C190-E110C

SHIMADZU
Excellence in Science

High Performance Liquid Chromatograph Preparative System

Prominence Preparative HPLC System

Prominence Preparative System [Product Concept]

The most important aspects of separation and purification are purity results, preparative processing speed, and cost-effectiveness. The Prominence preparative system enhances all of these aspects in each scale-up process.

Scale-Up Processes

- Consideration of separation conditions using an analytical column
- Consideration of load amount expansion improvement conditions using an analytical column

⋮

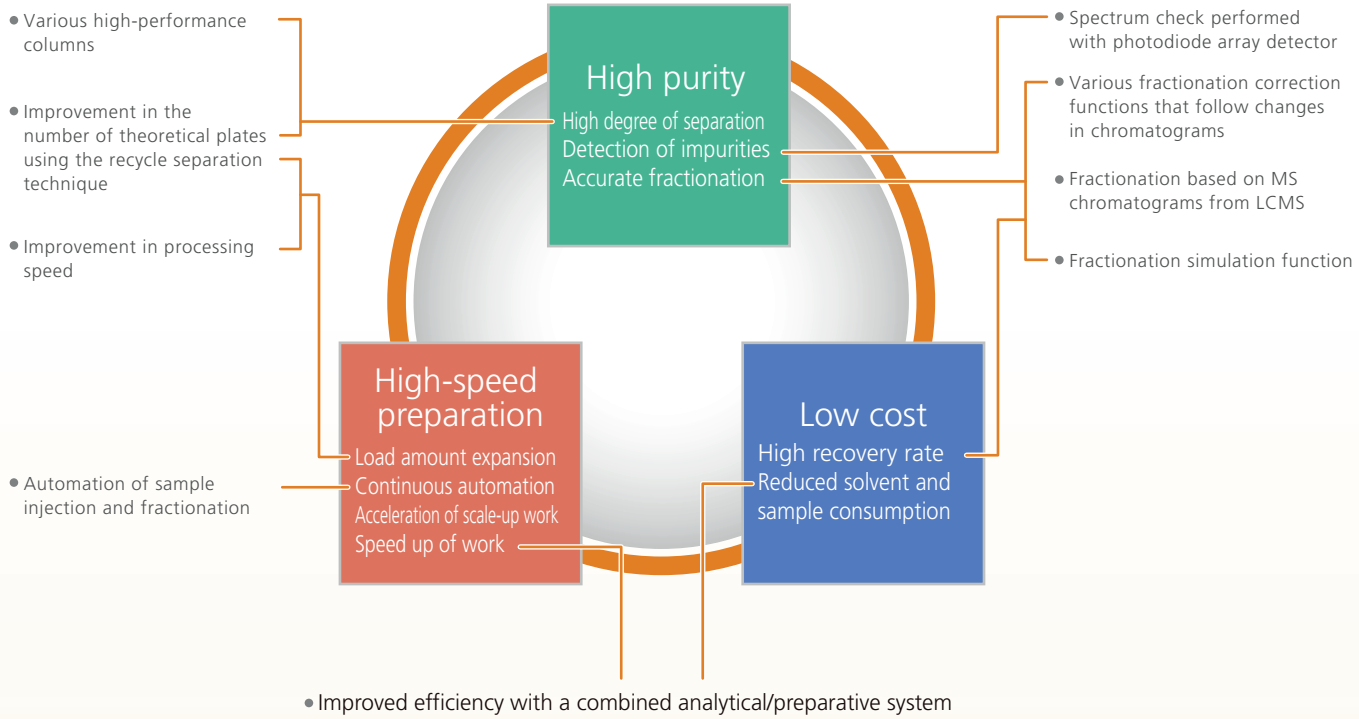
- Confirmation of chromatogram pattern reproducibility using a preparative column

⋮

- Consideration of fractionation conditions using a preparative column and fraction purity check using an analytical column that includes reconfirmation of the chromatogram pattern

