SHIMADZU

C190-E141
Nexera Special Edition

LC World Talk

SHIMADZU'S NEWSLETTER FOR THE HPLC GLOBAL COMMUNITY

SPECIAL EDITION

Nexera

Ultra High Performance Liquid Chromatograph

Experience the Evolution of the World's Only No Compromise UHPLC

Nexera


SPD-20A
CTO-30A
LC-30AD
LC-30AD
SIL-30AC
DGU-20A
LCMS-2020
SHIMADZU

Continues to Evolve

Released as the World's Only No Compromise UHPLC in March 2010

Now with a Low-pressure Gradient Function

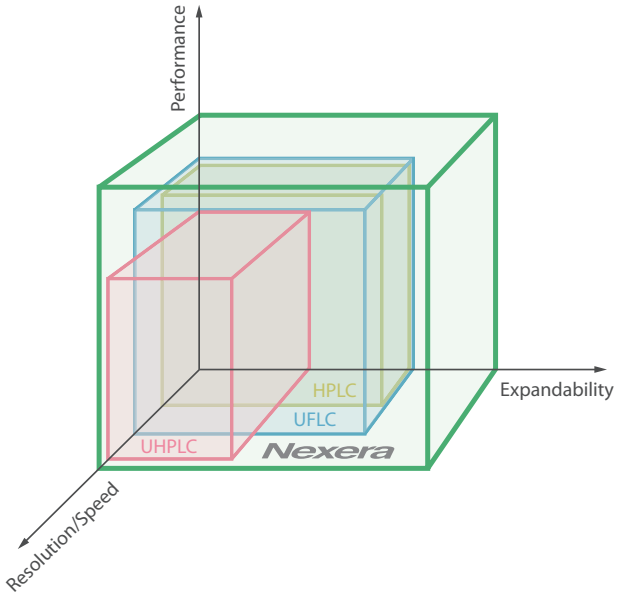
To increase productivity and throughput in labs, ultra-high pressure LC has become a mainstream technique. When developing a UHPLC, our goal was not just to develop another UHPLC system; our goal was to develop a system that meets all analysis requirements without compromising reliability, robustness, and expandability. To achieve this, we incorporated all the core competencies of Shimadzu's businesses, from materials testing to aircraft equipment development, to develop more than just another specialized system.

The Shimadzu Nexera was released this year as the next-generation UHPLC. At 130 MPa (19,000 psi), Nexera is the world's only no compromise UHPLC, offering the speed, versatility, ruggedness, reproducibility, and superior performance for all applications.

This September, Shimadzu released the Nexera low-pressure gradient unit and extended the flow rate to 10 mL/min, which allows for precise control of four solvents. Nexera is continuously evolving to meet all customer demands, proving to be a true all-round HPLC.

3D Visualization of Application Range

Encompassing analytical, ultrafast, and UHPLC analyses, Nexera represents the latest development in HPLC design to meet all the technical challenges of a UHPLC system and guarantee maximum performance in all fields.



Maximizing Performance

Nexera offers precise solvent delivery, excellent reproducibility, and near-zero carryover, and ensures fully reliable analysis in all application fields through refinement of each component.

Maximizing Throughput

With a pressure range up to 130 MPa, high-speed injection, overlap injection, and highly-efficient gradient mixing, Nexera enables ultra-high speed and ultra-high resolution analysis.

Maximizing Expandability

Nexera's column oven and autosampler, in concert with the modular nature of the system, expand the application range. These applications include high-temperature analysis, green LC, auto-sample pretreatment, multidimensional LC, low-pressure/high-pressure gradient, and method development.

Nexera Features

Nexera Modules

The LC-30AD pump ensures stable UHPLC solvent delivery up to 130 MPa (19,000 psi). The flow rate extended to 10 mL/min is suited for a wide application range. The LC-30AD incorporates micro plunger-driven precision solvent delivery control to enable precise gradient delivery, even at the rapid concentration shifts in fast gradient programming. In addition, it adopts an ultra-low volume mixer (20 µL) based on micro reactor technology. The low-volume mixer minimizes gradient delay to ensure highly efficient mixing. A low-pressure gradient for control of four solvents is now available by incorporating the low-pressure gradient unit into the LC-30AD pump.

The SIL-30AC autosampler features the world's fastest sample injection (10 seconds), and now includes the auto pretreatment and overlapping functions as standard as well as an optional loop-injection method configuration to minimize delay volume. With reduction of the needle contact area, special coatings, surface treatments, and a new needle seal, the SIL-30AC autosampler reaches a new level of low carryover performance. Moreover, the SIL-30AC offers thorough rinsing of the sample path with multiple rinse solvents to eliminate carryover of even the most stubborn of compounds.

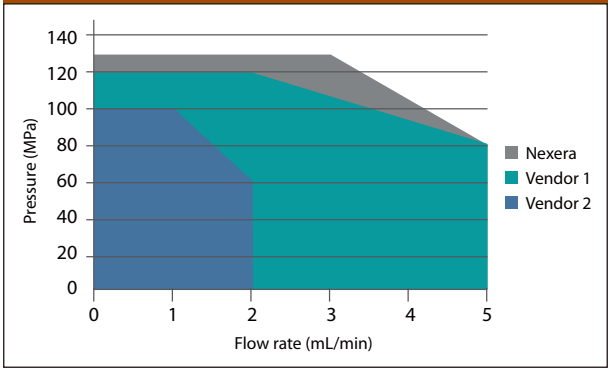
The Rack Changer II accommodates up to 12 sample plates (96 well, 384 well, vial plates) to allow up to 4608 samples to be continuously analyzed unattended. It incorporates fine temperature control with a cooling function (4 to 40ºC) to minimize sample degradation during the process.

The CTO-30A column oven provides precise temperature control up to 150ºC with a newly designed solvent pre-heater, a proprietary Intelligent Heat Balancer (IHB), and post-column solvent cooling. The solvent pre-heater and IHB ensure uniform column temperature even at high flow rate conditions. In addition, the block heater design of the CTO-30 is quick to reach the set temperature, dramatically reducing the wait time before starting analysis. This fast heating capability is especially useful when conducting high-temperature (over 100˚C) and green LC applications.

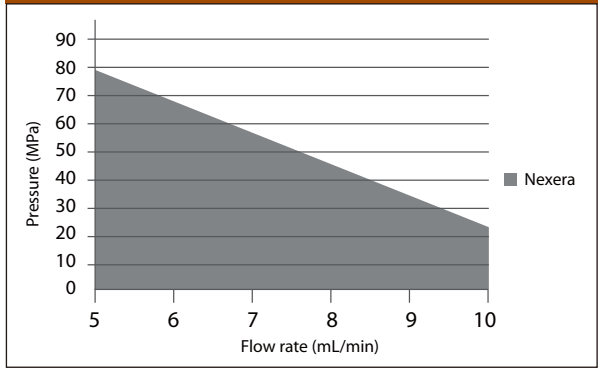
Maximizing Throughput

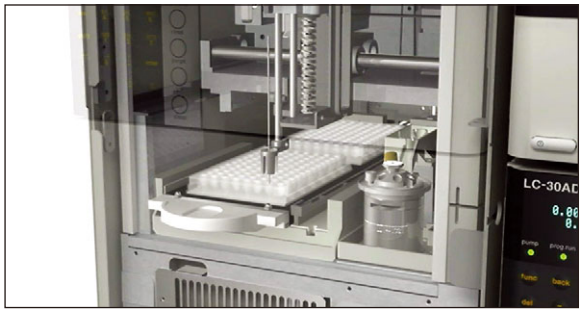
With Nexera, the available range in **pressure** and **flow rate** has been increased as shown below. The widest applicable cover range not only offers use of ultra-fast LC columns, such as sub-2µm particle columns, fused-core columns, etc., but also conventional, high-temperature, and small bore columns. The optimized materials and refined design for the plungers, plunger seals, needle, needle seal, and autosampler valves support a wide range of applications and deliver reliable, stable analysis.

Maximum pressure: 130MPa



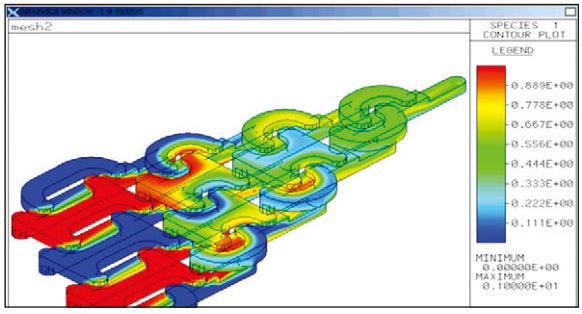
Only NEXERA is available in this range





World's Fastest Autosampler

With the reliable XYZ mechanics and optimized alignment of the injection parts, the SIL-30AC allows for rapid injections (10 seconds). Near-zero carryover and accurate and precise injection provide true UHPLC analysis.



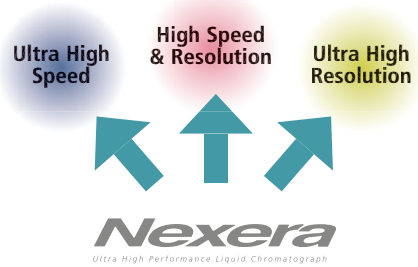
Minimized Delay Volume

The new mixer (MiRC) was developed based on study of micro reactor technologies. The standard MiRC mixer (20 µL) gives reduced gradient delay with highly efficient mixing under ultra-high pressure conditions. An optional loop injection configuration is also available to minimize delay volume even further.

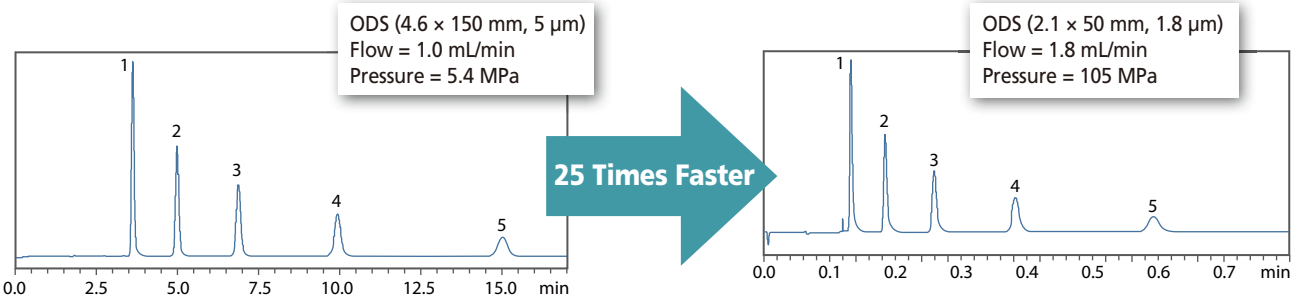
Uniform Column Heating Supports UHPLC Analysis

Temperature distribution across a column can cause peak broadening and peak shape deterioration, especially in UHPLC analysis. The Nexera CTO-30A column oven incorporates two independently controllable heaters to minimize temperature distribution. A low-volume pre-heater helps to control mobile phase and column temperature uniformly, eliminating band diffusion.

