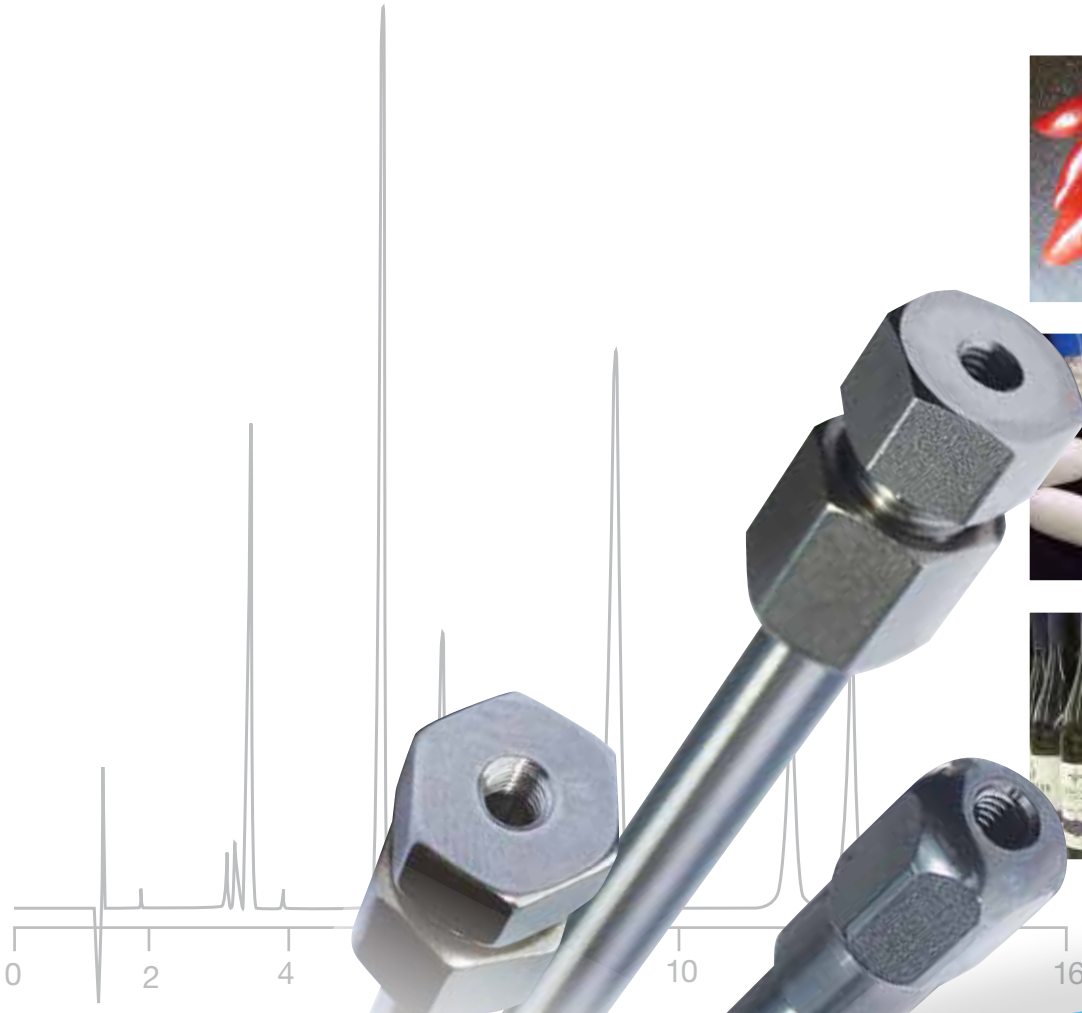
PRINCETON CHROMATOGRAPHY INC



constantly innovating & pushing the limits of HPLC & SFC

广州菲罗门科学仪器有限公司
Guangzhou FLM Scientific Instrument Co., Ltd

PRINCETON CHROMATOGRAPHY INC

ABOUT US

Princeton Chromatography Inc., based in Cranbury, New Jersey, USA, was founded in 1994. We have over 40 years experience in chromatography and are one of the earliest developers of novel commercial SFC phases.

Princeton Chromatography Inc. delivers the highest quality, cutting edge products backed by unmatched technical support. From SFC to HPLC, analytical to preparative, all columns are manufactured on-site and subjected to rigid quality standards.

Every SFC and HPLC column is tested and shipped with an original chromatogram. All stationary phase media are bonded at our facility, so the quality and reproducibility of each batch can be closely monitored. All columns are packed and tested on-site by our team of production specialists to ensure the highest level of satisfaction for our customers.

Princeton Chromatography manufactures a wide range of phases for SFC and both reversed-phase and normal-phase HPLC. We are one of the world leaders in the development of innovative SFC phases.

With so many stationary phases and column dimensions to choose from, we can make your scale up easy and worry free. From 2.0 mm screening columns for LC-MS to kilograms of bulk media, we are with you every step of the way.

