JASCO

LC-2000Plus Series

High Performance Liquid Chromatography

Superior performance
Superior innovation
Superior reliability

LC-2000Plus HPLC system

JASCO was founded in 1958 to produce optical spectroscopy products for university research departments. The experience gained by JASCO in both optical design and computer technology led to the production of spectrophotometric detectors for HPLC. The move into the HPLC market continued with the production of solvent delivery systems, gradient elution devices and a complete range of detectors. JASCO has more than 30 years experience in the design and development of innovative chromatography instrumentation for a wide range of applications. A worldwide network of companies supports the full range of analytical instrumentation in educational, industrial, quality control and research laboratories.

The LC-2000Plus Series is JASCO's latest development in High Performance Liquid Chromatography, meeting the key requirements of today's analytical laboratory.

Compact design

- *30 cm depth is designed to maximize laboratory bench space*
- *Safe-stacking modular architecture*

Flexibility and versatility

- *Semi-micro, analytical and preparative solvent delivery systems*
- *Isocratic and high or low-pressure gradient systems*
- *Manual or autosampling injection systems with available temperature control*
- *Solvent switching, mixing, degassing and a selection of 3 column ovens*
- *Wide range of detectors*
- *Biocompatible chromatography*

Integrated control and data analysis

- *PC system or direct keypad control*
- *Total solutions for system control, data acquisition, processing, interpretation and reporting*
- *Direct control by MS software packages for high-throughput LC/MS applications*

Minimum set-up time

- *Quick set-up time*
- *Easy to use*

Productivity and automation

- *Excellent throughput via instrument selection and optimization*
- *Range of autosamplers to maximize laboratory time*

Sensitivity, resolution, reproducibility and linearity

- *Pulse-free, accurate flow*
- *Excellent linearity, minimum sample carry-over*
- *Low noise for maximum sensitivity and operating stability*

System reliability, validation and ISO accreditation

- *Validation support for regulatory requirements*
- *IQ/OQ support*

Qualified service and technical support

- *More than 30 years experience*
- *Certified service representatives*

LC-2000Plus system flexibility

From simple routine analysis to complicated system specific configurations and field upgrades

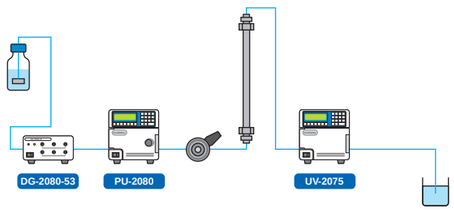
Our wide range of detectors, pumps and column ovens offers the flexibility to build the ideal system.

Isocratic system

A compact, efficient, and economical system

Simple isocratic separations

This stand-alone system includes a pump, degasser, manual injector and UV/Vis detector. The PU-2080 Pump offers a variable flow rate and memory capacity to store up to 10 files of 64-step programs. The UV-2070/2075 UV/Vis detector provides extremely high sensitivity, spectral scanning and wavelength time-programming. The system can be easily upgraded to full automation as well as elution mode for gradient operations.

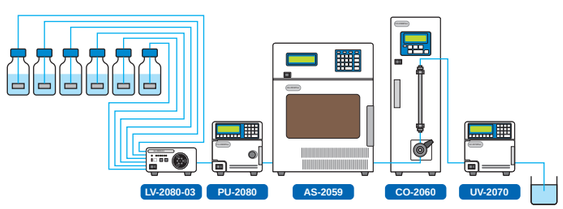


Solvent switching system

A flexible, automatic six-way valve system

Automatic solvent switching

The LV-2080-03 automatic six-way valve unit enables a sequential switching of solvents during measurements such as amino acid analysis. Up to six different solvents can be connected.

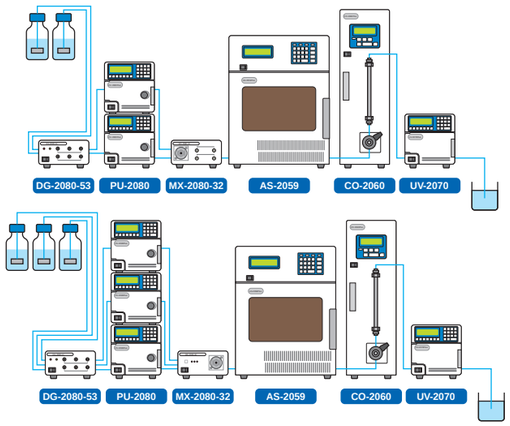


High-pressure gradient systems

2 pump binary gradient / 3 pump ternary gradient elution

High performance, high reliability gradient elution

The PU-2080's integrated time programming controls a two-pump binary gradient. By using the JASCO chromatography data system, up to a 3-pump ternary gradient is possible. The MX-2080-32 is a high pressure dynamic mixer, capable of mixing up to 3 solvents under high pressure. By changing the chamber capacity, the instrument can be used in various applications from semi-micro HPLC with a volume down to 20 µL to semi-preparative HPLC.

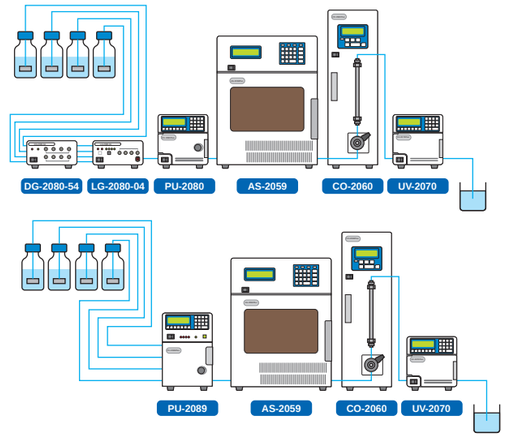


Low-pressure gradient systems

One pump ternary/quaternary gradient

Stable delivery of both volatile and viscous solvents

The LG-2080-04 low-pressure gradient unit is designed to be used with the PU-2080, enabling up to a 4-solvent quaternary gradient. The PU-2089 is a compact HPLC Quaternary low pressure gradient pump designed to meet the rigorous requirements of a wide range of research and routine gradient applications. Built-in low-pressure proportioning valve and degasser enable the highest flexibility in solvent choices and excellent gradient solvent delivery.

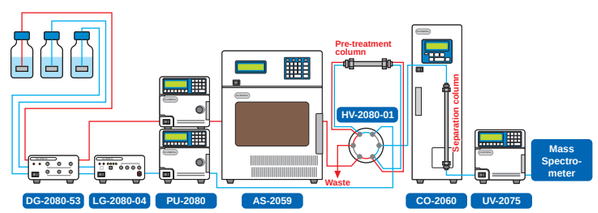


Low-pressure gradient system with column switching

On-line deproteinization by a pre-treatment column

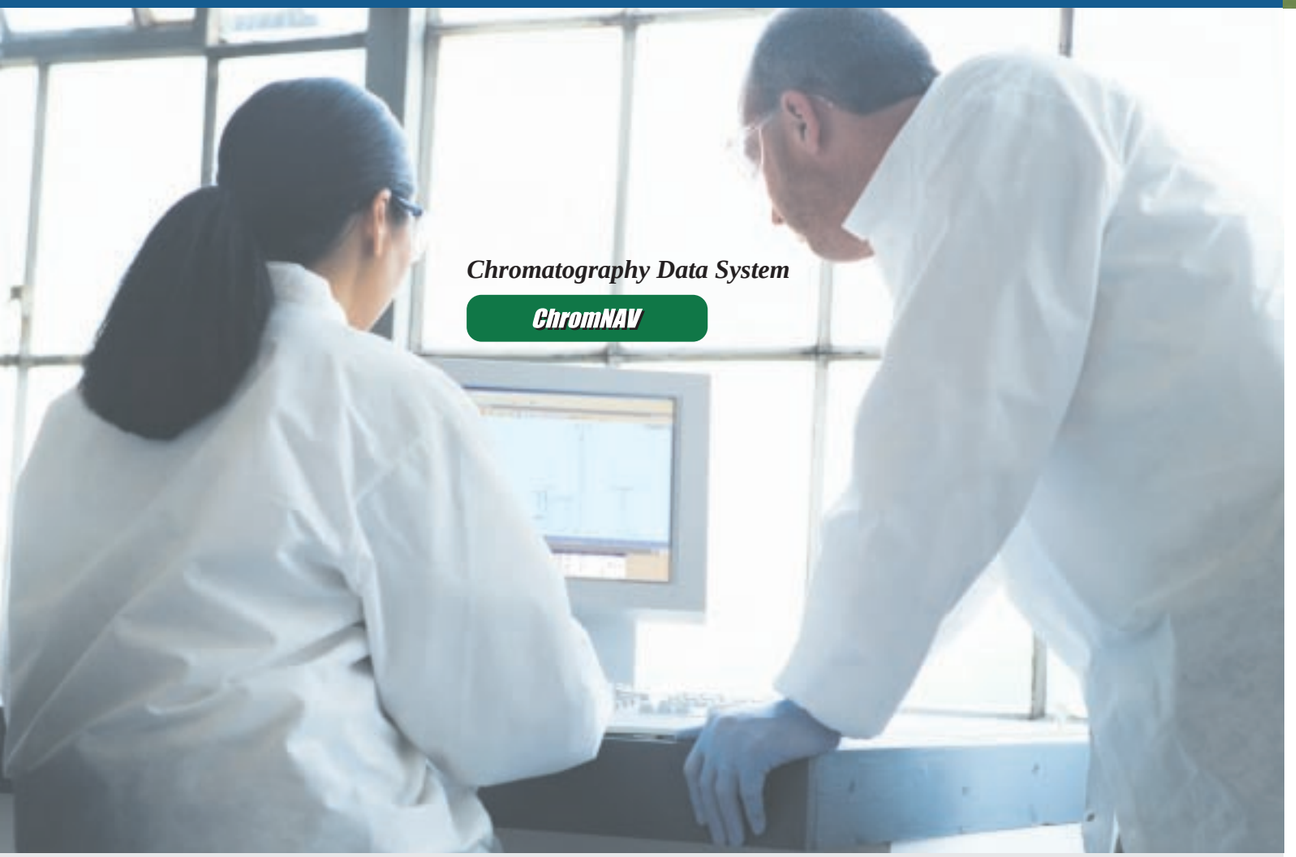
Widely used for drug analysis in bio-samples

This system enables on-line pre-treatment of samples such as deproteinization, pre-concentration, and impurity removal. The system is ideal for automated drug analysis in bio-samples. The pre-treatment column selectively elutes and disposes of proteins and other macromolecules while low molecular weight compounds such as drugs are trapped (red flow line). By switching the column switching valve, the trapped compounds are introduced into a separation column and separated in low-pressure gradient mode (blue flow line). The target drug compounds eluted are detected by a UV detector or a mass spectrometer with high sensitivity and selectivity.



