C190-E185C

SHIMADZU
Excellence in Science

Supercritical Fluid Extraction/Chromatograph System

Nexera UC

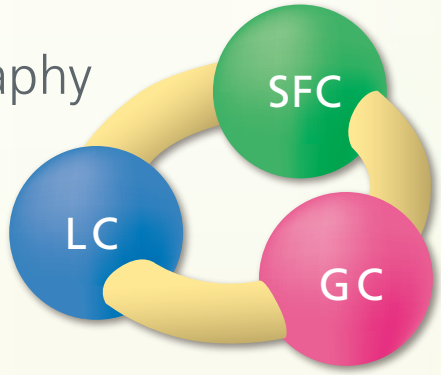
Unified Chromatography…

Just another chromatographic technique… or the only technique you'll need?

Conventional LC/MS and GC/MS face these challenges...

- Time-consuming sample preparation
- Degradation of labile compounds during sample preparation
- Low abundant peaks hidden in noise

Unified Chromatography



Nexera™ UC improves your analytical workflow by utilizing a completely new separation technology, **Unified Chromatography**, which unites sample separation, analysis with various separation modes, and high-sensitivity detection.

2015 R&D 100 WINNER

Received a 2015 "R&D 100" award from the American technology information magazine, "R&D Magazine."

PITTCON® Editors' GOLD AWARD presented in recognition of the Best New Products at PITTCON® 2015

Received a Gold Award at the Pittcon 2015 Editors' Awards.

SFE (Supercritical Fluid Extraction) : An extraction method using supercritical fluid. It is available as a pretreatment method for solid sample analyses.
SFC (Supercritical Fluid Chromatography) : The chromatographic technique using supercritical fluids as mobile phases. With its unique properties, it enables high-speed, high-resolution analyses.

Nexera UC Unified Chromatography provides uncompromising solutions to these problems.

Fully automated on-line sample preparation and analysis

Target compounds are automatically extracted and analyzed.

Even labile compounds can be analyzed without degradation

Sample extraction is performed under light-shielding and anaerobic conditions, preventing the degradation of labile analytes.

Unified speed of analysis, sensitivity, and resolution

Supercritical fluid enables highly efficient sample extraction and high resolution chromatographic analysis. The result; improved sensitivity and throughput for multi-analyte analyses.

Supercritical fluid is a fluid over its critical point. It has unique properties like liquid and gas. Low viscosity, high diffusion coefficient, liquid-like dissolving power. CO_2 is most popular for use.

Fully automated on-line sample preparation and analysis of target compounds

Nexera UC on-line SFE-SFC is a revolutionary system that combines on-line SFE and SFC in a single flow path (patented technology). Target compounds are extracted from solid samples and then automatically transferred to SFC/MS so that no human intervention is required. The Nexera UC on-line SFE-SFC system reduces the time for pretreatment of samples and acquires highly accurate data.

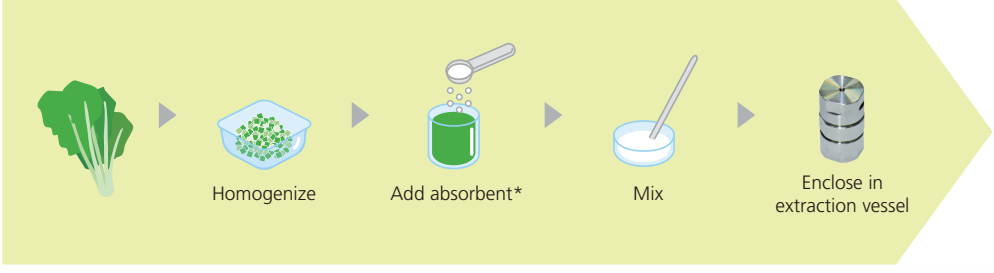
Comparison of QuEChERS sample preparation and Nexera UC in the analysis of residual pesticides

A typical sample preparation takes 35 minutes and requires several manual steps. With Nexera UC, the same sample can be ready for on-line SFE/SFC analysis in as little as five minutes with only a few simple sample preparation steps.