PRINCETON CHROMATOGRAPHY INC. OFFERS:

- Widest selection of bonded achiral SFC phases on the market
- Wide range of HPLC phases for analytical and preparative applications
- Bulk materials for HPLC
- Custom column packing services for SFC, SMB and preparative applications
- Chiral media repacking services
- Small scale purification service

SFC Overview

Supercritical Fluid Chromatography (SFC) is a chromatographic technique which uses a supercritical fluid as the mobile phase. Although SFC has been around for some time, its adaptation as an orthogonal technique to HPLC, particularly in the pharmaceutical industry, has seen an increase over the last few years. This interest has been fuelled by the increasing requirement for high throughput and a desire for 'green' techniques. Large reductions in the use of solvents have significant benefits in terms of decreased sample processing and drying-down times in preparative SFC, as well as providing cost and safety benefits.

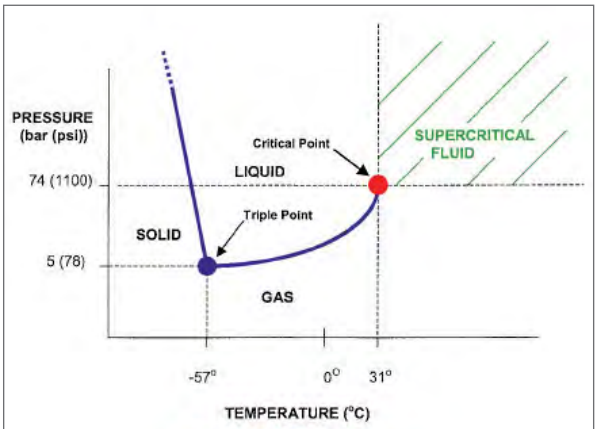


Figure 1. CO_2 Phase Diagram

Liquefied CO_2 is most commonly used as the main fluid in SFC, with the addition of a modifier such as methanol (typically 2% to 60% v/v) to aid elution of very polar or ionic compounds. The modifier improves the solvating power of the supercritical fluid and enhances the selectivity of the separation. Supercritical fluids can have solvating powers similar to organic solvents but with higher diffusivity, lower viscosity and lower surface tension. The lower viscosity allows higher flow rates compared to HPLC, leading to faster methods. Any solute soluble in methanol or a less polar organic solute will elute in SFC. For polar compounds, a more polar additive may also be added to the mobile phase to facilitate elution and improve peak shape.

Packed column SFC has developed from HPLC instrumentation and columns. The mobile phase is kept supercritical by an electronically controlled variable pressure restrictor positioned after the detector.

Key Benefits of SFC

- Fast analyses
- Reduced solvent consumption
- High flow rates possible
- Lower cost per sample
- Compatible with MS
- Excellent for preparative separations

Retention mechanisms in SFC are currently not well understood, but depend mainly on the nature of the stationary phase. SFC is generally seen as a normal-phase technique, predominantly using polar stationary phases, along with less polar mobile phases. However, hydrophobic C18 bonded silica phases offer a reversed-phase retention mode and different selectivity. In fact any HPLC phase can be used for SFC, in addition to the wide range of available phases specifically designed for SFC.

The table below shows typical starting conditions for an achiral analytical SFC assay. For basic analytes, a pyridine based column is a good starting point. For acidic compounds, a diol type column may be more retentive. Neutral compounds do not generally require an additive for elution.

Typical Analytical Conditions for Achiral SFC

Stationary Phase	Silica, Diol, 2-Ethylpyridine etc.
Column Dimensions Length i.d.	 5, 10, 75, 150, 250 mm 2.0, 3.0, 4.0, 4.6 mm
Mobile Phase CO_2 Modifier Additive 1*	Flow rate: 1 – 5 ml/min Methanol 0.1% Diethylamine or 15mM ammonium acetate (for basic compounds) 0.1% TFA or 0.1% formic acid (for acidic compounds)
Gradient	5 – 50% modifier
Pressure	100 - 200 bar
Temperature	35 – 45°C
Detection	UV, MS, ELSD, CAD

* 1 - 5% water may also be added if required

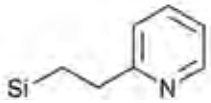
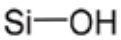
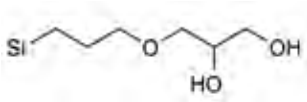
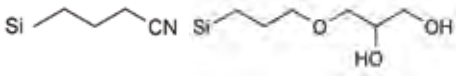
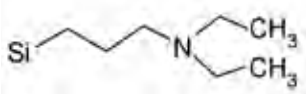
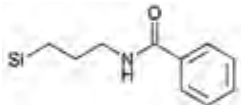
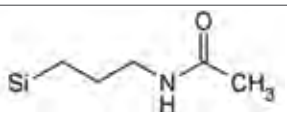
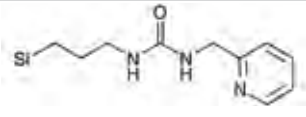
PRINCETON CHROMATOGRAPHY INC