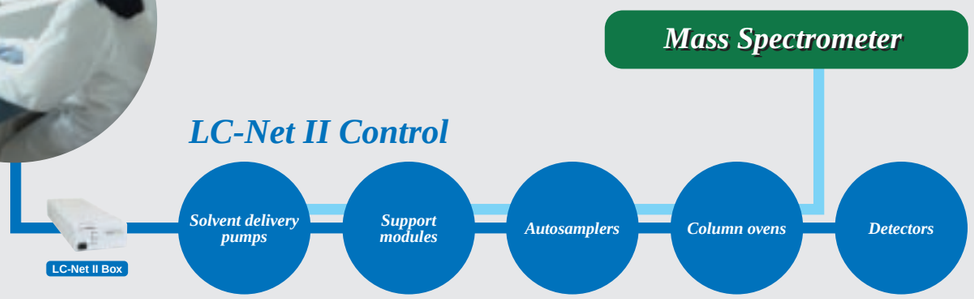
Building a better system

Full automation of all JASCO HPLC components

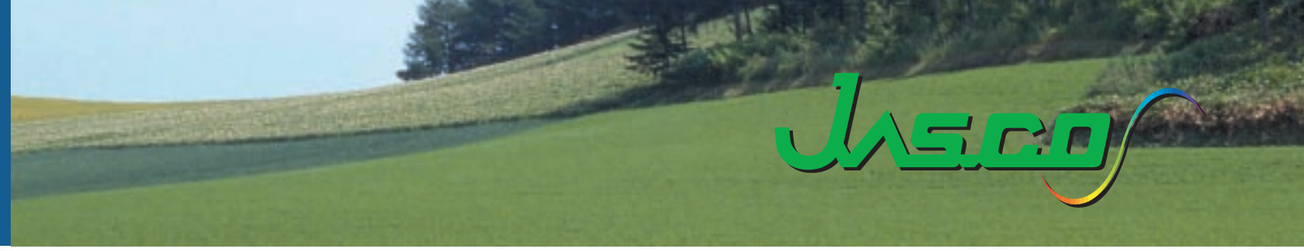


Mass Spec Interface Capability

JASCO HPLC components can be interfaced with most commercial MS systems. Direct control is available with Analyst® and Xcalibur™ software packages.



In stand-alone mode, the microprocessors in the individual components offer advanced programs. Each component can freely interact with other HPLC modules via a built-in interface and can be triggered from an external event generated by a computer or other LC module. Full PC control is also provided when incorporated into a JASCO HPLC system with the JASCO chromatography data systems.



The individual components can be used as stand-alone modules using the integrated keypad and LCD display, or combined into a complete HPLC system with computer control.

Scalable flexibility

Solvent delivery pumps

Analytical scale

- **PU-2080** *Flow rate up to 10 mL/min*
- **PU-2080i** *Inert with PEEK components*
- **PU-2089** *Quaternary gradient pump*
- **PU-2089i** *Inert with PEEK components*

Semi-micro scale

- **PU-2085** *Flow rate up to 4 mL/min*

Semi-preparative scale

- **PU-2086** *Flow rate up to 20 mL/min*

Preparative scale

- **PU-2087** *Flow rate up to 50 mL/min*

Powerful accessories

Support modules

- **LG-2080-02** *Low pressure mixer (3 solvents)*
- **LG-2080-04** *Low pressure mixer (4 solvents)*
- **DG-2080-54** *In-line degasser (4 solvents)*
- **DG-2080-53** *In-line degasser (3 solvents)*
- **MX-2080-31** *High pressure mixer (3 solvents)*
- **MX-2080-32** *High pressure mixer (3 solvents)*
- **LV-2080-03** *Six-solvent selection valve*
- **HV-2080-01** *Two-position switching valve*
- **RV-2080-02** *Recycle valve*

Excellent productivity

Autosamplers

- **AS-2055** *50 × 2 mL vials standard*
- **AS-2057** *Integrated Peltier temperature control*
- **AS-2055i** **AS-2057i** *Inert with PEEK components*
- **AS-2050** *100 × 2 mL vials standard*
- **AS-2051** *Integrated Peltier temperature control*
- **AS-2059** *120 × 2 mL vials standard*
  Optional Peltier temperature control

Precise temperature control

Column ovens

- **CO-2060** *15°C below ambient to 80°C*
- **CO-2065** *10°C above ambient to 80°C*
- **CO-2067** *15°C below ambient to 65°C*

High sensitivity and stability

Detectors

UV-Vis detection

- **UV-2070** *190 to 900 nm*
- **UV-2075** *190 to 600 nm*
- **UV-2077** *Multi-wavelength*
- **MD-2010** *Diode array 195 to 600 nm*
- **MD-2015** *Diode array 200 to 900 nm*

Chemiluminescence detection

- **CL-2027** *Chemiluminescence detector*

Chiral detection

- **CD-2095** *Circular Dichroism detector*
- **OR-2090** *Chiral detector*

Fluorescence detection

- **FP-2020** *Fluorescence detector*

Refractive index detection

- **RI-2031** *RI detector*

System control and data analysis software

The total solution for HPLC system control and data management for chromatographers

ChromNAV Chromatography Data System

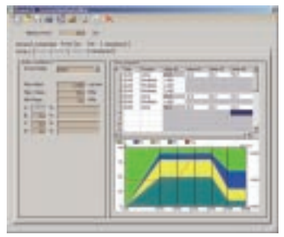
- ***Controls JASCO X-LC Series, LC-2000 Series, LC-1500 Series, and more***
- ***Controls up to four systems simultaneously***
- ***Acquires data at a sampling rate of 100 Hz and is compatible with X-LC detectors.***
- ***ChromNAV CFR is available for 21 CFR Part 11 compliance.***

System Control and Data Acquisition

ChromNAV can control up to four systems simultaneously. The LC-NetII/ADC is the hardware interface between your PC and the system components. Up to four channels of analog data can be acquired by each LC-NetII/ADC.

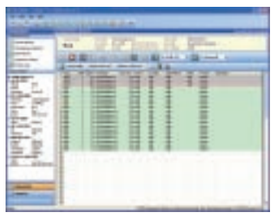
Control Method Editor

A graphical display of the changes in the solvent composition and flow rate by the pump time program makes the gradient conditions easier to visualize, greatly facilitating method development.



Acquisition Sequence

The Acquisition Sequence function allows the user to create the calibration curve and perform quantitative calculations automatically while also supporting batch processing of the data acquisition.



System Monitoring

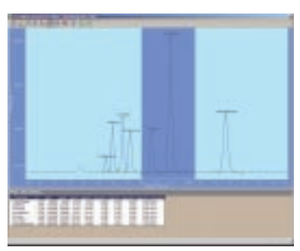
The system monitoring window enables the user to view setting parameters of each module and the system status in real time.

Powerful Data Analysis Functions

ChromNAV includes all standard chromatography calculations, such as reliable peak integration and identification, powerful and easy quantification, a quick user-defined reporting format and versatile data conversion for data export. Peak calculation results can be sent to Microsoft® Excel automatically.

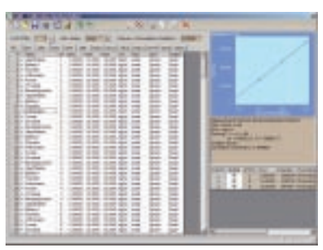
Easy Manual Peak Processing

In addition to the automatic peak processing's powerful capabilities, easy baseline manipulation allows manual peak processing.



Multiple Calibration Curves

For a specific component, a single calibration curve can be created using the data of the preferred channel or multiple calibration curves can be created with data from different channels.



Multiple Chromatogram Display Modes

The multiple chromatogram display modes make it easy to visually compare chromatograms from different detectors or different acquisition tasks.

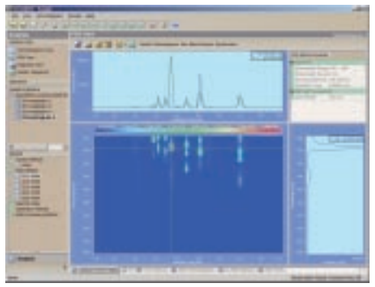
PDA Detector Control and Data Analysis

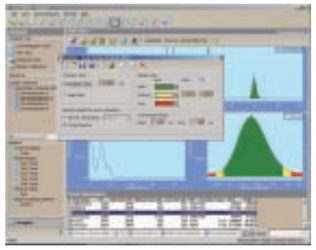
PDA Data Analysis

PDA data analysis is a standard feature in ChromNAV. Some useful tools for manipulating spectra, such as peak purity calculation, spectrum search, etc., are fully supported. Installed as part of the ChromNAV software package, JASCO's Spectra Manager software is provided to perform advanced spectral analysis.

Peak Purity Check

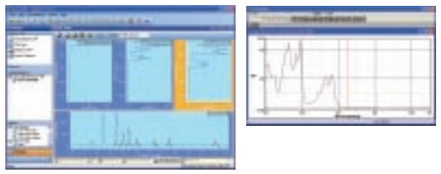
ChromNAV calculates peak purity by comparing the spectrum within the peak. The purity distribution map for each peak is available and can be displayed graphically.





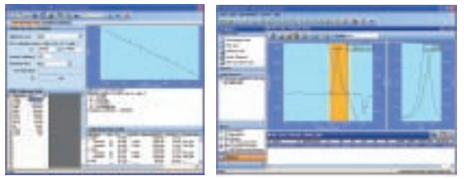
On-flow Spectra Using Spectra Manager™

A powerful cross-platform software package, Spectra Manager is standard for rapid spectral scanning using UV, 4 ch-UV, Fluorescence and Circular Dichroism detectors and data processing functions.



Optional GPC Add-on

The optional GPC package allows molecular weight distribution calculations. Molecular weight distribution is displayed together with the calculation results and the chromatogram.



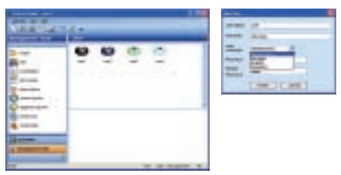
Automatic System Diagnostics

The ChromNAV automatically diagnoses the systems. Diagnostic results are saved together with measured chromatograms.

ChromNAV CFR

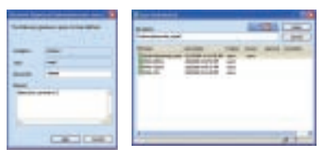
Users and Privileges

User privileges can be set at different security levels.



