C190-E236A

SHIMADZU
Excellence in Science

Semi-Preparative Supercritical Fluid Chromatography System

Nexera UC Prep

Unparalleled performance, unparalleled flexibility

The Nexera™ UC Prep is a new preparative supercritical fluid chromatography system that offers both the high basic performance developed for the previous Nexera UC model and original state-of-the-art preparative SFC technologies.

It resolves a number of issues in preparative tasks, reducing labor and improving efficiency while fitting into pre-existing workflows. Not only does the Nexera UC Prep achieve superior recovery rates for purification, it provides flexible system configurations in a compact design, requiring low installation space and allowing you to maximize lab resources.

Winner of the Pittcon 2019 Editors' Awards Gold Prize

Unique LotusStream™ separator technology achieves higher recovery rates

Unique gas-liquid separation technology is used to minimize the potential for low sample recovery due to eluate scattering during carbon dioxide vaporization, achieving high recovery rates even for volatile compounds.

Simple operation fits seamlessly into preparative workflow

The dedicated software with intuitive preparative settings ensures peaks can be separated reliably by users of all experience levels.

Compact, benchtop design

This space-saving benchtop model includes a carbon dioxide pump that does not require an external chiller (cooling system for heat generated when pumping CO_2 at high flow rates). In addition, one unit can handle a wide range of flow rates, lowering installation costs.

Add fractionation capabilities to the analytical SFC system

By adding a fraction collector to the analytical scale SFC, small volume fractionation is also possible. A complete workflow can be carried out seamlessly on one system, from method development to fractionation.

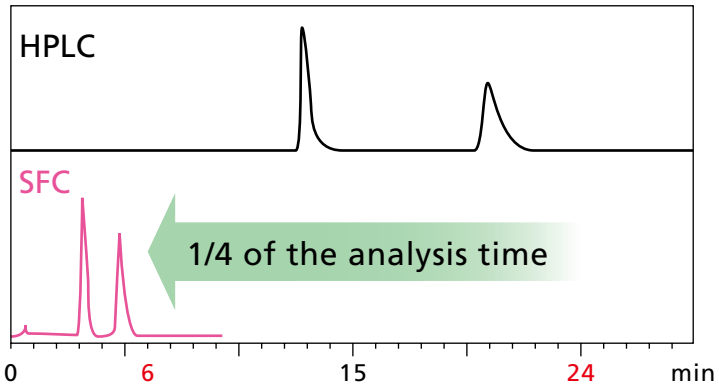
Supercritical fluid: A fluid that has surpassed the critical point, and has the characteristics of both a gas and a liquid such as low viscosity, high diffusivity and high solubility. Carbon dioxide is the most commonly-used supercritical fluid for analysis and preparative tasks.

Unique technology achieves higher recovery rates

In purification using SFC, the target compounds are recovered in high concentrations in an organic solvent, which saves time not only during analysis, but also during post-run processing after preparative tasks are complete. The Nexera UC Prep maximizes fractionation output with its high recovery rates and ability to carry out continuous preparative work that further shortens the user's waiting time.

SFC shortens analysis times

Due to the low viscosity and high diffusivity of supercritical carbon dioxide, column backpressure for SFC is low even at high flow rates which enables faster analysis without sacrificing column efficiency. This allows significantly shorter analysis times than HPLC.



High recovery rates

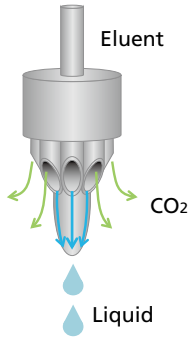
In preparative SFC, one factor that results in lower recovery rates is increased scattering of the eluent when the CO_2 returns from a supercritical to a gaseous state. The Nexera UC Prep's patented gas-liquid separator, the LotusStream separator, successfully reduces sample dispersion and carryover, while also achieving high recovery rates. These high recovery rates can be obtained regardless of flow rate or modifier concentration, even for volatile compounds such as the fragrance linalool.