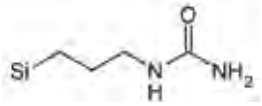
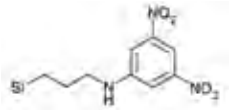
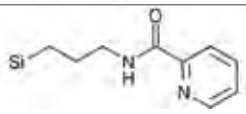
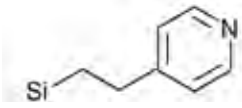
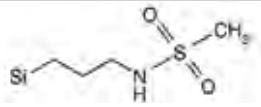
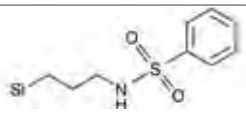
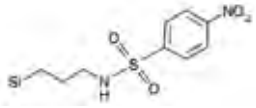
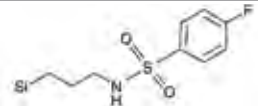
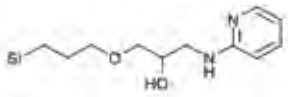
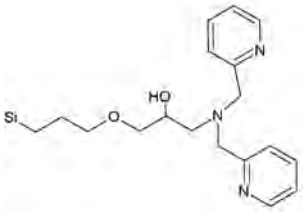
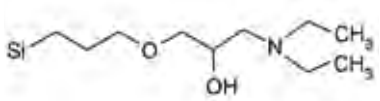
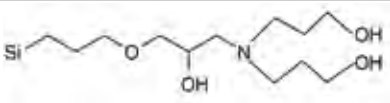
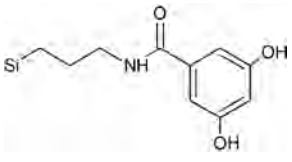
PrincetonSFC Phases

Achiral SFC separations typically require 'normal-phase' type polar stationary phases, such as silica, amino, cyano and diol. Although these phases are adequate for many applications, there is still a need for additional polar phases to meet the demands of difficult separations.

At Princeton Chromatography we have led the way in developing a series of novel amide, urea and pyridine phases that enhance the capability of the SFC technique by providing increased selectivity and loading capacity. Princeton Chromatography was the first company to develop and market the popular 2-Ethylpyridine phase which was launched in 2001 and later the 4-Ethylpyridine phase. PrincetonSFC 2-Ethylpyridine is non-endcapped and has become the column of choice for achiral SFC analysis of basic compounds. This phase generally requires no addition of amines to the eluent, producing excellent peak shape and reproducibility.

A diol phase is a popular and versatile stationary phase for SFC. We have also developed several different hydroxylated stationary phases, most notably the HA Series, which offer excellent selectivity and retention characteristics. These phases are a great starting point for impurity analysis.

Phase	Pore Size (Å)	Particle Size (µm)	Structure	Phase Code
2-Ethylpyridine	60 100 300	3, 5, 10 2.5, 3, 5, 10 3, 5, 10		77
Silica	60 100	3, 5, 10 3, 5, 10		10
Cyano	60 100	3, 5, 10 3, 5, 10		07
DIOL	60 100	3, 5, 10 3, 5, 10		09
DIOL-HL	60	5, 10		79
2CN:DIOL	60 100	3, 5, 10 3, 5, 10		86
Amino	60 100	3, 5, 10 3, 5, 10		08
DEAP (Diethylamino)	60	3, 5, 10		75
Benzamide	100	3, 5, 10		76
PA (Propylacetamide)	60	3, 5, 10		80
PPU (Propylpyridylurea)	100	3, 5, 10		82

Phase	Pore Size (Å)	Particle Size (µm)	Structure	Phase Code
Propylurea	100	3, 5, 10		36
DNP (Dinitrophenyl)	100	3, 5, 10		93
Pyridine Amide	60	3, 5, 10		83
4-Ethylpyridine	60 100	3, 5, 10 3, 5, 10		90
Methane Sulfonamide	60	3, 5, 10		91
Benzene Sulfonamide	100	3, 5, 10		92
4-Nitrobenzene Sulfonamide	100	3, 5, 10		95
4-Fluorobenzene Sulfonamide	100	3, 5, 10		96
HA-Pyridine	60	3, 5, 10		87
HA-Dipyridyl	100	3, 5, 10		88
HA-DEA (Diethylamino)	60	3, 5, 10		65
HA-DHP (Dihydroxypropyl)	100	3, 5, 10		69
3,5-Dihydroxyphenyl	100	3, 5, 10		45

PRINCETON CHROMATOGRAPHY INC

PrincetonSFC Analytical Columns

PrincetonSFC analytical columns are available with lengths of 50 to 250 mm and internal diameters of 2.0, 3.0, 4.0 and 4.6 mm. All PrincetonSFC columns are individually quality assured by SFC. Available particle sizes are 3, 5 and 10 µm, with an additional 2.5 µm particle size phase available for the PrincetonSFC 2-Ethylpyridine columns. Pore sizes of 60, 100 and 300Å (for 2-Ethylpyridine phase) are available.

Ordering Information

In order to determine the part number of your required PrincetonSFC analytical column, just insert the phase code **X** from the table below into the part number table (e.g. for a 150 x 4.6 mm 2-Ethylpyridine column with a pore size of 60 Å and a particle size of 5 µm, the part number is 150046-01577).