Ultra-High Speed Analysis



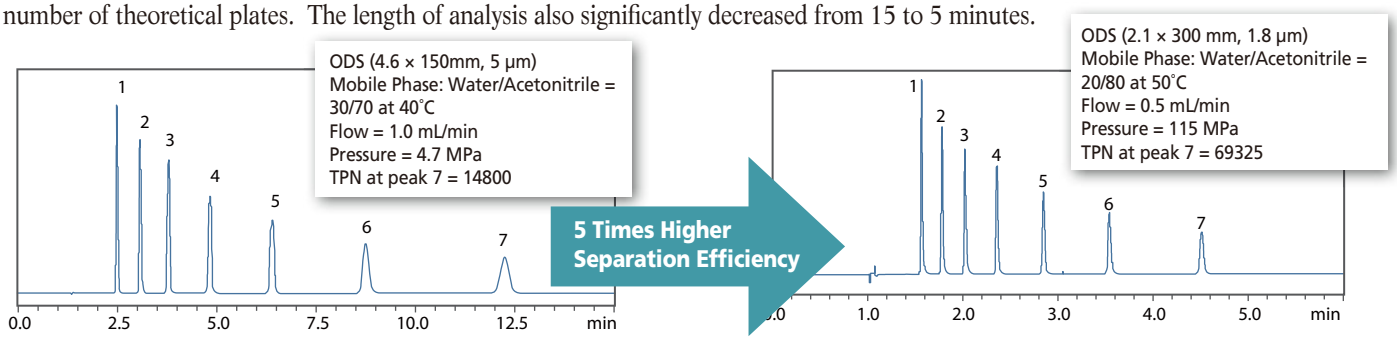
In this example, by switching to a column with a sub-2 micron particle size, three times shorter, and nearly doubling the flow rate (8.5 times faster linear velocity), it was possible to achieve an astonishing 25-fold increase in the speed of the analysis.



The following analytes were detected at 245 nm listed in the order of elution: Acetophenone (1), Propiophenone (2), Butyrophenone (3), Valerophenone (4), Hexanophenone (5). The Mobile Phase was Water/Acetonitrile at 45/55, 40˚C.

Ultra-High Resolution Analysis

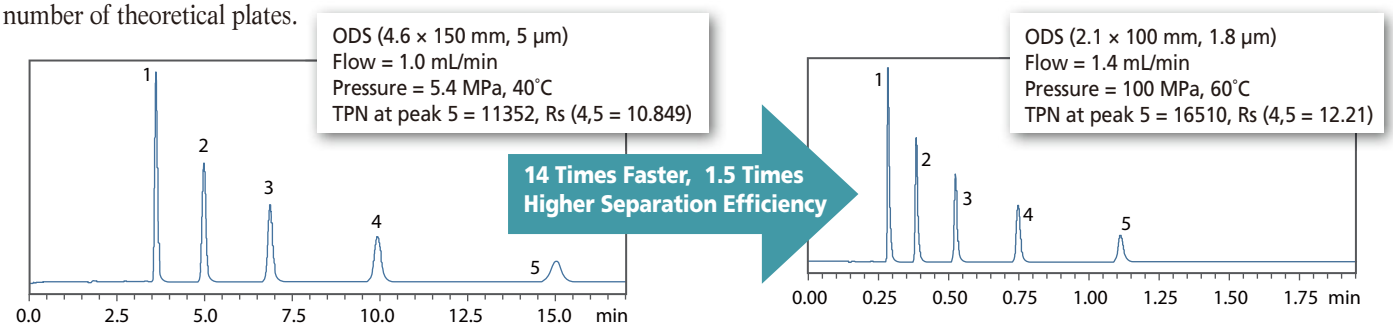
Nexera allows the use of longer sub-2 µm particle columns to improve separation efficiency. Increasing the column length while using a sub-2 µm particle size leads to a significant increase in the separation efficiency as shown here by a 5-fold increase in the number of theoretical plates. The length of analysis also significantly decreased from 15 to 5 minutes.



In this example, two 150 mm columns with 1.8 µm particles were connected sequentially for a total length of 300 mm. The following analytes were detected at 245 nm listed in the order of elution: Acetophenone (1), Propiophenone (2), Butyrophenone (3), Valerophenone (4), Hexanophenone (5), Heptanophenone (6), Octanophenone (7).

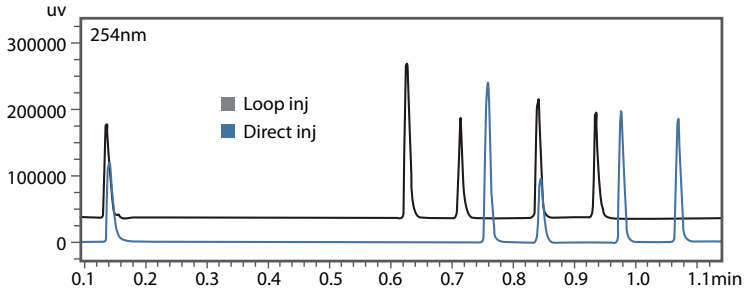
High-speed and High-resolution Analysis

Conducting analysis with a 100 mm length, sub-2 µm particle size column while increasing the flow rate and temperature achieves a 14-fold increase in the speed of analysis. Additionally, a 1.5 times higher separation efficiency is realized as shown by the higher number of theoretical plates.



The following analytes were detected at 245 nm listed in the order of elution: Acetophenone (1), Propiophenone (2), Butyrophenone (3), Valerophenone (4), Hexanophenone (5). The Mobile Phase was Water/Acetonitrile at 45/55.

Minimized System Delay by Optional Loop Injection Method



Analytical Conditions

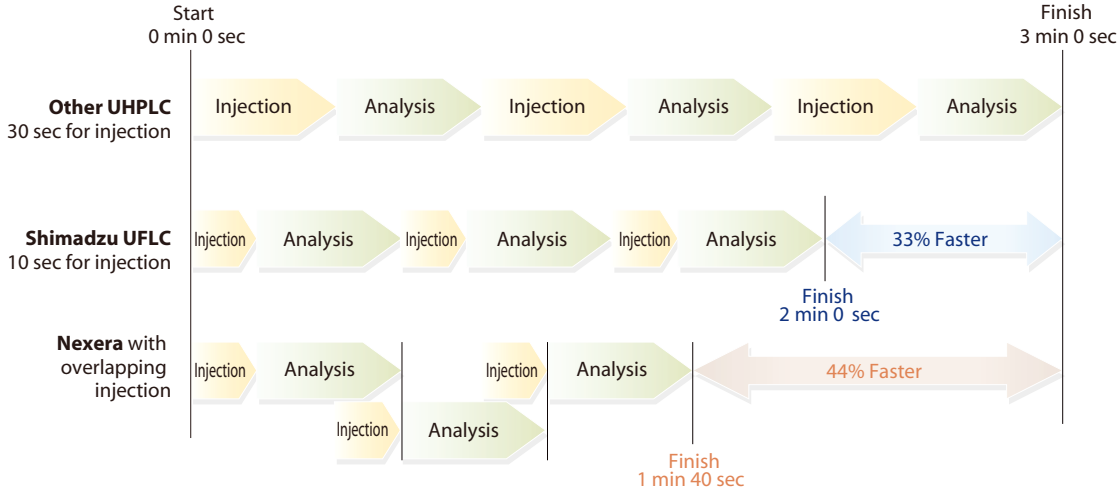
Column:	Kinetex (2.1 × 50mm, 2.6 µm)
Mobile phase:	A: water, B: acetonitrile
Gradient:	0min (B.15%), 1min (B 80%), 1.01min (B15%),
Flow rate:	0.8mL/min
Methyl paraben:	50ppm, Acetophenone: 50ppm
Propyl paraben:	50ppm, Butyl paraben: 50ppm

To minimize system delay, the SIL-30AC autosampler can be easily re-configured by the user to provide the absolute lowest system delay volume by conversion to a loop injector. As shown on the left, gradient delay time can be reduced drastically using loop injection. The combination of loop injection and the MiRC small-volume mixer supports ultra-fast gradients without gradient delay.

In addition, two loop injection methods, partial loop and full loop, are available with the SIL-30AC autosampler.

Reducing Cycle Times – Overlap Injections

The SIL-30AC autosampler is the world's fastest autosampler, requiring only 10 seconds for one injection. This speed enables reduces the total cycle time for analytical sequences considerably. Moreover, the overlapping injection feature reduces the total analysis time for the utmost in high throughput.



Maximized Sample Capacity

With increased speed, capacity becomes a limiting factor for unattended operation. The optional rack changer automatically loads micro plates into the SIL-30AC's sample compartment. The 12-plate capacity ensures convenient processing of over 4600 samples. The rack incorporates a 4ºC to 40ºC cooling function, matching that of the SIL-30AC.

Maximizing Performance

Shimadzu's passion has always been to improve performance, ease of use, and flexibility for all HPLC environments. That passion continues with Nexera, which offers the reliability, versatility, and superior performance for all applications.

Near-zero Carryover

Carryover is a major concern, especially when the HPLC is used as a front end to a mass spectrometer. Shimadzu continues to improve its low carryover reputation with the Nexera autosampler.

The SIL-30AC achieves a new level of carryover performance. A combination of technological improvements, including a reduction of the needle contact area, flow-through needle design, specially-coated needle, surface treatments, and a new needle seal, prevents the sample contact area from being contaminated. In addition, the SIL-30A has several ways to rinse contaminants off the sample contact area and sample flow path. Dip rinse and active rinse are available for washing the outer surface of the needle as with the Prominence SIL-20A(C) autosampler. Moreover, the inside of the needle and injection port can be washed out with multiple solvents, meaning active rinsing of all contact surfaces is available.

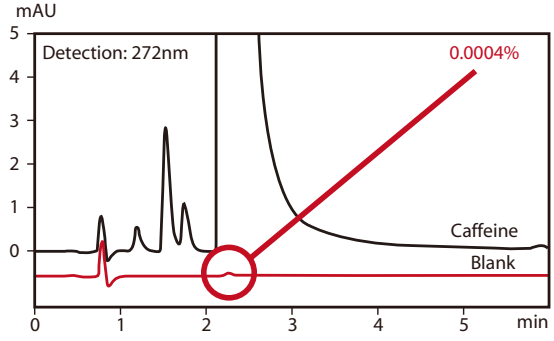
Carryover of Neutral Compounds

Without applying the injection port rinse, needle internal rinse, and needle outer surface rinse, caffeine injected at the concentration of 4 g/L produced a carryover of only 0.0004% in the subsequent injection of a blank (post-blank 1). The injection of a blank was followed by another blank injection (post-blank 2) at which point no carryover was detected using the current method.

