

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

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.

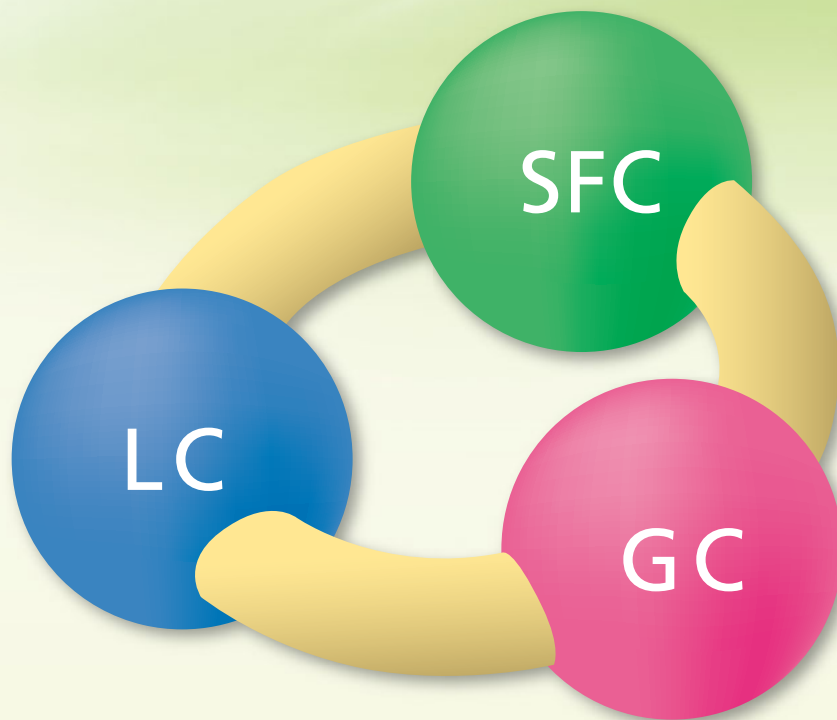
Unified speed of analysis, sensitivity, and resolution

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. CO₂ is most popular for use.



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.

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.

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. 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

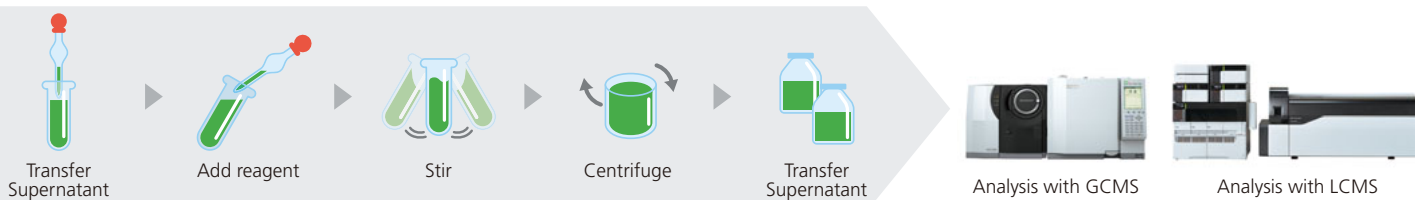
5 min



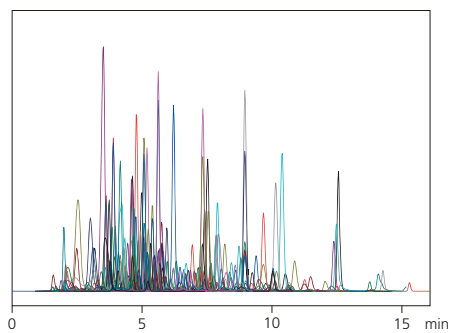
* "Miyazaki Hydro-Protect", Patented in Japan No. 3645552



35 min



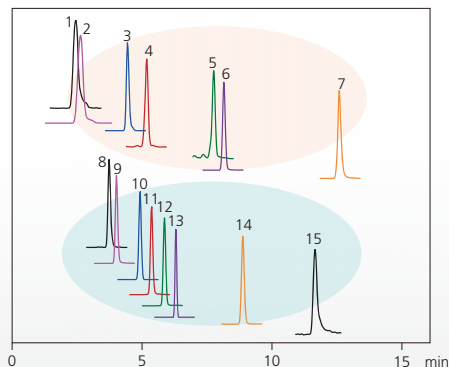
SFE
(about 4 minutes)