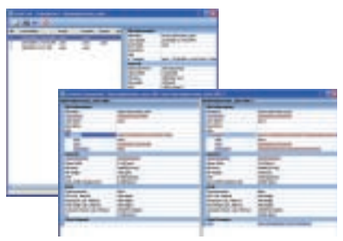
Electronic Signature

Three types of electronic signatures (Created, Reviewed, and Approved) are available. The customer cannot modify any approved data or methods.



Audit Trails

The Audit Trail function records and archives all operations, including any file modifications.



Wide range of solvent delivery systems

Intelligent HPLC pumps offering a wide flow range for all applications.

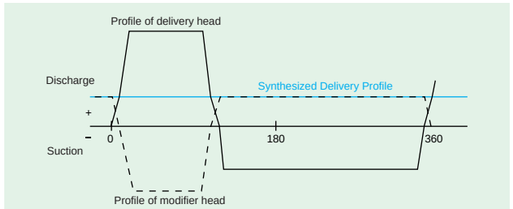
PU-2080 Analytical

Compact full function HPLC pump

- *Compact size, only 15 cm W × 15 cm H*
- *Flow range 1 μL/min to 10 mL/min*
- *Less than 0.1% flow rate precision at 0.2 ~ 5.0 mL/min*
- *Versatile time-based programming of high pressure binary and low pressure ternary gradient elution*
- *Ceramic plungers with an automatic plunger cleaning system for a long, maintenance-free lifetime*

Excellent pump performance offering accurate and precise analytical results.

The Slow Suction Quick Delivery (SSQD) system provides reliable and stable solvent delivery over a wide flow rate range using only 2 plungers and 2 check valves. The pulse-free flow assures maximum detector sensitivity. The pump head design also minimizes maintenance requirements.



Ceramic plungers

The use of ceramic plungers, known for their excellent wear resistance, enables the delivery of a wide variety of solvents, including organic solvents and buffer solutions.

Two-solvent switching valve and plunger cleaning mechanism are standard.

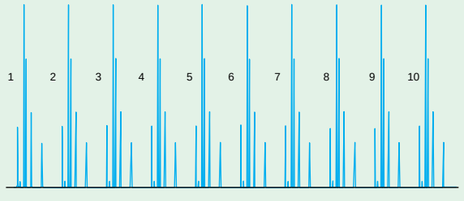
When a strong buffer solution must be fed into the mobile phase, salt will deposit on the plunger, thereby disturbing delivery, causing leaks due to plunger seal damage, and clogging the separation column. The plunger cleaning mechanism is a useful means for preventing such problems before they happen. In addition, the use of a valve for switching between two solvents makes it easy to replace the solvent in the flow route by a manual switching operation.

Highly reproducible delivery

The pump enables a highly reproducible delivery with a flow precision of 0.1% RSD in the range between 0.2 and 5 mL/min, the flow rate most commonly used.

Reproducibility of retention time

The figure illustrates excellent reproducibility of retention time, RSD less than 0.05% for the measurement of Phthalic Esters.



Retention time

No.	DMP	DEP	DPP	DBP
1	2.509	3.411	5.467	9.752
2	2.508	3.410	5.465	9.749
3	2.507	3.408	5.463	9.748
4	2.508	3.409	5.464	9.747
5	2.508	3.408	5.466	9.745
6	2.507	3.408	5.463	9.743
7	2.505	3.406	5.460	9.741
8	2.507	3.408	5.460	9.742
Ave.	2.5074	3.4085	5.4635	9.7459
SD	0.001188	0.001512	0.002563	0.003796
RSD (%)	0.04737	0.04436	0.04692	0.03895

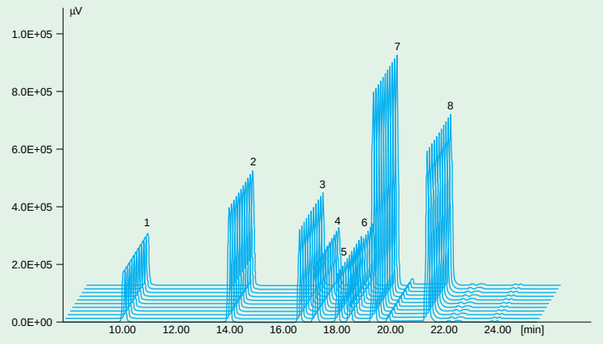
PU-2089 Analytical

Quaternary low pressure gradient pump

- *Compact size, only 15 cm W × 22.5 cm H*
- *SSQD pumping method for the most reliable, accurate and stable solvent delivery*
- *Built-in proportioning valve and degasser for low-pressure mixing of up to four solvents without having to reconfigure the system*
- *Flow range 1 μL/min to 10 mL/min*
- *Less than 0.1% flow rate precision at 0.2 ~ 5.0 mL/min*
- *Plunger cleaning mechanism as standard*

Excellent gradient reproducibility

The use of a new high-precision valve for low-pressure gradients improves gradient resolution and enables more accurate gradient analysis.



Reproducibility of retention time at gradient mode (n=10)

Pek No.	Mean	SD	%RSD
1	10.224	0.007	0.070
2	13.950	0.006	0.039
3	16.452	0.005	0.033
4	17.004	0.005	0.029
5	17.793	0.005	0.026
6	18.223	0.005	0.026
7	19.073	0.004	0.022
8	20.985	0.006	0.029

[Condition]

Column: Crestpak C18T-5 (4.6 x 250 mm)
Temperature: 40°C
Mobile phase: A: H_2O B: CH_3OH
Gradient condition:

Time (min)	0.0	15.0	25.0	25.1	(1 cycle 45min)
A%	50	0	0	50	
B%	50	100	100	50	

Flow rate: 1.0 mL/min
Injection volume: 20 μL
Wavelength: UV 260 nm
Sample: 1: Benzene 2: Naphthalene 3: Fluorene 4: Anthracene 5: Fluoranthene 6: Pyrene 7: Chrysene 8: Benzo[a]pyrene

PU-2080i / PU-2089i Inert

For biological separations without metallic material contact

JASCO offers the PU-2080i and PU-2089i that are manufactured by using polyetheretherketone (PEEK) instead of metal parts which may become exposed to fluids. This allows analyses without concern about sample decomposition or absorption caused by metal.

Wide range of solvent delivery systems

Intelligent HPLC pumps offering a wide flow range for all applications.

PU-2085 Semi-micro

Ideal for low flow rate semi-micro and LC/MS applications

- *Flow range 1 μL to 4 mL/min*
- *SSQD pumping system ideal to assure the most reliable and pulse free solvent flow*
- *A guaranteed flow rate precision within 0.1% assures excellent reproducibility of retention time at 0.05~2.0 mL/min*
- *Optimization of the pump head, check valve, and plunger enables stable semi-micro delivery with a low pulse flow, which results in a stable baseline*
- *Versatile time based programming of high pressure binary gradient elution*

High-sensitivity analysis for semi-micro scale

Semi-micro analysis is the most useful method when sample volumes are limited and is often the preferred method in the biochemical or pharmaceutical research environments for highly sensitive analysis. The PU-2085 accommodates low flow rates for 1 to 2 mm columns to reduce solvent consumption and disposal.

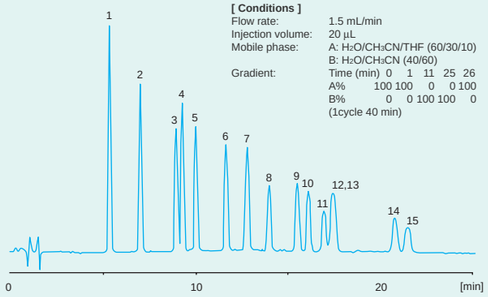
Analysis of 2, 4-DNPH derivatives of aldehydes and ketones

Samples:

1. Formaldehyde
2. Acetaldehyde
3. Acetone
4. Acrolain
5. Propionaldehyde
6. Crotonaldehyde
7. Butylaldehyde
8. Benzaldehyde
9. Isovaleraldehyde
10. Varelaldehyde
11. o-Tolualdehyde
12. m-Tolualdehyde
13. p-Tolualdehyde
14. Hexaldehyde
15. 2,5-Dimethylbenzaldehyde

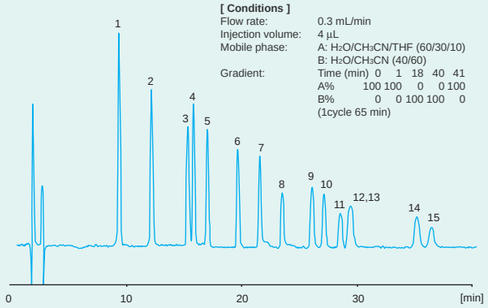
Conventional separation at the flow rate of 1.5 mL/min

[Conditions]
Flow rate: 1.5 mL/min
Injection volume: 20 μL
Mobile phase: A: $H_2O/CH_3CN/THF$ (60/30/10)
B: H_2O/CH_3CN (40/60)
Gradient: Time (min) 0 1 11 25 26
A% 100 100 0 0 100
B% 0 0 100 100 0
(1cycle 40 min)



Semi-micro separation at the flow rate of 0.3 mL/min

[Conditions]
Flow rate: 0.3 mL/min
Injection volume: 4 μL
Mobile phase: A: $H_2O/CH_3CN/THF$ (60/30/10)
B: H_2O/CH_3CN (40/60)
Gradient: Time (min) 0 1 18 40 41
A% 100 100 0 0 100
B% 0 0 100 100 0
(1cycle 65 min)



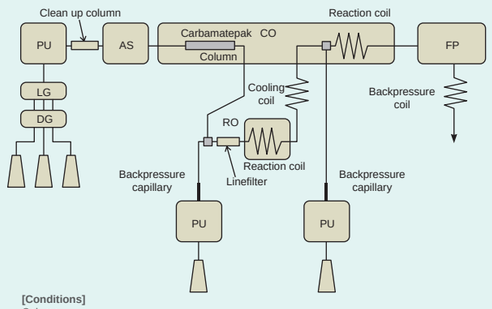
Optimized pump head, check valve, and plunger

The pump head, check valve, and plunger are optimized for stable semi-micro delivery with pulse-free flow, resulting in a stable baseline.

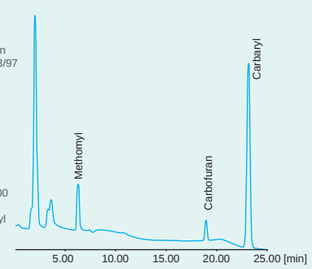
Ideal for reagent pump

The PU-2085 is an ideal reagent pump for post-column derivatization systems.