QuEChERS ··· Requires 35 minutes of sample preparation

Nexera UC ··· As little as 5 minutes to be ready for analysis

5 min



Extraction and analysis with SFE-SFC-MS

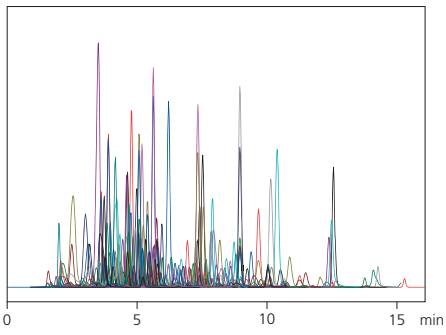
* "Miyazaki Hydro-Protect", Patented in Japan No. 3645552

35 min


Analysis with GCMS™


Analysis with LCMS™

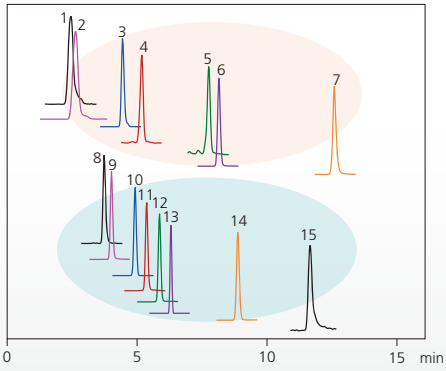
SFE
(about 4 minutes)



Simultaneous Analysis of 500 Pesticides

Hundreds of compounds are simultaneously analyzed with Nexera UC. These include pesticides that are usually analyzed with LC and LC/MS/MS or GC and GC/MS/MS. Nexera UC enables analysis of compounds over a wide polarity range.

SFE
(about 4 minutes)



Analysis of Compounds with Wide Polarity Range

Pesticide compound analysis with GC or GC/MS/MS

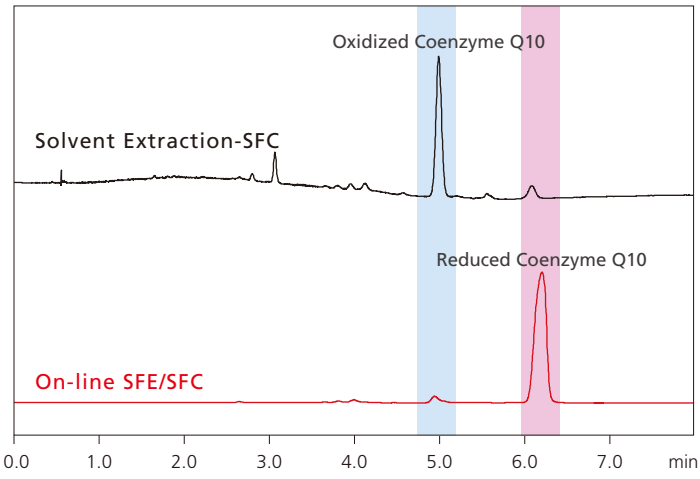
1. Diazinon
2. Metalaxyl
3. Tolclofos-methyl
4. Lenacil
5. Mepronil
6. Dioxathion
7. Cypermethrin

Pesticide compound analysis with LC or LC/MS/MS

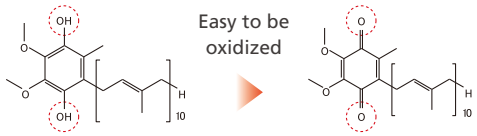
8. Aramite
9. Isouron
10. Acephate
11. Aminocarb
12. Cyazofamid
13. Diquat
14. Chromafenozide
15. Imidacloprid

Prevent degradation of labile compounds

With conventional solvent extraction, labile compounds may react with extraction solvents or could be oxidized and/or degraded.

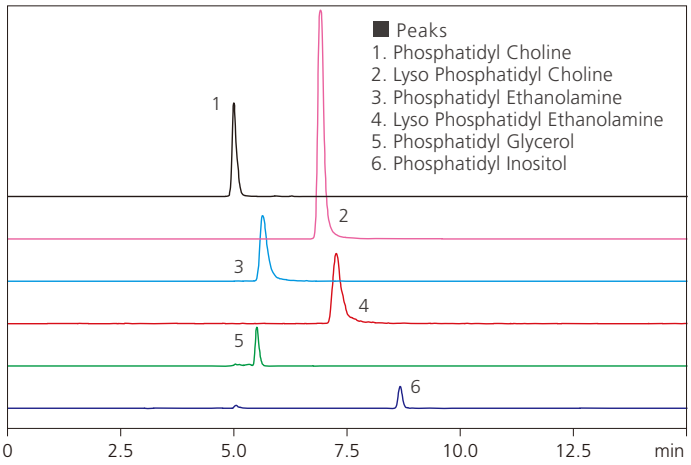


Extraction and analysis of reduced coenzyme Q10 in supplements

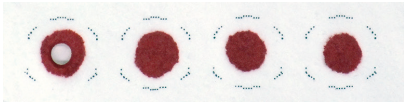


Analysis of biomarkers from dried blood spots (DBS)

Nexera UC can extract a trace amount of liquid samples. For biomarker validation, the preparation requires simply enclosing a blood spot in the 0.2 mL special extraction vessel.