Comparison for 1% linalool

Equipment	Recovery rate
Conventional separator	78.0%
LotusStream Separator	96.7%

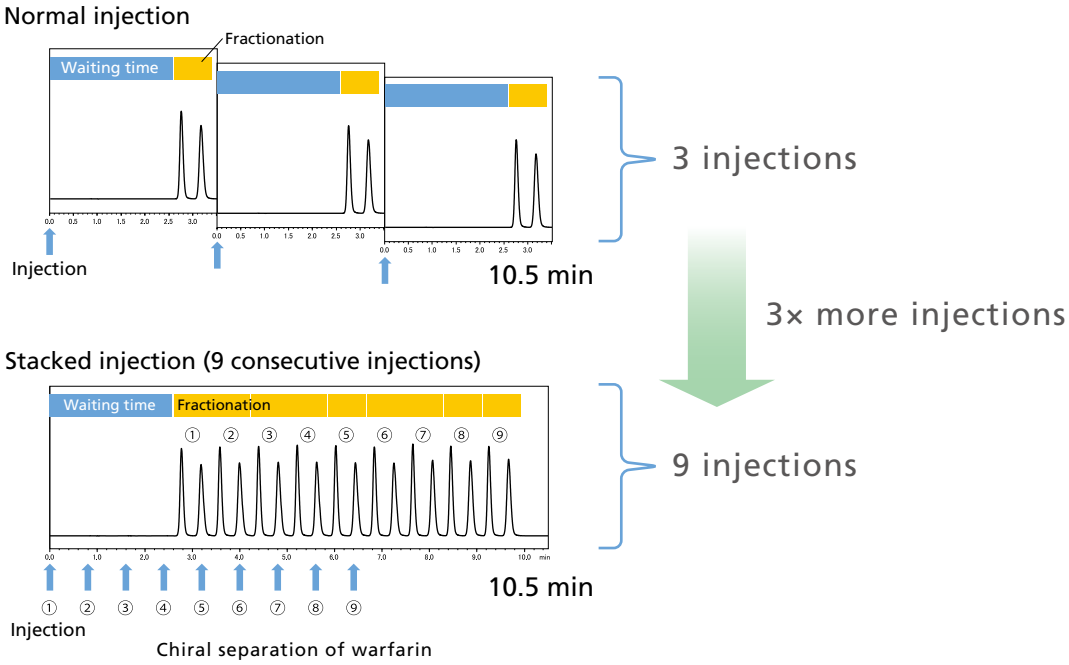
LotusStream separator (patented technology)

Decreases flow rate without increasing the pipe diameter by splitting flow through multiple channels. The CO_2 is discharged externally while the liquid travels along the column and drips directly into the collection vessel without dispersing or scattering the eluate.



Stacked injection function eliminates waiting time

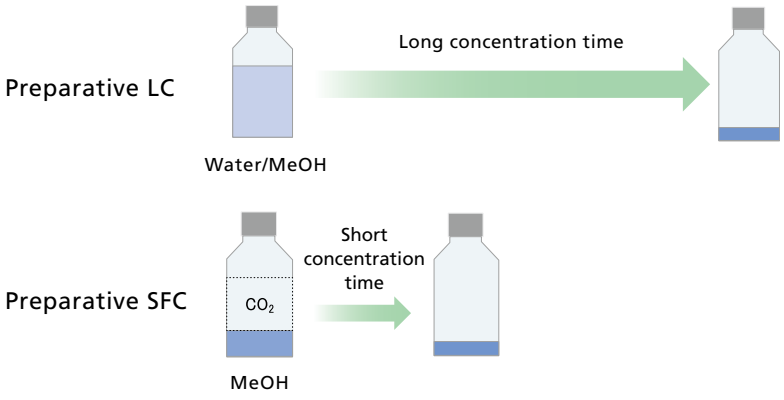
Normal injection wastes time between peak elutions. Using the Nexera UC Prep's stacked injection function, samples can be injected continuously without any waiting time, enabling more samples to be processed. Settings for this function can be specified easily in the dedicated software.



Chiral separation of warfarin

Simple post-run processing

Because most of the mobile phase is vaporized supercritical CO_2, only the organic solvent (modifier) added to change the polarity of the mobile phase remains after preparative work. Since there is no water content in the recovery fraction, the concentration time is significantly shorter.



Prep Solution enables a seamless preparative workflow

The dedicated software, Prep Solution, ensures that it is simple to scale up from an analytical to a preparative workflow, and makes it easy to configure parameter settings. It greatly increases the efficiency of preparative workflows.

Easy to understand even for first-time users

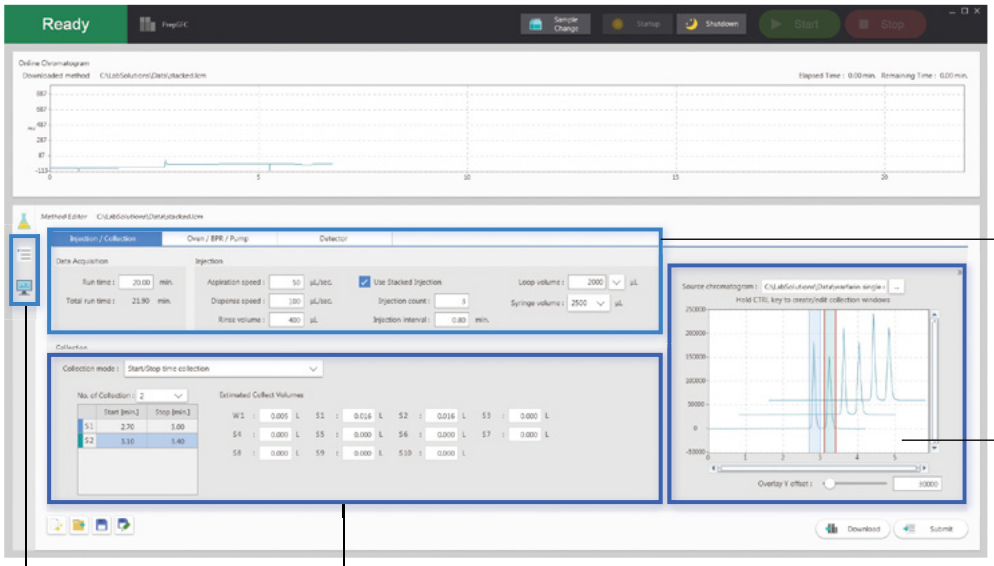
The parameter settings in Prep Solution have been kept as concise and intuitive as possible, so that all users can operate the system with minimal training. This also avoids the risk of wasting samples through human error.