PHASE CODES:

Phase	Code X	Phase	Code X	Phase	Code X
2-Ethylpyridine	77	Benzamide	76	Benzene Sulfonamide	92
Silica	10	PA	80	4-Nitrobenzene Sulfonamide	95
Cyano	07	PPU	82	4-Fluorobenzene Sulfonamide	96
DIOL	09	Propylurea	36	HA-Pyridine	87
DIOL-HL	79	DNP	93	HA-Dipyridyl	88
2CN:DIOL	86	Pyridine Amide	83	HA-DEA	65
Amino	08	4-Ethylpyridine	90	HA-DHP	69
DEAP	75	Methane Sulfonamide	91	3,5-Dihydroxyphenyl	45

Pore Size (Å)	Particle Size (µm)	Column Length (mm)	Column i.d. (mm)			
			2.0	3.0	4.0	4.6
60	3	50	050020-013X	050030-013X	050040-013X	050046-013X
60	3	75	075020-013X	075030-013X	075040-013X	075046-013X
60	3	100	100020-013X	100030-013X	100040-013X	100046-013X
60	3	150	150020-013X	150030-013X	150040-013X	150046-013X
60	3	250	250020-013X	250030-013X	250040-013X	250046-013X
60	5	50	050020-015X	050030-015X	050040-015X	050046-015X
60	5	75	075020-015X	075030-015X	075040-015X	075046-015X
60	5	100	100020-015X	100030-015X	100040-015X	100046-015X
60	5	150	150020-015X	150030-015X	150040-015X	150046-015X
60	5	250	250020-015X	250030-015X	250040-015X	250046-015X
60	10	50	050020-010X	050030-010X	050040-010X	050046-010X
60	10	75	075020-010X	075030-010X	075040-010X	075046-010X
60	10	100	100020-010X	100030-010X	100040-010X	100046-010X
60	10	150	150020-010X	150030-010X	150040-010X	150046-010X
60	10	250	250020-010X	250030-010X	250040-010X	250046-010X
100	3	50	050020-033X	050030-033X	050040-033X	050046-033X
100	3	75	075020-033X	075030-033X	075040-033X	075046-033X
100	3	100	100020-033X	100030-033X	100040-033X	100046-033X
100	3	150	150020-033X	150030-033X	150040-033X	150046-033X
100	3	250	250020-033X	250030-033X	250040-033X	250046-033X
100	5	50	050020-035X	050030-035X	050040-035X	050046-035X
100	5	75	075020-035X	075030-035X	075040-035X	075046-035X
100	5	100	100020-035X	100030-035X	100040-035X	100046-035X
100	5	150	150020-035X	150030-035X	150040-035X	150046-035X
100	5	250	250020-035X	250030-035X	250040-035X	250046-035X
100	10	50	050020-030X	050030-030X	050040-030X	050046-030X
100	10	75	075020-030X	075030-030X	075040-030X	075046-030X
100	10	100	100020-030X	100030-030X	100040-030X	100046-030X
100	10	150	150020-030X	150030-030X	150040-030X	150046-030X
100	10	250	250020-030X	250030-030X	250040-030X	250046-030X
300	3	50	050020-083X	050030-083X	050040-083X	050046-083X
300	3	75	075020-083X	075030-083X	075040-083X	075046-083X
300	3	100	100020-083X	100030-083X	100040-083X	100046-083X
300	3	150	150020-083X	150030-083X	150040-083X	150046-083X
300	3	250	250020-083X	250030-083X	250040-083X	250046-083X
300	5	50	050020-085X	050030-085X	050040-085X	050046-085X
300	5	75	075020-085X	075030-085X	075040-085X	075046-085X

Guard cartridges are available for PrincetonSFC analytical columns – please enquire.

PrincetonSFC Analytical Columns (continued)

Pore Size (Å)	Particle Size (µm)	Column Length (mm)	Column i.d. (mm)			
			2.0	3.0	4.0	4.6
300	5	100	100020-085X	100030-085X	100040-085X	100046-085X
300	5	150	150020-085X	150030-085X	150040-085X	150046-085X
300	5	250	250020-085X	250030-085X	250040-085X	250046-085X
300	10	50	050020-080X	050030-080X	050040-080X	050046-080X
300	10	75	075020-080X	075030-080X	075040-080X	075046-080X
300	10	100	100020-080X	100030-080X	100040-080X	100046-080X
300	10	150	150020-080X	150030-080X	150040-080X	150046-080X
300	10	250	250020-080X	250030-080X	250040-080X	250046-080X

Guard cartridges are available for PrincetonSFC analytical columns – please enquire.

PrincetonSFC Semi-preparative and Preparative SFC Columns

All Princeton semi-preparative and preparative SFC columns are packed using the same high quality bonded phases as the corresponding analytical columns, making scale up from analytical dimensions seamless and straightforward. Princeton preparative columns are available with internal diameters from 7.8 to 50.0 mm and in lengths from 50 mm to 250 mm. All columns are quality controlled by SFC and individual SFC documentation is included with each column.