Extraction and analysis of phospholipid-added plasma on DBS
(Column: Shim-pack UC-X Diol)

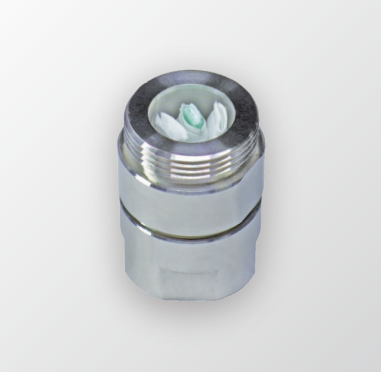


Blood spots on DBS

An extraction vessel for DBS

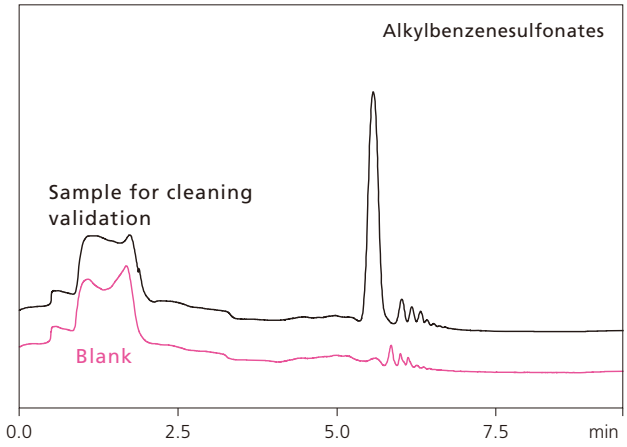
Only a few simple preparation steps for cleaning validation

Nexera UC can be applied to cleaning validation which is performed in the pharmaceutical industry to confirm that manufactuaring equipment has been properly cleaned. Nexera UC automatically runs a series of steps from extraction to analysis, by only putting the sample swab in the extraction vessel. In conventional cleaning validation, the sample swab needs to be extracted with water, and then the extraction is analyzed by TOC. However, when a target compound is hydrophobic, swab extraction is performed with ethanol and TOC is not applicable. Nexera UC is capable of performing both types of cleaning validation.



An extraction vessel enclosing sample swab

The sample is provided by Daiichi Sankyo Co., Ltd.



Extraction and analysis of a detergent-added swab

Supercritical fluid extraction of trace additives in polymers

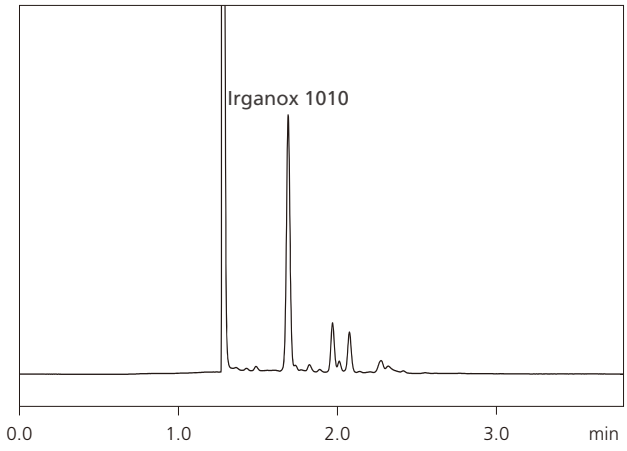
Polymer additives are widely used to prevent optical or thermal degradation, or to enhance functionalities. An example, Irganox 1010, is insoluble in THF or Chloroform, and hard to sublime. Therefore, analysis by GPC or GC is difficult. By simply homogenizing a sample and enclosing it in the extraction vessel, Nexera UC can detect labile or trace quantities of additives.