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

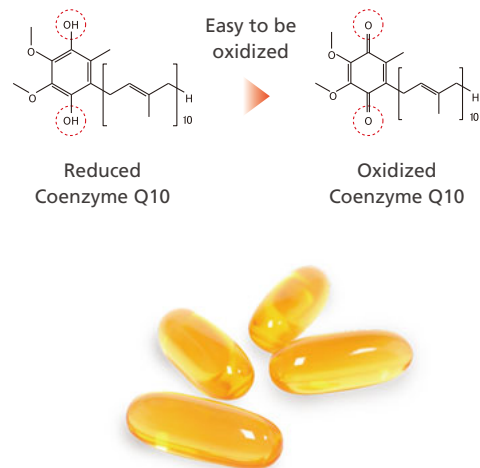
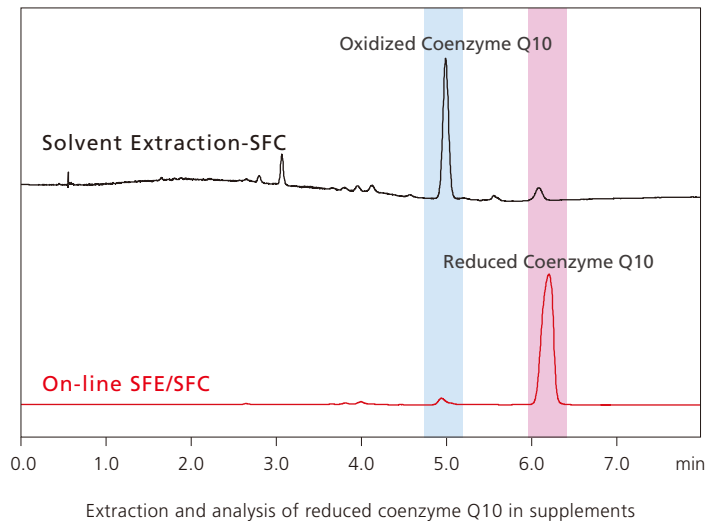
- | | |
|---------------------|-----------------|
| 1. Diazinon | 5. Mepronil |
| 2. Metalaxyl | 6. Dioxathion |
| 3. Tolclofos-methyl | 7. Cypermethrin |
| 4. Lenacil | |

► Pesticide compound analysis with LC or LC/MS/MS

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

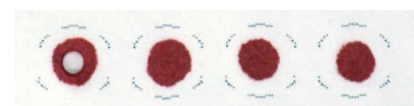
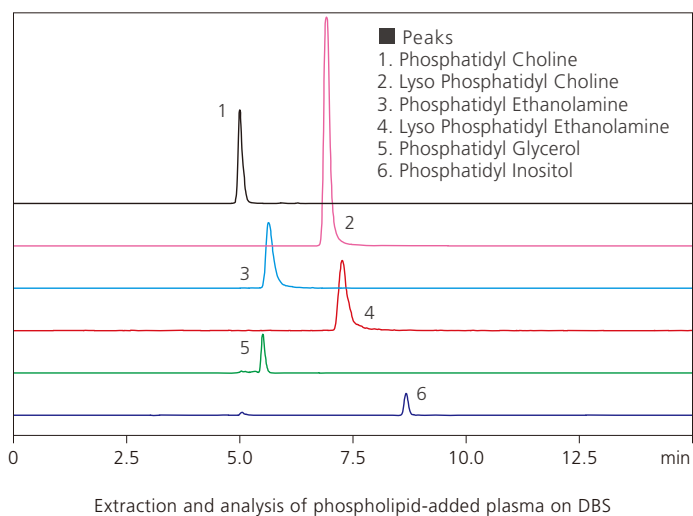
Prevent degradation of labile compounds

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



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.