1 Single analysis (peak check)

A trial analysis, or scouting run, prior to fractionation confirms component peak shapes and retention times. Analysis can be started by simply inputting basic parameters in the three onscreen tabs.

2 Simulation

The chromatogram obtained from the single analysis can be displayed in the simulation window, so that the collection start and stop times for each fraction can be selected with just a few mouse clicks. These settings can be applied to methods automatically.



Parameter settings
Input parameters for injection, fractionation, etc.

Simulation window
Simulations reflecting various parameter settings can be displayed, or peaks from the window can be selected to apply their parameter settings to a new analysis.

Tabs to switch windows
Toggle between windows with a single click

Stacked Fraction System

The fractionation method can be selected from four options (manual fractionation, time fractionation, peak integration fractionation with/without time program) depending on the purpose of the analysis. Using the “peak integration mode”, it is possible to assign individual slope and level values for fractionation start and end points, even for tailing peaks or other asymmetrical peaks.

Easily isolate the target peaks

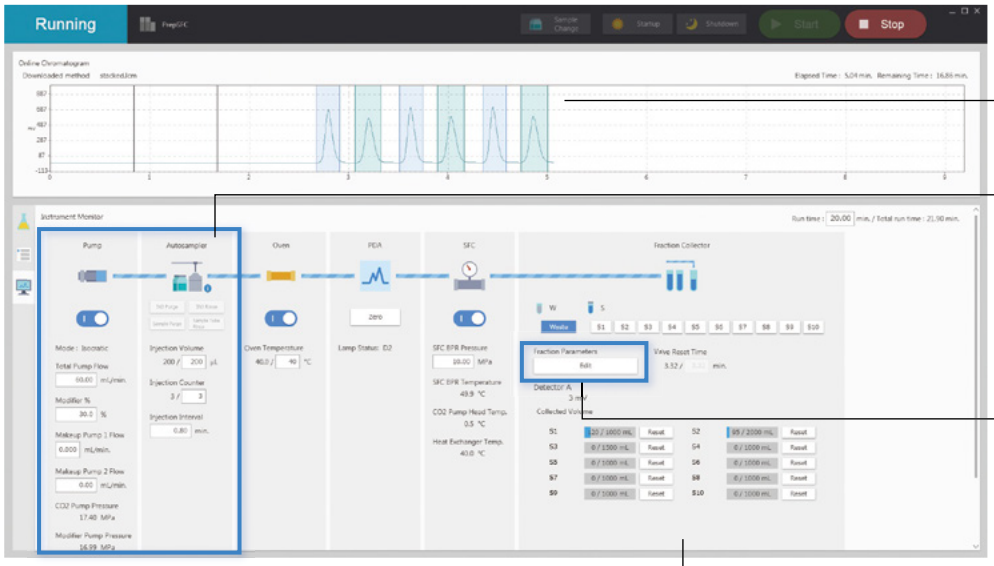
In case of peak shapes that are different from predictions or other unexpected situations, it is possible to change the preparative parameter settings while viewing the chromatogram. This eliminates the time and hassle involved in changing parameters and reanalyzing samples later on, as well as preventing the waste of valuable samples.

3 Fractionation

Samples are fractionated based on the user-selected parameters. The fraction range is displayed on the chromatogram, which can be checked in real time.

4 Adjust parameters during fractionation

Parameter settings for fractionation and injection can be adjusted during stacked injection (“on-the-fly” function).



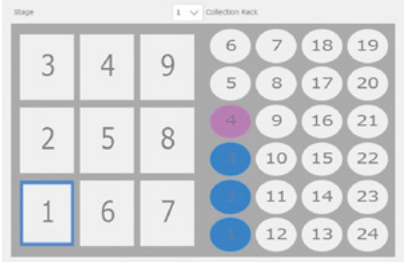
The fractionation range is displayed on the chromatogram.