Analytical Conditions

Column:	ODS (2.0 × 100 mm, 1.8 µm)
Pressure:	100 MPa
Mobile phase:	Methanol / Water = 2 / 8
Flow rate:	0.4 mL/min
Temperature:	40˚C
Injection volume:	5 µL

Injection	Carryover
Caffeine 4 g/L	-
Post-blank 1	0.0004%
Post-blank 2	Not Detected



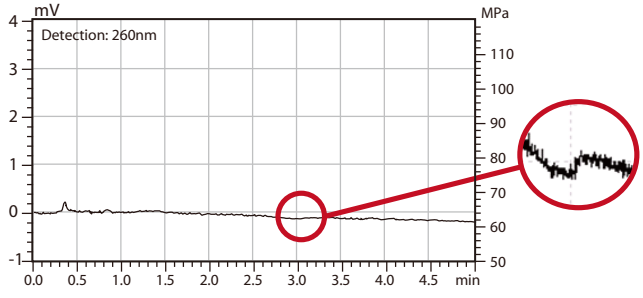
Carryover of Chlorhexidine

Chlorhexidine is a well-known basic compound that is often used for carryover evaluation due to its highly adsorptive behavior. In the following experiment 2 g/L chlorhexidine in water was introduced into the autosampler with the first sample injection. Use of injection port rinsing combined with the inner needle and outer surface rinse functions ensured carryover below the detection limit of the method.

Analytical Conditions

Column:	ODS (2.0 × 100 mm, 1.8 µm)
Operating pressure:	100 MPa
Mobile phase:	Methanol / Water = 2 / 8
Flow rate:	0.4 mL/min
Temperature:	30˚C
Injection volume:	5 µL
Rinse solution:	0.05 % formic acid in methanol
Needle wash:	Outer surface flush by rinse pump (1 second flush) Needle dip rinse (0 second) Needle internal rinse
Injection port rinse:	Performed

Injection	Carryover
Chlorhexidine 2 g/L	-
Post-blank 1	Not Detected

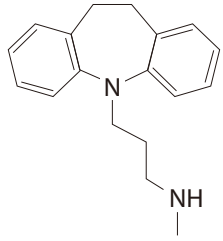


LCMS-2020 Carryover

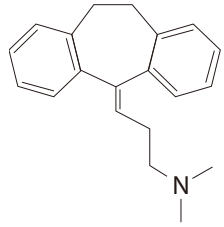
The LCMS-2020 single quadrupole mass spectrometer utilizes the Nexera autosampler's capability of multiple sample path rinsing with up to four different solvents. The chromatogram below shows an injection of a mixture of Desipramine and Amytriptyline at 5 µg/mL each. Both compounds are adsorbed to the needle and the injection port materials, causing carryover. The table below shows the comparable effectiveness of using different rinsing scenarios and the effect on carryover. Employing a needle dip rinse along with the needle pump rinse completely eliminates carryover of these compounds beyond the detection limit of the mass spectrometric method.

Nexera Rinse Setup	Desipramine Carryover	Amytriptyline Carryover
1. Needle Dip rinse	Not Detected (< 0.0042% or 1.0 picogram)	Not Detected (< 0.0027% or 0.68 picogram)
2. Needle Pump rinse		
3. Needle Internal rinse		
4. Injection Port rinse		
1. Needle Dip rinse	Not Detected (< 0.0042% or 1.0 picogram)	Not Detected (< 0.0027% or 0.68 picogram)
2. Needle Pump rinse		
3. Needle Internal rinse		
1. Needle Dip rinse	Not Detected (< 0.0042% or 1.0 picogram)	Not Detected (< 0.0027% or 0.68 picogram)
2. Needle Pump rinse		
1. Needle Dip rinse only	0.0098%	0.0078%
No rinse	0.052%	0.050%

Desipramine



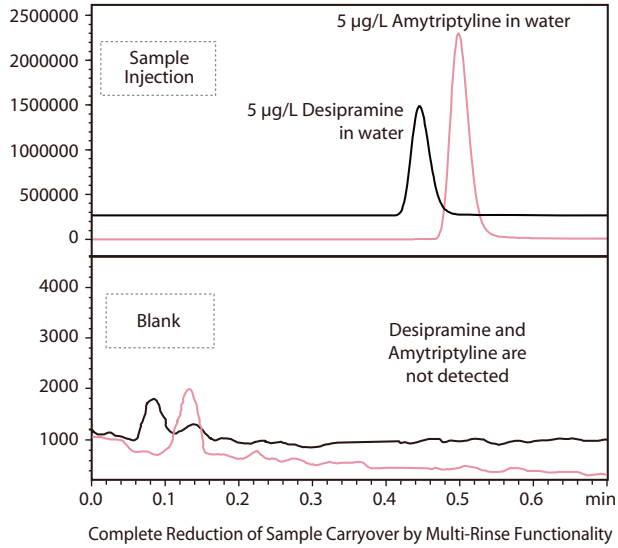
Amytriptyline



Analytical Conditions

Column:	ODS (2.1 × 100 mm, 1.8 µm)
Operating pressure:	95 MPa
Mobile phase:	A: 0.1% Formic Acid
	B: Acetonitrile/Water (25/75)
Gradient:	B 25%→50% (0.75 min)→90% (0.76)→25% (3.01 min)
Flow rate:	1.5 mL/min
Column temp:	40˚C
Injection volume:	5 µL
Detection:	LCMS-2020 ESI (+)
Needle dip rinse:	0.1% Formic Acid in Methanol or Acetonitrile
Needle pump rinse:	0.1% Formic Acid in Acetonitrile
Needle internal rinse:	0.1% Formic Acid in Methanol
Injection port rinse:	0.1% Formic Acid in Methanol

Simultaneous Analysis with Shimadzu LCMS-2020

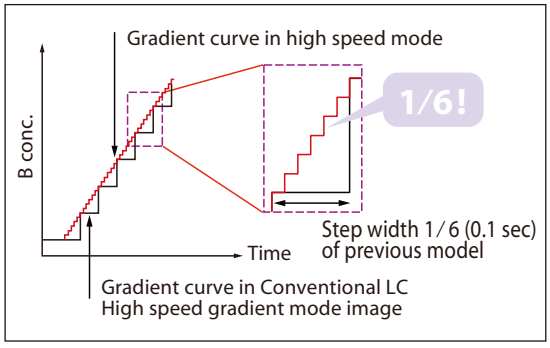


Complete Reduction of Sample Carryover by Multi-Rinse Functionality

Precise Sample Injection Regardless of Injection Volume

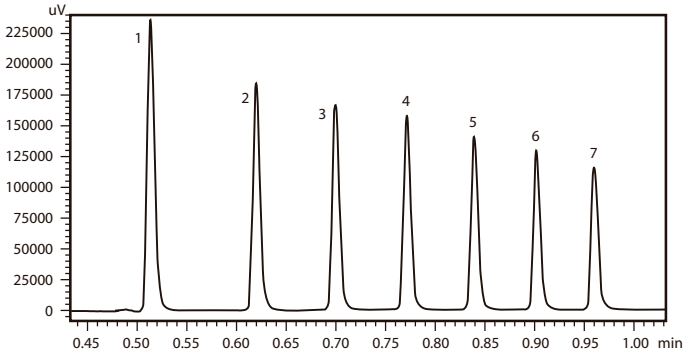
The SIL-30AC autosampler achieves excellent injection volume reproducibility for even 0.1 µL injections and high linearity, saving precious samples and a dilution step. This is accomplished through use of a high-resolution metering system (6nL/step) and an atmospherically-sealed valve system. As a result, the autosampler meets reliability requirements in all analyses – from micro to conventional to UHPLC separations.

Injection Vol [µL]	Reproducibility (%RSD, n=6)
0.2	0.281
0.4	0.237
1	0.111
2	0.039
5	0.031
10	0.043
20	0.044



High-resolution Pump Control Responding to High-speed Gradient

The LC-30AD pump features an automatic pulsation-correction mechanism and a high-speed parallel micro plunger design to provide pulse-free solvent delivery. The LC-30AD pump's gradient resolution is 6 times higher than conventional HPLC pumps in order to respond to ultra-high speed gradients. Utilizing a combination of the high-resolution pumps and a highly efficient gradient mixer, Nexera provides excellent retention time reproducibility – even in ultra-high speed gradient conditions.



Analytical Conditions

Column:	ODS (2.1 × 50 mm, 1.8 µm)
Mobile phase:	Water / Acetonitrile, 15 ⟶ 95% (0.80min)
Flow rate:	1.2 mL/min
Mixer:	20 µL volume
Column temp:	40˚C
Detection:	UV 245 nm
Injection:	2 µL injection, 25ppm

		Retention Time	% RSD Retention Time
1	Acetophenone	0.51 min	0.068
2	Propiophenone	0.62 min	0.039
3	Butyrophenone	0.70 min	0.034
4	Valerophenone	0.77 min	0.045
5	Hexanophenone	0.84 min	0.042
6	Heptanophenone	0.90 min	0.034
7	Octanophenone	0.96 min	0.033

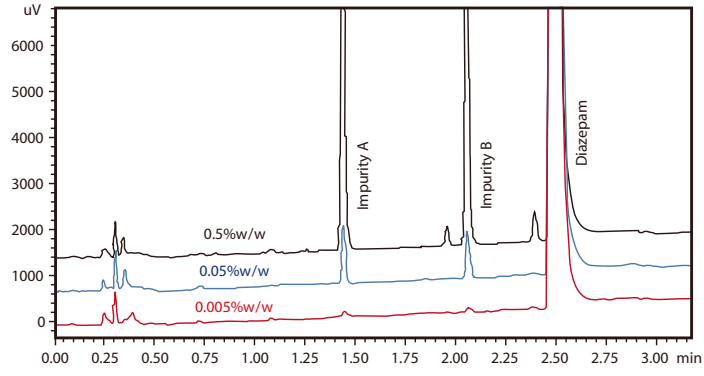
Highly Sensitive UV and Photodiode Array Detectors

Trace-level measurements, such as impurities analysis, require a wider dynamic range and lower baseline disturbances. With a temperature-controlled flow cell and a stray-light correction function, both the SPD-20A UV and SPD-M20A Photo Diode Array detectors offer the high level of stability, sensitivity, and linearity required for confident analysis.

The 100 Hz sampling speed of the SPD-20A/M20A ensures peak information can be captured without loss of resolution and exploits the full potential of ultra-fast LC columns.