Post-column derivatization of carbofuran, carbaryl and methomyl



[Conditions]
Column:
Carbamatepak
(4.0 mm I.D. x 150 mm L)
Eluent:
A; IPA, B; H_2O
10 min 15 min 0.1 min
(A/B) 3/97 → 20/80 → 20/80 → 3/97
1 cycle 40 min
Flow rate: 1.0 mL/min
Column temperature: 40ºC
Reagent 1: NaOH solution
Reagent 2: OPA solution
Reagent Flow rate:
0.5 mL/min each
Reaction temperature: 100ºC
Wavelength:
Ex. 339 nm, Em. 455 nm, Gain x100
Sample:
Carbofuran, Carbaryl and Methomyl
(0.0005, 0.005, 0.001 mg/L)
Injection volume: 200 μL



PU-2086 Semi-preparative / PU-2087 Preparative

Excellent pump performance in isocratic or gradient modes

- *High precision and reproducibility for isolation and purification requirements*
- *Dual plunger design optimal for high-volume delivery eliminates pulsation providing uniform flow over a wide range of flow rates*
- *Flow range to 20 mL/min (PU-2086)*
  Flow range to 50 mL/min (PU-2087)
- *A recycle valve is provided for convenient recycling methods*

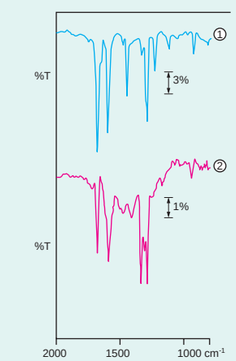
Impurity analysis in preparative HPLC

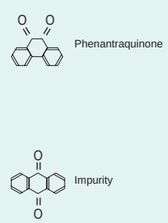
The PU-2086/2087 is used for compound purification and impurity identification in pharmaceutical research and development. The figure shows identification of an impurity in phenantroquinone. The collected fractions were analyzed using the IR diffuse reflectance measurement method.

Chromatogram of phenantraquinone

[Conditions]
Column: Finepak SIL C18
Wavelength: 250 nm
Eluent: CH_3CN/H_2O=(60/40)
Flowrate: 0.2%/30 μL

IR spectra of fractions

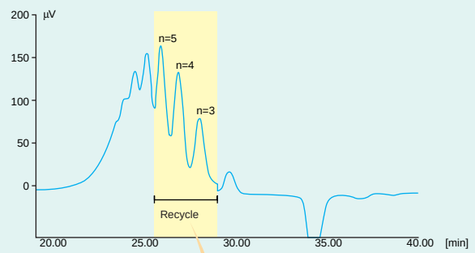


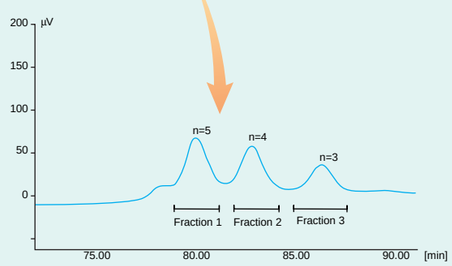


Recycle system in preparative chromatography

The PU-2086/2087 is capable of recycling chromatography, one of the crucial techniques in preparative chromatography. JASCO offers the automatic-flow switching RV-2080-02 recycling valve.

Separation of polystyrene oligomer (n-3, 4, 5) by recycle chromatography





Versatile autosamplers with sampling flexibility

Fully automatic intelligent sample injection system for increased productivity and analytical precision.

AS-2050/2051 Autosampler

Fully automatic sample injection systems with excellent productivity and the highest possible level of precision

- *Fixed loop or variable volume injection modes*
- *Reproducibility better than 0.2% RSD using 20 µL fixed loop injection mode with less than 0.01% sample contamination*
  With variable 10 µl injection mode, the RSD is better than 0.3%
- *100 samples with 2 mL vials standard*
  182 samples with 0.6 and 0.3 mL vials
  192 samples with two 96-well microplates
  768 samples with two 384-well microplates
- *5 operating modes; normal, two methods of pre-column derivatization, dilution, and zero-sample loss injections in stand-alone mode*
- *Injection volume from 0.1 µL to 200 µL (standard), 1 ~ 2000 µL (optional)*
- *Cooling and heating capability (AS-2051 only)*

AS-2055/2057 Autosampler

Compact automatic sample injection systems only 15 cm wide

- ***50 samples with 2 mL vials standard***
  84 samples with 0.6 and 0.3 mL vials
  96-well or 384-well microplate
- ***Cooling and heating capability (AS-2057 only)***
- ***Biocompatible models using PEEK (AS-2055i/2057i)***

Flexible interfacing with the JASCO HPLC system

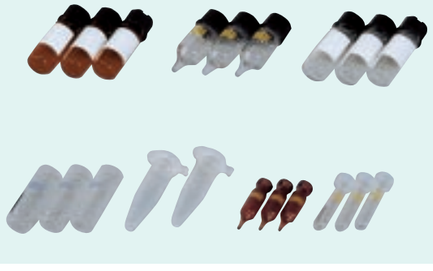
The AS-2050/2051/2055/2057 can be used as a stand-alone module through the built-in keypad and LCD display, or integrated into a complete HPLC system with computer control. In stand-alone mode, the advanced microprocessor on the AS-2050/2051/2055/2057 offers 10 user friendly programs with 64 steps per program. The AS-2050/2051/2055/2057 can freely interact with other HPLC modules via the integrated LC-Net interface and can be easily triggered from an external event generated by a computer or other LC module. Full PC control is also provided when incorporated in a JASCO HPLC system with the JASCO chromatography data system.

Zero sample-loss mode

In the zero sample-loss mode of the AS-2050/2051/2055/2057, the sample is sandwiched between two zones of mobile phase solvent, and the sample volume is drawn into the loop and injected without waste.

Trays and vials

For full automation, exchangeable racks are available. A wide variety of sample racks makes it possible to use almost all types of sample vials and tubes.



AS-2059 Autosampler

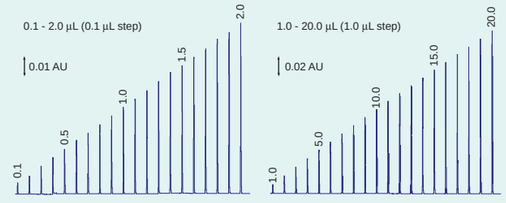
Unparalleled sampling flexibility with up to 768 well positions (two 384-well microplates) as an option for laboratory automation and combinatorial chemistry.

- *Variable sample volume injection method (Zero Sample Loss)*
- *Reproducibility less than 0.2% RSD for 5.1 to 100 µL injection*
- *Less than 0.002% sample contamination for 10 µL injections*
- *120 samples with 2 mL vials standard*
  224 samples with 0.6 and 0.3 mL vials
  192 samples with two 96-well microplates
  768 samples with two 384-well microplates
- *Random sample access is provided as well as random number of injections and random injection volume for each vial*
- *Optional Peltier cooling and heating unit (TC-2059)*
- *Automatic recognition of sample rack*

Temperature control

The AS-2059 offers a Peltier temperature control unit (TC-2059) as an option to expand the versatility of the instrument and maintain the integrity of all samples. (Temperature range: 4 to 60ºC)

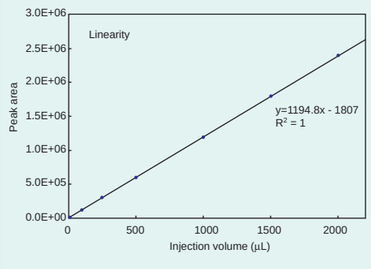
Resolutions of Injection Volume



[Conditions]

Eluent	: H_2O
Flow rate	: 1.0 mL/min
Coil	: ϕ 0.25 mm I.D. × 10 m SUS
Wavelength	: 270 nm
Sample	: 0.0025% Caffeine in H_2O (for 1.0 µL step)
	0.01% (for 0.1 µL step)

Excellent linearity and reproducibility



Injection reproducibility

Vol (µL)	CV (%)
1	9.4456
10	1.2340
100	0.2176
1000	0.1068
	(n=10)

[Conditions]

Column : Megapak C18-10
(ϕ 10 mm I.D. × 250 mm length)

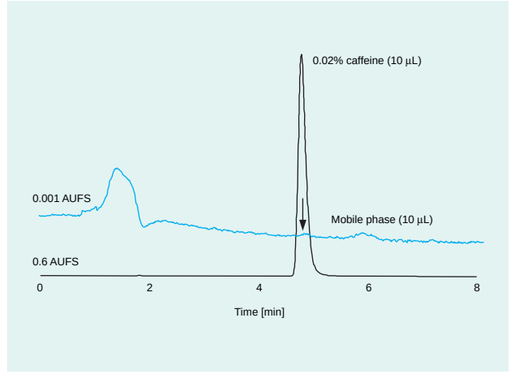
Flow rate	: 3.0 mL/min
Eluent	: CH_3OH
Column Temp.	: 40ºC
Wavelength	: 275 nm
Sample	: 0.002% DOP in CH_3OH

Flexible USER PROGRAM mode

In stand-alone mode, the injection sequence is programmable by using the USER PROGRAM mode. Pre-column derivatization, dilution and internal standard addition can be achieved automatically with the AS-2059. The fixed reagent vial rack allows a maximum of 6 reagent vials. Custom injection sequences can also be programmed.

Low carryover contamination

A low contamination level of 0.002% is achieved by reducing contact between the injection port and needle, which is the source of most contamination. An optional cleaning pump for samples that are difficult to dissolve in the mobile phase makes it possible to use cleaning solvents other than the mobile phase to clean the needle and injection port.



The figure above shows chromatograms obtained by injecting 10 µl of 0.02% caffeine, and then after cleaning twice, injecting 10 µL mobile phase. The ratio of the peak height of caffeine results in a carryover contamination value of 0.0008%.

Versatile column ovens and support modules

Temperature control with excellent reproducibility and precision

CO-2060/2065 Column ovens

Temperature control with excellent reproducibility and precision

- *Air circulation oven with digital PID control*
- *Range 15°C below ambient to 80°C (CO-2060)*
- *Range 10°C above ambient to 80°C (CO-2065)*
- *Accuracy ± 0.1°C at 40°C*
- *Standard configuration accepts two columns up to 40 cm in length*
- *Includes time programming functions*
- *Accepts a manual injector, a preheating coil, a reaction coil, and other components inside the oven*

CO-2067 Column oven

Compact column heater/cooler

- *Compact column heater/cooler employing an aluminium block design*
- *Range 15°C below ambient to 65°C*
- *Accuracy ± 0.1°C at 40°C*
- *Accepts two columns up to 15 cm or 25 cm in length*
- *Includes time programming functions*

Sample loop temperature control (CO-2060/2065)

The optional 7725i/9725i manual injector can be attached to the front of the CO-2060/2065 by using an optional panel. The temperature gradient within the column can be suppressed by making the sample loop the same temperature as the column.

