C190-E168

SHIMADZU
Excellence in Science

Ultra High Performance Liquid Chromatograph

# Nexera Quaternary System

# New Standard of Excellence in UHPLC/HPLC

Nexera X2

Ultra High Performance Liquid Chromatograph

## Quaternary System

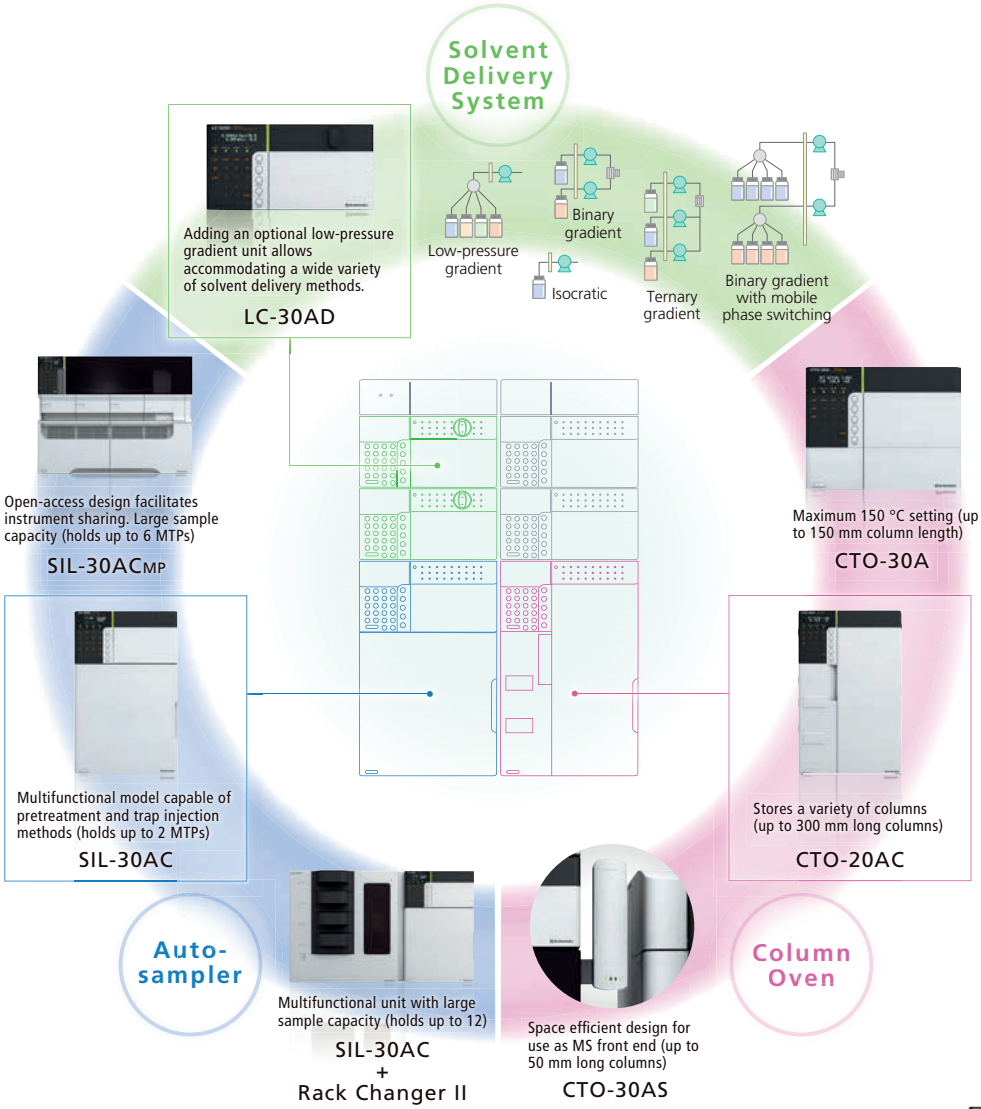
(Low-Pressure Gradient System)

- **Efficient method development with up to 16 mobile phase combinations**
- **Seamless method transfer from conventional HPLC to UHPLC**
- **Highly accurate solvent delivery ensures reliable analysis**
- **Expandable to Nexera Method Scouting System for automated method development processing**

The Nexera Quaternary System can be configured to include two solvent delivery units in combination with a low-pressure unit. Four types of mobile phases can be configured for each solvent delivery unit, resulting in a total of eight mobile phase types. This provides the flexibility to investigate up to 16 mobile phase combinations. Significant improvements in method development efficiency means users have more time to focus on other critical activities. The product range includes the Nexera Method Scouting System, which contains six columns and automates the method development process by automatically switching the column and mobile phase combinations. The Nexera Quaternary System not only provides the optimal system for HPLC/UHPLC method development but can be widely used for routine HPLC analysis. It continues the tradition of robust, reliable ultra-high performance.

# Combine Individual Modules to Configure a System Suited to Specific Application Requirements

Nexera X2 remains compatible with other Shimadzu LC modules that exhibit additional performance benefits, providing maximum flexibility to configure the perfect system for your requirements, including ultrafast LC systems.