Soxhlet extraction

About 8 to 24 hours reflux

Extraction by Nexera UC

Place sample directly into extraction vessel



Extraction and analysis of polymer additives in polyethylene

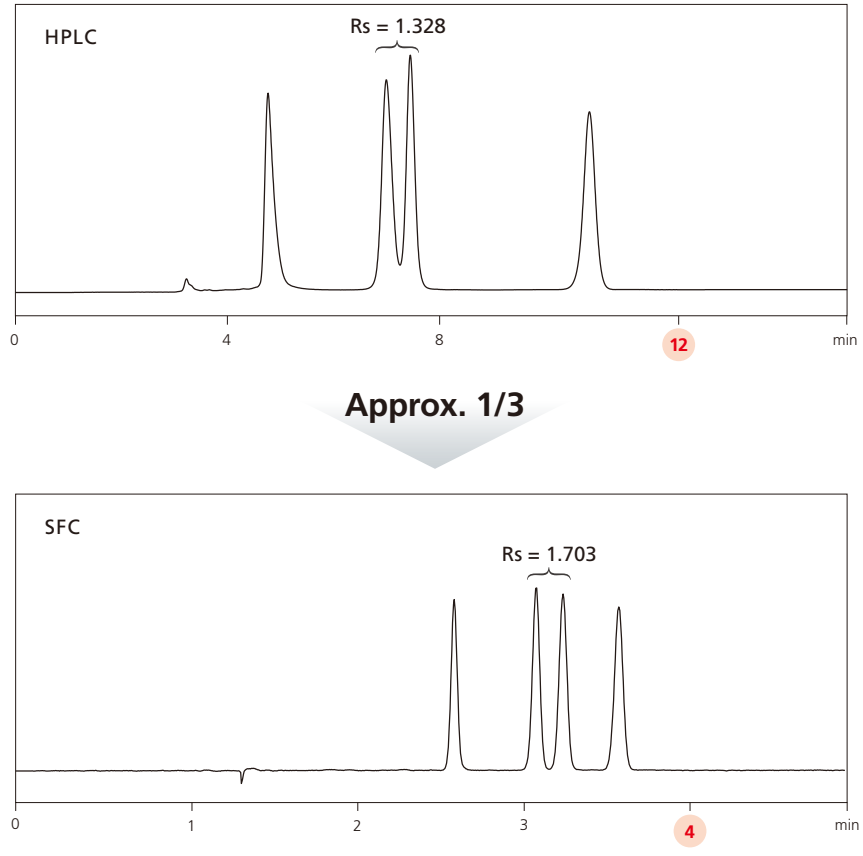
Unified speed of analysis, sensitivity, and resolution

Solutions provided by Nexera UC

- Very fast separation speed due to the relatively low viscosity of supercritical fluid
- Improved peak capacity and chromatographic resolution
- Efficient separation of analogues and/or chiral compounds by high penetration mobile phase
- Different separation mode leads to high sensitivity
- Improved sensitivity resulting from split-less introduction into detector
- Reduction of environmental impacts and costs by reducing amount of organic solvents needed

Higher resolution

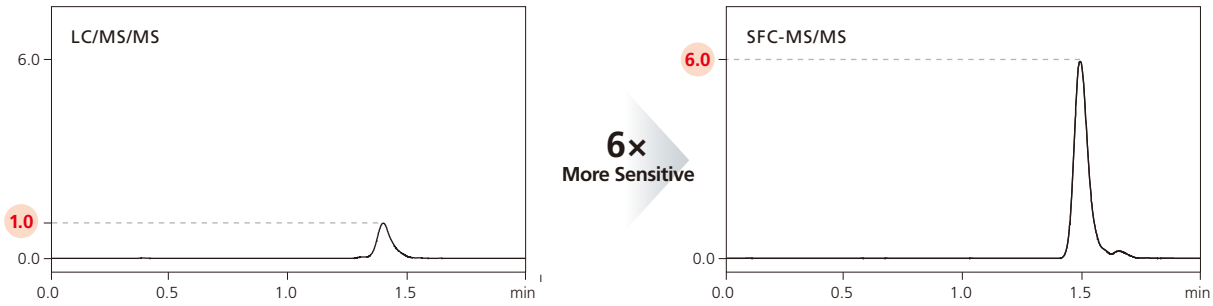
Improved separation and detection capabilities result from the low viscosity and high diffusion coefficient of supercritical fluid. As shown below, Nexera UC demonstrates high-separation selectivity for isomeric compounds that are difficult to separate by conventional LC.