Analytical Conditions

Column:	ODS (2.1 × 100 mm, 1.8 µm)
Mobile phase:	Water / Acetonitrile, 25% ⟶ 40% (0.10min) ⟶ 70% (3.0min)
Flow rate:	0.8 mL/min
Column temp:	30˚C
Detection:	UV 240 nm



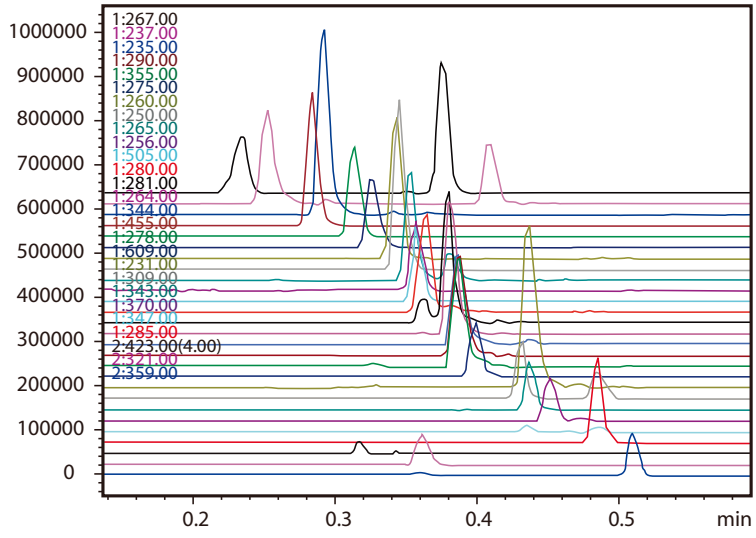
Maximizing Expandability

Nexera is built around modular flexibility, allowing multiple system configurations to address a variety of applications, including multidimensional LC, online SPE, and method development. Additionally, ultra-high speed injection and ultra-low carryover provide the ultimate in system performance with unsurpassed efficiency and productivity, clearly demonstrating this system's power as a mass spectrometer front end.

Nexera as a Mass Spectrometer Front End

The ultra-low carryover, ultra-high speed injection, minimized dead volume, reliable solvent delivery, and accurate sample injection meet all requirements in LCMS and LCMS/MS analysis. Shimadzu's single quad LCMS-2020 offers ultra-high speed scanning and ultra-high speed polarity switching without sacrificing sensitivity, and supports ultra-high speed analysis to ensure UHPLC-type separations.

As shown in the figure on the right, 30 pharmaceuticals could be detected at a 15000 u/sec scan speed and 15 msec polarity switching speed, even in a 30 sec chromatographic run.



Analytical Conditions

Column:	C18 (2.1 × 50 mm, 1.8 µm)
Mobile phase:	A: 0.1 % formic acid in water B: 0.1 % formic acid in acetonitrile
Gradient:	B 3% ⟶ 95 % (0.50 min)
Detection:	ESI (+/–), LCMS-2020
Scan speed:	15000 u/sec

Positive

Atenolol (267)
Procaine (237)
Lidocaine (237)
Atropine (290)
Yohimbine (355)
Chlorpheniramine (275)
Propranolol (260)
Alprenolol (250)
Tetracaine (265)
Diphenhydramine (256)
Doxepin (280)
Dipyridamol (505)
Desipramine (267)
Imipramine (281)
Nortriptyline (264)
Amitriptyline (278)
Dibucaine (344)
Verapamil (455)
Reserpine (609)
Carbamazepine (237)
Isopropylantipyrine (231)
Alprazolam (309)
Trizolam (343)
Cilostazol (370)
Nifedipine (347)
Diazepam (285)
Warfarin (309)

Negative

Cefuroxime (423)
Chloramphenicol (321)
Nitrendipine (359)

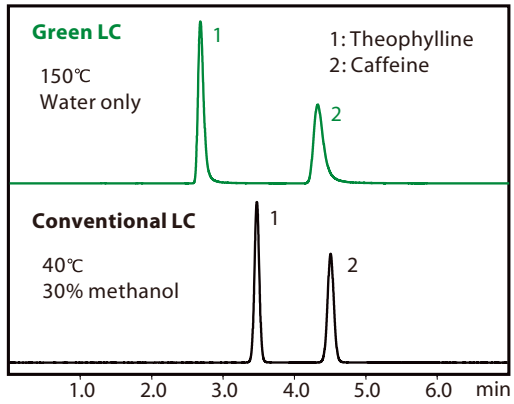
Auto Sample Pretreatment

The SIL-30AC autosampler incorporates pre-treatment functionalities such as dilution, addition of an internal standard, and pre-column derivatization schemes. These new features enable unattended operation for increased accuracy, precision, and speed for high-throughput operation.

Green Chromatography

Green chromatography requires stable and reliable column temperature control at a high temperature. The CTO-30A column oven provides accurate temperature control up to 150ºC with a newly designed solvent pre-heater, a proprietary Intelligent Heat Balancer (IHB), and post-column solvent cooling. The solvent pre-heater and IHB ensure uniform column temperature, even at the high flow rates achievable with Nexera.

The chromatogram shows the separation of theophyline and caffeine under "green" conditions. They were eluted using only water as a mobile phase at 150 ºC temperature conditions.



Comparison between Green and Conventional LC

Green LC

Column:	Shodex ET-RP1 (3.0 × 150 mm)
Mobile phase:	water
Flow rate:	0.5 mL/min
Column temp:	150˚C

Conventional LC

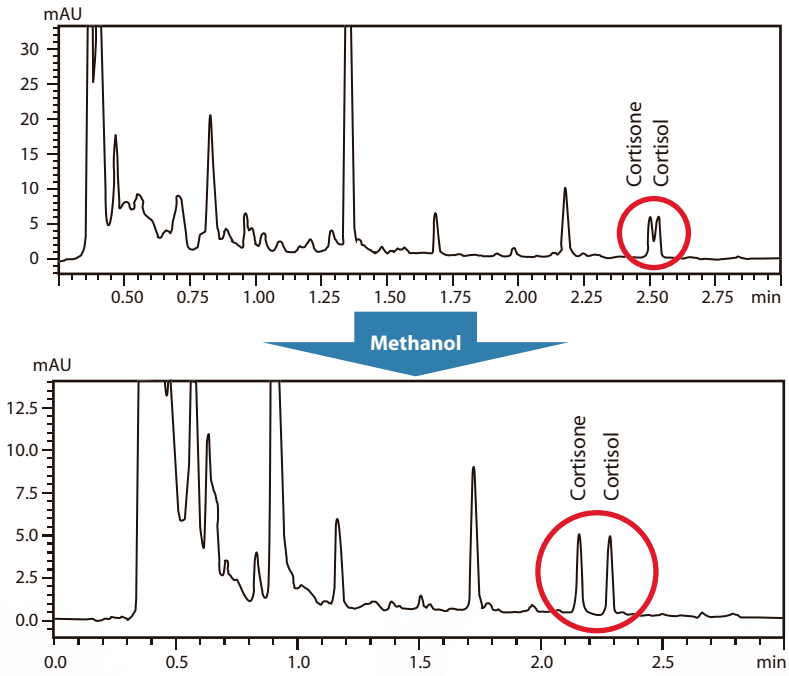
Column:	ODS (4.6 × 150 mm, 5 µm)
Mobile phase:	methanol / water = 3/7
Flow rate:	1.0 mL/min
Column temp:	40˚C

Use of Alternate Solvents for Separation

In liquid chromatography, acetonitrile is often the mobile phase ingredient of choice because of its elution strength in reverse phase analysis, low viscosity, and low absorption in a wide range of the UV spectrum. However, in order to improve peak selectivity, researchers sometimes need to look for alternative solvents. With its wide pressure range (up to 130 MPa), Nexera affords unlimited flexibility in choosing the ideal composition of the mobile phase, and even enables use of such viscous solvents as methanol that significantly increase the back pressure.

When switching from an acetonitrile-based to methanol-based mobile phase, the pressure in the system increases significantly. Nexera's wide pressure range allows alternative solvent usage and seamless transition to methanol-based methods. This becomes especially useful in light of the acetonitrile shortage in recent years.

The chromatograms below show the separation of cortisone and cortisol in urine (each 5 µg/mL, spiked) using both acetonitrile and methanol. The methanol mobile phase improved the peak resolution between cortisone and cortisol.



Analytical Conditions for Acetonitrile

Column:	ODS (2.1 × 100 mm, 1.8 µm)
Pressure:	69 MPa
Mobile phase:	A: 0.1% formic acid in water B: acetonitrile
Gradient:	B: 10%→60% (3.5 min)
Flow rate:	0.6 mL/min
Column temperature:	40°C
Detection:	UV 245 nm

Analytical Conditions for Methanol

Column:	ODS (2.1 × 100 mm, 1.8 µm)
Operating pressure:	108 MPa
Mobile phase:	A: 0.1% formic acid in water B: methanol
Gradient:	B: 30%→90% (3.0 min)
Flow rate:	0.6 mL/min
Column temperature:	40°C
Detection:	UV 245 nm

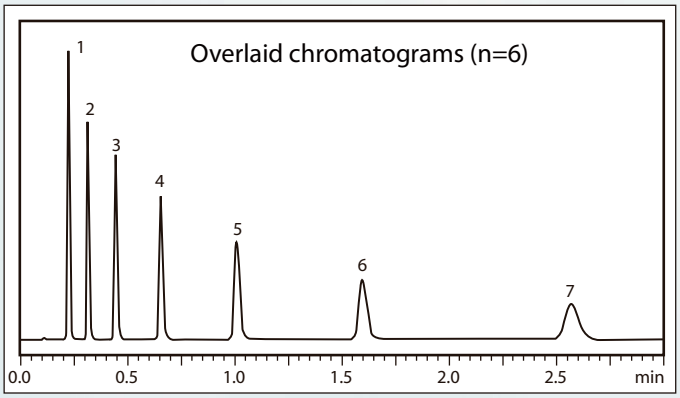
Nexera Low Pressure Gradient

Ultimate flexibility with excellent performance

The Nexera UHPLC has received a significant amount of attention since its release at Pittcon 2010. Now, Shimadzu releases a low-pressure gradient unit for the Nexera LC-30AD pump.

The low-pressure gradient unit offers both a quaternary gradient, which is often used in conventional analysis, and flexible solvent selection in the method development process, providing dynamic solvent blending and continuous analysis by multiple mobile phase conditions. In conjunction with the release of the low-pressure gradient unit, Shimadzu has increased the flow rate range of the LC-30AD pump to 10 mL/min. The extended flow rate range is suited for both conventional HPLC and UHPLC separations. The flexible modular design and addition of a quaternary low-pressure gradient expand the application range from routine analysis and research study to method development.

Installation of the low-pressure gradient into the Nexera LC-30AD pump enables use of a quaternary gradient with a single pump, achieving solvent delivery at a maximum pressure of 130 MPa. Using a low-pressure gradient saves both initial and running costs. The low-pressure gradient configuration enables the blending of 4 solvents in any combination, saving time on pre-blending of solvents and preventing waste of solvent by over-preparation of pre-blended solvents.

