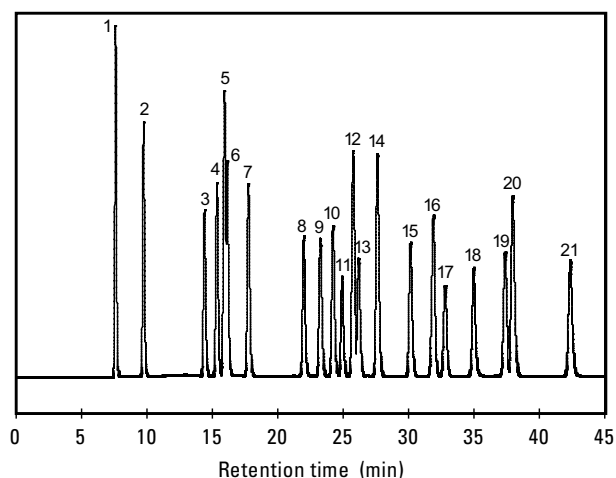
Column: TSKgel ODS-100V (4.6mm ID × 15 cm L);  
Mobile phases: (A) H<sub>2</sub>O (B) ACN; Gradient: 0 min (B: 60%) - 20 min (B: 100%);  
Flow rate: 1.0 mL/min; Temp: 50 °C; Detection: UV@225nm;  
Inj. Volume: 10 µL; Concentration: 10 mg/L each; Samples: 1. Cyasorb UV-24, 2. BHA, 3. Ionox 100, 4. Seesorb 101, 5. Tinuvin P, 6. Yoshinox SR, 7. Seesorb 202, 8. BHT, 9. Noclizer M-17, 10. Yoshinox 2246R, 11. Topanol CA, 12. Yoshinox 425, 13. Cyanox 1790, 14. Cyasorb UV-531, 15. Ionox 220, 16. Nonflex CBP, 17. Tinuvin 326, 18. Tinuvin 120, 19. Irganox 3114, 20. Uvtext OB, 21. Tinuvin 327, 22. Tinuvin 328, 23. Irganox 1010, 24. Irganox 1330, 25. Irganox 1076, 26. Irgafos 168

**FIGURE 7**  
Analysis of organic acids with TSKgel ODS-100V



Column: TSKgel ODS-100V (4.6 mm ID × 25 cm L)  
Mobile phase: 0.1 % H<sub>3</sub>PO<sub>4</sub> (pH 2.3); Flow rate: 1.0 mL/min;  
Temp: 40 °C; Inj. Volume: 10 µL; Samples: 1. Oxalic acid (0.1 mg/mL) 2. L-Tartaric acid (0.5 mg/mL) 3. Formic acid (1.0 mg/mL) 4. L-Malic acid (1.0 mg/mL) 5. L-Ascorbic acid (0.1 mg/mL) 6. Lactic acid (1.0 mg/mL) 7. Acetic acid (1.0 mg/mL) 8. Maleic acid (0.01 mg/mL) 9. Citric acid (1.0 mg/mL) 10. Succinic acid (1.0 mg/mL) 11. Fumaric acid (0.025 mg/mL) 12. Acrylic acid (0.1 mg/mL) 13. Propionic acid (2.0 mg/mL) 14. Glutaric acid (1.0 mg/mL) 15. Itaconic acid (0.025 mg/mL)

**FIGURE 9**  
Analysis of nucleotides with TSKgel ODS-100V



Column: TSKgel ODS-100V (4.6 mm ID × 25 cm L)  
Mobile phases: (A) 20 mmol/L *t*-butylamine + H<sub>3</sub>PO<sub>4</sub> (pH 6.8) (B) A/MeOH (90/10); Gradient: 0 min (B: 0%) - 35 min (B: 100%); Flow rate: 1.0 mL/min;  
Temp: 25 °C; Detection: UV@260nm; Inj. Volume: 2 µL; Concentration: 0.3 g/L each; Samples: 1. CMP, 2. UMP, 3. CDP, 4. dUMP, 5. GMP, 6. IMP, 7. UDP, 8. CTP, 9. TMP, 10. GDP, 11. IDP, 12. AMP, 13. UTP, 14. dGMP, 15. TDP, 16. GTP, 17. ITP, 18. ADP, 19. TTP, 20. dAMP, 21. ATP