## Routine UHPLC System with a Single Solvent Delivery Unit

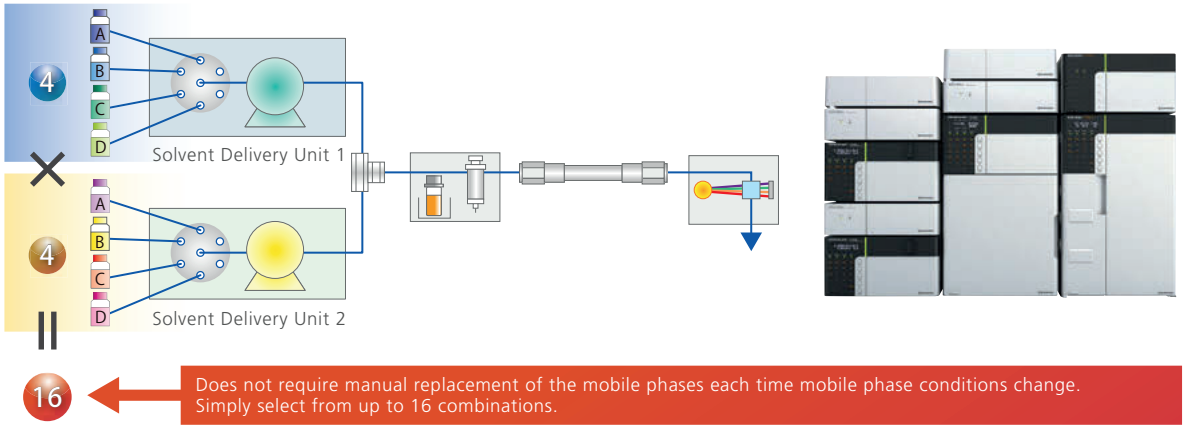
A Nexera Quaternary System configured with a single solvent delivery unit permits low-pressure gradient analysis using up to four solvents. More cost-effective than a high-pressure gradient analysis system, it offers gradient analysis of multiple mobile phase types.

## Nexera Quaternary System Expanded to Handle 16 Mobile Phase Combinations

Adding a low-pressure gradient unit to a Nexera X2 binary gradient system offers automatic switching of up to four mobile phases per solvent delivery unit. Therefore, a system incorporating two solvent delivery units provides up to 16 mobile phase combinations. One solvent delivery unit can be used for low-pressure gradient analysis using four solvents.

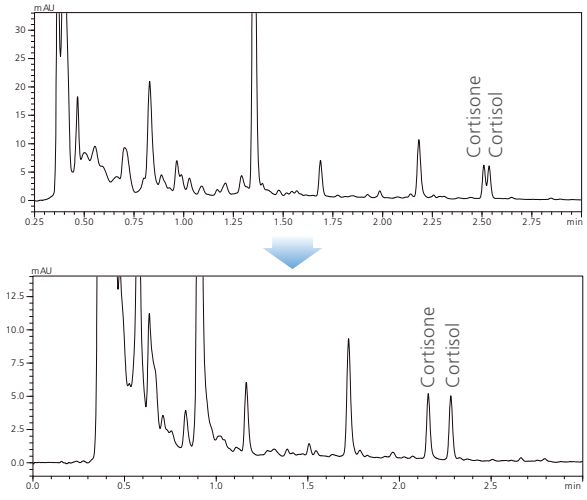
# Efficient Method Development with up to 16 Mobile Phase Combinations

With the Nexera Quaternary system incorporating two solvent delivery units, up to four types of mobile phases can be loaded for each solvent delivery unit to investigate up to 16 mobile phase combinations. By eliminating the need to manually change the mobile phases each time the mobile phase conditions are changed, this system reduces the labor time required for mobile phase preparation.




## Greatly Reduced Workload to Investigate Mobile Phases During Method Development

The optimal separation conditions differ according to the sample. Put simply, a wide variety of mobile phase combination candidates is available for reverse-phase analysis. For example, although acetonitrile is generally used as the mobile phase for reverse-phase analysis, it may not achieve adequate separation for some samples. The Nexera Quaternary system, incorporating two solvent delivery units, offers more efficient method development by making it simple to switch to another preloaded mobile phase.




Preloading frequently-used mobile phases allows immediately switching to a different mobile phase combination

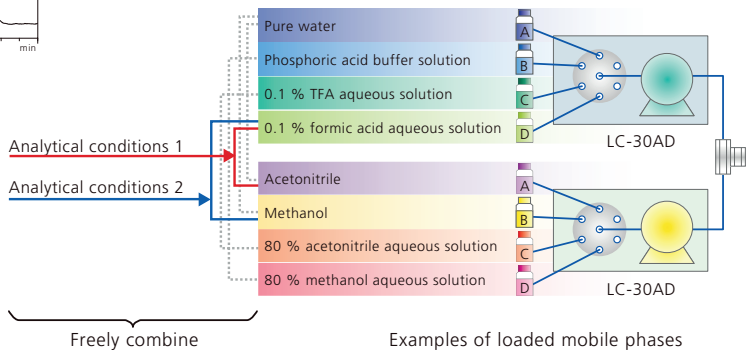
More efficient method development

### Analytical Conditions 1

| | |
|---|---|
| Mobile phase | A: 0.1 % formic acid aqueous solution<br>B: Acetonitrile<br>Gradient elution |
| Time program | B. Conc. 10 % → 60 % (3.5 min) |
| Flow rate | 0.6 mL/min |