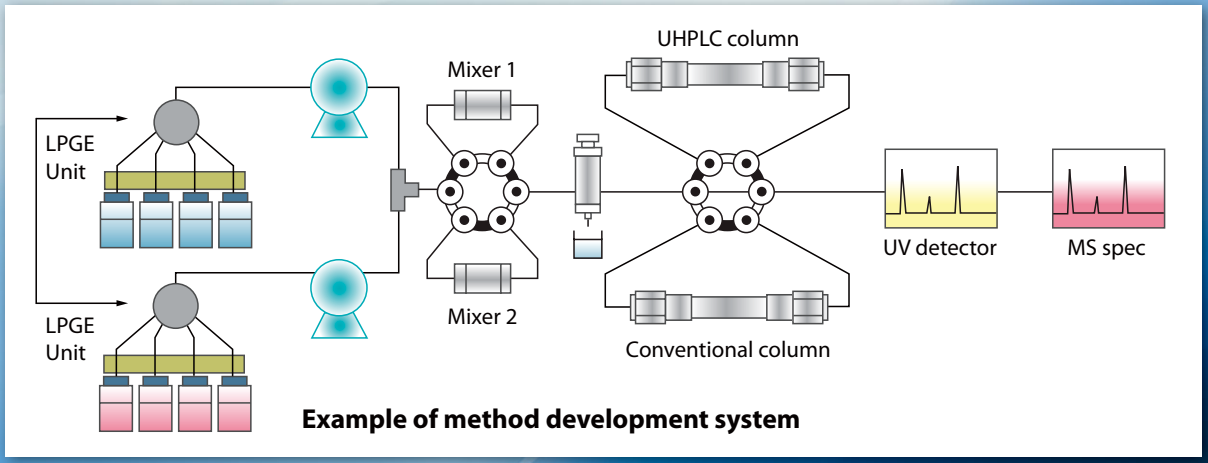


Nexera Ultra High Performance Liquid Chromatograph	Low-pressure Gradient		High-pressure Gradient	
	R.T. (min)	%RSD	R.T. (min)	%RSD
1: Acetophenone	0.224	0.228	0.235	0.216
2: Propiophenone	0.316	0.149	0.333	0.165
3: Butyrophenone	0.444	0.102	0.469	0.129
4: Valerophenone	0.655	0.054	0.695	0.092
5: Hexanophenone	1.008	0.047	1.076	0.089
6: Heptanophenone	1.594	0.057	1.708	0.066
7: Octanophenone	2.567	0.062	2.760	0.065

The excellent solvent delivery performance provides a high level of retention time reproducibility in both high-pressure and low-pressure gradient configurations. The figure above shows a comparison of retention time reproducibility in low-pressure and high-pressure gradient analysis. The low-pressure gradient provided excellent retention time reproducibility similar to a high-pressure gradient.

Flow rate:	1.0 mL/min
Mobile phase:	A / B = water / acetonitrile = 45 / 55
Oven:	40°C
Column:	Shim-pack XR-ODS III (2.0 × 50 mm, 1.6 µm)

The Nexera low-pressure gradient unit also works as a 4-solvent selection valve. Installing the low-pressure gradient unit into four Nexera LC-30AD pumps allows for solvent switching of 16 solvents. The flow-selection concept enables enhanced efficiency in routine analysis by multiple methods and in method development processes.



Example of method development system

User's VOICE

Nexera

Mr. Shinobu Kudoh

Executive Director

Director & Test Facility Management

SNBL – Shin Nippon Biomedical Laboratories, Ltd.

Contract Research Company

Bioanalysis Research Center

Could you explain your company's business?

The SNBL has been expanding business of drug development services to all stages of pharmaceutical development, including translational research, worldwide. SNBL drug safety research laboratories and overseas affiliate companies in the USA, Europe and China play crucial roles in SNBL's global strategies and operations. The SNBL has established a full range of business structures to support a full range of drug development, including preclinical studies, Phase I, II, III and IV clinical trials together with drug analysis, pharmacokinetic analysis and biometrics, and SMO (Site Management Organization) services.

The bioanalysis research center conducts a wide range of assays to quantify small and large drug compounds and their related compounds, such as metabolites and degradation products, either in biological specimens or pharmaceuticals with fully validated methods. Highly selective and sensitive quantitation methods can be developed in a short time prior to the assays. At BRC, we are encouraged to provide rapid method development with validation and the following assay especially to where it is demanded, i.e., for high-throughput screening in drug discovery and clinical trials.

What performance were you most interested in when evaluating Nexera?

We evaluated its carryover performance mainly as a front-end HPLC for high-sensitivity quantitation with triple quadrupole MS. In general, an acceptable carryover level in bioanalysis does not exceed 20 % of LLOQ (lower limit of quantitation) and is evaluated by injection of HLOQ (higher limit of quantitation) sample(s), which is followed by injection of blank matrix sample(s) to see whether the peak present which exists at the same retention time of the analyte is acceptable or not. I believe that carryover needs to be evaluated under stricter conditions, e.g. injecting 10-times higher concentration of HLOQ before blank matrix injection to see whether the carryover level influences the quantitation of the subsequent sample peak since the concentrations of actual samples from customers sometimes overshoot the validated calibration range. Therefore, to ensure the reliability over as wide a determination range as possible, carryover performance is considered to be a key factor for HPLC evaluation.

Which samples do you use for carryover evaluation?

We have several samples which have caused serious carryover through bioanalysis. Some hydrophobic compounds, particularly those having a series of aromatic functional group in the planar structure like fluorescence labeling reagents, are highly likely to lead to carryover. Compounds that have elements and moieties to form coordinate bondings in the molecule are also possible compounds causing carryover through my experience.

How were results of carryover evaluation of Nexera?

The reduced carryover level surprised me. We assumed that evaluation testing should have been carried out with various rinse solvents to reduce carryover, but we didn't need the solvents. The original choice of solvent provided the minimum level of carryover. It seems even sticky compounds don't remain in the sample paths. I understand that one of the common concepts of the Prominence and Nexera design for carryover reduction is to prevent sample adsorption on their mechanical parts which contact with sample solutions. It seemed to me that Nexera was superior in total to Prominence with regard to carryover prevention capability. A single needle dip rinse was found to have been effective enough to minimize carryover level and so other rinse procedures planned were not necessary in most samples tested.

We didn't feel the need to rinse the needle and the injection port with multiple solvents because the initial contamination level of Nexera is significantly low and use of the simple rinse method minimized the carryover level.

Do you think sample adsorption on the needle's outer surface causes contamination? The Nexera autosampler can rinse not only the outside of the needle but also the inside with multiple solvents. Do you think the needle internal rinse is effective to reduce carryover?

Contamination is mainly caused by adhesion of the sample constituents onto the sampling needle's outer surface that contacts with the needle-port or injection-port as well as other sample solutions. It is quite likely that endogenous substances of biological matrices or an analyte itself might adhere onto

or interact with rough surfaces, in microscopic view, inside the needle and more biological constituents or analyte compounds tend to stick onto it as the sample injection goes, which leads to carryover. Occasionally, we can see carryover only when a repeat injection of deproteinized samples is done but cannot see it with the injection of standard sample or vice versa.

Therefore, I imagine that the physical state, such as roughness and uniformity of the inner surface as well as the outer one of the sampling needle is a potential cause of contamination leading to carryover even if a mobile phase is kept flowing through it. This is because the mobile phase should not be a strong dissolving solvent, otherwise a sufficient retention onto a stationary-phase, hence a good resolution, is hardly achieved. Consequently, smoothing the inner surface and treating it similarly to the outer surface probably contributes to reducing risks of carryover. With the same reasons, internal rinse with a choice of solvents that can be performed with Nexera would be a good and strong function to solve a carryover problem.

■ **Shimadzu's autosampler has adopted a specially-coated needle to reduce carryover. Do you think the specially-coated needle that Shimadzu has adopted for the autosampler is effective to reduce carryover?**

Yes. As explained in the above, I think the specially-coated outer surface of the needle and the polished inner surface are very effective to reduce carryover

■ **Do you think the Nexera autosampler met the carryover level you expected?**

Yes. As I have mentioned, honestly speaking, it was far better than I expected although I felt some points regarding mechanical functioning needed to be brushed up. This might be a kind of endless story between avaricious users with a variety of requests and manufacturers improving and building instruments to meet the requests as much as possible.

■ **Could you tell us how long it takes to develop a method for bioanalysis?**

It sometimes takes more time to solve problems we face in ensuring quantitation reliability than to establish a methodological framework in the assay method development process. We have established our own development procedure as process flow charts based on our experience especially with LC-MS/MS for more than a decade.

This process begins with selection of a proper analytical column from those we have tested under some typical eluent conditions for MS analysis with ESI, and categorized them into a rank. It normally takes a half day to optimize MS conditions with grasping ionization trends with possible eluent conditions and one day to optimize LC conditions by referring to the ionization trends grasped, standing on the sample treatment is done with a simple deproteinization. If the deproteinization does not seem to be adequate for some reason, a unique sample treatment process should be developed within three days. When we encounter problems not only with ion suppression or ion enhancement but also adsorption or adhesion to vials, an ion source and LC sample path that result in biased error of quantitative value, it's not so easy to solve the problems depending on the analytes' natures and matrix kinds such as plasma and urine in the samples.

There are many factors to consider although we have set some experimental tests for assumable interaction in our process chart already. It, however, sometimes takes longer than two weeks for a series of trial-and-error type of experiments to resolve the issues. A pre-validation process that takes place in parallel with method development in a late stage is useful as it often reveals other problems that delay completion of method development. If the instrument can cut down on the labor needed to reduce carryover, it significantly enhances the efficiency of the method development process.

■ **What feelings do you have about injection reproducibility and precision from your evaluation of Nexera as a MS-front end HPLC?**

It was excellent as well as Prominence.

■ **Do you have any suggestion for improvement of a LCMS-front end HPLC?**

If an autosampler is composed of some replaceable unit like with GC, it is particularly useful in cleanup of the autosampler when a serious contamination issue arises. The concept allows restarting sample analysis with the newly assembled components, such as a new injection port with a clean syringe, a set of suitable rinse solvents unit, etc. Finding causes for problems like contamination becomes much easier by disassembling each unit and physically and chemically cleaning them up separately. The productivity of bioanalysis is possibly increased with such an instrument.

■ **It sounds like a novel idea. Our last question: do you have any requests for Shimadzu?**

I expect Shimadzu to develop a new ion source and a less expensive LC-MS/MS that enables stable spray and nebulization by secure and firm positioning of an ion source with a capillary nebulizer and drier so that every user can maintain ionization sensitivity easily, even after cleaning up the ion-source. Soon, I think mainstream instruments will support quantitative determination and a high level of qualitative profiling at the same time.

I think that a hybrid with ion mobility functioning at the Q1 or before Q1 is also a charming instrument for many users. Furthermore, I expect LC-MS vendors such as Shimadzu to develop next-generation ionization methods to replace ESI. Over 20 years have passed since the first ESI ion source was commercialized. ESI has been used widely as the most common ionization method, leaving various problems unsolved. In the near future, I expect Shimadzu, which manufactures superior HPLC systems, to develop a new ionization method more suitable for LC-MS.