Ordering Information

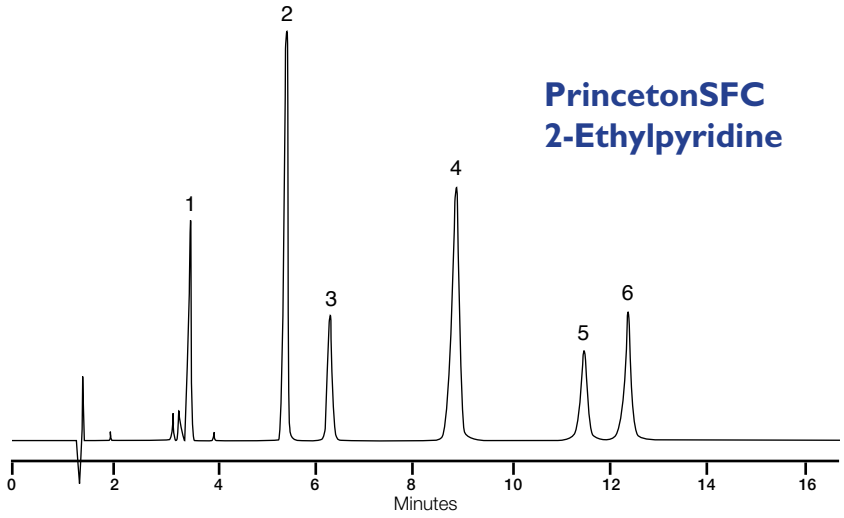
Part numbers are determined using the same phase codes as for analytical columns (see page 4 for phase code table). e.g. for a 250 x 21.2 mm Propylurea column with a pore size of 100 Å and particle size of 10 µm, the part number is 250212-03036

Pore Size (Å)	Particle Size (µm)	Column Length (mm)	Column i.d. (mm)				
			7.8	10.0	21.2	30.0	50.0
60	5	50	050078-015X	050100-015X	050212-015X	050300-015X	050500-015X
60	5	100	100078-015X	100100-015X	100212-015X	100300-015X	100500-015X
60	5	150	150078-015X	150100-015X	150212-015X	150300-015X	150500-015X
60	5	250	250078-015X	250100-015X	250212-015X	250300-015X	250500-015X
60	10	50	050078-010X	050100-010X	050212-010X	050300-010X	050500-010X
60	10	100	100078-010X	100100-010X	100212-010X	100300-010X	100500-010X
60	10	150	150078-010X	150100-010X	150212-010X	150300-010X	150500-010X
60	10	250	250078-010X	250100-010X	250212-010X	250300-010X	250500-010X
100	5	50	050078-035X	050100-035X	050212-035X	050300-035X	050500-035X
100	5	100	100078-035X	100100-035X	100212-035X	100300-035X	100500-035X
100	5	150	150078-035X	150100-035X	150212-035X	150300-035X	150500-035X
100	5	250	250078-035X	250100-035X	250212-035X	250300-035X	250500-035X
100	10	50	050078-030X	050100-030X	050212-030X	050300-030X	050500-030X
100	10	100	100078-030X	100100-030X	100212-030X	100300-030X	100500-030X
100	10	150	150078-030X	150100-030X	150212-030X	150300-030X	150500-030X
100	10	250	250078-030X	250100-030X	250212-030X	250300-030X	250500-030X
300	5	50	050078-085X	050100-085X	050212-085X	050300-085X	050500-085X
300	5	100	100078-085X	100100-085X	100212-085X	100300-085X	100500-085X
300	5	150	150078-085X	150100-085X	150212-085X	150300-085X	150500-085X
300	5	250	250078-085X	250100-085X	250212-085X	250300-085X	250500-085X
300	10	50	050078-080X	050100-080X	050212-080X	050300-080X	050500-080X
300	10	100	100078-080X	100100-080X	100212-080X	100300-080X	100500-080X
300	10	150	150078-080X	150100-080X	150212-080X	150300-080X	150500-080X
300	10	250	250078-080X	250100-080X	250212-080X	250300-080X	250500-080X

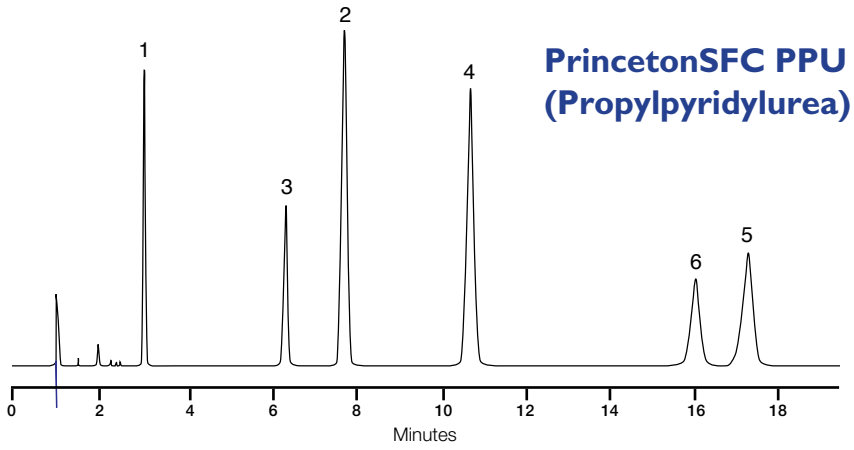
Guard cartridges are available for PrincetonSFC preparative columns – please enquire.