# RPC

## ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size (µm)	Number theoretical plates	Maximum pressure drop (MPa)
<b>TSKgel Stainless steel columns</b>						
0021838	ODS-100V, 10 nm	1.0	3.5	3	≥ 2,900	15.0
0021839	ODS-100V, 10 nm	1.0	5.0	3	≥ 4,500	15.0
0021814	ODS-100V, 10 nm, pk 3*	2.0	1.0	3	≥ 500	30.0
0022700	ODS-100V, 10 nm	2.0	2.0	3	≥ 1,500	12.0
0021813	ODS-100V, 10 nm	2.0	3.5	3	≥ 4,000	15.0
0021812	ODS-100V, 10 nm	2.0	5.0	3	≥ 5,700	15.0
0021811	ODS-100V, 10 nm	2.0	7.5	3	≥ 8,600	21.0
0021938	ODS-100V, 10 nm	2.0	10.0	3	≥ 11,500	24.0
0021810	ODS-100V, 10 nm	2.0	15.0	3	≥ 17,500	24.0
0022701	ODS-100V, 10 nm	2.0	25.0	3	≥ 28,000	30.0
0022702	ODS-100V, 10 nm	3.0	2.0	3	≥ 2,000	12.0
0022703	ODS-100V, 10 nm	3.0	3.5	3	≥ 4,000	12.0
0021842	ODS-100V, 10 nm	3.0	5.0	3	≥ 6,000	15.0
0021843	ODS-100V, 10 nm	3.0	7.5	3	≥ 9,000	21.0
0021939	ODS-100V, 10 nm	3.0	10.0	3	≥ 12,000	24.0
0021844	ODS-100V, 10 nm	3.0	15.0	3	≥ 18,000	24.0
0022704	ODS-100V, 10 nm	3.0	25.0	3	≥ 29,000	30.0
0022705	ODS-100V, 10 nm	4.6	2.0	3	≥ 2,500	12.0
0022706	ODS-100V, 10 nm	4.6	3.5	3	≥ 4,500	12.0
0021831	ODS-100V, 10 nm	4.6	5.0	3	≥ 6,500	15.0
0021830	ODS-100V, 10 nm	4.6	7.5	3	≥ 9,750	21.0
0021940	ODS-100V, 10 nm	4.6	10.0	3	≥ 13,500	24.0
0021829	ODS-100V, 10 nm	4.6	15.0	3	≥ 19,500	24.0
0022707	ODS-100V, 10 nm	4.6	25.0	3	≥ 30,000	30.0
0021457	ODS-100V, 10 nm	2.0	5.0	5	≥ 3,000	18.0
0022708	ODS-100V, 10 nm, pk 3*	2.0	1.0	5	≥ 300	28.0
0022709	ODS-100V, 10 nm	2.0	2.0	5	≥ 1,000	9.0
0022710	ODS-100V, 10 nm	2.0	3.5	5	≥ 2,500	9.0
0022711	ODS-100V, 10 nm	2.0	7.5	5	≥ 5,500	18.0
0022712	ODS-100V, 10 nm	2.0	10.0	5	≥ 7,000	18.0
0021458	ODS-100V, 10 nm	2.0	15.0	5	≥ 11,000	18.0
0022713	ODS-100V, 10 nm	2.0	25.0	5	≥ 18,000	18.0
0022714	ODS-100V, 10 nm	3.0	2.0	5	≥ 1,000	9.0
0022715	ODS-100V, 10 nm	3.0	3.5	5	≥ 3,000	9.0
0022716	ODS-100V, 10 nm	3.0	5.0	5	≥ 4,000	12.0
0022717	ODS-100V, 10 nm	3.0	7.5	5	≥ 6,000	18.0
0022718	ODS-100V, 10 nm	3.0	10.0	5	≥ 8,500	18.0
0022719	ODS-100V, 10 nm	3.0	15.0	5	≥ 13,000	18.0
0022720	ODS-100V, 10 nm	3.0	25.0	5	≥ 21,000	18.0
0022721	ODS-100V, 10 nm	4.6	2.0	5	≥ 1,500	9.0
0022722	ODS-100V, 10 nm	4.6	3.5	5	≥ 3,000	9.0
0022723	ODS-100V, 10 nm	4.6	5.0	5	≥ 4,500	12.0
0022724	ODS-100V, 10 nm	4.6	7.5	5	≥ 7,000	18.0
0022725	ODS-100V, 10 nm	4.6	10.0	5	≥ 9,000	18.0
0021455	ODS-100V, 10 nm	4.6	15.0	5	≥ 14,000	18.0
0021456	ODS-100V, 10 nm	4.6	25.0	5	≥ 23,000	21.0
0022726	ODS-100Z, 10 nm, pk 3*	2.0	1.0	3	≥ 500	30.0
0022727	ODS-100Z, 10 nm	2.0	2.0	3	≥ 1,500	12.0