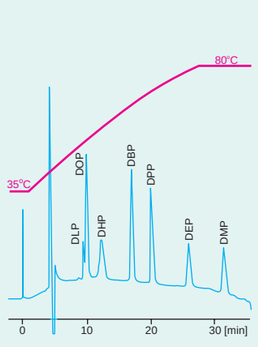
7725i

9725i

Column temperature time-programming

If a constant temperature is not adequate for separation, the temperature time programming function is effective for higher resolution.

Separation of phthalic esters by column temperature programming



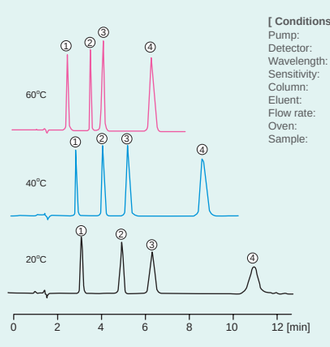
[Conditions]

Pump:	PU-2080
Detector:	UV-2070
Wavelength:	250 nm
Sensitivity:	0.16 AUFS
Eluent:	iso Octane/AcOEt (97/3)
Column:	Finepak SIL
Flow rate:	1.0 mL/min
Oven:	CO-2060
Temperature:	35°C ~ 80°C

Increased efficiency at elevated temperatures

If the sample is not heat sensitive, the use of elevated temperatures reduces analysis time and solvent waste.

Example of the use of elevated temperature



[Conditions]

Pump:	PU-2080
Detector:	UV-2070
Wavelength:	250 mm
Sensitivity:	0.3 AUFS
Column:	Finepak SIL C_{18}
Eluent:	CH_3CN/H_2O (90/10)
Flow rate:	1.0 mL/min
Oven:	CO-2060
Sample:	① Benzene ② Anthracene ③ Pyrene ④ Benz(a)pyrene

RO-2061 Reaction oven

For post-column derivatization applications such as carbamate analysis and sugar analysis systems where high temperatures are required

- *Range 10°C above ambient to 200°C*
- *Accuracy ± 0.2°C at 100°C*
- *Inside dimensions, 150(W) × 45(H) × 300(D) mm for reaction coils*
- *Accepts a column up to 25 cm in length*

LG-2080-04/02

Low pressure gradient units

Proportioning valves controlled by the PU-2080

- *Up to 4 solvents (LG-2080-04)*
  Up to 3 solvents (LG-2080-02)
- *Precision of solvent composition: ± 0.2%*
- *Precision of linear gradient: ± 1%*
- *Flowrate range: 0.3 mL/min to 3 mL/min*
- *Solvent-wetted materials: PTFE and PEEK*

DG-2080-54/53

In-line degasser

Vacuum degassing by membrane separation

- *Up to 4 solvents (DG-2080-54)*
- *Up to 3 solvents (DG-2080-53)*
- *Maximum flowrate: 3 mL with water*
- *Solvent-wetted materials: PEEK, fluoropolymer membrane*
- *Solvent hold-up volume: Approx. 10 mL each line*

MX-2080-31

3-solvent high pressure mixer

Static mixing

- *Up to 3 solvents*
- *Standard mixing (flow line 1) and high sensitivity mixing (flow line 2)*
- *Serial connection from flow line 1 to flow line 2 enables higher sensitivity analysis*
- *Flow rate: 0.5 to 20 mL/min*

MX-2080-32

3-solvent high pressure mixer

Dynamic mixing

- *Up to 3 solvents*
- *Mixing chamber capacity: 1.5 mL (standard), 20 µL, 50 µL, 80 µL, 250 µL, 400 µL, 3 mL, 5 mL and 10 mL (optional) for various applications from semi-micro to semi-preparative HPLC*

LV-2080-03

Solvent selector valve

An automatic six-way valve for the sequential switching of solvents for use with with the PU-2080 HPLC pump. Up to six solvents can be connected.

HV-2080-01

Column switching valve

A two position valve for use in flow line switching between columns and auto-injector. The valve position can be switched manually or automatically via a contact closure.

LG-2080-04

DG-2080-54

MX-2080-32

LV-2080-03

HV-2080-01

UV-Visible detectors

Excellent optical characteristics and fully programmable

UV-2070/2075 UV-Vis Detector

The most compact, full-featured UV/Visible detectors occupying only 15 cm of bench space

- *Czerny-Turner mount monochromator enables a wide wavelength range*
- *190 - 900 nm (UV-2070), 190 - 600 nm (UV-2075)*
- *Single dye-cast aluminium optical bench for excellent mechanical and thermal stability*
- *The tapered cell design eliminates baseline variation*
- *On-the-fly spectral scanning*

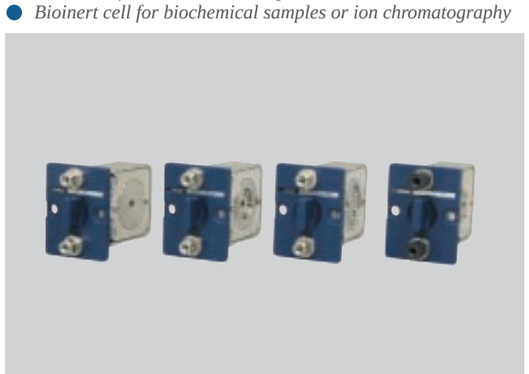
Full intelligent functions

Front panel programming allows up to 10 program files with up to 64 steps each. Time programmable parameters include Wavelength, Range, Autozero, Response and Spectral scanning. Self-diagnostic functions are provided for start-up hardware checks as well as monitoring for solvent leakage, lamp-off, etc. during operation. To extend lamp life, a timer is provided to shut off the lamp after completing the run.

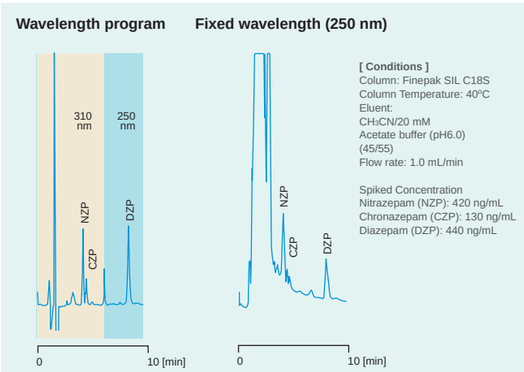
The UV-2070/2075 can easily be interfaced with the JASCO HPLC system using the JASCO chromatography data system. The software offers full automation of the JASCO HPLC system including the UV-2070/2075 and other components.

A variety of flow cells

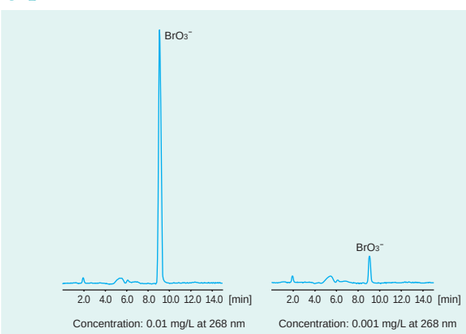
- *Micro cell*
- *Preparative cell*
- *Ultra high pressure cell for SFC, LC-MS*
- *PTFE cell for biochemical samples*
- *Bioinert cell for biochemical samples or ion chromatography*



Analysis of anti-anxiety drugs in serum by wavelength program



Highly selective analysis of bromate ion by post-column derivatization



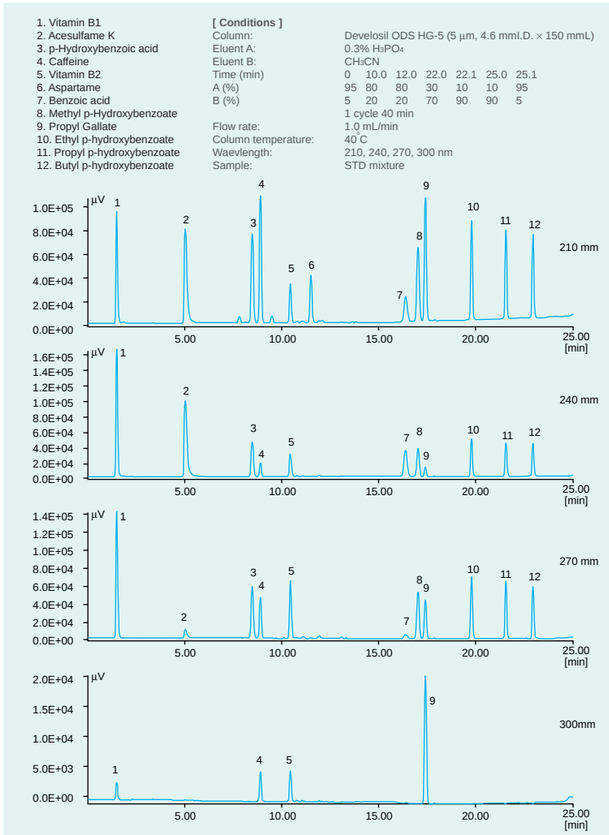
UV-2077 Multi-wavelength UV-Vis Detector

36-element discrete diode-array, enabling truly simultaneous multi-wavelength detection in real-time with maximum sensitivity and selectivity

- *Significantly lowered baseline noise and drift due to unique electronics and optics*
- *Simultaneous monitoring of 4 different wavelengths with optional ratio output for peak purity*
- *Range 200 - 600 nm, 1 nm intervals*
- *Spectral acquisition without interruption*

Four wavelength monitor of food additives

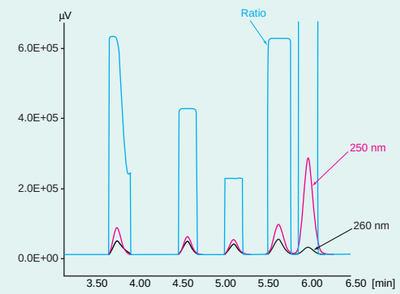
Four different measurement wavelengths can be set when measuring samples that contain constituents with differing absorption wavelengths.



Purity testing of compounds by ratio chromatography

If the desired peak is a pure sample, the ratio chromatogram obtained will show a fixed value, but if there are impurities, the ratio value will vary. Purity testing for peaks can be accomplished in this manner.

Peak purity ratio chromatogram



Wide range of detectors

High sensitivity, high resolution and wide dynamic range

MD-2010/2015 Diode Array Detector

The MD-2010 and MD-2015 are both powerful and flexible high sensitivity diode array HPLC detectors.