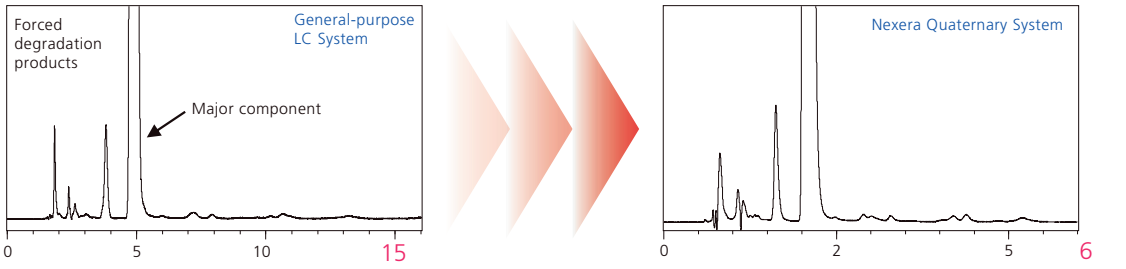
### Analytical Conditions 2

| | |
|---|---|
| Mobile phase | A: 0.1 % formic acid aqueous solution<br>B: Methanol |
| Time program | B. Conc. 30 % → 90 % (3.0 min) |
| Flow rate | 0.6 mL/min |



# Seamless Transfer from Conventional HPLC to UHPLC

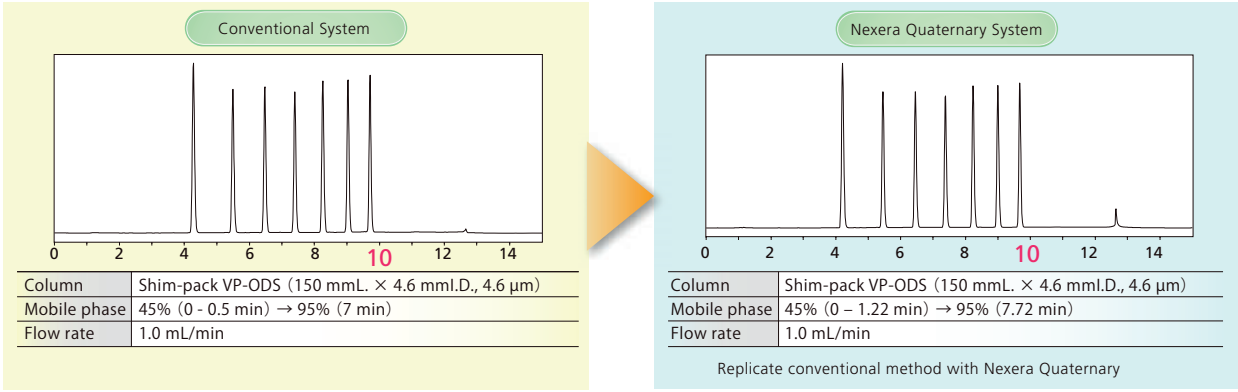
The Nexera X2 eliminates the need to categorize systems as a dedicated HPLC or UHPLC system. A single Nexera X2 can handle both analyses. The Nexera Quaternary System in its basic configuration incorporates a single solvent delivery unit for low-pressure gradient analysis using up to four solvents. This allows the system to replicate conventional HPLC methods and allows the smooth transfer of HPLC methods to UHPLC methods. As a result, single system can handle a diverse range of applications.




| | |
|---|---|
| Column | Shim-pack VP-ODS (150 mmL. × 4.6 mmI.D., 4.6 µm) |
| Mobile phase | 50 mmol/L phosphoric acid buffer solution (pH 7.0) / methanol = 2/3 |
| Flow rate | 1.0 mL/min |

| | |
|---|---|
| Column | Shim-pack XR-ODS (75 mmL. × 3.0 mmI.D., 2.2 µm) |
| Mobile phase | 50 mmol/L phosphoric acid buffer solution (pH 7.0) / methanol = 2/3 |
| Flow rate | 0.40 mL/min |

Faster Analysis of Rabeprazole Sodium Active Pharmaceutical Ingredient




| | |
|---|---|
| Column | Shim-pack VP-ODS (150 mmL. × 4.6 mmI.D., 4.6 µm) |
| Mobile phase | 45% (0 - 0.5 min) → 95% (7 min) |
| Flow rate | 1.0 mL/min |

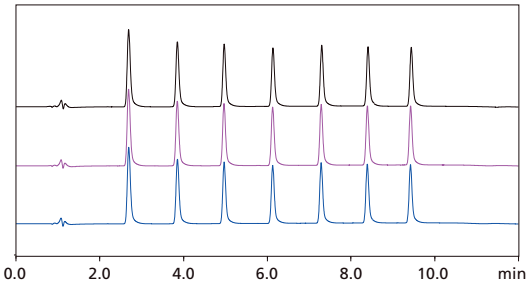
| | |
|---|---|
| Column | Shim-pack VP-ODS (150 mmL. × 4.6 mmI.D., 4.6 µm) |
| Mobile phase | 45% (0 – 1.22 min) → 95% (7.72 min) |
| Flow rate | 1.0 mL/min |

Replicate conventional method with Nexera Quaternary

Replicating the General-Purpose Conventional Method

## High Pumping Accuracy Provides More Reliable Analysis Data

The Nexera Quaternary System inherits the high pumping accuracy of the Nexera X2 to achieve highly accurate analysis even at low flow rates. The ability to handle analysis from very low flow rates up to UHPLC analysis is the great advantage of the Nexera X2 all-round LC.