Comparison of retention time and separation acquired by Conventional LC and SFC
(sample: α-tocopherol, column: Shim-pack UC-X Sil)

Sensitivity results from different separation modes in HPLC vs SFC

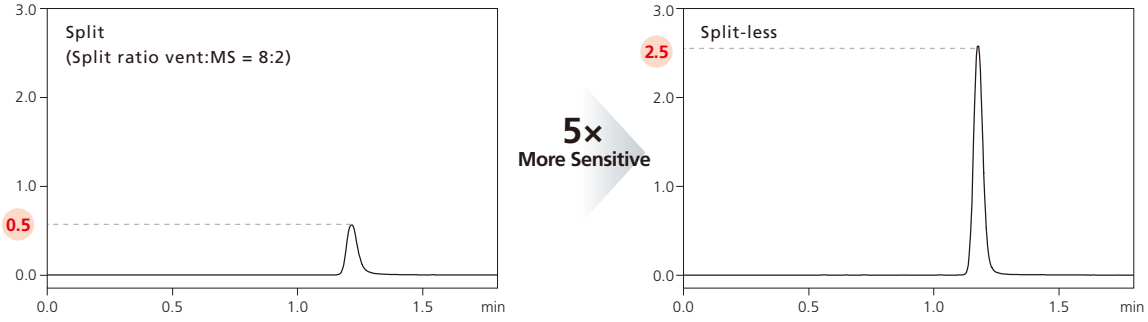
Supercritical fluid has unique properties different from liquid.
Using SFC in front of a mass spectrometer offers greater sensitivity than achieved with LC/MS/MS.



Comparison of peak intensity detected by the same MS detector.
(Sample: Prostagrandin D2 10 pg)

Enhanced sensitivity using splitless transfer to MS

Low dead volume back pressure regulator suppresses diffusion of peaks and can transfer the total eluate directly to a mass spectrometer to achieve higher sensitivity.

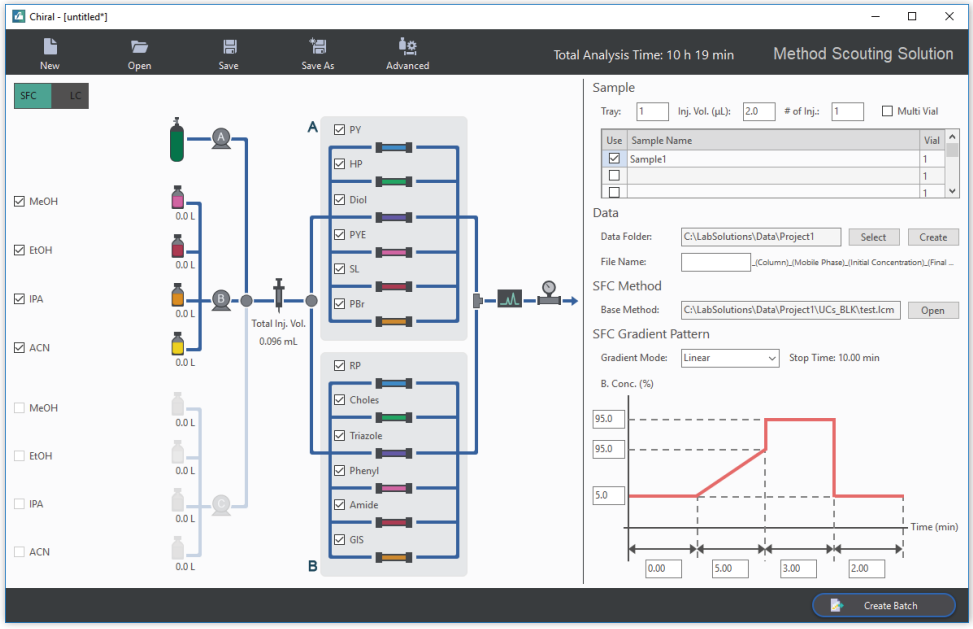


Comparison of intensity of two peaks detected by the same MS detector.
(Sample: Reserpine 10 pg)