Thank you so much for your time.


SPD-20A
CTO-30A
LC-30AD
LC-30AD
SIL-30AC
SHIMADZU

Auto Internal Standard Addition Using the Pretreatment Function of the Nexera SIL-30AC Autosampler

Sample Pretreatment

The Nexera SIL-30AC autosampler supports secure sample pretreatment and controls mixing and reaction processes to realize reproducible pre-label reactions. It also incorporates an auto pretreatment function that can automate the sample dilution, sample addition, mixing, and derivatization processes. In addition, with multiple rinse functions, the SIL-30AC provides reliable sample pretreatment while reducing carryover. In this note, we introduce an example of an auto internal standard addition.

Internal Standard Method

External standard methods for creating calibration curves are very popular because of the ease of standard sample preparation. Such a method requires accurate and reproducible injection volumes of standard and sample solutions in order to create an accurate calibration curve and determine accurate concentrations of target compounds in the samples.

On the other hand, internal standard methods can correct for injection volume variability, including variation of analysis conditions, such as flow rate, sensitivity, ion suppression, vaporization of sample solvent, and composition of mobile phase. These methods require the addition of an internal standard into samples before injection into the HPLC. When analyzing many samples, the internal standard addition process significantly increases preparation process time of all samples.

The Nexera SIL-30AC autosampler provides excellent injection reproducibility of even small injections without an internal standard. However, some methods require the use of an internal standard according to SOP. The SIL-30A autosampler incorporates a pretreatment function to respond to this need. It can add the internal standard into each sample automatically just before HPLC analysis.

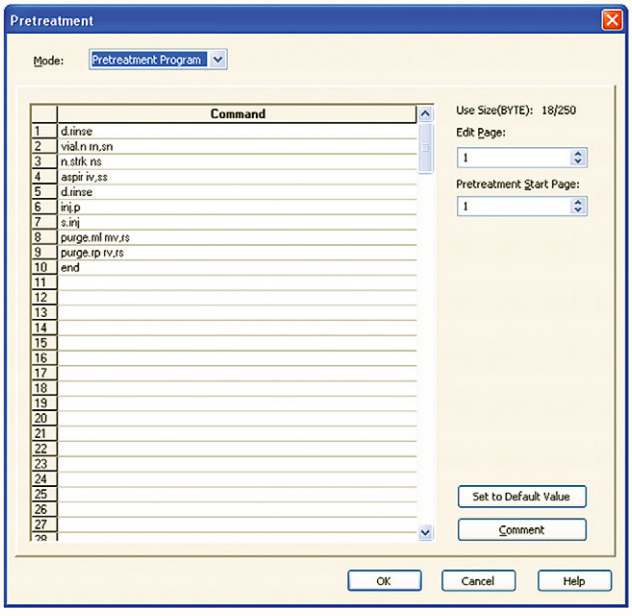
In addition, the SIL-30A can support two internal standard addition methods. In a simultaneous internal standard injection method, sample suction is followed by internal standard suction, then the two solutions are injected into the HPLC. This method corrects for variability of peak area caused by variation in the environment, such as room temperature fluctuation. With the other method, internal standard-mixed sample methods can correct for variability of peak area by sample absorption and degradation because the internal standard solution and sample solution are mixed in another vial before injection into the HPLC.

Additionally, an internal standard requires the following conditions for selection.

- Peak of an internal standard must be separated from other peaks in the samples
- A compound that is used as an internal standard must not be contained in the samples
- It's preferable that the internal standard elutes near a target analyte
- It's preferable that the chemical structure of the internal standard is similar to a target analyte

Various Pretreatment Functions

All pretreatment functions can be controlled by the LabSolutions workstation software. Preset template programs can be selected. LabSolutions also allows you to customize a pretreatment program with a wide variety of commands to enable an advanced pretreatment process. Created pretreatment programs are saved in the software along with the analysis method files.



Auto Preparation of Internal Standard-mixed Solution

Internal standard-mixed samples can correct for variability of injection volume. After suction of the internal standard and sample, they are discharged into a new vial. After mixing, the mixed solution is aspirated through the sampling needle to inject into the HPLC. The detailed procedure is as follows.

(1) Aspirate ISTD solution from an ISTD vial

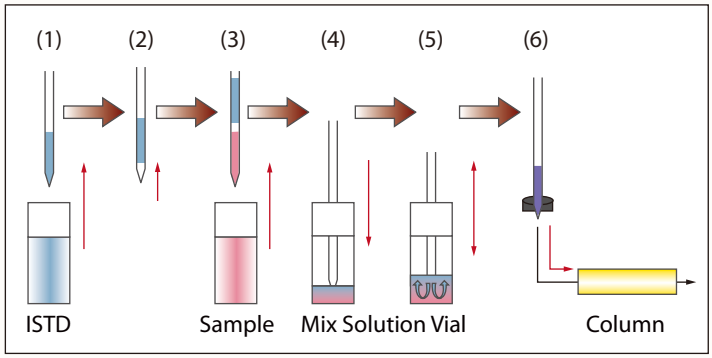
(2) Aspirate air (if necessary)

(3) Aspirate sample solution from a sample vial

(4) Discharge ISTD and sample with dilution solvent into a mix solution vial

(5) Mix ISTD, sample and dilution solvent

(6) Inject into HPLC



Example of Internal Standard Addition

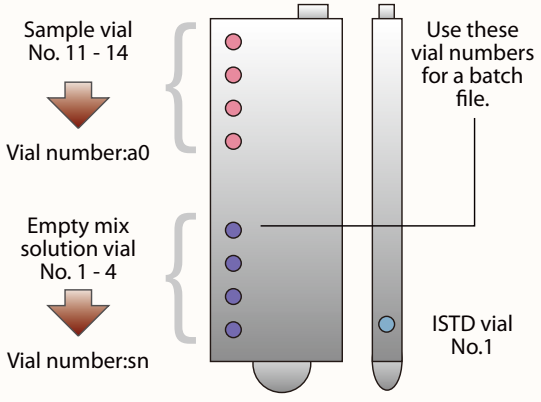
n. drain:	moves the needle to the drain position
disp 600, rs:	discharges 600 µL dilution solvent from the needle to purge inside of tubing at the set rinsing speed
vial. n 0, 1:	moves the needle to vial 1 in the rack 0
n.strk ns:	lowers needle position to set the needle stroke
aspir 10, ss:	aspirates 10 µL of ISTD at the set sample speed
air.a 0.1, ss:	raises needle position to aspirate 0.1 µL of air at the sample speed
d. rinse:	moves the needle to the rinse port, and then rinses the needle by dipping the needle in rinse solvent
a0 = sn + 10 *:	specifies a sample vial position; this command means that the sample vials are placed in the vial positions that are 10 number bigger than the positions of the mix solution vials
vial.n 1, a0:	moves the needle to the sample vial placed in the vial position a0 in the rack 1
n.strk ns:	lowers needle position
aspir 10, ss:	aspirates 10 µL of ISTD at the set sample speed
vial.n rn, sn:	moves the needle to the vial number that was specified in sample analysis batch (this vial corresponds to the vial for mix)
n.strk ns:	lowers needle position
disp 100, ss:	discharges 100 µL of solution, including 10 µL of ISTD, 10 µL of sample, 0.1 µL of air and dilution solvent
mix 3,5,45,2,10:	starts mixing process
n.drain:	moves the needle to the drain port
disp 100, rs:	discharges 100 µl dilution solvent from the needle to purge inside of tubing
d.rinse:	moves the needle to the rinse port to rinse the needle by dipping
Inj.p:	moves the needle to the injection port
v.inj:	switches valve position to inject position
wait 2.0:	holds the current position during 2 minutes to wash the needle inside with mobile phase
goto f0:	jumps to the standard injection pretreatment file
end:	ends pretreatment

*By placing sample vials and mixed solution vials evenly spaced apart, samples can be pretreated and injected sequentially using the same pretreatment program. In the pretreatment program, the vial positions are set as follows.

a0 = sn + 10

a0 : sample vial number

sn : mix solution number



Analysis Example of Internal Standard Addition Using Auto Pretreatment

In this example, Methyl paraben for an ISTD (400 µg/mL), and Ethyl paraben (50 µg/mL, 100 µg/mL, 200 µg/mL, and 400 µg/mL) for a target analyte were used. A rinse solvent was used as a dilution solvent.

The SIL-30AC can rinse the inside of the needle with 3 solvents. When one of them is used for dilution, the other two can be used for rinsing the inside of the needle. In this example, the dilution factor was 10 for both the internal standard and the samples. Each sample was injected 6 times to calculate reproducibility of peak area ratio of the internal standard and the analyte.

Table 1: Reproducibility of peak area ratio of ISTD and ethyl paraben

Conc. (µg/mL)	Peak Area Ratio %RSD
5	0.142
10	0.270
20	0.074
40	0.093

Figure 1 shows overlaid chromatograms of ISTD and ethyl paraben. The six chromatograms were very consistent during the analysis. Reproducibility of peak area ratio of internal standard and ethyl paraben at each sample concentration is shown in table 1. In all concentration areas, the auto pretreatment provided excellent reproducibility. As shown in Figure 2, linearity of the peak area ratio was also excellent in all ranges.

The auto internal standard addition not only saves time and effort but also minimizes human error in the sampler pretreatment process.

Accurate sample measurement and flexible pretreatment parameters support secure internal standard addition to samples in all analysis areas, such as quality control, environmental analysis, toxicological assessment, metabolite analysis, and clinical study. Additionally, accurate time control of the mixing and reaction processes, reliable reaction agent addition, thorough rinsing of sample paths, and a wide variety of pretreatment commands are essential for automation of pre-label derivatization. The pretreatment functions of the SIL-30AC autosampler enable automation of complex applications such as pre-label derivatization.