Parameters currently being applied to fractionation are displayed here. Settings for modifier concentration and stacked injection parameters (injection volume, number and interval) can be changed while viewing the chromatogram.

Fractionation time range and threshold values can be changed mid-analysis. In addition to a fractionation mode for target peaks, there is a mode for fractionation of “waste” intervals between peaks.

Stacked Fraction System

For the Multi-Fraction System, fraction collector racks are displayed here, with different display colors depending on the current status (fractionation complete / in progress / not started).

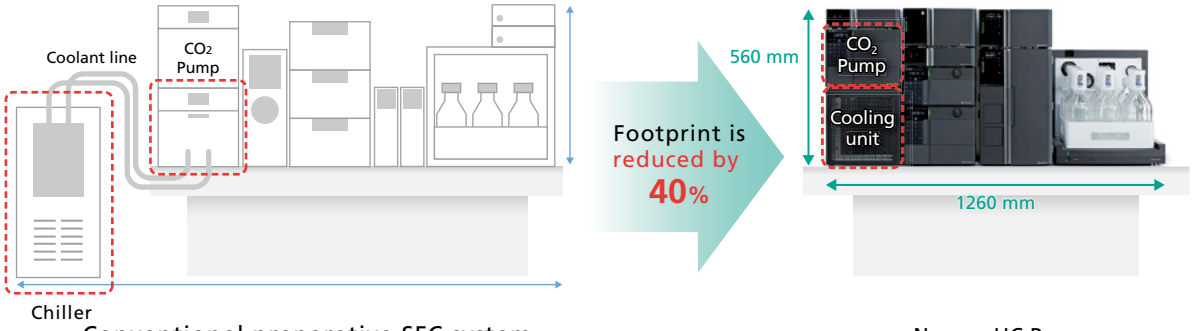


Compact, benchtop design

This space-saving benchtop model includes a carbon dioxide pump that does not require an external chiller (cooling system for heat generated when pumping CO_2 at high flow rates). In addition, one unit can handle a wide range of flow rates, lowering installation costs.

Benchtop system that can be installed anywhere

Usually a chiller is required to cool the solvent delivery pump when pumping CO_2 at high flow rates. However, the Nexera UC Prep features a compressor-type cooling unit, reducing the size of the system and allowing it to be installed anywhere. Its footprint is equivalent to an analytical scale SFC system.



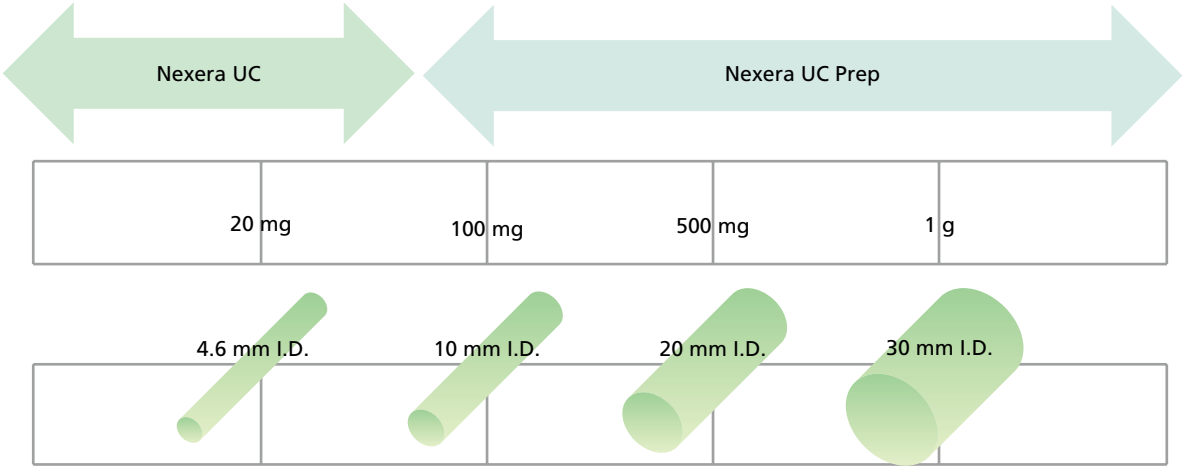
Conventional preparative SFC system

Nexera UC Prep

Wide range of flow rates available

In a single system, the Nexera UC Prep can handle flow rates from 10 to 150 mL/min for fractionation of a range of sample sizes, from a few hundred mg up to a few grams.

Typical max. load (one injection on a 250 mm column)



Add fractionation capabilities to the analytical SFC system

By adding a fraction collector to the analytical scale SFC system, it is possible to upgrade to a small-volume preparative system. A complete workflow can be carried out seamlessly on one system, from method development to fractionation.