| | |
|---|---|
| Column | Shiseido CAPCELL PAK MGII (150 mmL. × 1.0 mmI.D., 3.0 µm) |
| Mobile phase | A: Water<br>B: Acetonitrile |
| Time program | B. Conc. 45 % (0 - 0.5 min) → 95 % (8.0 – 10.0 min) |
| Flow rate | 0.08 mL/min |

Note: Using delayed injection

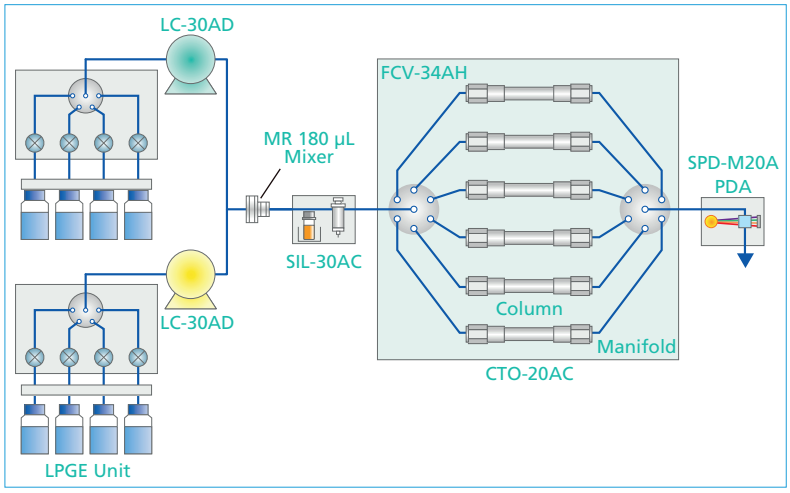
Analysis of Seven Alkylphenones

# Expandable to Method Scouting System to Automate the Method Development Process

The Nexera Method Scouting system is an automated method development system. It can accept up to six columns and eight mobile phases and automatically switch between up to 96 combinations while acquiring data. It permits highly efficient method development by automatically acquiring data overnight and during other down-times.

Method Scouting Solution

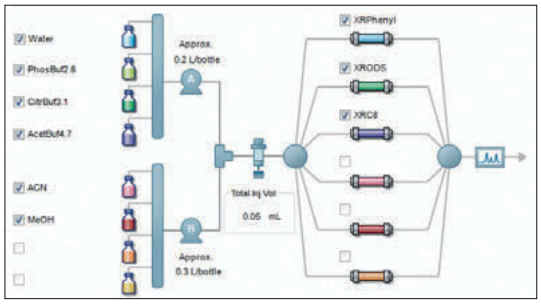
Nexera Method Scouting System




Basic configuration of the Nexera Method Scouting System

## Automated Analysis and Great Labor Savings in Analysis Setup

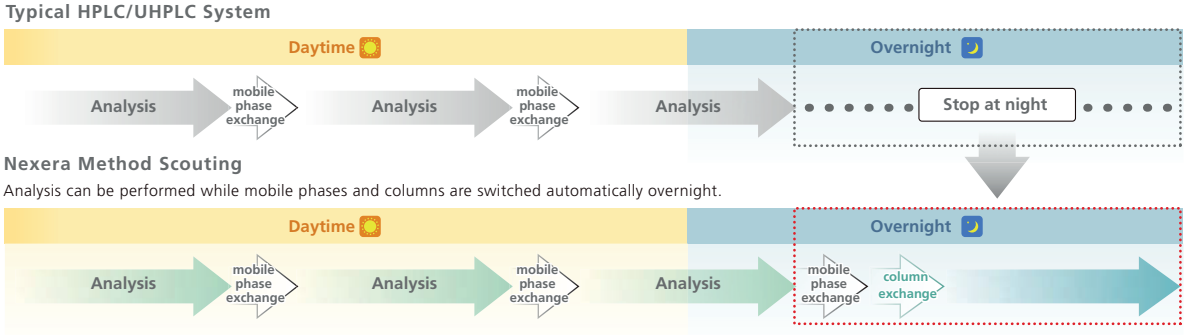
The Nexera Method Scouting system significantly reduces the preparation time for analytical work, and eliminates human error when creating method files and setting schedules. When up to six columns, eight mobile phase solvents, and ten gradient settings are available, the potential number of combinations is 96. Manually creating numerous method files and setting schedules for them takes an inordinate amount of time and is likely to result in errors. The Nexera Method Scouting system automatically creates the necessary batch files for the entire workflow, eliminating potential errors in method creation.




Column and mobile phase selection window
During analysis, columns and mobile phases can be set by selecting them in the graphical user interface.

## Improved Method Development Efficiency by Working Overnight

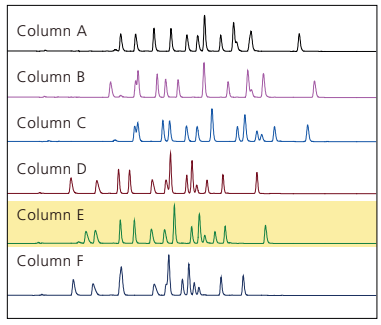
When an analysis is run, dedicated software automatically switches the columns and mobile phases during the analysis. It can operate unmanned during holidays or overnight. The operator is free of chores to create method files, prepare mobile phases, or switch columns. These effects combine to improve throughput for method development by up to a factor of 10.