Analytical Conditions

Column:	Shim-pack XR-ODSII (2 × 50 mm, 2.2 µm)
Mobile phase:	A: Water / Acetonitrile = 75 / 25
Flow rate:	0.5 mL/min
Column temp:	40˚C
Detection:	254 nm
Injection volume:	5 µL (of ISTD mixed solution)
Peaks:	1: ISTD; methyl paraben 400 µg/mL 2: ethyl paraben (50, 100, 200, 400 µg/mL)

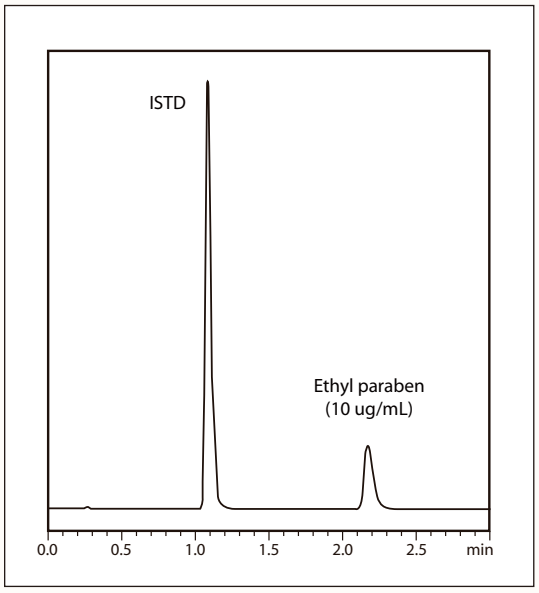


Figure 1: Overlaid chromatograms of ISTD and ethyl paraben (n=6)

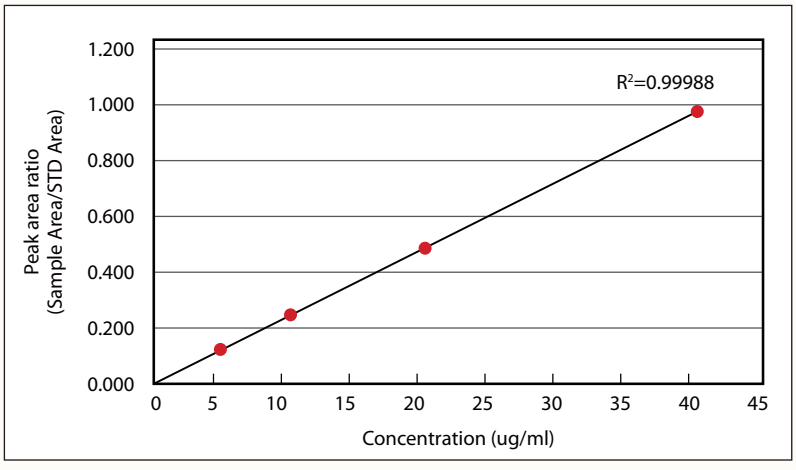


Figure 2: Linearity of peak area ratio

The World's Most Sensitive HPLC Fluorescence Detectors

Shimadzu's new fluorescence detectors offer world-class sensitivity, reliable performance, improved ease of maintenance, and supportive validation functions. They support a wide range of applications, from conventional analysis to ultra-fast analysis in all fields, including environmental, food, and clinical.

World's Highest Sensitivity

If you are looking for high sensitivity in fluorescence detectors, Shimadzu's RF-20A/RF-20Axs are the solution. Utilizing a newly designed optical system, the RF-20A and RF-20Axs offer world-class levels of sensitivity. A water Raman S/N ratio of at least 2000 for the RF-20Axs and 1200 for the RF-20A makes these detectors powerful tools for analyses demanding the detection of trace-level components. Shimadzu also measures dark noise for factory inspection. When using dark signal as noise reference, the water Raman S/N ratio is at least 20,000 for the RF-20Axs and 15,000 for the RF-20A.

The top figure shows an example of the ultra-high sensitivity analysis of anthracene. A S/N ratio of 21.5 was achieved for an injection of 10.48fg anthracene (RF-20Axs). This is equivalent to approx. 1.5 fg limit of detection (S/N ratio = 3).

Enhanced Reproducibility Performance of RF-20Axs Using Cell Temperature Control

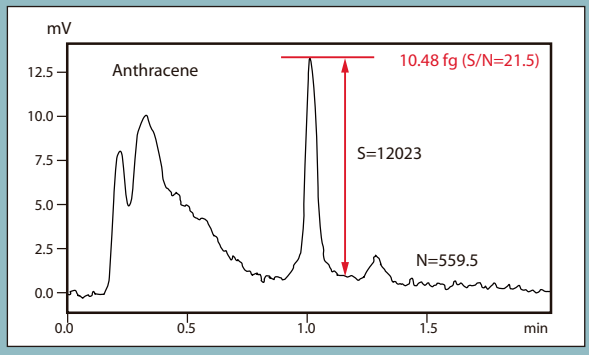
Fluorescence intensity drops as the temperature rises. A fluctuation of about 1°C may result in approximately 5% intensity fluctuations for some compounds.

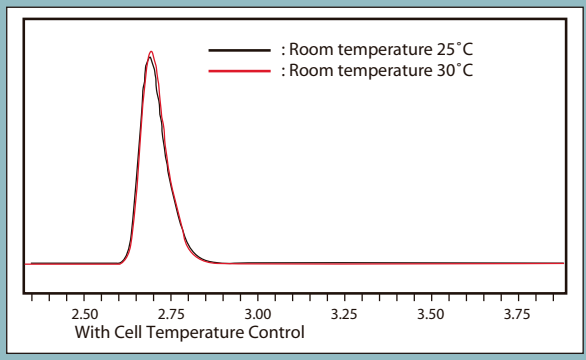
Temperature change in analysis environments affects reproducibility of the fluorescence signals even if the temperature shift is very small. To prevent this, the RF-20Axs features a temperature-controlled cell with a cooling function. This maintains the cell at a constant temperature regardless of any variation in the room temperature to ensure superb reproducibility with stable signals.

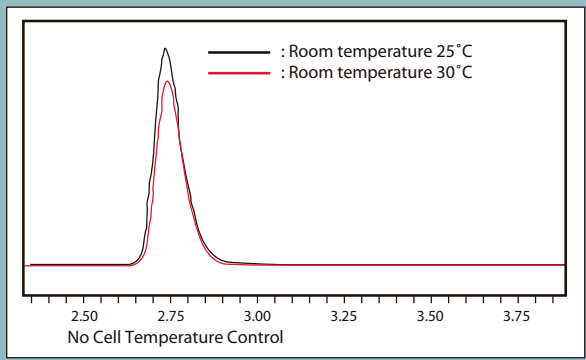
As shown, without temperature control the unstable cell temperature due to a temperature change from 25°C to 30°C decreased the peak area by approximately 17% with reproducibility of 6.3% RSD (n=6). Use of the temperature control cell, however, provided outstanding reproducibility of 0.3 % RSD (n=6).

Support for Ultra-fast Analysis

Fast response is required to follow the sharp peaks obtained by ultra-fast analysis. The 10 ms response of the RF-20A and RF-20Axs permits ultra-fast analysis without loss of separation. In addition, the highly sensitive simultaneous analysis of multiple components requires detection at the optimal wavelengths. The RF-20A and RF-20Axs permit ultra-fast, high-sensitivity multi-component analysis. Presented on the next page is the analysis of polycyclic aromatics using wavelength switching via a time program.

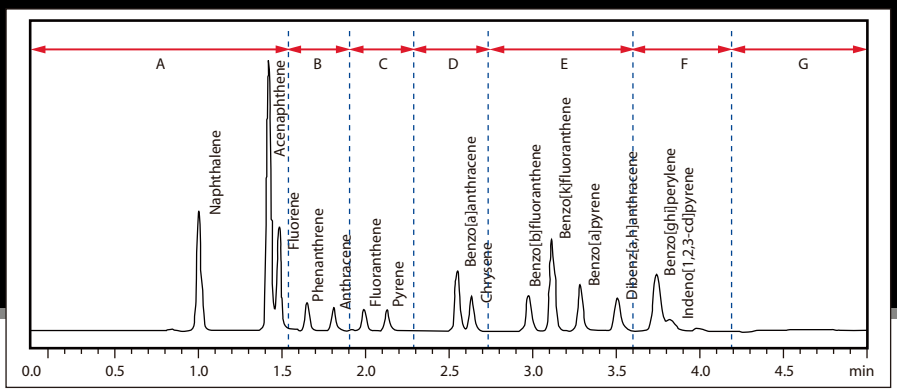






Analytical Conditions

Column:	SUPELCOSIL LC-PAH C18, (4.6 × 50 mm, 3 µm)
Mobile phase:	A: water B: acetonitrile
Gradient:	B 50 % (0–0.5 min) ⟶ 50–88 % (0.5–3.0 min) ⟶ 88 % (3.0–4.2 min)
Flow rate:	3.0 mL/min
Column temp:	40°C



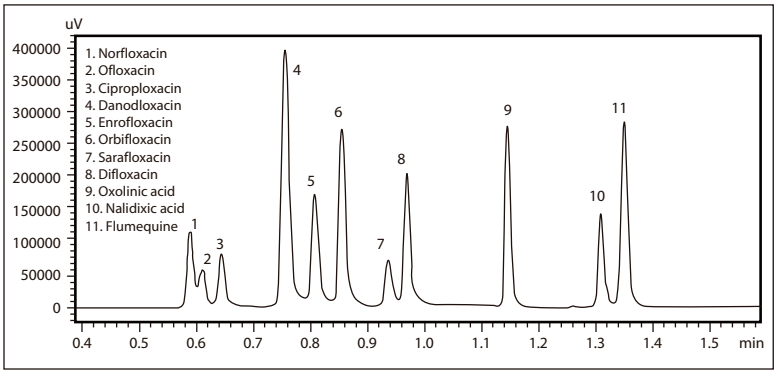
Time-programmed wavelength switching

Ex; 270 nm, Em; 330 nm
Ex; 250 nm, Em; 370 nm
Ex; 330 nm, Em; 430 nm
Ex; 270 nm, Em; 390 nm
Ex; 290 nm, Em; 430 nm
Ex; 370 nm, Em; 460 nm
Ex; 270 nm, Em; 330 nm

RF-20A/20Axs as a Nexera Detector

The RF-20Axs supports fluorescence detection in UHPLC analysis. The 100 Hz sampling rate of the RF-20A/20Axs fluorescence detectors permits ultra-fast LC analysis with no loss of separation.

As shown on the right, 11 quinolones were analyzed by Nexera with the RF-20Axs fluorescence detector. A time-programmed wavelength was used for detection of quinolones at optimum wavelengths. 11 quinolones were eluted within 1.4 minutes with good sensitivity and peak shape.



Analytical Conditions

Column:	ODS (3.0 × 50mm, 3 µm)
Mobile phase:	A: 0.05 % formic acid in water
	B: 0.05 % formic acid in acetonitrile
Gradient:	B 8 % → 16 % (0.75 min) → 36 % (1-1.5 min)
Flow rate:	2.0 mL/min
Column temp:	55°C
Detection:	Ex. 295 nm, Em. 455 nm (0–1.05 min)
	Ex. 325 nm, Em. 365 nm (1.05–3 min)

Flow Cell and Lamp replacement at front panel.

Easy Maintenance

The Xenon lamp and flow cell can be replaced at the front panel. No positional adjustment is required when replacing the Xenon lamp, and no tools are required to replace the flow cell. Additionally, the Xenon lamp life has been extended to 2000 hours, four times longer than previous Shimadzu lamps. This significantly reduces running costs and downtime.

Powerful Validation Support

The RF-20Axs detector incorporates an automatic wavelength accuracy check function using an internal low-pressure mercury lamp. It provides simple confirmation of the wavelength accuracy for validation. If wavelength calibration is required, it can be easily performed at the front panel.