Blood spots on DBS



An extraction vessel for DBS

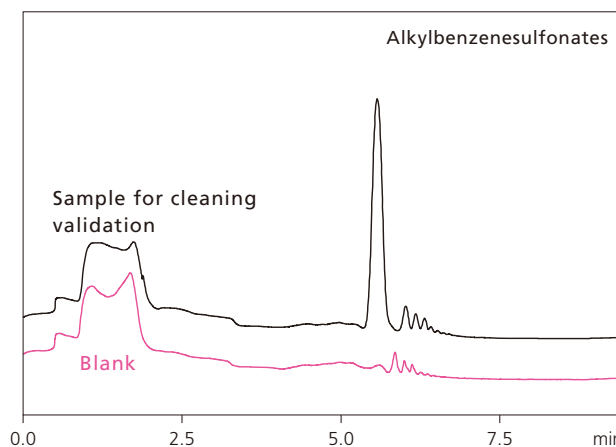
Only a few simple preparation steps for cleaning validation

Nexera UC can be applied to cleaning validation which is performed in the pharmaceutical industry to confirm that manufacturing 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

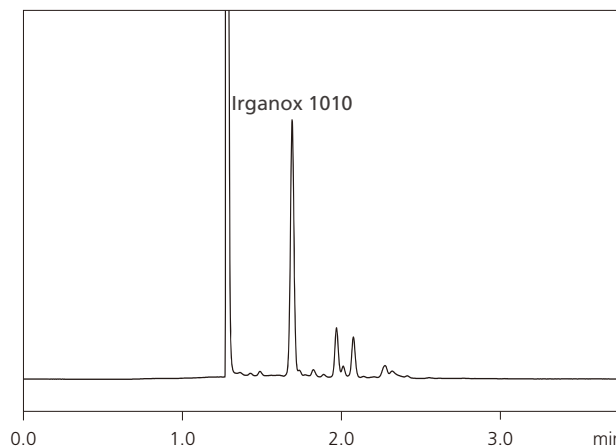


About 8 to 24 hours reflux

Extraction by Nexera UC



Place sample directly into extraction vessel



Extraction and analysis of polymer additives in polyethylene

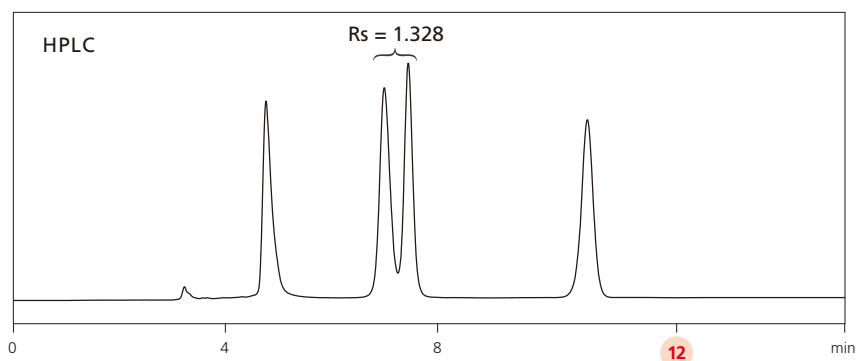
Unified speed of analysis, sensitivity, and resolution

Solutions provided by Nexera UC

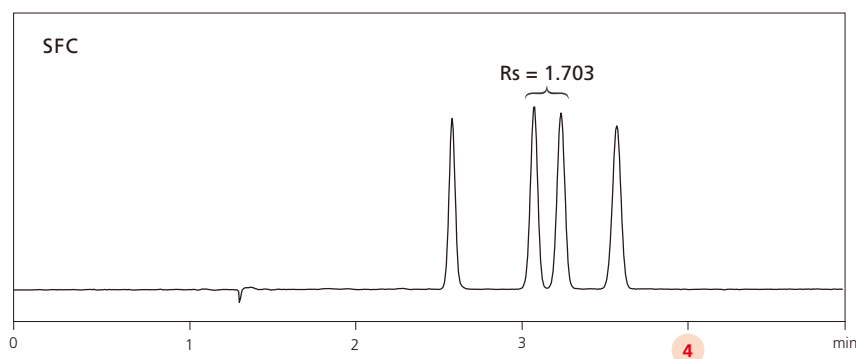
- Very fast separation speed due to the relatively low viscosity of supercritical fluid
- Improved peak capacity and chromatographic resolution
- Efficient separation of analogues and/or chiral compounds by high penetration mobile phase
- Different separation mode leads to high sensitivity
- Improved 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.