- ***MD-2010: 195 - 650 nm (1 nm data interval)***
- ***MD-2015: 200 - 900 nm (1.5 nm data interval)***
- ***Noise level as low as 0.7 × 10^{-5} AU***
- ***Drift less than 1 × 10^{-3} AU/hour***
- ***A wide dynamic range assures linear response up to 2.0 AU***

High sensitivity and wide dynamic range

The innovative design of the MD-2010/2015 is a breakthrough in diode array technology with a noise level as low as 0.7 × 10^{-5} AU and drift of less than 1 × 10^{-3} AU/hour. The wide dynamic range assures the absorbance is linear up to 2.0 AU. The combination of wide dynamic range and high resolution allow acquisition of precise UV spectral data needed for accurate determination of main components as well as impurities. The optimized, high resolution optical system is essential for differentiation of components which have similar spectral shapes.

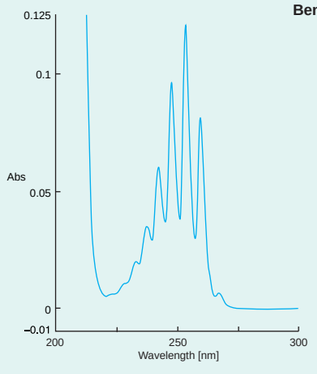
Powerful stand-alone operation

Used without a computer, the MD-2010/2015 detectors offer much more than other HPLC detectors. For routine analysis, there are outputs for 3 chromatograms of different wavelengths and an output of a ratio chromatogram of two different wavelengths. Spectral measurement can be taken at any time throughout a chromatographic run by a single key stroke. The MD-2010/2015's memory can store as many as 50 UV spectra along with conditions such as retention time, sample number, and chromatographic peak number.

High resolution

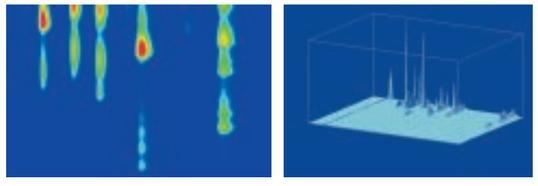
The benzene spectrum below shows excellent performance for both sensitivity and spectral resolution ensured by the optimized optical design of the MD-2010/2015.

Benzene spectrum



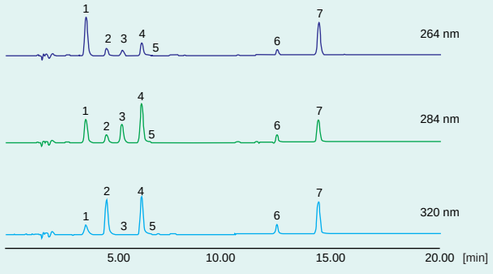
Software for control and data acquisition

The JASCO chromatography data system provides the researcher with sophisticated data acquisition and processing.
- Real-time monitoring of 3-D spectra
- Variety of data display modes, such as 3-D chromatogram, simultaneous display of contour plot, six chromatograms, ratio chromatogram and UV spectra
- Chromatographic peak purity check
- Quantitative analysis at the optimum wavelength



Simultaneous analysis of seven veterinary drugs

The MD-2010/2015 detectors are equipped with a four-channel analog output terminal (3 wavelength chromatograms and 1 ratio chromatogram). They can also be used as multi-channel detectors without a PC.



1: Sulfadimidine
2: Quinoxaline-2-carboxylic acid
3: 5-Propylsulfonyl-1H-benzimidazole-2-amine
4: Thiabendazole
5: Oxytetracline
6: Isometamidium
7: Flubendazole

FP-2020 Fluorescence Detector

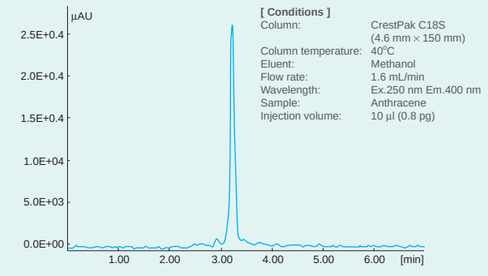
The FP-2020 Intelligent Fluorescence Detector is recognized as the industry's most sensitive detector.

- ***Signal-to-noise ratio of better than 350:1 for the Raman water peak***
- ***Wide wavelength range for both excitation and emission from 220 to 700 nm (~ 900 nm with an optional PMT)***
- ***Versatile time-programming capabilities***
- ***On-the-fly spectral acquisition for both emission and excitation***
- ***Special low dispersion (LD) cell for optimum peak shape***

Maximum Sensitivity

Improvement in the optical design and mirror coatings allow greater efficiency in the collection of fluorescence energy resulting in detection of anthracene (S/N = 2) at levels as low as 6.6 femtograms. With a S/N of greater than 350:1, the FP-2020 ensures detection and quantification for applications with very low compound concentrations.

Highly sensitive measurement of anthracene

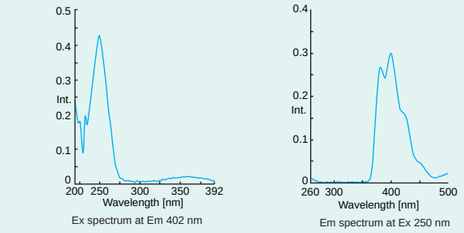


The detection limit (S/N=2) is 6.6 femtograms.

Rapid Spectral Scanning

A rapid spectral scan function allows on-flow spectral scanning of both emission and excitation spectra without interrupting the chromatographic elution. The FP-2020 can store up to 10 Ex and Em spectra. Spectral measurements can be performed manually or using a timer program.

On-flow spectral measurement of anthracene



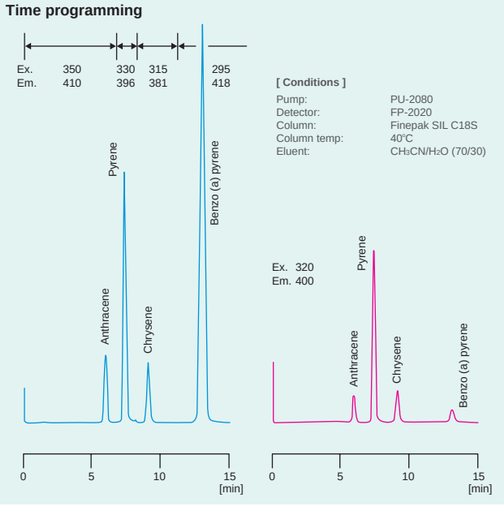
Ex spectrum at Em 402 nm

Em spectrum at Ex 250 nm

Versatile time programming capabilities

Versatile time-programming capabilities are provided for wavelength, response, gain, spectral scan, etc., permitting highly selective detection of various compounds.

Time programming



A variety of flow cells

In addition to the standard 16 μL flow cell, various type of flow cells are available, such as: Micro flow cell (5 μL), Capillary flow cell, Chemiluminescence flow cell and inert flow cells. A rectangular cell holder is also available: 10 mm × 10 mm cuvettes can be used with the FP-2020 to provide spectrofluorometric measurements for methods development and finding optimal Ex and Em wavelengths.

Optical detectors

Offering over 45 years of experience in optical design and performance

CD-2095 Circular Dichroism Chiral Detector

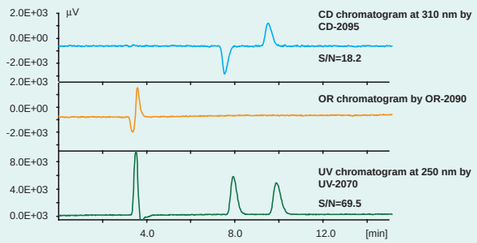
The world's first Circular Dichroism based detector for chiral chromatography

- ***Simultaneous acquisition of CD, UV and g-factor signals***
- ***Direct determination of optical isomer separation and purity***
- ***Spectral scanning capability***
- ***Up to 100× greater sensitivity than ORD***
- ***Wide range of applications, including drug analysis, drug discovery, biochemical analysis, natural product analysis, organic synthesis, etc.***

Highly sensitive and selective detection

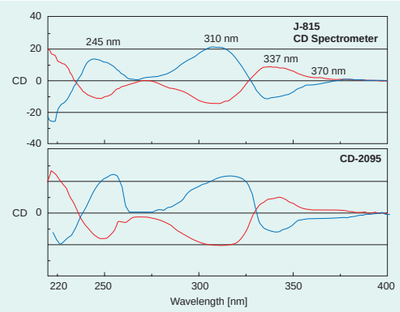
Chromatograms of flavanone (0.1 µg injected) using the CD-2095, the OR-2090 optical rotation detector and the UV-2070 UV-Vis detector are shown below. A 0.1 µg injection provides a CD chromatogram demonstrating a good S/N ratio. The UV detector also offered a good chromatogram. However, the OR-2090 failed to detect a peak. The CD-2095 gave approximately 200 times higher sensitivity than the OR-2090. Also it is remarkable that both UV and OR detectors gave significant solvent peaks which were not observed in the data from the CD-2095 as a result of the dual-beam signal from the differences in the left and right absorptions. The non-chiral absorbance change without CD is canceled. With the UV chromatogram, both peaks are in the same direction, while with the CD chromatogram, the peaks of the D and L enantiomers are in opposite directions, confirming optical isomer separation.

Separations of flavanone (0.1 µg)



CD Spectral collection

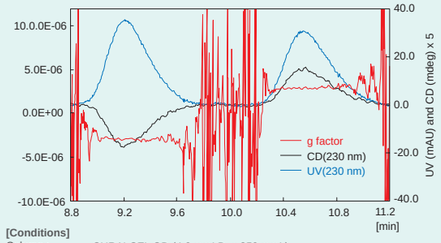
Both CD spectra of flavanone collected with the CD-2095 and a conventional CD spectropolarimeter (JASCO Model J-815) are shown in the figure. The major peaks at 245, 310 and 337 nm are in agreement in each spectrum.



Optical purity determination by g-factor

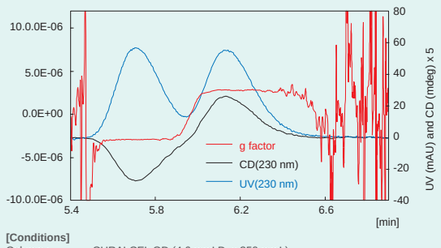
The g-factor is a ratio chromatogram of CD and UV signals. It is calculated by delta AU/AU, and is independent of the concentration. Its value stays at a constant level along a chromatographic peak if the optical purity is kept constant during the peak elution. The figures below illustrate the CD and UV chromatograms and the g-factor plotted along the time axis. The g-factor maintains a constant level when a peak is being eluted and becomes unstable when there is no peak, because both the CD and UV signal become zero when they are on the baseline, resulting in a zero/zero calculation. When the separation is incomplete, the g-factor trace varies in a different manner, increasing linearly from the minimum to the maximum, and crossing the zero level at the UV peak minimum. This means that the solute eluted in the retention time range from 5.9-6.0 min is not optically pure. The elution at 5.95 min has an enantiometoric excess of 50%. Utilizing the g-factor trace, the optical purity of the peak components can be determined easily and without fractionation.