# Workflow with the Nexera Method Scouting System

**Step 1.**
Perform mobile phase and column scouting. Once the base method has been created, the software automatically sets the mobile phase and column combination. This minimizes errors when creating methods.

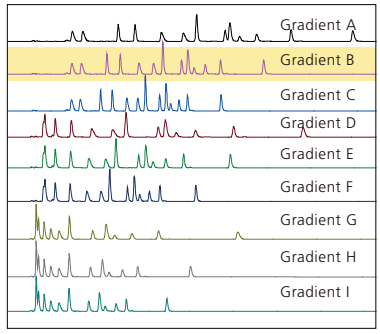
**Evaluation 1: Check the Chromatogram**
Make an overall evaluation of the total number of detected peaks, resolution, and elution times to narrow down the column and mobile phase suitable for the analyte



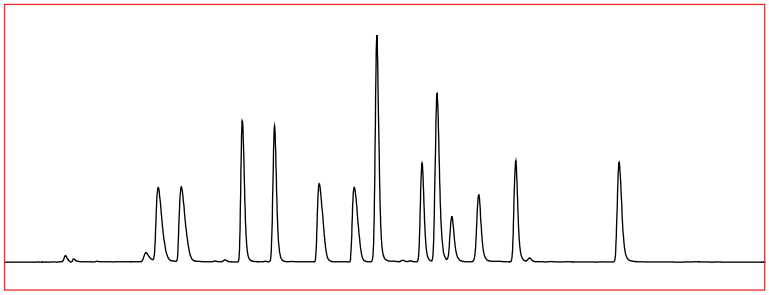

Step 1: Search for the optimal column and mobile phase

**Step 2.**
Search for the gradient conditions using the column and mobile phase determined at Step 1. Once the basic settings have been made, the software automatically changes the settings and acquires the data.

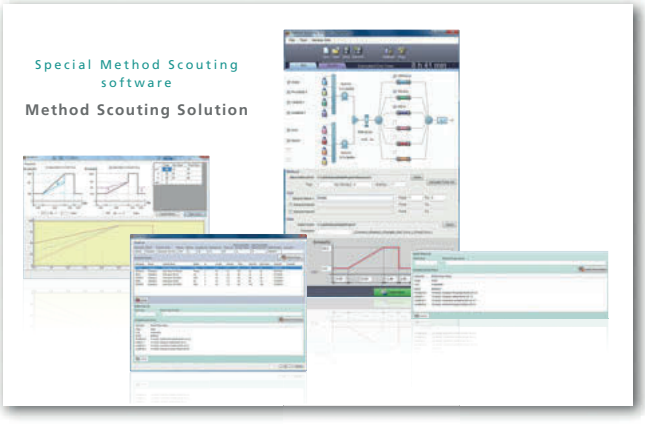
**Evaluation 2: Check the Chromatogram**
Make an overall evaluation of the total number of detected peaks, resolution, and elution times to search for the optimal conditions.

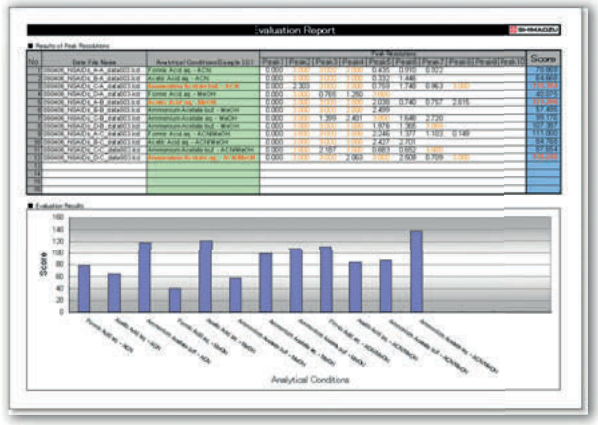



Step 2: Search for the optimal gradient



**Step 3.**
Optimal Method Created Combining Column E and Gradient B




The optional CLASS-Agent Report uses peak separations in the obtained chromatogram to calculate the evaluation values.

# Nexera X2: Performance You Expect from a Proven Leader in UHPLC/HPLC

Nexera X2 Autosampler
SIL-30AC

The Nexera X2 SIL-30AC / SIL-30ACMP autosamplers offer superior performance, such as ultralow carryover and stable injection accuracy from 0.1 µL to improve the analysis reliability.

- Support for a Wide Range of Injection Volumes from HPLC to UHPLC
- Multi-Rinse Mechanism for Ultralow Carryover Performance

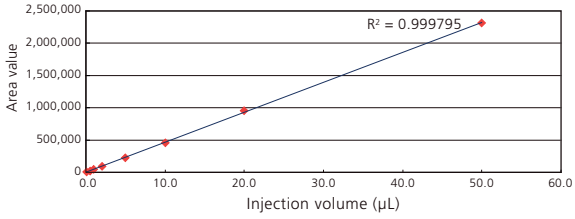
## Two Models Support a Diverse Range of Applications

The Nexera X2 series includes two autosampler models: the SIL-30AC that offers automatic pretreatment and switching to loop injection, and the SIL-30ACMP which handles a large number of samples. Recognized as the cleanest and fastest autosampler on the market, the SIL-30ACMP is the ideal front-end LC for LC/MS. Naturally, both models can be configured as a Quaternary system or mobile phase switching system. Select the model that best suits your requirements.