The system check function in the LabSolutions workstation software automatically checks all items essential for instrument management, including lamp time and wavelength accuracy. The system check results are automatically saved in data files to allow confirmation of the instrument status during analysis to enhance the reliability of the analytical data.

Nexera DEVELOPMENT STORY

For several years, UHPLC has received significant attention as a key technology to increase productivity in research and development and reduce production lead time.

In UHPLC analysis, small particle columns are mainly used because of their excellent separation efficiency. However, since small particle columns produce higher back pressure, specialized HPLCs for ultra-high pressure analysis have been necessary. These specialized systems have often compromised basic performance parameters such as carryover, reproducibility, durability, and expandability.

According to Masami Tomita, LC Business Unit Manager (shown above), Shimadzu began the Nexera development process by first determining customers' requirements in UHPLC markets. We aimed at developing an "all-round LC with the world's highest UHPLC performance," exchanging opinions among R&D and marketing staffs around the world.

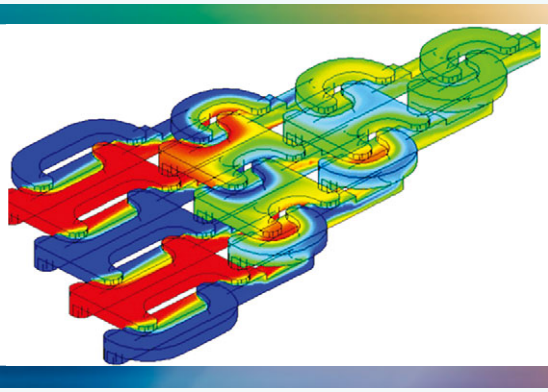
While "pressure" is the most important factor to realizing ultra-high pressure LC, it's not the only factor. Our goal was to develop an all-round HPLC that meets all UHPLC requirements but doesn't compromise performance and flexibility in other, more conventional scenarios.

For example, reduction of delay volume is very important for users, especially those who use fast gradient methods with a mass spectrometer. To address this requirement, we conducted extensive research on new gradient mixers in order to increase mixing efficiency and reduce mixer volume. Nexera's new mixer has multilayer disks that incorporate a microscopic flow path into the base using micro processing engineering. As a result, the mixing efficiency has been simulated to optimize mixing by calculating the mixing state in the mixers, statistically using a newly created simulation model.

The following figure is an example of the simulation results. We prepared several prototypes to test actual mixing performance, but the performance was not in agreement with the theoretical value of the simulation. Further research revealed that parts of the prototypes might not be able to be processed according to the simulation theory.

Collaborating with a parts processing company, we then adopted a new process technology. The new prototype showed the mixing performance we expected. The mixer provided a similar level of mixing efficiency at a volume five times smaller than with the previous model.

Incorporating all the core competencies of Shimadzu's businesses, from materials testing to aircraft equipment development, resulted in "Nexera" – the next era in UHPLC technology. Overcoming technical difficulties with Shimadzu passion and teamwork, Nexera was launched at Pittcon 2010 as a next-generation HPLC. Now, Nexera attracts a great deal of attention as the best all-round HPLC. But work remains, and Shimadzu engineers continue to improve performance, ease of use, and flexibility to produce the most reliable and robust system for all analysis requirements.

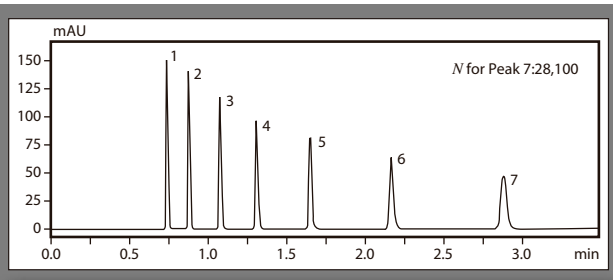


Nexera Shim-pack XR-ODS III UHPLC Columns

High Speed and High Resolution

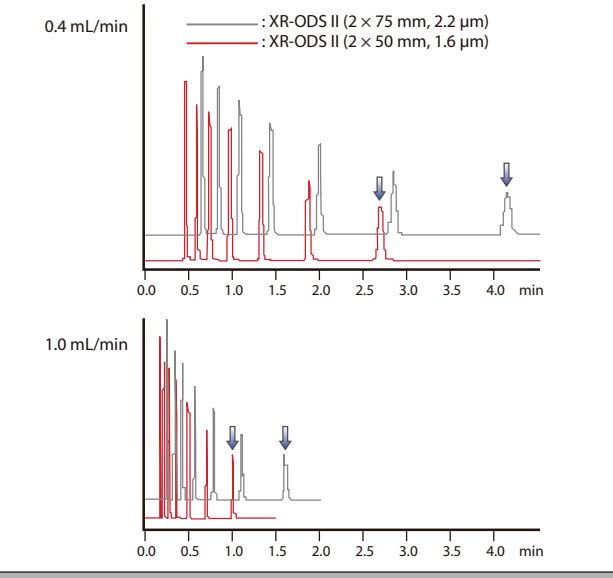
The Shim-pack XR-ODS III is a new high-performance UHPLC column with an increased pressure resistance of 100 MPa. The increased pressure tolerance enables high-speed and high-resolution analysis. In addition, it supports a wide range of applications as well as the use of water/methanol mobile phase and analysis near room temperature. The combination of Nexera and the Shim-pack XR-ODS III offers a new level of speed and resolution.

Column	Particle size	Pressure	I.D.	Length
Shim-pack XR-ODS III	1.6 µm	100 MPa	2.0 mm	50mm, 75mm
Shim-pack XR-ODS III	2.2 µm	100 MPa	2.0 mm	150mm, 200mm



Analytical Conditions

Column: Shim-pack XR-ODS III (2.0 × 200 mm, 2.2 µm)
Mobile phase: Water / Acetonitrile = 3 / 7 (v/v)
Flow rate: 1.0 mL/min
Column temp: 80˚C
Detection: Absorbance 254 nm
Peaks: 1: Acetophenone, 2: Propiophenone, 3: Butyrophenone, 4: Valerophenone, 5: Hexanophenone, 6: Heptanophenone, 7: Octanophenone



The Shim-pack XR-ODS III lineup contains two types of particle sizes. The Shim-pack XR-ODS III 2.2 µm columns provide an excellent balance of resolution and speed. The maximum pressure has been increased to 100 MPa and the extended column lengths maintain reasonable system back pressures for excellent resolution and faster analysis times.

The Shim-pack XR-ODS III 1.6 µm columns achieve ultra-fast analysis, providing high separation efficiency in a high flow rate range through adoption of small particles.

The figure to the left shows the chromatograms of alkyl phenones using a 200mm Shim-pack XR-ODS III 2.2 µm column. The adoption of 2.2 µm particles enables use of a longer column length for higher separation performance.

1.5 times faster

Flow rate	XR-ODS II 2.2 µm	XR-ODS III 1.6 µm	Speed up
0.4 mL/min	4.16 min	2.70 min	1.5 times
1.0 mL/min	1.60 min	1.01 min	

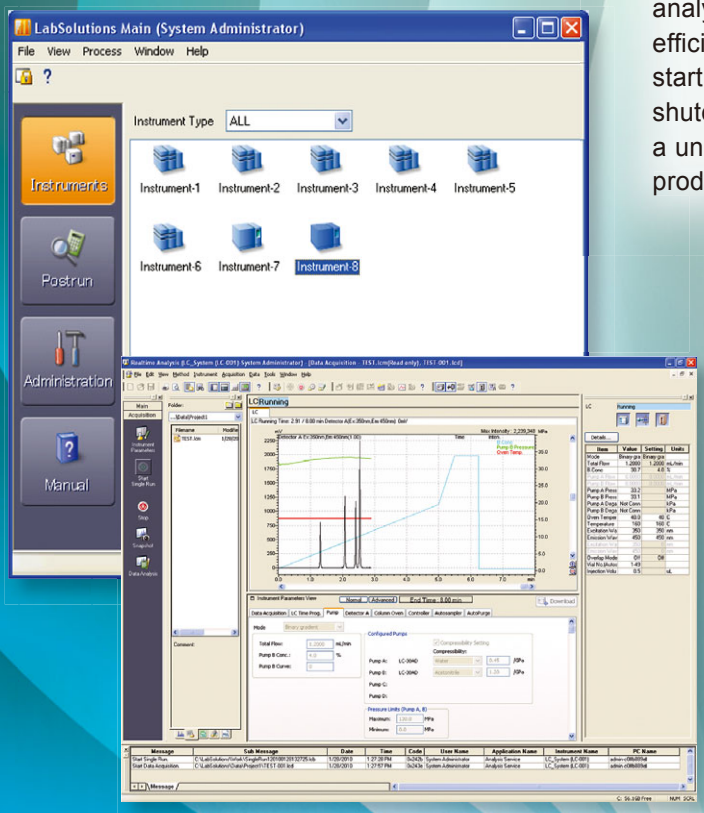
Maintain theoretical plate at high flow rate

Flow rate	XR-ODS II 2.2 µm	XR-ODS III 1.6 µm
0.4 mL/min	13733	11026
1.0 mL/min	10400	10858
Rate of TPN decrease	**24.3%**	**.5%**

The 50mm Shim-pack III 1.6 µm column is 1.5 times faster than the 75mm Shim-pack XR-ODS II 2.2 µm column while providing the same level of theoretical plate number as shown in the chromatogram to the left and in the above tables.

Since the Shim-pack XR-ODS III 1.6 µm maintains the level of the theoretical plate number at higher flow rates, it can reduce analysis time through the joint effect of increased flow rates and shorter column lengths.

Integrated LC/GC Control Software
LabSolutions Ver. 5.3



LabSolutions Ver. 5.3 chromatography workstation makes analysis workflow from analytical operation to data management more efficient. LabSolutions supports automation of all workflows from auto startup, system check, and baseline check to auto purge and auto shutdown. Now with integrated LC/GC control, LabSolutions provides a unified, easy-to-use operating environment for increased laboratory productivity and customized operation.

LabSolutions Ver. 5.3 features:

- Control of Nexera series, Prominence HPLC series, LC-2010 series, LC-VP series, LC-10A series, ELSD-LTII, GC-2010 Plus, GC-2010, GC-2014, GC-14B, AOC-20i/s and TurboMatrix HS
- Simultaneous control of four LCs and GCs or a mix of these systems from a single PC
- Automation of data acquisition operations from system startup and column equilibration to schedule data acquisition and system shutdown
- User customization of operating windows provides user-friendly operation environment
- More efficient data analysis and data preview in improved, simple-to-use Quant Browser
- Complete regulatory compliance includes audit trails, log browsers and validation support tools
- Highly flexible reports formats

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SHIMADZU CORPORATION. International Marketing Division
3. Kanda-Nishikicho 1-chome, Chiyoda-ku, Tokyo 101-8448, Japan
Phone: 81(3)3219-5641 Fax. 81(3)3219-5710
URL http://www.shimadzu.com

Printed in Japan 3295-11016-15ANS