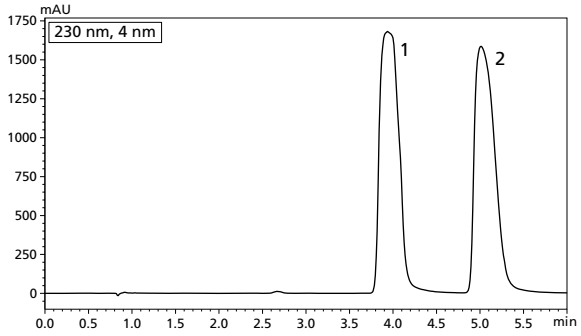
Upgrade to Analytical Fraction System

By adding a fraction collector to the analytical scale SFC, small-volume fractionation is also possible. A complete workflow can be carried out seamlessly on one system, from method development to fractionation.

Nexera UC

Fraction collector
FRC-40 SF

Shimadzu's unique LotusStream separator allows fractionation of small volumes, even into vessels such as 1.5 mL vials, without scattering of the solvent.



Separation of optical isomers of *trans*-stilbene oxide

Peak	Recovery rate
Peak 1	98%
Peak 2	93%

Extensive column lineup opens up analysis options

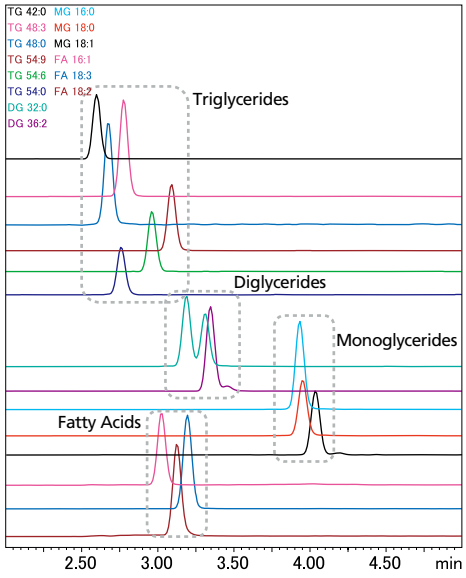
Shim-pack™ UC series columns are designed specifically for Nexera UC series SFC systems. When using supercritical fluids for analysis, retention behavior can vary significantly depending on the type of stationary phase. To optimize separation, a variety of columns should be used to determine which phase gives the best resolution in the shortest time. The extensive choice of column sizes available means that operations can be scaled up seamlessly from analytical SFC to preparative SFC.

	Functional group	4.6 × 250 mm	10 × 250 mm	20 × 250 mm	28 × 250 mm
Shim-pack UC-Diol II	Diol	227-32606-02	227-32606-03	227-32606-04	227-32606-05
Shim-pack UC-Sil II	—	227-32607-02	227-32607-03	227-32607-04	227-32607-05
Shim-pack UC-HyP	3-Hydroxphenyl	227-32600-02	227-32600-03	227-32600-04	227-32600-05
Shim-pack UC-Py	Pyridinyl	227-32601-02	227-32601-03	227-32601-04	227-32601-05
Shim-pack UC-PBr	Pentabromobenzyl	227-32602-02	227-32602-03	227-32602-04	227-32602-05
Shim-pack UC-Choles	Cholesteryl	227-32603-02	227-32603-03	227-32603-04	227-32603-05
Shim-pack UC-PyE	Pyrenylethyl	227-32604-02	227-32604-03	227-32604-04	227-32604-05
Shim-pack UC-Triazole	Triazole	227-32605-02	227-32605-03	227-32605-04	227-32605-05

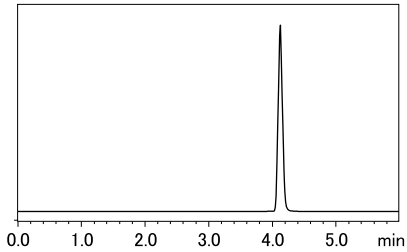
Choosing a column

Since normal phase is the main separation mode used for SFC, normal phase UC-Diol II columns are commonly used. UC-Diol II columns can be used for analyzing a wide variety of compounds, from phospholipids to highly-polar peptides. UC-Py columns exhibit similar behavior to ethylpyridine-based columns, and also display very versatile performance.

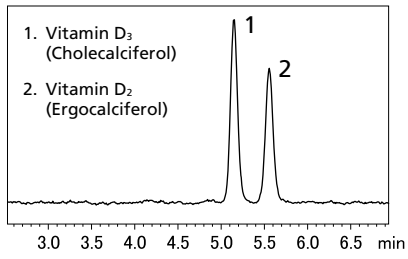
In addition, UC-HyP columns can uniquely separate lipids by class. Columns with multiple interaction modes can improve separation of isomers or compounds that are difficult to separate by LC. Prime candidates include the UC-Choles, which contains a cholesteryl group, the UC-PyE, with strong π–π interactions, and the UC-PBr, which applies a dispersion force to Br.