Separation of ibuprofen (1 µg)



[Conditions]

Column :	CHRALCEL OD (4.6 mmI.D. x 250 mmL)
Eluent :	n-Hexane / IPA / TFA (100/1/0.1)
Flow rate :	1.0 mL/min
Temperature :	25°C
Sample :	Ibuprofen (1 µg)



[Conditions]

Column :	CHRALCEL OD (4.6 mmI.D. x 250 mmL)
Eluent :	n-Hexane / IPA / TFA (100/4/0.1)
Flow rate :	1.0 mL/min
Temperature :	50°C
Sample :	Ibuprofen (1 µg)

OR-2090 Chiral Detector

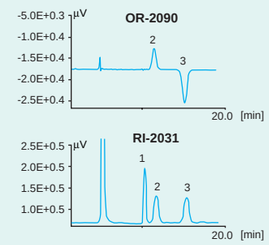
The OR-2090 is specifically designed for the detection of optically active compounds such as amino acids, sugars and terpenes

- ***Low noise and drift***
- ***Hg/Xe lamp to cover the wavelength range from UV to visible***
- ***Patented flow cell for low dispersion***
- ***Auto-aligning flow cell is easily removed for cleaning***
- ***Artifact free***

High-selectivity by optical rotation monitoring

Polarimeters used in measuring optical isomers are specifically designed for use in HPLC, which makes them effective for selectively detecting optically active substances in natural products. The figure to the right shows sugar chromatograms measured by the RI-2031 and the OR-2090. The RI-2031 detects all sugar compounds in the sample, while the OR-2090 detects only the optically active sugar compounds.

Sugar measurement by the OR-2090 and the RI-2031



1. meso-Erythritol
2. D(+) - Xylose
3. D(-) - Fructose

[Conditions]

Column:	Finepak SIL NH2-5
Eluent:	CH_3CN / 0.3% H_3PO_4 (pH3) = 85 /15
Gain:	x100
Flow rate:	1.0 mL/min
Column temperature:	40°C
Injection volume:	10 µL
Sample:	STD mixture (10 mg/mL)

CL-2027 Chemiluminescence

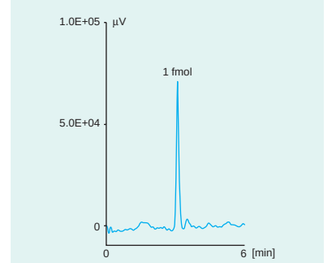
Detection of optically active compounds

- ***Equipped with a low dispersion flow cell***
- ***Sensitive detection of lipids, nucleotides, nitrogen oxides (NOx) and catecholamines***

Highly sensitive detection

Background noise becomes extremely low because substance excitation is performed by a chemical reaction rather than an excitation light source. This enables a high degree of sensitivity.

High-sensitivity measurement of dipyridamole



RI-2031 Refractive Index

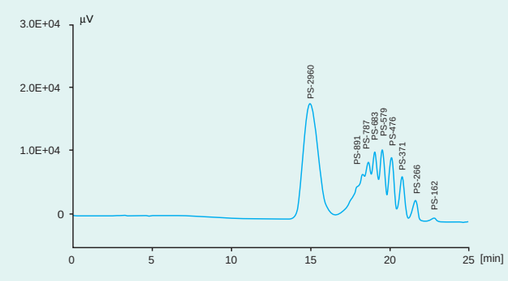
High-sensitivity detection with a prism flow cell

- ***Analytical and semi-preparative flow rate to 50 ml/min***
- ***Low noise, stable baseline***
- ***Time programming for sensitivity range and reference cell purging***
- ***Temperature stabilization from 10°C above ambient to 45°C***

Molecular weight distribution

The RI-2031 can be used for calculating molecular weight distribution because peak size, according to an RI detector, is nearly proportional to concentration.

GPC chromatogram of polystyrene standards



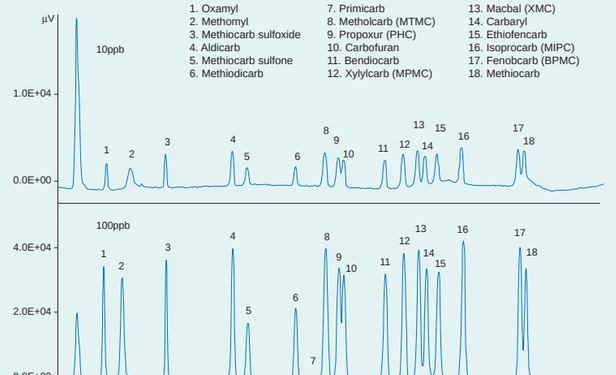
Dedicated analysis systems

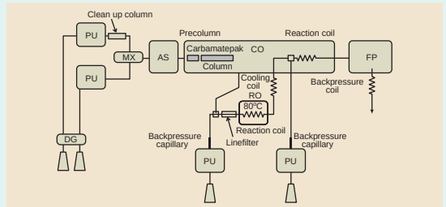
Ready solutions for multiple applications

N-methyl carbamate pesticides

Post-column derivatization with semi-micro HPLC

This N-methyl carbamate pesticide analysis system employs OPA post-column derivatization and fluorescence detection. High-pressure gradient elution with semi-micro HPLC and highly sensitive detection using the fluorescence detector enables a maximum 18-component analysis in one injection.





[Conditions]

Column:	CarbamatePak
Column temperature:	40°C
Eluent:	A: H_2O B: CH_3OH C: THF

Time(min)	0	1.5	3	15	35	40	45	45.1
A(%)	88	88	90	85	70	65	65	88
B(%)	12	12	0	0	0	0	0	12
C(%)	0	0	10	15	30	35	35	0

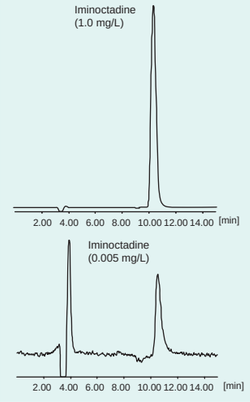
Flow rate:	0.2 mL/min
Reaction Eluent-1:	50 mM NaOH 0.1 mL/min, 80°C
Reaction Eluent-2:	OPA* 0.1 mL/min 40°C
Wave length:	Ex 339 nm, Em 455 nm
Injection volume:	5 μL

* Sodium Tetraborate buffer/OPA/Mercaptoethanol (1000/5/0.05)

Iminoctadine triacetate analysis system

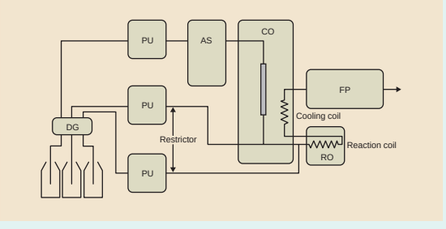
Post-column derivatization and fluorescence detection

This system is designed for iminoctadine triacetate analysis. It uses a fluorescence detector to measure iminoctadine by means of ion chromatography and post-column derivatization.



[Conditions]

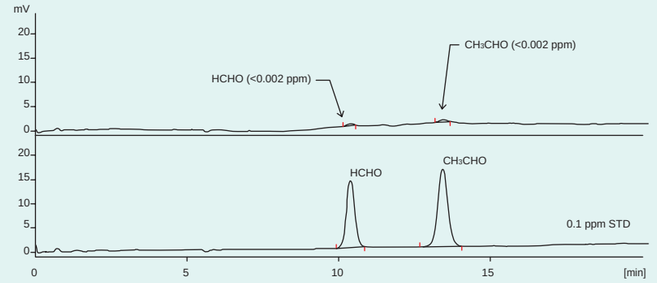
Column:	Develosil ODS-HG-5 (4.6 mm I.D. × 150 mm L)
Eluent:	A/B= 15/7 A: 14.1 mg $NaClO_4$ + 400 mg NaOH + 1.8 mL lactic acid in H_2O B: acetonitrile
Column temperature:	50°C
Reagent 1:	NaOH solution
Reagent 1 Flow rate:	0.2 mL/min
Reagent 2:	Ninhydrin solution
Reagent Flow rate:	0.1 mL/min
Reaction temperature:	90°C
Wavelength:	Ex. 395 nm, Em. 500 nm, Gain: ×100
Sample:	Iminoctadine triacetate (1.0, 0.005 mg/L)
Injection volume:	20 μL

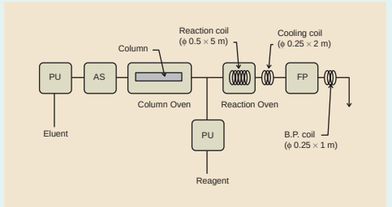


Formaldehyde and acetaldehyde in tap water

1, 3-cyclohexanedione post column derivatization

This system enables high sensitivity measurements of formaldehyde and acetaldehyde at the ppb level without any pre-processing by means of post-column derivatization and fluorescence detection employing 1, 3-cyclohexanedione as a reaction reagent. This method can be applied not only to environmental water analysis, including rainwater, river water, and lake water, but also to food analysis.





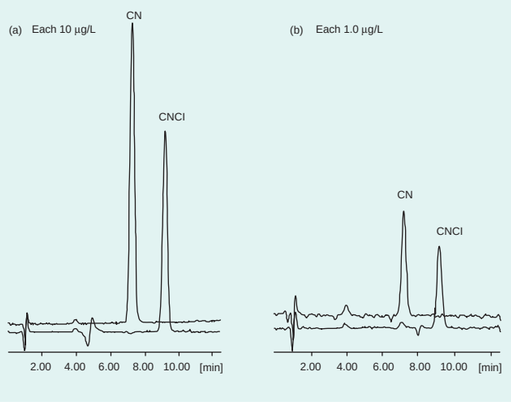
[Conditions]

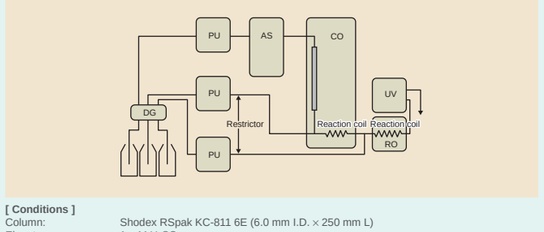
Column:	Shodex Ionpak KC-801P+KC-811
Eluent:	3 mM $HClO_4$
Eluent Flow rate:	1.0 mL/min
Column Temperature:	60°C
Reagent:	2.5 g Cyclohexanedione + 20 g Ammonium acetate + 10 mL Acetic acid in 500 mL H_2O
Reagent Flow rate:	0.6 mL/min
Reaction Temperature:	120°C
Wave length:	Ex; 366 nm, Em: 440 nm, Gain: ×10
Sample:	STD tap water
Injection Volume.:	100 μL

Cyanide ion and cyanogen chloride

Ion chromatography post-column absorption spectroscopy

Ion chromatography post-column absorption spectroscopy is employed in the analysis of cyanide ions and cyanogen chloride. This analysis method forms cyanide by allowing chloramine T to react with cyanogen eluted from the column. The cyanide then reacts with a 4-pyridinecarboxylic acid/pyrazolone solution. The blue color obtained is measured at a wavelength of 638 nm to determine the quantity of cyanide ions and cyanogen chloride.