Nexera SIL-30ACMP Autosampler Supports
Multi-Sample Analysis

## Support for Diverse Injection Volumes from HPLC to UHPLC

The SIL-30ACMP supports an injection volume range of 0.1 µL to 50 µL. Linearity is achieved within a broad injection range, from small injection volumes for UHPLC up to several tens of µL on conventional models. The SIL-30ACMP provides excellent repeatability even in the injection of a volume of 1 µL or less.



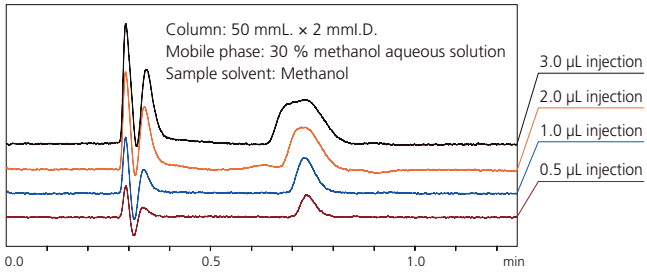

| Injection Volume (µL) | Repeatability (n = 6) |
|---|---|
| 0.1 | 0.67% |
| 0.2 | 0.32% |
| 0.5 | 0.26% |
| 0.7 | 0.14% |
| 1 | 0.11% |

| Injection Volume (µL) | Repeatability (n = 6) |
|---|---|
| 2 | 0.09% |
| 5 | 0.05% |
| 10 | 0.05% |
| 20 | 0.04% |
| 50 | 0.03% |

Injection Repeatability (Actual Values)

## Why is Sub-1 µL Injection Accuracy Needed for UHPLC?

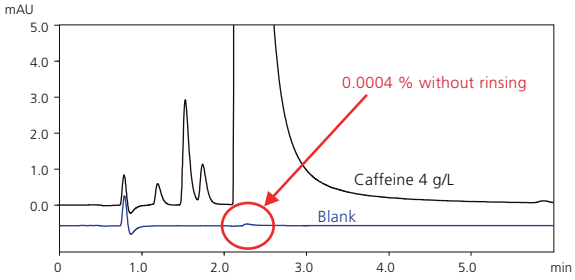
As shown in the figure to the right, column sizes with an I.D. of approximately 2 mm, which are often used on a UHPLC, are susceptible to the influence of sample solvents, and it may be difficult to increase the injection volume. However, since the Nexera X2 is capable of high-precision injection of small volumes, the influence of sample solvents can be suppressed even if pretreated organic solvent-rich samples are injected directly.




In the case of sample solvents having an elution strength greater than that of the mobile phase, the peak shape is sometimes deformed when the injection volume is increased.

## Ultra-Low Carryover Performance Supports High-Sensitivity Analysis

HPLC detectors, such as mass spectrometers, are becoming more sensitive each year. Consequently, HPLC systems are requiring increasingly lower carryover levels. The Nexera SIL-30AC/SIL-30ACMP systems provide the reliability and flexibility to achieve exceptional carryover performance.

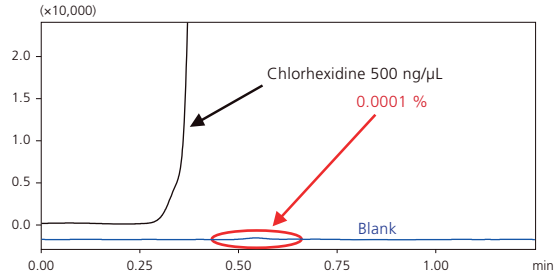



### Ultralow carryover achieved without rinsing

When rinsing is performed to keep carryover low, the total analysis time sometimes increases as the number of analyses increases. Nexera X2 autosamplers excel in suppressing carryover even without rinsing.

### Ultralow carryover even on a high-sensitivity LC/MS/MS

Ultralow carryover performance is required with LC/MS systems. The Nexera X2 autosampler demonstrates exceptional carryover performance even on compounds such as chlorhexidine that are very prone to adsorption.