Approx. 1/3

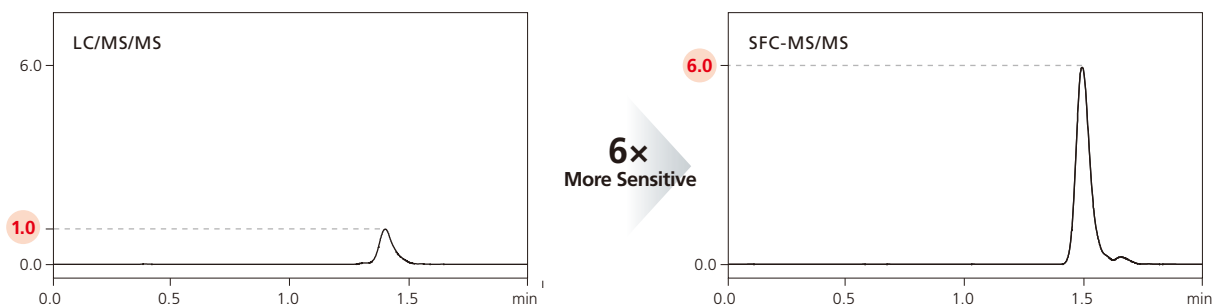


Comparison of retention time and separation acquired by Conventional LC and SFC (sample: α -tocopherol)

Sensitivity results from different separation modes in HPLC vs SFC

Supercritical fluid has unique properties different from liquid.

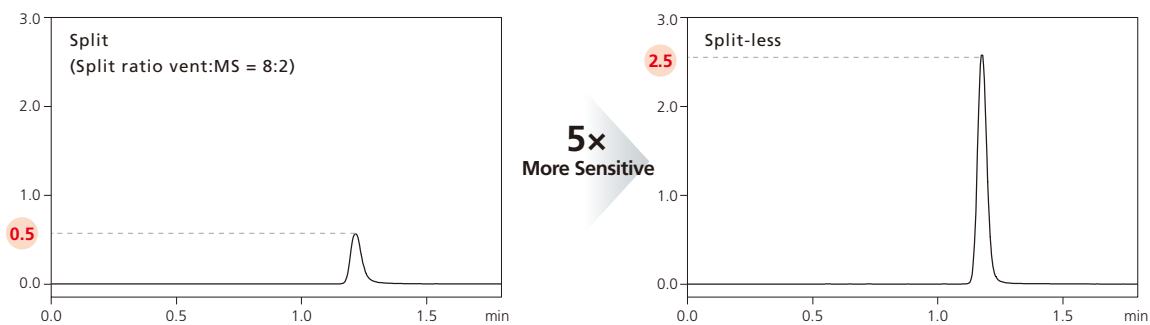
Using SFC in front of a mass spectrometer offers greater sensitivity than achieved with LC/MS/MS.



Comparison of peak intensity detected by the same MS detector.
(Sample: Prostaglandin 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.