\*needs cartridge holder



Part #	Description	ID (mm)	Length (cm)	Particle size (µm)	Number theoretical plates	Maximum pressure drop (MPa)
0022728	ODS-100Z, 10 nm	2.0	3.5	3	≥ 4,000	15.0
0022729	ODS-100Z, 10 nm	2.0	5.0	3	≥ 5,700	15.0
0022730	ODS-100Z, 10 nm	2.0	7.5	3	≥ 8,600	21.0
0022731	ODS-100Z, 10 nm	2.0	10.0	3	≥ 11,500	24.0
0022732	ODS-100Z, 10 nm	2.0	15.0	3	≥ 17,500	24.0
0022733	ODS-100Z, 10 nm	2.0	25.0	3	≥ 28,000	30.0
0022734	ODS-100Z, 10 nm	3.0	2.0	3	≥ 2,000	12.0
0022735	ODS-100Z, 10 nm	3.0	3.5	3	≥ 4,000	12.0
0022736	ODS-100Z, 10 nm	3.0	5.0	3	≥ 6,000	15.0
0022737	ODS-100Z, 10 nm	3.0	7.5	3	≥ 9,000	21.0
0022738	ODS-100Z, 10 nm	3.0	10.0	3	≥ 12,000	24.0
0022739	ODS-100Z, 10 nm	3.0	15.0	3	≥ 18,000	24.0
0022740	ODS-100Z, 10 nm	3.0	25.0	3	≥ 29,000	30.0
0022741	ODS-100Z, 10 nm	4.6	2.0	3	≥ 2,500	12.0
0022742	ODS-100Z, 10 nm	4.6	3.5	3	≥ 4,500	12.0
0022743	ODS-100Z, 10 nm	4.6	5.0	3	≥ 6,500	15.0
0022744	ODS-100Z, 10 nm	4.6	7.5	3	≥ 9,750	21.0
0022745	ODS-100Z, 10 nm	4.6	10.0	3	≥ 13,500	24.0
0022746	ODS-100Z, 10 nm	4.6	15.0	3	≥ 19,500	24.0
0022747	ODS-100Z, 10 nm	4.6	25.0	3	≥ 30,000	30.0
0022748	ODS-100Z, 10 nm, pk 3*	2.0	1.0	5	≥ 300	28.0
0022749	ODS-100Z, 10 nm	2.0	2.0	5	≥ 1,000	9.0
0022750	ODS-100Z, 10 nm	2.0	3.5	5	≥ 2,500	9.0
0021460	ODS-100Z, 10 nm	2.0	5.0	5	≥ 3,000	18.0
0022751	ODS-100Z, 10 nm	2.0	7.5	5	≥ 5,500	18.0
0022752	ODS-100Z, 10 nm	2.0	10.0	5	≥ 7,000	18.0
0021459	ODS-100Z, 10 nm	2.0	15.0	5	≥ 11,000	18.0
0022753	ODS-100Z, 10 nm	2.0	25.0	5	≥ 18,000	18.0
0022754	ODS-100Z, 10 nm	3.0	2.0	5	≥ 1,200	9.0
0022755	ODS-100Z, 10 nm	3.0	3.5	5	≥ 3,000	9.0
0022756	ODS-100Z, 10 nm	3.0	5.0	5	≥ 4,000	12.0
0022757	ODS-100Z, 10 nm	3.0	7.5	5	≥ 6,000	18.0
0022758	ODS-100Z, 10 nm	3.0	10.0	5	≥ 8,500	18.0
0022759	ODS-100Z, 10 nm	3.0	15.0	5	≥ 13,000	18.0
0022760	ODS-100Z, 10 nm	3.0	25.0	5	≥ 21,000	18.0
0022761	ODS-100Z, 10 nm	4.6	2.0	5	≥ 1,500	9.0
0022762	ODS-100Z, 10 nm	4.6	3.5	5	≥ 3,000	9.0
0022763	ODS-100Z, 10 nm	4.6	5.0	5	≥ 4,500	12.0
0022764	ODS-100Z, 10 nm	4.6	7.5	5	≥ 7,000	18.0
0022765	ODS-100Z, 10 nm	4.6	10.0	5	≥ 9,000	18.0
0021461	ODS-100Z, 10 nm	4.6	15.0	5	≥ 14,000	18.0
0021462	ODS-100Z, 10 nm	4.6	25.0	5	≥ 23,000	21.0