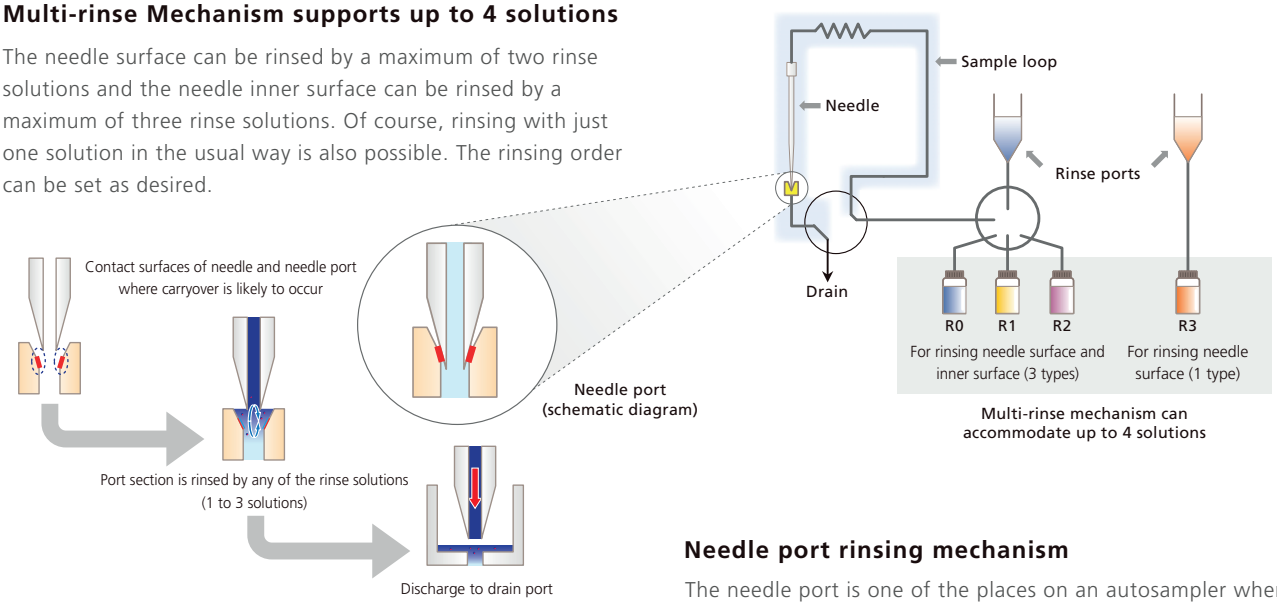



## Multi-Rinse Mechanism Eliminates Carryover

In the batch analysis of multiple components, components with greatly differing polarities are frequently analyzed together. In this situation, sufficient rinsing may not be achieved using only one type of rinse solution. To combat this, the SIL-30AC/SIL-30ACMP has not only been designed with hardware components that are less likely to adsorb, but also has a modified rinse mechanism designed to achieve even lower carryover.

### Multi-rinse Mechanism supports up to 4 solutions

The needle surface can be rinsed by a maximum of two rinse solutions and the needle inner surface can be rinsed by a maximum of three rinse solutions. Of course, rinsing with just one solution in the usual way is also possible. The rinsing order can be set as desired.



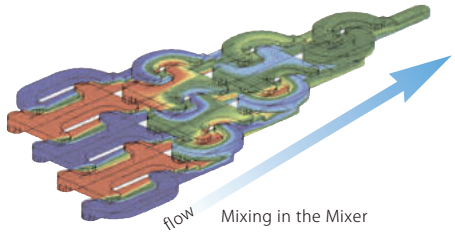

### Needle port rinsing mechanism

The needle port is one of the places on an autosampler where carryover is likely to occur. On the SIL-30AC/SIL-30ACMP, the needle port is rinsed automatically.

# More Reliable Mixing (High-Efficiency Gradient Mixer)

Newly designed models have been added to the lineup of micro-reactor gradient mixers for Nexera. In addition to the 20 µL mixer that is ideal for a front-end LC for LC/MS and the 180 µL mixer that provides maximum mixing efficiency, 40 µL and 100 µL mixers offering a good balance between mixing performance and gradient delay have been added to the product range. The customer can select the ideal capacity for their needs.

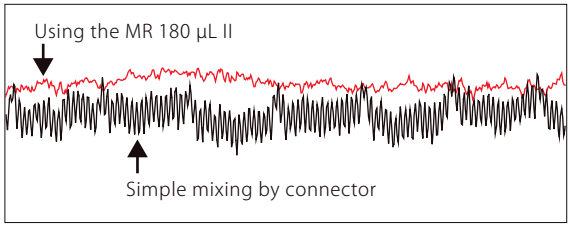

MR 20 µL




Mixing in the Mixer

| Mixer Lineup |
|---|
| MR 20 µL |
| MR 40 µL |
| MR 100 µL |
| MR 180 µL II |

High-Efficiency Gradient Mixers Incorporate Micro-Reactor Technology

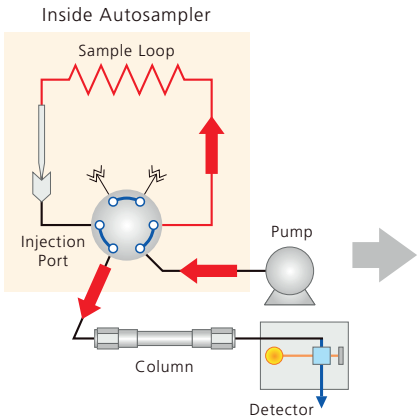



| | |
|---|---|
| Column | Shim-pack XR-ODS (50 mmL. × 3.0 mmI.D.) |
| Mobile phase | A: 100 mmol/L phosphoric acid solution pH 2.1<br>B: Acetonitrile |
| Time Program | B.Conc 5 % |
| Flow rate | 0.8 mL/min |

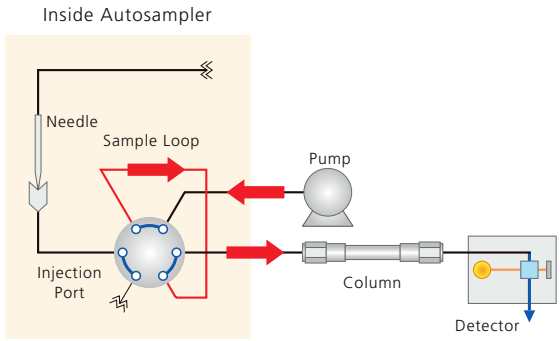
Minimal baseline fluctuation, even high-concentration buffer solurion

## Simply Alter the Piping to Change the Injection Method (loop-injection kit)

To keep the injection method of your existing instrument but reduce the delay volume, simply use the loop injection kit to change the SIL-30AC autosampler piping. This changes the injection method from the standard total volume injection (direct injection) method to loop injection. An existing instrument can be easily changed and no special units are required.