SFC Applications

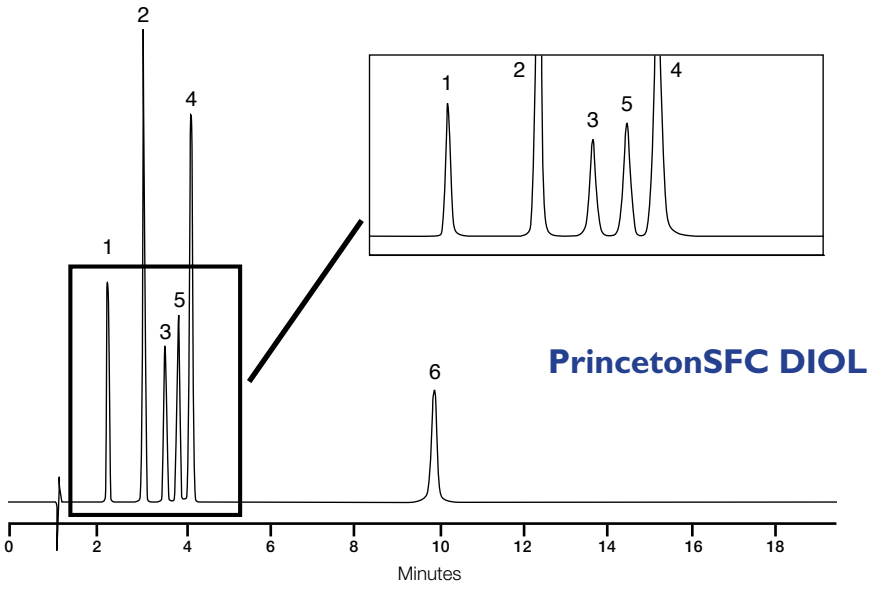
Selectivity of PrincetonSFC 2-Ethylpyridine, PPU and DIOL



PrincetonSFC 2-Ethylpyridine



PrincetonSFC PPU (Propylpyridylurea)



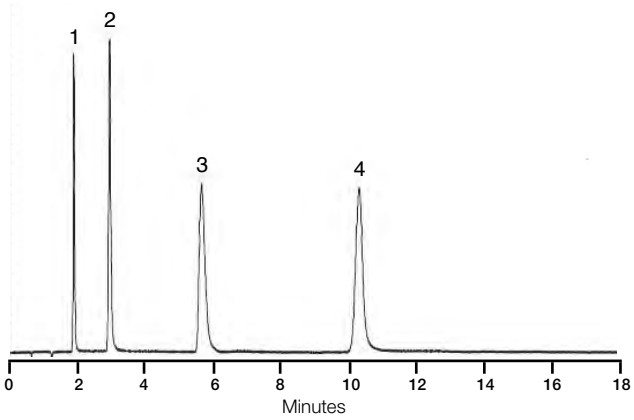
PrincetonSFC DIOL

Column Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (80:20)
Flow Rate: 2.0 ml/min
Detection: UV at 230 nm

1. Ibuprofen
2. Aspirin
3. Ketoprofen
4. Indomethacin
5. Diclofenac
6. Sulindac

Changing stationary phase is a powerful tool for altering selectivity

SFC Applications



Separation of Four β-Blockers

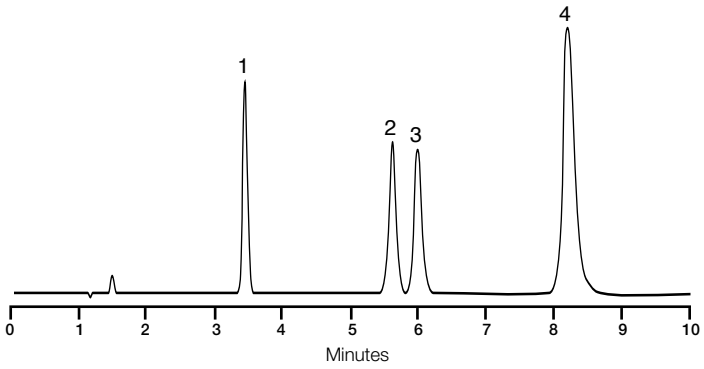
Column: PrincetonSFC 2-Ethylpyridine, 60 Å, 5 µm
Catalog No: 250046-01577
Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (90:10)
Additive: 0.1% N,N-diisopropylethylamine
Flow Rate: 5 ml/min
Temperature: 40°C
Detection: UV at 220 nm
Injection Volume: 4 µl

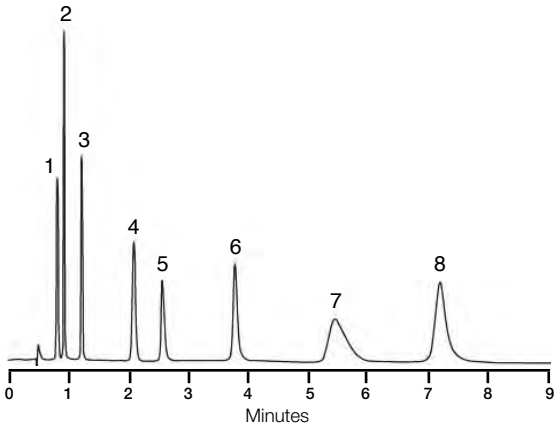
1. Metopropol tartrate	7.3 mg/ml
2. dl-Propranolol HCl	2.5 mg/ml
3. Acebutolol HCl	10.8 mg/ml
4. Pindolol	4.8 mg/ml

Diuretic Compounds

Column: PrincetonSFC Benzamide, 100 Å, 5 µm
Catalog No: 250046-03576
Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (75.25)
Flow Rate: 2 ml/min
Temperature: 40°C
Detection: UV at 220 nm