Easy and efficient method scouting for separating chiral compounds

Automatically performs a variety of method scouting processes

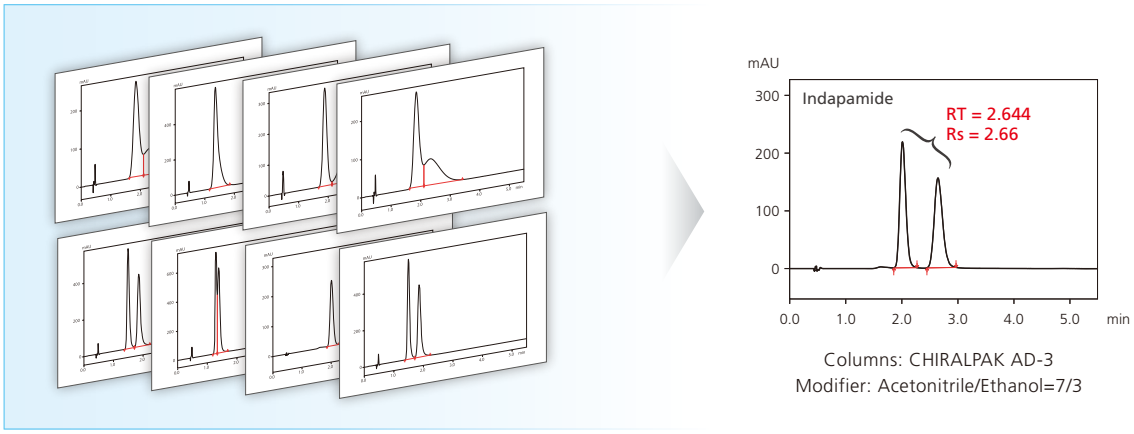
The high-speed performance of SFC can shorten the time required for method scouting.
It automatically generates a large number of methods by utilizing combinations of up to 12 columns, four modifiers, and different ratios of modifiers to mobile phase.



A screen shot of Method Scouting Solution for Nexera UC user interface.

Chiral analysis with "Nexera UC Chiral Screening System"

CHIRALPAK® Series and CHIRALCEL® Series columns (Daicel Corporation) for chiral analysis are capable of resolving a wide variety of compounds by showing complementary separation targets.
The combination of the Nexera UC Chiral Screening System and these columns simplifies method scouting for chiral analysis.



Columns: CHIRALPAK AD-3
Modifier: Acetonitrile/Ethanol=7/3

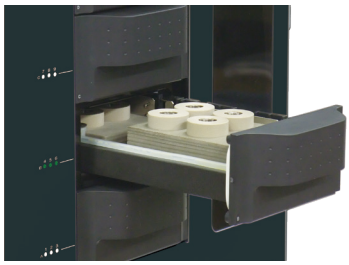
CHIRALPAK® and CHIRALCEL® are registered trademarks of Daicel Corporation.

Innovative technologies packaged into robust modules

Customized modules for Nexera UC based on Nexera technology

Supercritical Fluid Extraction Unit SFE-30A

This unit operates at a maximum temperature of 80°C to allow faster and more complete extractions.
Two sizes of extraction vessels (5 mL and 0.2 mL) can be chosen based on the sample amount.
This unit has the internal capacity to run up to four samples automatically; with the addition of an optional rack changer, it can accommodate unattended operation for up to 48 samples.



Rack changer: max. 48 samples

Two sizes of extraction vessels

CO_2 Solvent Delivery Unit LC-30ADSF / Back Pressure Regulator Unit SFC-30A

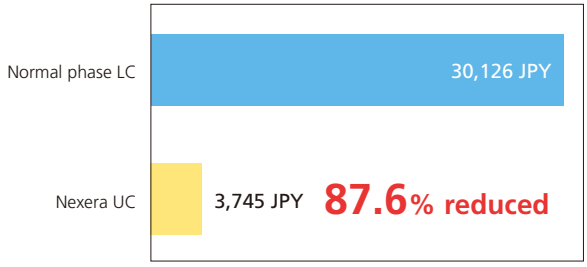
Stable baseline with low pulsation is realized by LC-30ADSF with a built-in cooler for pump heads, which delivers mobile phases up to 5 mL/min at pressures up to 66 MPa. The low dead volume of SFC-30A (0.7 µL) allows a mass spectrometer to be directly connected to the SFC system without splitting so that higher sensitivity can be achieved.

LC-30ADSF

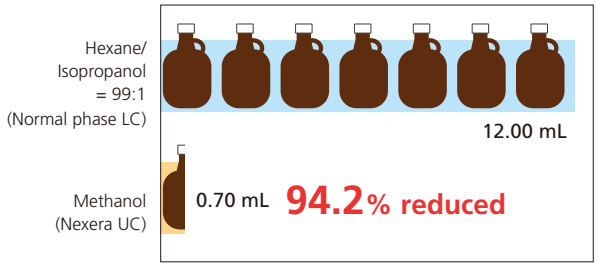
SFC-30A

Nexera UC reduces environmental impact

Comparison of costs and consumption of organic solvent for a single analysis by conventional normal-phase LC vs. SFC is shown below. By using SFC, the total cost of analysis is reduced by 87.6% and the consumption of organic solvent is reduced by 94.2%.