Standard total volume injection




Loop injection (option)

Changing the injection method involves changing the piping.
No additional units are required.

# Nexera X2 Series

In addition to the systems below, the Nexera X2 modules can be used to configure systems that meet a user's specific requirements. The Nexera X2 is an UHPLC system that can be configured as a wide range of systems - from a simple isocratic system to a complex 2D system that drives the switching valves

UHPLC system boasting optimal sensitivity and resolution. *i*-PDeA* offers new separation methods and *i*-DReC** offers extended dynamic range.

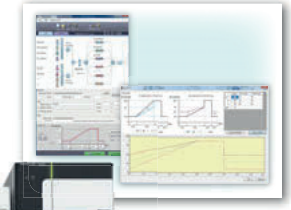
*Intelligent Peak Deconvolution Analysis
**Intelligent Dynamic Range Calculator

Nexera SR System

The Nexera Quaternary System with a single solvent delivery unit is a simple, low-cost model. The Nexera Quaternary System with two solvent delivery units offers automatic mobile phase switching to reduce the workload for method development.

Nexera Quaternary System

Nexera Quaternary System
(Two solvent delivery units support automatic mobile phase switching.)



This is a method development system that uses dedicated software to continuously acquire data while automatically switching between 96 combinations of mobile phases and columns.

Nexera Method Scouting System

Nexera MP System

System based on the SIL-30AC$_{MP}$ Autosampler that can accept up to 2304 samples as standard. This is the ideal front-end LC for LC/MS to obtain remarkable high speed and sensitivity. Adding a low-pressure gradient unit to this system supports automatic mobile phase switching.

## Specifications

| System | | |
|---|---|---|
| System volume | 40 µL (when using small-volume piping) | |
| Maximum operating pressure | 130 MPa (3.0 mL/min max.)<br>80 MPa (3.0001 to 5.0 mL/min)<br>22 MPa (5.0001 to 10.0 mL/min) | |
| Solvent delivery unit | LC-30AD + Quaternary unit | |
| Settable flow rate range | 0.0001–10.0000 mL/min (in 0.0001 mL/min step) | |
| Number of loaded mobile phases | 4 solvents max. for each solvent delivery unit) | |
| Gradient type | Low-pressure gradient | |
| Flow rate accuracy | ±1.0% (under specified conditions) | |
| Concentration accuracy | ±0.5% (under specified conditions) | |
| Autosampler | SIL-30AC | SIL-30AC$_{MP}$ |
| Injection volume range | 0.1 to 10.0 µL (in 0.1 µL step), 10 to 50 µL (in 1 µL step) | |
| Injection volume accuracy | ±1.0% (total volume injection method, under specified conditions) | |
| Injection volume repeatability | RSD ≤ 0.25% (under specified conditions) | RSD ≤ 1.0% (0.5–0.9 µL), RSD ≤ 0.5% (1.0–1.9 µL)<br>RSD ≤ 0.25% (2.0–4.9 µL), RSD ≤ 0.2% (5.0–50 µL) |
| Cross-contamination | 0.0015% max (without rinsing, caffeine, UV detection) | 0.0015% max (without rinsing, caffeine, UV detection)<br>0.0015% max (with rinsing, chlorhexidine, mass spectrometer) |
| Needle cleaning | Set as required before and after sample injection. Cleans exterior and interior of needle. Max. 4 solutions. | |
| Column oven | CTO-30A | CTO-20AC |
| Temperature setting range | 4 to 150°C (in 1°C step) | 4 to 85°C (in 1°C step) |
| Temperature control range | (Room temp. +5) to 150°C | (Room temp. –10) to 85°C |
| Temperature control precision | ±0.05°C (in case of room temp. of 25°C) | 0.1°C max. (0.04°C max. normally) |
| Detector | SPD-20A UFLC | SPD-M20A |
| Wavelength range | 190–700 nm | 190–800 nm |
| Wavelength accuracy | ±1 nm max. | |
| Noise | 1.2 × $10^{-5}$ AR max. (standard semi-micro cell, under specified conditions)<br>< 0.5 × $10^{-5}$ AU max. (conventional cell, under specified conditions) | 0.6 × $10^{-5}$ AU (under specified conditions) |
| Drift | 2 × $10^{-4}$ AU/h max. (standard semi-micro cell, under specified conditions)<br>< 1 × $10^{-4}$ AU/h max. (conventional cell, under specified conditions) | 5 × $10^{-4}$ AU/h (under specified conditions) |

Note: Refer to the comprehensive brochure for Nexera X2 for details.

SHIMADZU

Shimadzu Corporation

**www.shimadzu.com/an/**



Printed in Japan 3655-06308-30ANS