Simultaneous lipid analysis (UC-Diol II)



Peptide (UC-Diol II)



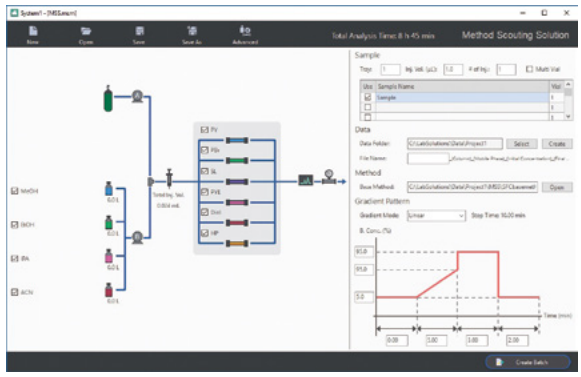
Vitamin D isomer (UC-PyE)

Ideal for column scouting

In HPLC analysis, water-based mobile phases are generally used for reversed phase analysis, and non-water based mobile phases for normal phase analysis. However, in SFC analysis a mixture of supercritical carbon dioxide and a modifier (an organic solvent such as methanol) is used as the mobile phase, regardless of the stationary phase. This means the same mobile phase composition can be used for successive analysis with all columns.

Method scouting for optimization of separation conditions and scaling up to preparative size

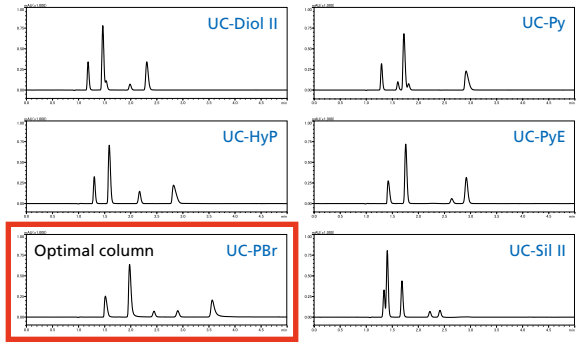
For high-purity isolation, target peaks need to be adequately separated, for which the user must determine optimum column and separation parameter settings (method scouting). The Nexera UC chiral screening system and dedicated Method Scouting Solution software can be used to screen columns more quickly and accurately (Step1). Once the optimum column has been identified, smoothly scale up to preparative scale flow rates, preserving the peak separation while increasing the mass load (Step 2).



Method Scouting Solution Ver. 2

Step 1 Method scouting at analytical scale

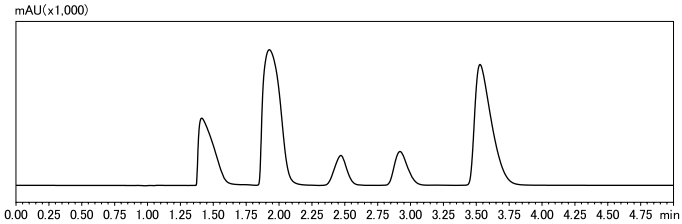
Method scouting is easy even for first-time users — simply execute the batch table generated automatically by the dedicated software. The system can automatically switch between different settings to run the scouting process continuously day or night, even for multiple modifiers and columns. Various types of data can be displayed in the data browser and multi-data reports generated with resolution values for all data to assist in evaluating separation conditions.



Step 2 Scaling up

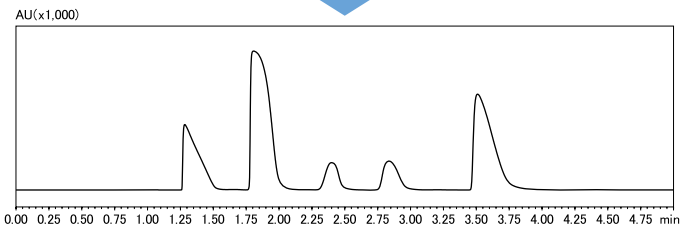
Using a Shim-pack UC series column enables you to increase mass load while maintaining separation performance. The optimum preparative column determined from Step 1 can be used to scale up the column size, flow rate and injection volume based on the desired fraction volumes.

4.6 mm I.D. column (Nexera UC)



Column: Shim-pack UC-PBr 4.6 × 250 mm
Flow rate: 3.0 mL/min
Injection volume: 20 µL
Fraction volume: 10 mg

20 mm I.D. column (Nexera UC Prep)



Column: Shim-pack UC-PBr 20 × 250 mm
Flow rate: 56.7 mL/min
Injection volume: 500 µL
Fraction volume: 250 mg

Choose the optimal configuration for your application

Stacked Fraction System: supports injection volumes up to 20 mL for large volume fractionation

This system is optimized for large volume fractionation involving repeated injection of samples which may contain several compounds. The FRS-40 unit includes both injector and fraction collector functionality, so that the same unit can be used for repeated sample injections and gram-level preparative work. It supports injection volumes up to 20 mL* and collection of ten fractions. Compatible with flow rates from 10 to 150 mL/min and 10 to 30 mm I.D. columns.