Comparison of costs



Comparison of organic solvent consumption

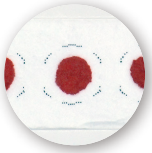
System configuration examples

On-line SFE-SFC-MS System

In this system, solid samples are extracted by supercritical fluid and introduced to SFC on-line. The time for pretreatment of samples is drastically shortened. In addition, samples are extracted under light-shielding and anaerobic conditions in order to protect labile analytes from degradation.

Simultaneous analysis of pesticides over a wide range of polarity

With conventional methods, both LC (LC/MS/MS) and GC (GC/MS/MS) are needed to analyze pesticides. In contrast, the Nexera UC On-line SFE-SFC system can extract and analyze the full range of pesticides automatically. Pretreatment requires only homogenization and dehydration, which takes 1/7 the time of the QuEChERS method. Adding the optional Rack Changer enables automated analysis of up to 48 samples.



Extraction and analysis of labile samples without degradation

Samples are extracted under light-shielding and anaerobic conditions so that labile compounds can be analyzed without degradation.

Quick start of cleaning validation in pharmaceutical industry

Regardless of the sample polarity, the only required preparation step is enclosing the sample swab in an extraction vessel. The Nexera UC On-line SFE-SFC-MS system automatically starts extraction for analysis.

Analysis of polymer additives where other analytical instruments struggle

Polymer additives are insoluble in THF or chloroform and hard to sublime; therefore, GPC and GC are not applicable. The Nexera UC On-line SFE-SFC system easily extracts and analyzes them.

Nexera UC/s SFC/UHPLC Switching System

This system can switch automatically between SFC analysis and UHPLC analysis and make measurements on a single sample in each separation mode. It enhances user-friendliness and operability by allowing the investigation of separation conditions and performing reverse-phase high-speed analysis in a single system. Shimadzu also provides a kit to upgrade from your current UHPLC system to the UHPLC/SFC switching system.

Analytical Fraction System

By adding the FRC-40 SF fraction collector to the Nexera UC, small-volume fractionation is also possible. A complete workflow can be carried out seamlessly on one system, from evaluation of analytical conditions with method scouting to fractionation on the order of a few mg. Shimadzu's unique, patented LotusStream separator successfully reduces sample dispersion and carryover while also achieving high recovery rates.

SFE Pretreatment System

This system allows the pretreatment of samples using supercritical fluid. An extraction operation that changes the types of modifiers (up to four types) and concentrations to mix with supercritical carbon dioxide can be performed on each sample. The extracted material is collected in a test tube using a FRC-40 SF fraction collector. The LotusStream separator allows fractionation of small volumes, even into vessels such as 1.5 mL vials, without dispersion of the solvent. In addition to analysis by SFC, the system is ideal for measurements using other analytical systems such as GCMS and NMR.

Chiral Screening System

This system is best for developing methods to separate chiral compounds.
It automatically generates a large number of methods by utilizing combinations of up to 12 columns, four modifiers, and a different ratio of modifiers to mobile phase.

SFC-UV System

This is the minimum setup of Nexera UC and is suitable to replace both normal phase and reverse phase LCs. A wide range of analyte polarity can be covered by the combination of supercritical fluid and modifiers (for example, MeOH). Hazardous organic solvents such as hexane or chloroform are eliminated. This system reduces environmental impact by utilizing low-toxicity mobile phases and completing analyses in a shorter time.

Shim-pack™ UC Series

In the analysis with supercritical fluid chromatograph system Nexera UC, because diffusion of the sample band in mobile phase is high compared with liquid chromatography, separation behavior changes significantly due to different types of columns.
Shim-pack UC series was designed with variety types of stationary phases which making it suitable for the mobile phase of high diffusion and low viscosity liquid carbon dioxide.