#### TSKgel Guard column products

0021997	ODS-100V Guardgel Cartridge, pk 3*	2.0	1.0	3	For all 3 µm ODS-100V 2 & 3 mm ID columns
0021453	ODS-100V Guard Cartridge, pk 3*	3.2	1.5	5	For all ODS-100V 4.6 mm ID columns
0021841	ODS-100V Guard Cartridge, pk 3*	2.0	1.0	5	For all 5 µm ODS-100V 2 & 3 mm ID columns
0021454	ODS-100Z Guard Cartridge, pk 3*	3.2	1.5	5	For all ODS-100Z 4.6 mm ID columns
0021996	ODS-100Z Guardgel Cartridge, pk 3*	2.0	1.0	3	For all 3 µm ODS-100Z 2 & 3 mm ID columns
0021995	ODS-100Z Guardgel Cartridge, pk 3*	2.0	1.0	5	For all 5 µm ODS-100Z 2 & 3 mm ID columns

\*needs cartridge holder

NOTE: Tosoh Bioscience offers guard columns and guard cartridges to protect your analytical column. Guard cartridges are usually delivered in packages of three and require the appropriate cartridge holder. In general cartridges for 4.6 mm ID columns are produced in 3.2 mm ID and 1.5 cm length. They require the cartridge holder 19018. Guard cartridges for 2 mm ID columns are 2 mm ID x 1 cm L and require holder 19308.

# RPC

## FAST RP COLUMNS TSKgel ODS-140HTP

### HIGHLIGHTS

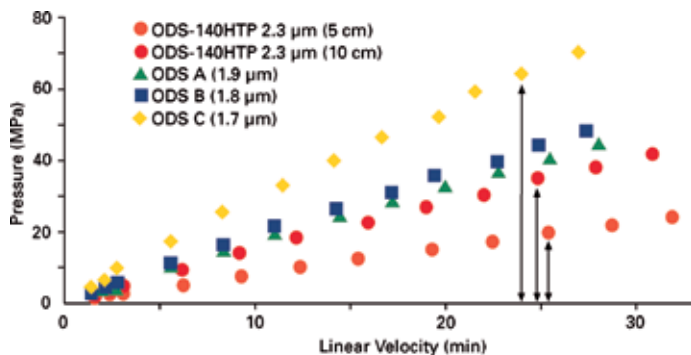
- Moderate pressure at high flow rates
- High resolution and high efficiency
- High throughput applications
- Compatible with HPLC and UPLC systems
- Moderate carbon content
- Poly-layer bonding chemistry

TSKgel ODS-140HTP columns were developed for use in high throughput applications, including drug discovery, pharmacokinetics and peptide digest separations. They are packed with 2.3 μm particles, providing high resolution and short analysis times at moderate pressure. The lower pressure drop reduces the burden on the hardware, allowing TSKgel ODS-140 HTP columns to be used with either UHPLC or conventional HPLC systems. The backpressure of this columns is less than half of the pressure of a sub-2 μm column of the same dimensions (FIGURE 10).

### APPLICATIONS

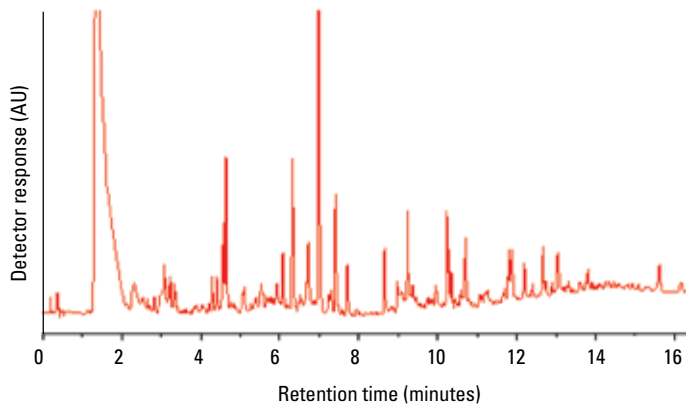
In Vietnamese and Chinese traditional medicine, hot aqueous extract of *Crinum latifolium* is used because of its antitumor activity. *Crinum latifolium* is thought to possess antiviral and immunostimulative properties and shows immunomodulatory properties in human peripheral blood mononuclear cells. The analysis of products derived from plant extracts is a challenging chromatographic task. Due to the high number of components the column needs to provide a high peak capacity, as shown in FIGURE 11.