1. Diazoxide
2. Bendroflumethiazide
3. Hydroflumethiazide
4. Hydrochlorothiazide



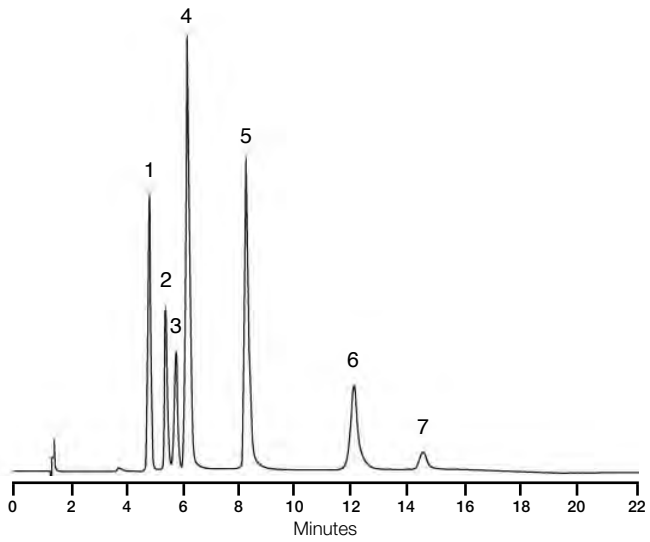


Separation of Basic Compounds

Column: PrincetonSFC Propylurea, 100 Å, 5 µm
Catalog No: 150046-03536
Dimensions: 150 x 4.6 mm
Eluent: CO_2 - CH_3OH (90:10)
Additive: 0.1% diethylamine
Flow Rate: 4.0 ml/min
Detection: UV at 254 nm

1. 7-Azaindole
2. 2-Benzylamino-4-methylpyridine
3. 2H-Pyrido[3,2,b]-1,4-oxazin-3(4H)-one
4. 4-Azabenzimidazole
5. Niacinamide
6. 1-Aminoisoquinoline
7. 2,6-Diaminopyridine
8. 1-(2-Pyridyl)piperazine

SFC Applications



Separation of β-Blockers

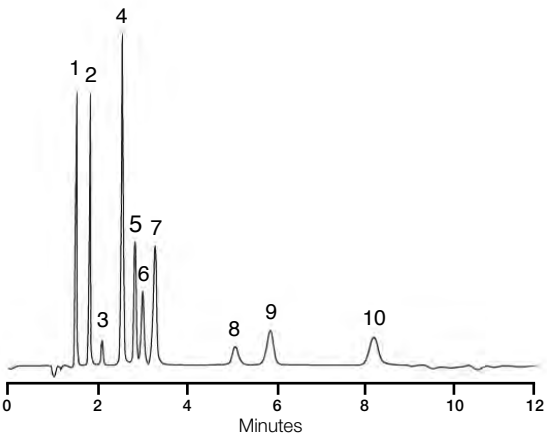
Column: PrincetonSFC Silica, 5 µm
Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (70:30)
Additive: 0.1% TEA
Flow Rate: 2.0 ml/min
Detection: UV at 273 nm

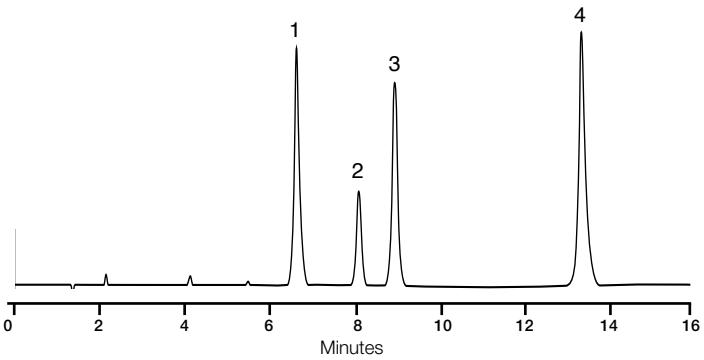
1. Timolol
2. Oxprenolol
3. Metroprolol
4. Propranolol
5. Pindolol
6. Acebutolol
7. Atenolol

SFC Separation of Test Compounds on PrincetonSFC Methane Sulfonamide

Column: PrincetonSFC Methane Sulfonamide, 5 µm
Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (60:40)
Additive: 0.2% diethylamine
Flow Rate: 2.35 ml/min
Detection: UV at 254 nm

1. Caffeine
2. Theophylline
3. Theobromine
4. Thymine
5. Uracil
6. 5-Fluorouracil
7. Adenine
8. Hypoxanthine
9. 5-Fluorocytosine
10. Cytosine





Separation of Steroids

Column: PrincetonSFC Benzamide
Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (90:10)
Flow Rate: 2 ml/min
Temperature: 40°C
Detection: UV at 254 nm