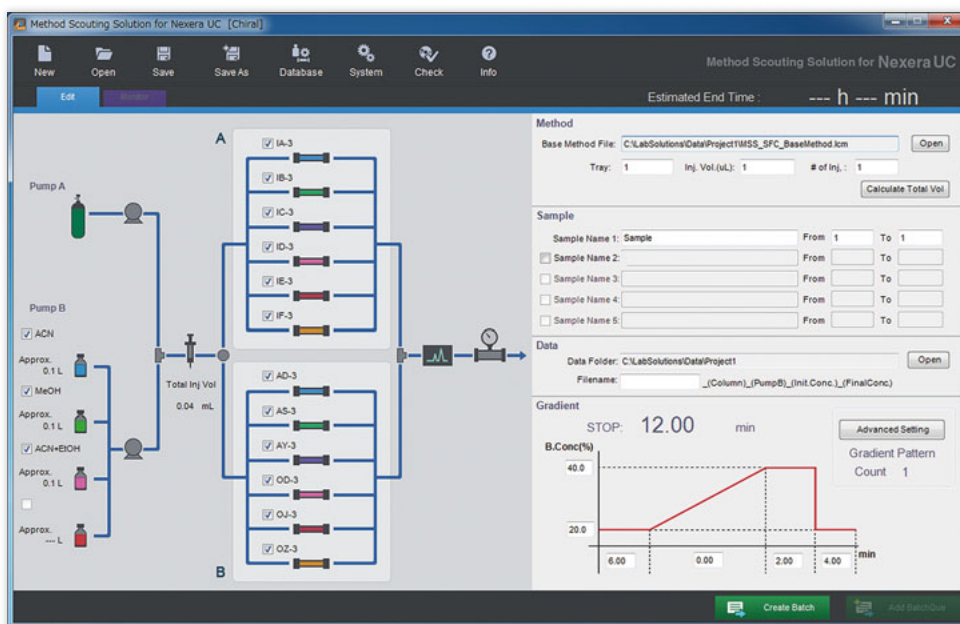
Comparison of intensity of two peaks detected by the same MS detector.
(Sample: Reserpine 10 pg)

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.

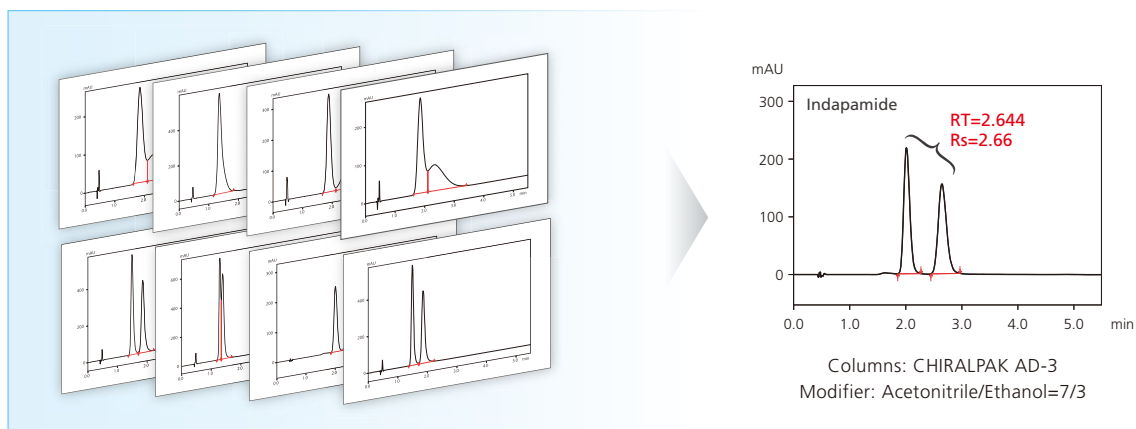


A screen shot of Method Scouting Solution for Nexera UC user interface.

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.



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

CO₂ Solvent Delivery Unit LC-30AD_{SF} / Back Pressure Regulator Unit SFC-30A

Stable baseline with low pulsation is realized by LC-30AD_{SF} 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.



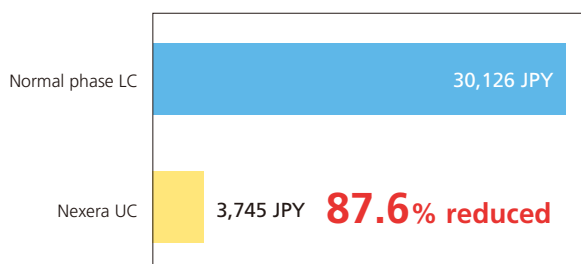
LC-30AD_{SF}



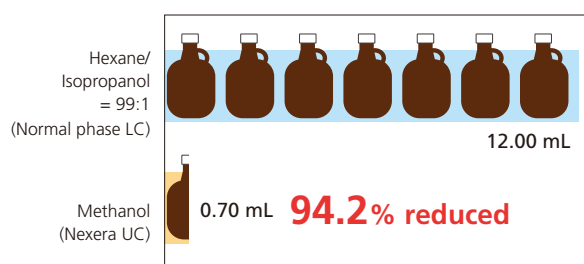
SFC-30A

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

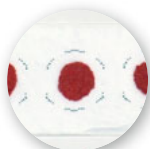
Nexera UC On-line SFE-SFC-MS System

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 UFMS System

This system realizes high speed and high resolution by using supercritical fluid. The low volume of the SFC-30A back pressure regulator unit transfers all eluate from the column to a mass spectrometer in order to achieve high-sensitivity analysis.