*optional

Multi-Fraction System: for multiple peak fractionation of impurities and natural products

This system is suitable for preparative tasks involving samples with many peaks detected, such as impurities in pharmaceutical compounds. Volumes of up to 2 mL* can be injected using an autosampler that holds up to 162 samples (using 1.5 mL vials). Three rack types can be selected for the FRC-40 SF fraction collector, which can recover up to 540 fractions (using 10 mL vials). With support for flow rates from 10 to 150 mL/min, columns with an internal diameter from 10 to 30 mm can be used.

*optional

Analytical Fraction System: analytical flow and fraction collection in one system

This system is intended for analytical scale fractionation only requiring fraction volumes of several mL to recover up to 20 mg of material (used to check synthesis for example). By connecting an FRC-40 SF fraction collector to the Nexera UC system, analytical columns from 2.1 to 4.6 mm I.D. can be run at flow rates up to 5 mL/min for small volume fraction collection.

Key Features

		Stacked Fraction System	Multi-Fraction System	Analytical Fraction System
Flow rate range		10.0 – 150.0 mL/min		0.0001 – 5.0 mL/min
Supported columns		I.D.: 10–30 mm Length: up to 250 mm		I.D.: 2.0–4.6 mm Length: up to 250 mm
Injection unit		No. of samples processed: 1 Max. injection volume: 2 mL (optional: 20 mL)	No. of samples processed: 252 (with 1 mL sample vial plate) 162 (1.5 mL sample vial plate) 84 (4 mL sample vial plate) 36 (10 mL sample vial plate) 72 (microtube plate) 288 (96-well microplate) 1,152 (384-well microplate) Max. injection volume: 2 mL (using syringe option)	No. of samples processed: 175 (with 1-mL sample vial plate) 105 (1.5-mL sample vial plate) 50 (4-mL sample vial plate) 192 (96-well microplate) 768 (384-well microplate) 192 (96-well deep-well plate) 768 (384-well deep-well plate) Max. injection volume: 5 µL (optional: 50 µL)
Collection	Supported containers Quantity	Bottles (screw-top: GL45) 1000 mL × 10, 2000 mL × 5	30 mL sample vial × 54 250 mL sample bottle × 20 500/1,000 mL sample bottle × 12 Test tube O.D. 18 mm × 216 Test tube O.D. 35 mm × 54	1.5 mL sample vial × 486 4 mL sample vial × 252 Test tube O.D. 10 mm × 540 Test tube O.D. 18 mm × 216
	Method	Valve switching (10 collection + 1 waste or 5 collection + 5 waste)	Open-bed with X–Y arm	
Volume recovered per analysis (approx.)		Up to 1 g (for 30 mm I.D. column)		Up to 20 mg (for 4.6 mm I.D. column)
Sample temperature control range		No temperature control	4–45°C	4–40°C
Support functions		Dedicated preparative software, stacked injection, parameter changing during analysis		Dedicated preparative software, parameter changing during analysis

Specifications

Semi-Preparative SFC System Nexera UC Prep Dedicated Units

LC-40P SF CO_2 solvent delivery unit

CO_2 cooling unit

CO_2 solvent delivery unit

Pump type		Parallel double-plunger reciprocating
Solvent delivery method		Constant flow rate delivery
Constant flow rate delivery	Flow rate setting range	0.0 to 150.0 mL/min
	Max. solvent delivery pressure	44 MPa (0.01 to 100.00 mL/min) 33 MPa (100.01 to 150.00 mL/min)
	Flow rate accuracy	±2 % (20 mL/min and 100 mL/min, when liquefied carbon dioxide is pumped at 15 MPa, and room temperature constant between 24 to 28°C.)
Pump head	Cooling method	Refrigerant recirculation (using 60 % aqueous ethylene glycol solution)
	Temperature accuracy	±5°C
	Temperature precision	2°C
Pressure limiter function		Upper/lower limit values
Line filter		2 µm
Time Programs		Ten flow rate, event, and loop (repeats program) files with total of 320 steps
Pressure display accuracy		Within ±2 % or ±0.5 MPa, whichever is greater
Plunger rinse flow channels		Automatic rinsing kit included standard
Operating temperature/Humidity range		4 to 32°C and 20 to 85 % RH
Dimensions		W 260 × D 600 × H 210 mm, excluding protrusions
Weight		28 kg
Power supply		100 to 240 V AC, 400 VA, 50/60 Hz