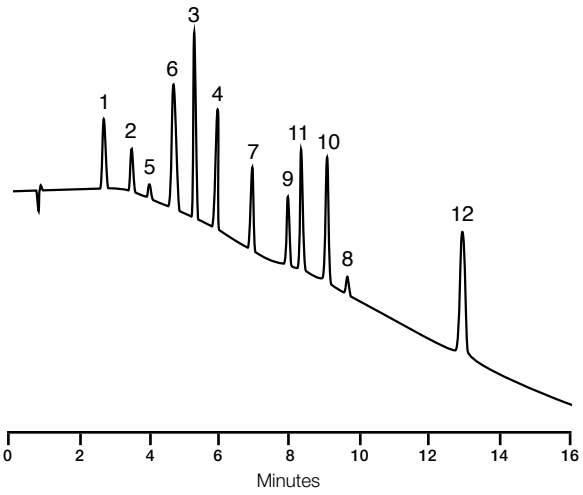
1. Corticosterone
2. Cortisone
3. Prednisone
4. Prednisolone

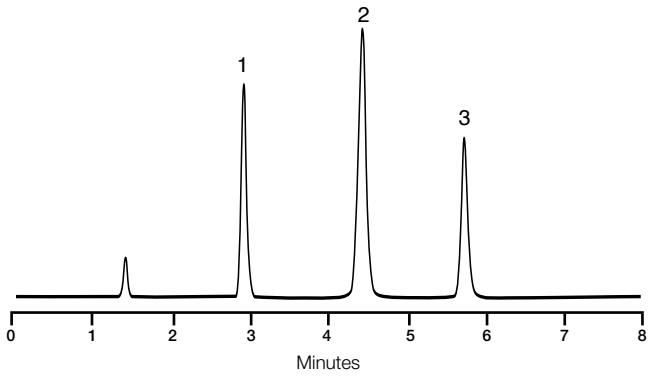
SFC Applications

Test Mixture on PrincetonSFC 2CN:DIOL

Column: PrincetonSFC 2CN:DIOL, 100 Å, 5 µm
Dimensions: 150 x 4.6 mm
Gradient: 0-1 mins 5% CH_3OH (0.1% diethylamine)
1-18 min 5%-40% CH_3OH
18-22 min 40% CH_3OH
22-30 min - initial conditions
Flow Rate: 3 ml/min
Temperature: 40°C
Detection: UV at 254 nm

1. Caffeine
2. Theophylline
3. Thymine
4. Uracil
5. Fenoprofen
6. Flurbiprofen
7. Prednisone
8. Hypoxanthine
9. Hydrocortisone
10. Sulfamerazine
11. Sulfamethoxazole
12. Sulfaguanidine





Separation of Antimicrobials

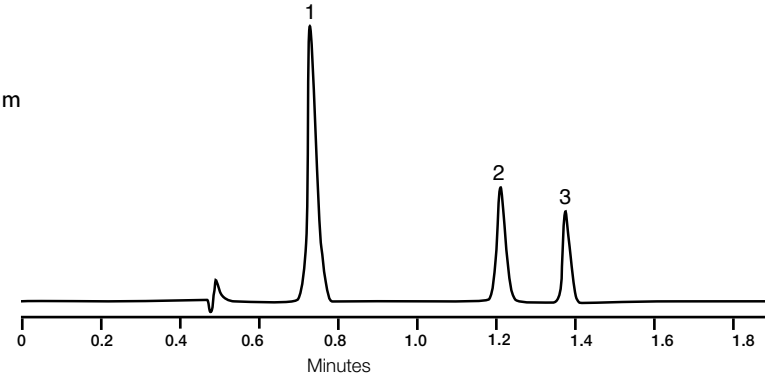
Column: PrincetonSFC Propylacetamide
Dimensions: 250 x 4.6 mm
Eluent: CO_2 - CH_3OH (80:20)
Flow Rate: 2 ml/min
Temperature: 40°C
Detection: UV at 254 nm

1. Furazolidone
2. Sulfadimethoxine
3. Sulfaquinoxiline

Separation of Pyridine Amides

Column: PrincetonSFC 2-Ethylpyridine. 100 Å, 5 µm
Dimensions: 150 x 4.6 mm
Eluent: CO_2 – CH_3OH (85:15)
Flow Rate: 4.0 ml/min
Temperature: 40°C
Detection: UV at 220 nm

1. Picolinamide
2. Niacinamide
3. Isonicotinamide



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Global Distribution Partner
Hichrom Ltd, 1 The Markham Centre, Station Road, Theale, Reading, Berkshire RG7 4PE UK
T: +44 (0) 118 9303660 • F: +44 (0) 118 9323484 • Email: sales@hichrom.co.uk • www.hichrom.co.uk

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地址：广州天河北路179号尚层国际商务楼13层
邮编：510620
网址：www.gzflm.com
邮箱：gz@gzflm.com

北京办事处：010-64468933
上海办事处：021-34553051
成都办事处：028-85190497

广州菲罗门科学仪器有限公司
Guangzhou FLM Scientific Instrument Co., Ltd

Princeton Chromatography Inc.
1206 Cranbury So. River Road, Cranbury, NJ 08512
T: 1-609-860-1803 • F: 1-609-860-1805 • Email: sales@pci-hplc.com • www.pci-hplc.com

Global Distribution Partner
Hichrom Ltd, 1 The Markham Centre, Station Road, Theale, Reading, Berkshire RG7 4PE UK
T: +44 (0) 118 9303660 • F: +44 (0) 118 9323484 • Email: sales@hichrom.co.uk • www.hichrom.co.uk