Off-line simultaneous analysis of trace pesticides in foods

The Nexera UC UFMS system is able to reduce analysis times while maintaining high sensitivity. Combining the low volume of the SFC-30A back pressure regulator unit with supercritical fluid provides sensitivity six times higher than conventional LC-MS and requires 1/3 the time.



Analysis of fatty acids and phospholipids that have many analogues

Phospholipids have many analogues. Since their UV spectra are very similar, MS detection is more suitable for analysis. The Nexera UC UFMS system can analyze these compounds accurately and with high separation.



Analysis of synthetic compounds

Finding a suitable analytical method for the analysis of synthetic compounds is often a time consuming task, requiring the user to manually change columns and mobile phases to test different combinations. Nexera UC UFMS simplifies this task by automatically screening different combinations of columns and mobile phases to find the most suitable conditions. Additionally, the polarity of the mobile phase can be adjusted by the addition of modifiers, allowing a greater number of possibilities to be evaluated.

System configuration examples

Nexera UC 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.



Nexera UC 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.



Nexera UC Customized Units

Supercritical Fluid Extraction Unit SFE-30A

SFE-30A extracts solid samples, or samples adsorbed into solid, directly by supercritical fluid. It can extract analytes from a variety of matrices and operates at temperatures up to 80°C. It can accept two different extraction vessels with internal volumes of 5 mL and 0.2 mL. This unit automatically extracts four samples as standard and 48 samples when connected with Rack Changer (optional).



	SFE-30A (228-45219-XX)
Number of processable samples	4
Extraction vessel volume	0.2 mL, 5.0 mL
Maximum operation pressure	40 MPa
Temperature control range	10°C above room temperature to 80°C
Operating temperature range	15 to 28°C
Dimensions, weight	W260 × D500 × H415 mm, 30.4 kg
Power requirements	AC 120 V, 230 V, 450 VA, 50/60 Hz

CO₂ Solvent Delivery Unit LC-30AD_{SF}

This delivery unit has a built-in cooler for pump heads and delivers supercritical fluid up to 5 mL/min at 66 MPa.



	LC-30AD _{SF} (228-45217-XX)
Solvent delivery method	Micro-volume double plunger pump
Plunger capacity	10 µL
Flow-rate setting range	0.0001 to 5.0000 mL/min
Maximum pumping pressure	66 MPa (0.0001 to 3.0000 mL/min), 44 MPa (3.0001 to 5.0000 mL/min)
Flow-rate accuracy	Less than ±1% or ±2 µL/min, whichever is greater (1 to 40 MPa, under specified conditions) Less than ±2% or ±2 µL/min, whichever is greater (40 to 60 MPa, under specified conditions)
Flow-rate precision	Less than 0.06%RSD or 0.02 minSD whichever is greater
Pressure limits function	Upper and lower limits
Plunger rinsing mechanism	Equipped with an automatic rinsing kit
Operating temperature range	15 to 28°C
Dimensions, weight	W 260 × D500 × H280 mm, 25.5 kg
Power requirements	AC 100 V, 230 V, 600 VA, 50/60 Hz

Supercritical Fluid Back Pressure Regulator Unit SFC-30A

This unit achieves extremely high sensitivity by transferring eluate from a column to a mass spectrometer without splitting.



	SFC-30A (228-45218-XX)
Pressure setting range	10 to 40 MPa (0.01 MPa step)
Pressure control accuracy	0.10 MPa (100% CO ₂)
Maximum setting pressure	40 MPa
Temperature control range	40 to 70°C (1°C step)
Safety measures	Thermo sensor, Thermal fuse, Leak sensor, BPR cover sensor
Operating temperature range	15 to 28°C
Dimensions, weight	W260 × D500 × H140 mm, 12 kg
Power requirements	AC 120 V, 230 V, 300 VA, 50/60 Hz

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).



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