CO_2 cooling unit

Cooling method	Compressor-type recirculation
Refrigerant	R407C
Operating temperature/Humidity range	4 to 32°C and 20 to 85 % RH
Dimensions	W 260 × D 600 × H 280 mm, excluding protrusions
Weight	39 kg
Power supply	100 V AC, 1.3 kVA, 50/60 Hz

SFC-40P back-pressure regulator

Pressure setting range	1 MPa – 40 MPa (0.01 MPa step)
Pressure control precision	0.3 MPa
Pressure capacity	40 MPa
Temperature control range	0 to 70°C (1°C steps)
Operating temperature/Humidity range	4 to 32°C and 20 to 85 % RH
Dimensions	W 260 × D 500 × H 140 mm, excluding protrusions
Weight	17 kg
Power supply	100 to 240 V AC, 900 VA, 50/60 Hz

HEX-40 heat exchanger

Pressure capacity	40 MPa
Temperature setting range	0 to 70°C (1°C steps)
Operating temperature/Humidity range	4 to 32°C and 20 to 85 % RH
Dimensions	W 260 × D 500 × H 70 mm, excluding protrusions
Weight	8 kg
Power supply	100 to 240 V AC, 600 VA, 50/60 Hz

For Stacked Fraction System

FRS-40 sampler & fraction collector

Sample injection as well as fraction recovery

This single unit can perform everything from sample injection to fraction recovery.

Supports a wide range of injection volumes

Switch easily between different sample loops and syringes to change the injection volume.

Two fractionation modes available

Choose either a mode for supporting up to 10 fractions or one for 5 fractions and recovery between all peaks.

Pressure capacity	Injection system: 44 MPa Recovery system: 8 MPa
Number of samples	1
Number of fractions	10 max.
Injection method	Loop injection
Injection volume range	0.1 µL – 2,000 µL
Operating temperature/Humidity range	4 to 32°C and 20 to 85 % RH
Dimensions	W 390 × D 710 × H 410 mm, excluding protrusions
Weight	39 kg
Power supply	100 to 240 V AC, 150 VA, 50/60 Hz

For Multi-Fraction System

FRC-40 SF fraction collector

Holds up to 540 test tubes

Supports not only a variety of test tubes and small volume sample vials, but also flasks and other large containers suitable for large-scale preparative work for processing liters of samples.

Compatible with a variety of containers

Various racks can be used to reduce labor in transferring containers e.g. different capacities can be chosen based on the fraction volumes or the post-fractionation processing steps.

Space-Saving Design

Even with its small installation footprint, the unit can hold up to nine standard MTP sample vial racks or test tube racks, which contributes to using laboratory space more effectively.

Fraction vials	1.5 mL vials 4.0 mL vials 10, 12, 16, 18, 25, or 35 mm diameter test tubes 250, 500, or 1,000 mL bottles
Operating temperature/Humidity range	4 to 32°C and 20 to 85 % RH
Dimensions	W 390 × D 730 × H 560 mm, excluding protrusions
Weight	30 kg
Power supply	100 to 240 V AC, 150 VA, 50/60 Hz

Optional parts

Additional items are available as options based on the requirements of the preparative method.

A/D conversion board kit for multiple detection triggers (P/N:228-5519-41)

This kit is required for preparative processes using multiple detection triggers. If only the UV signal is used as a trigger in the preparative workflow, compounds with low UV absorption are difficult to fractionate and there is also a risk of accidentally collecting unseparated compounds triggered by the same detection channel. By using the MS signal as the trigger, high-purity fractions can be recovered simply by specifying the *m/z* value of the target compounds. Install additional hardware based on the number of detection trigger channels required.

Syringe Unit

This is a syringe unit for the SIL-40. It is compatible with injections up to 2 mL.

Syringe Unit

High-pressure flow channel switching valve
FCV-20AH$_2$ (P/N: 228-45025-41)
FCV-12AH (P/N: 228-45013-57)

The valve position is controlled based on the event input signal.
Max. operating pressure: 34.3 MPa
Operating pH range: pH 1 to 10
Operating temperature range: 4 to 35 °C

FCV-20AH$_2$

FCV-12AH

Reservoir switching valve
FCV-11AL (P/N: 228-45048-58)
FCV-11ALS (P/N: 228-45049-58)
FCV-230AL (P/N: 228-45163-58)

Switches between solvents using a solenoid valve. The FCV-11AL can switch between two solvents for up to three solvent delivery units (LC-20AR) or the FCV-11ALS for one solvent delivery unit. The FCV-230AL can switch between two solvents (or optionally four solvents) for one solvent delivery unit (LC-20AR/20AP).

FCV-11AL

FCV-230AL

Sample rack

The sample rack can hold a wide variety of containers, such as MTPs, various sample vials, or various test tubes. Six colors are available, so a separate color can be assigned to each user to avoid confusing samples.

SHIMADZU

Shimadzu Corporation

www.shimadzu.com/an/

First Edition: September 2019