➤ FIGURE 10 Column backpressure versus particle size



Column: TSKgel ODS-140HTP 2.3 μm (2.0 mm ID x 5.0 cm, 10 cm L)  
Sub-2 μm ODS columns (2.1 mm ID x 5.0 cm L); Eluent: H<sub>2</sub>O/CH<sub>2</sub>CN - 50/50

➤ FIGURE 11 Analysis of crinum latifolium



Column: TSKgel ODS-140HTP 2.3 μm, 2.1 mm ID x 10 cm L;  
Sample: *Crinum latifolium* L extract, 2 μl; Eluent: A: water, B: acetonitrile;  
Gradient: 0 min (5% B), 1.2 min (5% B), 4 min (30% B), 15 min (68% B),  
15.1 min (100% B), 20min (100% B); Flow rate: 0.4 mL/min; Temp.: 40°C;  
Detection: UV@220 nm; Sampling rate: 80 Hz

### ➤ ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size (μm)	Pore size (nm)	Number theoretical plates	Maximum pressure drop (MPa)
21927	TSKgel ODS-140HTP	2.1	5.0	2.3	14	≥ 7,000	60.0
21928	TSKgel ODS-140HTP	2.1	10.0	2.3	14	≥ 14,000	60.0

#### TSKgel stainless steel columns



## FAST RP COLUMNS TSKgel Super-ODS / Super-Octyl / Super-Phenyl

### HIGHLIGHTS

- The silica particles used in Super series columns are monodisperse spherical 2.3  $\mu\text{m}$  beads with 11 nm (110 Å) pores
- TSKgel Super-ODS, Super-Octyl and Super-Phenyl packings are bonded with, respectively, C18, C8 and phenyl functional groups. The bonded phases have a polymeric structure. An exhaustive endcapping reaction minimizes the presence of residual silanol groups
- 2  $\mu\text{m}$  particles provide superior resolution and speed, as well as improved sensitivity
- Pressure drop is not excessive due to the monodisperse particle size distribution

### APPLICATIONS

#### TSKgel SUPER-ODS, SUPER-OCTYL, SUPER-PHENYL

Recommended for small molecular weight compounds (<10,000 Da) such as peptides, amino acids, tryptic digests, nucleotides, pharmaceutical molecules, and food and beverage samples.

### OPTIMIZING RESULTS WITH FAST RP COLUMNS

Super series columns can be used on a regular HPLC system if the dead volume is minimized, although optimal results are obtained with an UHPLC system.

The following recommendations are for 4.6 mm ID columns. Use proportionately lower values for 2 mm ID columns.

1. A guard filter is highly recommended to reduce particulate contamination from the sample or system components.
2. Keep sample volume less than 10  $\mu\text{L}$ .
3. To ensure minimal extra-column volume, keep tubing as short as possible (extra-column volume less than 5  $\mu\text{L}$  between column and detector).
4. Conventional 0.1 mm ID connecting tubing may be used (0.005).
5. The smallest detector time constant should be selected (if possible, less than 50 ms).
6. The detector flow cell should be 2  $\mu\text{L}$  or less for best results. A standard HPLC flow cell (10  $\mu\text{L}$ ) can be used as an alternative, however, it is recommended that the heating coil is removed.

### ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size ( $\mu\text{m}$ )	Number theoretical plates	Flow rate (mL/min) range	Maximum pressure drop (MPa)
<b>TSKgel Stainless Steel Columns</b>							
0020015	Super-ODS, 11 nm	1.0	5.0	2.3	$\geq 15,000$	0.03 - 0.05	15.0
0019541	Super-ODS, 11 nm	2.0	5.0	2.3	$\geq 6,000$	0.15 - 0.2	25.0
0019542	Super-ODS, 11 nm	2.0	10.0	2.3	$\geq 12,000$	0.15 - 0.2	25.0
0018154	Super-ODS, 11 nm	4.6	5.0	2.3	$\geq 8,000$	1.0 - 2.5	30.0
0018197	Super-ODS, 11 nm	4.6	10.0	2.3	$\geq 16,000$	1.0 - 2.5	30.0
0020013	Super-Octyl, 11 nm	2.0	5.0	2.3	$\geq 15,000$	0.15 - 0.20	15.0
0020014	Super-Octyl, 11 nm	2.0	10.0	2.3	$\geq 1,500$	0.15 - 0.20	30.0
0018275	Super-Octyl, 11 nm	4.6	5.0	2.3	$\geq 8,000$	1.0 - 2.5	30.0
0018276	Super-Octyl, 11 nm	4.6	10.0	2.3	$\geq 16,000$	1.0 - 2.5	30.0
0020017	Super-Phenyl, 11 nm	2.0	5.0	2.3	$\geq 3,000$	0.15 - 0.20	8.0
0020018	Super-Phenyl, 11 nm	2.0	10.0	2.3	$\geq 6,000$	0.15 - 0.20	15.0
0018277	Super-Phenyl, 11 nm	4.6	5.0	2.3	$\geq 8,000$	1.0 - 2.5	30.0
0018278	Super-Phenyl, 11 nm	4.6	10.0	2.3	$\geq 16,000$	1.0 - 2.5	30.0
<b>Guard column products</b>							
0019672	Guard cartridge, pk 3*	2.0	1.0	2.3	For 2 mm ID Super-ODS columns		
0019308	Cartridge holder				For P/N 0019672		
0018207	Guard filter, pk 3*	4.0	0.4		For 4.6 mm ID columns (Super-ODS, -Octyl, -Phenyl)		
0018206	Guard filter holder	4.0	0.4		For P/N 0018207		

\*needs cartridge holder

# RPC

## TRADITIONAL RP COLUMNS TSKgel ODS-80Ts / ODS-80T<sub>M</sub> / Octyl-80Ts / CN-80Ts

### HIGHLIGHTS

- ODS-80 is prepared from spherical silica with 8 nm pores
- Monomeric-bonded phase chemistry for optimal lot-to-lot reproducibility
- High (80T<sub>M</sub>) or complete (80Ts) endcapping shields the silica surface from participating in solute retention through ionic interaction
- Particles contain 8 nm pores for fast mass transfer of solutes in the 100 to 6,000 Da MW range
- Available in particle sizes of 5 μm, 10 μm, and 20 μm
- Large surface area and high sample capacity

### APPLICATIONS

#### TSKgel ODS-80T<sub>M</sub>

- Hydrophobic and hydrophilic peptides, synthetic peptides, purity check, peptide mapping
- General purpose column for low MW pharmaceuticals, basic compounds, nucleosides, nucleotides, purines and pyrimidines

#### TSKgel ODS-80Ts

- Complete endcapping makes the TSKgel ODS-80Ts a good choice for strongly basic compounds and for applications that require operation at pH 7.5

#### TSKgel Octyl-80Ts

- Faster kinetics than ODS, but lower hydrophobic selectivity
- Lower hydrophobic selectivity of Octyl versus ODS

#### TSKgel CN-80Ts

- Alternative to ODS and Octyl columns for analysis of polar compounds
- Solvent strength should be reduced to obtain similar retention to Octyl and ODS columns when separating non-polar compounds

### ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size (μm)	Number theoretical plates	Flow rate (mL/min) range	Maximum pressure drop (MPa)
<b>TSKgel Stainless Steel Columns</b>							
0018150	ODS-80Ts, 8 nm	2.0	15.0	5	≥ 11,000	0.15 - 0.18	20.0
0018151	ODS-80Ts, 8 nm	2.0	25.0	5	≥ 18,000	0.15 - 0.18	30.0
0017200	ODS-80Ts, 8 nm	4.6	7.5	5	≥ 4,500	0.8 - 1.0	10.0
0017201	ODS-80Ts, 8 nm	4.6	15.0	5	≥ 11,000	0.8 - 1.0	20.0
0017202	ODS-80Ts, 8 nm	4.6	25.0	5	≥ 18,000	0.8 - 1.0	30.0
0017380	ODS-80Ts, 8 nm	21.5	30.0	10	≥ 6,000	4.0 - 6.0	6.0
0016651	ODS-80T <sub>M</sub> , 8 nm	4.6	7.5	5	≥ 4,500	0.8 - 1.0	10.0
0008148	ODS-80T <sub>M</sub> , 8 nm	4.6	15.0	5	≥ 11,000	0.8 - 1.0	20.0
0008149	ODS-80T <sub>M</sub> , 8 nm	4.6	25.0	5	≥ 18,000	0.8 - 1.0	30.0
0014002	ODS-80T <sub>M</sub> , 8 nm	21.5	30.0	10	≥ 6,000	4.0 - 6.0	6.0
0017344	Octyl-80Ts, 8 nm	4.6	15.0	5	≥ 11,000	0.8 - 1.0	20.0
0017345	Octyl-80Ts, 8 nm	4.6	25.0	5	≥ 18,000	0.8 - 1.0	30.0
0017348	CN-80Ts, 8 nm	4.6	15.0	5	≥ 11,000	0.8 - 1.0	20.0
0017349	CN-80Ts, 8 nm	4.6	25.0	5	≥ 18,000	0.8 - 1.0	30.0
<b>Guard column products</b>							
0019325	ODS-80Ts Guard cartridge, pk 3 *	2.0	1.0	5	For all 2 mm ID ODS-80Ts / ODS-120T columns		
0019011	ODS-80Ts Guard cartridge, pk 3 *	3.2	1.5	5	For all 4.6 mm ID ODS-80Ts columns		
0019012	Octyl-80Ts Guard cartridge, pk 3 *	3.2	1.5	5	For all 4.6 mm ID ODS-80Ts columns		
0017385	ODS-80Ts Guard column	21.5	7.5	10	For P/N 0017380		
0014098	ODS-80T <sub>M</sub> Guard column	21.5	7.5	10	For P/N 0014002		
0019004	ODS-80T <sub>M</sub> Guard cartridge, pk 3 *	3.2	1.5	5	For 4.6 mm ID ODS-80T <sub>M</sub> columns		
0019013	CN-80Ts Guard cartridge, pk 3 *	3.2	1.5	5	For 4.6 mm ID CN-80Ts columns		