[Conditions]

Column:	Shodex RSpak KC-811 6E (6.0 mm I.D. × 250 mm L)
Eluent:	1 mM H_2SO_4
Flow rate:	1.0 mL/min
Column temperature:	40°C
Reagent 1:	0.1% Chloramin T in 0.1M phosphate buffer (pH 7.5)
Reagent 1 Flow rate:	0.5 mL/min
Reagent 2:	1-Phenyl-3-methyl-5-pyrazolone + 4-pyridinecarboxylate (Na)
Reagent 2 Flow rate:	0.5 mL/min
Reaction temperature:	80°C
Wavelength:	638 nm
Sample:	Cyanide ion, Cyanogen chloride (10 or 1.0 μg/L each)
Injection volume:	100 μL

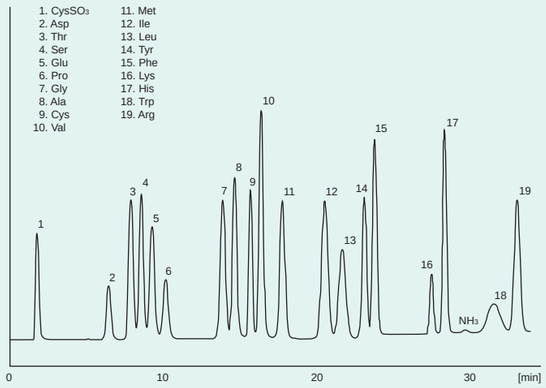
Dedicated analysis systems

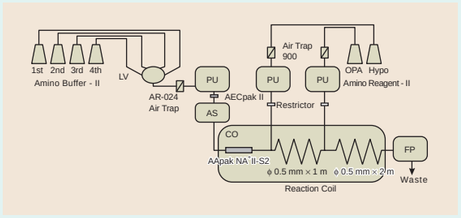
Ready solutions for multiple applications

Protein hydrolysate amino acids

OPA post-column derivatization and fluorescence detection

This amino acid analysis system uses post-column derivatization and fluorescence detection employing o-phthalaldehyde (OPA) as a reaction reagent. 20 kinds of protein hydrolysate amino acids were analysed in about 30 minutes. Changing the separation column and eluent makes it possible to support protein hydrolytic amino acids (Na column) or biologic amino acids (Li column).





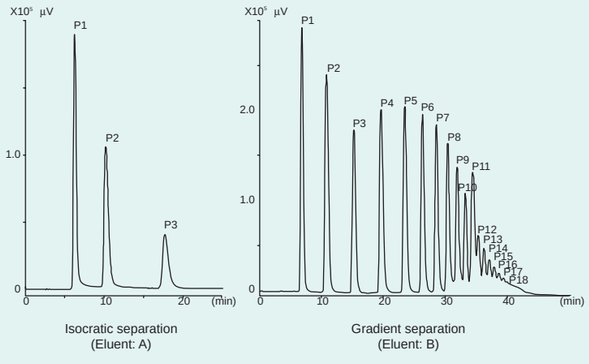
[Conditions]

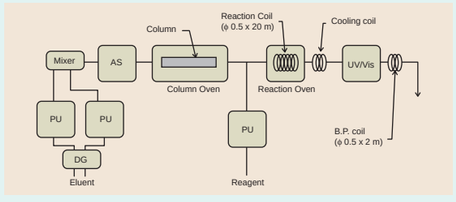
Column:	AApak Na II-S2
NH_3 trap column:	AECpakII
Eluent:	Amino Buffer-II
Reagent:	Amino Reagent-II
Wavelength:	Ex.345 nm Em.455 nm Gain ×10
Flow rate:	0.6 mL/min (Eluent) 0.4 mL/min (Reagent)
Sample:	Amino Acid Std. Soln. Type H Add $CysSO_3$ and Tryptophan
Injection volume:	10 µL

Polyphosphoric acid in food additives

Post-column derivatization and visible absorption detection

This system analyzes polyphosphoric acid in food additives used in fish cake and dairy products such as ice cream by means of post-column derivatization and visible absorption detection. The detectable wavelength is 830 nm for the heteropoly blue complex that is generated by molybdenum and phosphorus. The system can measure tripolyphosphate from metaphosphate in a short time using an isocratic elution solution. It can also separate and detect polyphosphoric acid with a degree of polymerization of 10 or more.





[Conditions]

Column: Finepak GEL SA-121
Eluent:
A: 0.1M KCl+1% EDTA-4Na(pH10)
B: 1M KCl+1% EDTA-4Na(pH10)

Time [min]	A/B
0	100/0
30	60/40
40	0/100
45	0/100
45.1	100/0

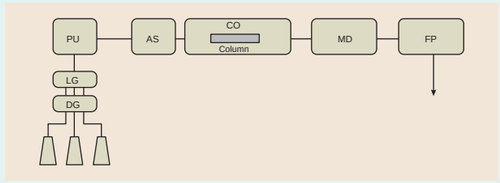
Eluent flow rate: 1.0 mL/min
Column temperature: 60°C

Reagent : 5 g $(NH_4)Mo_7/4H_2O$+0.6 g Zn in 1.8M H_2SO_4
Reagent flow rate: 0.5 mL/min
Reaction temperature: 140°C
Wavelength: 830 nm
Sample: polyphosphoric acid
Injection volume: 20 µL

Food additive compounds

Diode array and fluorescence detection

This is a system for simultaneously analyzing 43 different food additives at once. The diode array detector and fluorescence detector selectively detect multiple ingredients. The figure shows the chromatograms obtained at each wavelength with the photo diode array detector and the fluorescence detector. Peaks 13 (isosteviol) and 28 (diphenyl) that were not separated when using either 210 or 240 nm detection with the diode array detector were selectively detected at 270 nm (peak 13) using the diode array and fluorescence (peak 28) detectors.



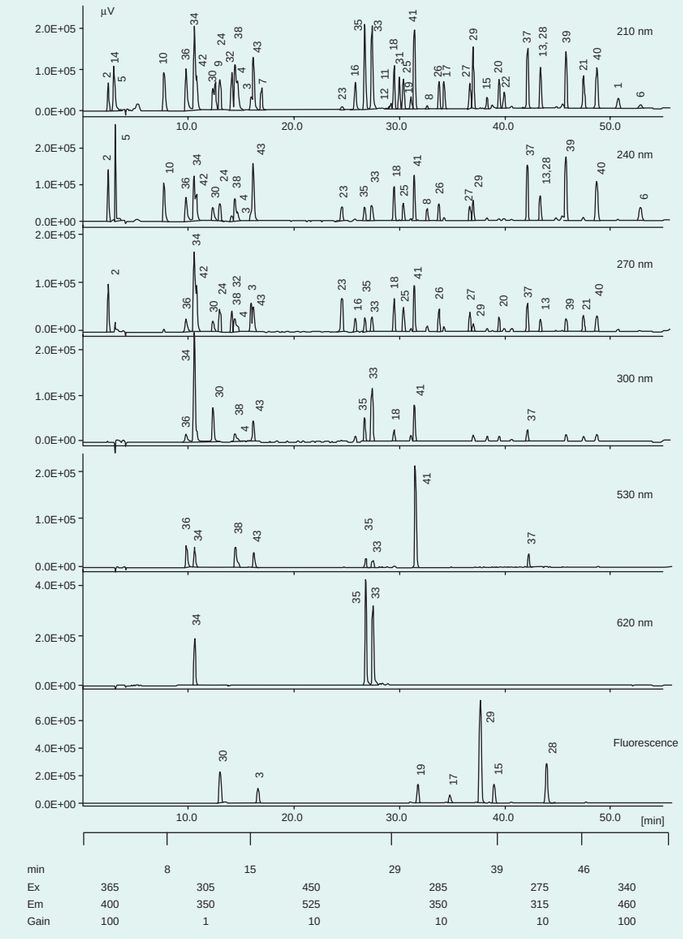
[Conditions]

Column:	CrestPak C18T-5
Eluent A:	0.3% H_3PO_4
Eluent B:	CH_3CN

Time [min]	0	20	40	50	50.1
A(%)	95	75	20	20	95
B(%)	5	25	80	80	5

1cycle 65 min

Wavelength range:	200-650 nm (MD-2010)
Wavelength program:	Below (FP-2020)
Flow rate:	1.0 mL/min
Column temperature:	40°C
Injection volume:	10 µL
Sample:	STD mixture



min		8	15	29	39	46
Ex	365	305	450	285	275	340
Em	400	350	525	350	315	460
Gain	100	1	10	10	10	100

Vitamin
1. Vitamin A (palmitate)
2. Vitamin B1 (thiamine nitrate)
3. Vitamin B2 (riboflavin)
4. Vitamin B12 (cyanocobalamin)
5. Sodium erythorbate
6. Ascorbic acid palmitic ester

Artificial sweeteners
7. Aspartame
8. Dipotassium glycyrrhizinate
9. Saccharin sodium
10. Acesulfame-K
11. Stevioside
12. Rebaudioside A
13. Isosteviol

Antioxidants
14. EDTA•2Na
15. Butylhydroxyanisol (BHA)
16. Propyl gallate (PG)
17. Nordihydroguaiaretic acid (NDGA)
18. 2,4,5-Trihydroxybutyrophenone (THBP)
19. tert-Butylhydroquinone (TBHQ)
20. Octyl gallate (OG)
21. Dodecyl gallate (DG)
22. 4-hydroxymethyl-2,6-di-tert-butyl phenol

Preservatives
23. Sorbic acid
24. Parahydroxybenzoate
25. Ethyl parahydroxybenzoate
26. Propyl parahydroxybenzoate
27. Butyl parahydroxybenzoate

Fungicides
28. Diphenyl (DP)
29. O-phenylphenol (OPP)
30. Thiabendazole (TBZ)
31. Imazalil

Others
32. Caffeine

Tar dye
33. B1
34. B2
35. G3
36. R2
37. R3
38. R102
39. R104-1
40. R106-1
41. R106
42. Y4
43. Y5

● Specifications are subject to change without notice.

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