■ Achieve high speed and high performance by utilizing the features of Nexera UC

■ Wide range of stationary phases meets diverse needs

■ High durability and stable reproducibility

	I.D. × L (mm)	3 µm	5 µm
Shim-pack UC-RP	2.1×150	227-30400-01	227-30402-01
	2.1×250	227-30400-02	227-30402-02
	4.6×150	227-30401-01	227-30403-01
	4.6×250	227-30401-02	227-30403-02
Shim-pack UC-GIS II	2.1×150	227-30404-01	227-30406-01
	2.1×250	227-30404-02	227-30406-02
	4.6×150	227-30405-01	227-30407-01
	4.6×250	227-30405-02	227-30407-02
Shim-pack UC-Diol	2.1×150	227-30408-01	227-30410-01
	2.1×250	227-30408-02	227-30410-02
	4.6×150	227-30409-01	227-30411-01
	4.6×250	227-30409-02	227-30411-02
Shim-pack UC-Diol II	2.1×150	227-32606-01	–
	4.6×250	–	227-32606-02
	10×250	–	227-32606-03
	20×250	–	227-32606-04
	28×250	–	227-32606-05
Shim-pack UC-Sil	2.1×150	227-30412-01	227-30414-01
	2.1×250	227-30412-02	227-30414-02
	4.6×150	227-30413-01	227-30415-01
	4.6×250	227-30413-02	227-30415-02
Shim-pack UC-Sil II	2.1×150	227-32607-01	–
	4.6×250	–	227-32607-02
	10×250	–	227-32607-03
	20×250	–	227-32607-04
	28×250	–	227-32607-05
Shim-pack UC-Amide	2.1×150	227-30416-01	227-30418-01
	2.1×250	227-30416-02	227-30418-02
	4.6×150	227-30417-01	227-30419-01
	4.6×250	227-30417-02	227-30419-02
Shim-pack UC-NH2	2.1×150	227-30420-01	227-30422-01
	2.1×250	227-30420-02	227-30422-02
	4.6×150	227-30421-01	227-30423-01
	4.6×250	227-30421-02	227-30423-02
Shim-pack UC-Phenyl	2.1×150	227-30424-01	227-30426-01
	2.1×250	227-30424-02	227-30426-02
	4.6×150	227-30425-01	227-30427-01
	4.6×250	227-30425-02	227-30427-02
Shim-pack UC-CN	2.1×150	227-30428-01	227-30430-01
	2.1×250	227-30428-02	227-30430-02
	4.6×150	227-30429-01	227-30431-01
	4.6×250	227-30429-02	227-30431-02

	I.D. × L (mm)	3 µm	5 µm
Shim-pack UC-HyP	2.1×150	227-32600-01	–
	4.6×250	–	227-32600-02
	10×250	–	227-32600-03
	20×250	–	227-32600-04
	28×250	–	227-32600-05
Shim-pack UC-Py	2.1×150	227-32601-01	–
	4.6×250	–	227-32601-02
	10×250	–	227-32601-03
	20×250	–	227-32601-04
	28×250	–	227-32601-05
Shim-pack UC-PBr	2.1×150	227-32602-01	–
	4.6×250	–	227-32602-02
	10×250	–	227-32602-03
	20×250	–	227-32602-04
	28×250	–	227-32602-05
Shim-pack UC-Choles	2.1×150	227-32603-01	–
	4.6×250	–	227-32603-02
	10×250	–	227-32603-03
	20×250	–	227-32603-04
	28×250	–	227-32603-05
Shim-pack UC-PyE	2.1×150	227-32604-01	–
	4.6×250	–	227-32604-02
	10×250	–	227-32604-03
	20×250	–	227-32604-04
	28×250	–	227-32604-05
Shim-pack UC-Triazole	2.1×150	227-32605-01	–
	4.6×250	–	227-32605-02
	10×250	–	227-32605-03
	20×250	–	227-32605-04
	28×250	–	227-32605-05
Shim-pack UC-Diol II (G)	10×20	–	227-32606-06
Shim-pack UC-Sil II (G)	10×20	–	227-32607-06
Shim-pack UC-HyP(G)	10×20	–	227-32600-06
Shim-pack UC-Py(G)	10×20	–	227-32601-06
Shim-pack UC-PBr(G)	10×20	–	227-32602-06
Shim-pack UC-Choles(G)	10×20	–	227-32603-06
Shim-pack UC-PyE(G)	10×20	–	227-32604-06
Shim-pack UC-Triazole(G)	10×20	–	227-32605-06

Column Pressure Capacity
- 3 µm particle diameter: 50 MPa
- 5 µm particle diameter (with 2.1 to 10 mm I.D.): 30 MPa
- 5 µm particle diameter (with 20 to 28 mm I.D.): 23 MPa

This product was co-developed with Osaka University, Kobe University, and Miyazaki Agricultural Research Institute in the program "JST-SENTAN" (Development of Systems and Technology for Advanced Measurement and Analysis) by Japan Science and Technology Agency (JST).

Shimadzu Corporation
www.shimadzu.com/an/

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