## TRADITIONAL RP COLUMNS TSKgel ODS-120A - TSKgel ODS-120T

### HIGHLIGHTS

- TSKgel ODS-120 contains polymeric-bonded octadecyl groups on 12 nm pore size silica
- TSKgel ODS-120A is not endcapped; TSKgel ODS-120T is endcapped with trimethylsilyl groups
- TSKgel 120T columns are available in 2 mm ID format
- Available in 5  $\mu\text{m}$  and 10  $\mu\text{m}$  particle sizes in analytical and semi-preparative columns respectively. Larger particle sizes are available in preparative columns
- Hardware: stainless steel columns for analytical, semi-preparative, and preparative separations

### APPLICATIONS

#### TSKgel ODS-120A

- Polymeric bonded ODS exhibits improved peak shape for the separation of complex geometric isomers, such as polynuclear aromatic hydrocarbons (PAH)
- TSKgel ODS-120A and 120T provide a similar separation at low pH for a mixture of catecholamines, while at pH 6 the basic solutes interact with negatively charged silanol groups on 120A, but not on 120T

#### TSKgel ODS-120T

- Endcapped ODS-120T is an alternative to ODS-80T<sub>M</sub> for peptide and protein separations

### ➤ ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size ( $\mu\text{m}$ )	Number theoretical plates	Flow rate (min) range	Maximum pressure drop (MPa)
<b>TSKgel stainless steel columns</b>							
0007636	ODS-120A, 12 nm	4.6	15.0	5	$\geq 7,000$	0.8 - 1.0	15.0
0007124	ODS-120A, 12 nm	4.6	25.0	5	$\geq 10,000$	0.8 - 1.0	20.0
0007129	ODS-120A, 12 nm	7.8	30.0	10	$\geq 6,000$	1.0 - 2.0	7.5
0006172	ODS-120A, 12 nm	21.5	30.0	10	$\geq 6,000$	4.0 - 6.0	6.0
0018152	ODS-120T, 12 nm	2.0	15.0	5	$\geq 6,500$	0.15 - 0.18	15.0
0018153	ODS-120T, 12 nm	2.0	25.0	5	$\geq 10,000$	0.15 - 0.18	20.0
0007637	ODS-120T, 12 nm	4.6	15.0	5	$\geq 7,000$	0.8 - 1.0	15.0
0007125	ODS-120T, 12 nm	4.6	25.0	5	$\geq 10,000$	0.8 - 1.0	20.0
0007130	ODS-120T, 12 nm	7.8	30.0	10	$\geq 6,000$	1.0 - 2.0	7.5
0007134	ODS-120T, 12 nm	21.5	30.0	10	$\geq 6,000$	3.0 - 6.0	6.0
<b>Guard column products</b>							
0019006	ODS-120T Guard cartridge, pk 3*	3.2	1.5	5	For all 2 mm ID ODS-120T columns		
0019005	ODS-120A Guard cartridge, pk 3*	3.2	1.5	5	For 4.6 mm ID ODS-120T columns		
0019018	Guard cartridge holder	3.2	1.5	For 3.2 mm ID cartridges			
0019308	Guard cartridge holder	2.0	1.5	For all 2 mm ID Guard columns			

# RPC

## POLYMER BASED RP COLUMNS TSKgel Octadecyl-NPR / -2PW / -4PW/ -Phenyl-5PW RP

### HIGHLIGHTS

- Polymer-based RPC columns are chemically stable at pH 2-12, allowing operation at basic pH where silica-based columns have limited chemical stability.
- Polymer-based columns can be cleaned and impurities removed by using either strong acid or base.
- Non-porous resins (NPR) or porous resins of various pore sizes available. Column selection is based on sample MW or application.
- 2.5 µm particle size TSKgel Octadecyl-NPR resin features fast kinetics resulting in high column efficiency and quantitative protein recovery at sub-microgram loads.
- TSKgel Octadecyl-2PW with 5 µm particle size and 12.5 nm pores size.
- TSKgel Octadecyl-4PW with 7 µm particle size and 50 nm pores size.
- TSKgel Phenyl-5PW with 10 µm particle size and an average pore size of 100 nm. In comparison with the Phenyl-5PW packing material used in HIC, the greater level of hydrophobicity in TSKgel Phenyl-5PW RP makes this material more suitable for use in RPC.

### APPLICATIONS

- TSKgel OCTADECYL-NPR**
- High efficiency purification of proteins and peptides at sub-microgram loads
  - Stable to higher pressures than porous particles
  - Improved recovery at low sample concentration over traditional porous resins
- TSKgel OCTADECYL-2PW**
- For analyzing small MW pharmaceutical compounds at basic pH
  - Faster analysis than competitive polymeric RPC columns
- TSKgel OCTADECYL-4PW**
- Recommended for peptides and small proteins
- TSKgel PHENYL-5PW RP**
- Ideal for the separation of proteins, including high MW
  - Able to handle high loads (high capacity)

### ORDERING INFORMATION

Part #	Description	ID (mm)	Length (cm)	Particle size (µm)	Number theoretical plates	Flow rate (mL/min) range	Maximum pressure drop (MPa)
<b>TSKgel stainless steel columns</b>							
0014005	Octadecyl-NPR nonporous	4.6	3.5	2.5	≥ 1,000	1.0 - 1.5	20.0
0018754	Octadecyl-2PW, (10 - 12.5 nm)	2.0	15.0	5	≥ 5,000	0.07 - 0.11	7.0
0017500	Octadecyl-2PW, (10 - 12.5 nm)	4.6	15.0	5	≥ 6,000	0.4 - 0.6	10.0
0017501	Octadecyl-2PW, (10 - 20 nm)	6.0	15.0	5	≥ 6,000	0.5 - 1.0	10.0
0018755	Octadecyl-4PW, 50 nm	2.0	15.0	7	≥ 2,000	0.08 - 0.17	10.0
0013351	Octadecyl-4PW, 50 nm	4.6	15.0	7	≥ 2,000	0.5 - 1.0	12.0
0016257	Octadecyl-4PW, 50 nm	21.5	15.0	13	≥ 2,000	3.0 - 6.0	2.5
0018756	Phenyl-5PW RP, 100 nm	2.0	7.5	10	≥ 400	0.05 - 0.1	1.0
0008043	Phenyl-5PW RP, 100 nm	4.6	7.5	10	≥ 500	0.5 - 1.0	3.0
0016260	Phenyl-5PW RP, 100 nm	21.5	15.0	13	≥ 1,000	6.0 - 8.0	3.0
<b>Glass columns</b>							
0014007	Phenyl-5PW RP Glass, 100 nm	8.0	7.5	10	≥ 700	1.0 - 2.0	2.0
<b>Guard column products</b>							
0019007	Phenyl-5PW RP Cartridge, pk 3 *	3.2	1.5	10	For P/N 0008043		
0017502	Octadecyl-2PW Guard column	4.6	1.0	5	For P/N 0017500		
0017503	Octadecyl-2PW Guard column	6.0	1.0	5	For P/N 0017501		
0019008	Octadecyl-4PW Cartridge, pk 3 *	3.2	1.5	7	For P/N 0013351		
0019308	Guard cartridge holder	2.0	1.0	For all 2 mm ID cartridges			
0019018	Guard cartridge holder	3.2	1.5	For 4.6 mm ID Octadecyl 4-PW and Phenyl-5PW RP columns			

\*needs cartridge holder