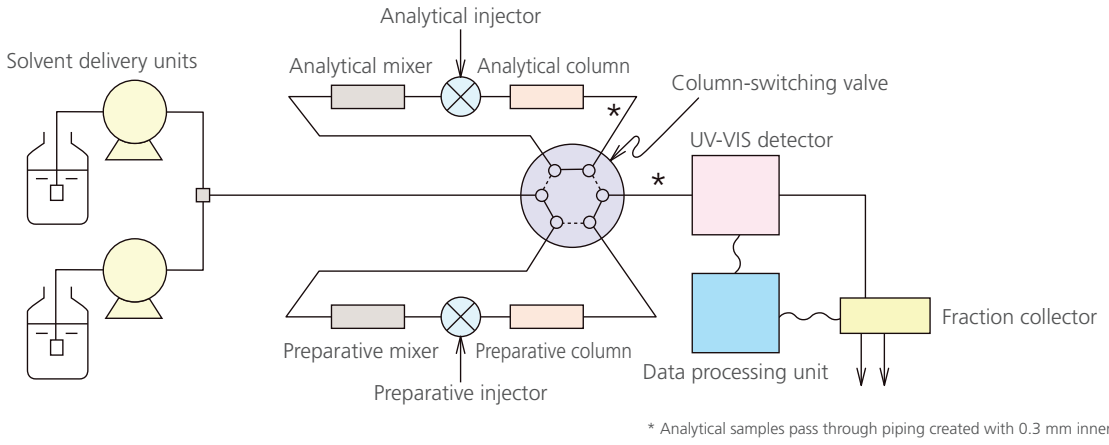
⋮

- Automated continuous preparative purification with a preparative column



Increased Efficiency of Processes from Consideration of Conditions to Scaling Up

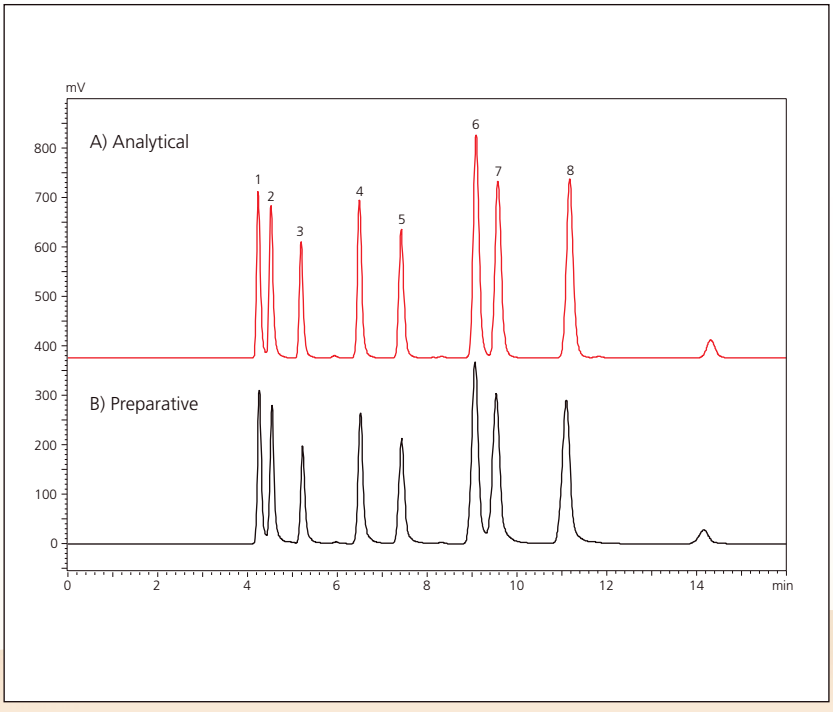
Starting the scale-up processes from the analytical column size and performing these processes with the same instrument help reduce the consumption of mobile phase solvent and sample as well as operational training costs. With the Prominence preparative system, in addition to handling both analytical and preparative isocratic elution, the flow channels can be configured to handle both analytical and preparative gradient elution.



* Analytical samples pass through piping created with 0.3 mm inner diameter tubes.

Example of Flow Channels in the Prominence Preparative System

The same column resins are commonly used in both analytical and prep for scale-up optimization.
The Prominence Prep system offers the user the ability to utilize a wide selection of prep columns by virtue of pressure tolerance to 42 MPa at a flow rate up to 100 mL. The figure below shows the typical example of a comparison between an analytical chromatogram (4.6 mm I.D.) and a preparative chromatogram (20 mm I.D.) with 5 µm particle, 250 mm length columns. The elution patterns indicate the system is suitable in providing an effective scale-up environment.



[Analytical Conditions]

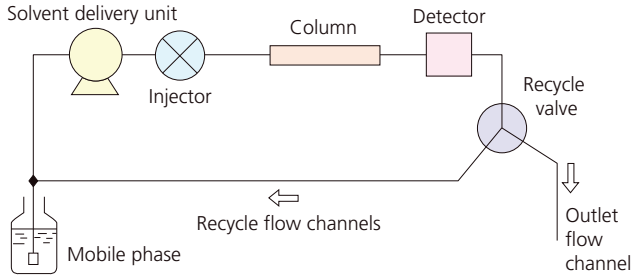
Column : Shim-pack PREP-ODS(H) Kit
A) 250 mmL. × 4.6 mmI.D., 5 µm
B) 250 mmL. × 20 mmI.D., 5 µm
Mobile phase : 0.1% formic acid / methanol = 1/9 (v/v)
Flow rate : A) 0.8 mL/min
B) 15 mL/min
Temperature : Room temperature
Detection : Absorbance 254 nm
Peaks : 1: Benzoic acid
2: 2-naphthol
3: Benzene
4: Naphthalene
5: Biphenyl
6: Phenanthrene
7: Anthracene
8: Fluoranthene

Recycle Separation Technique Increases Efficiency
[Separation Efficiency]

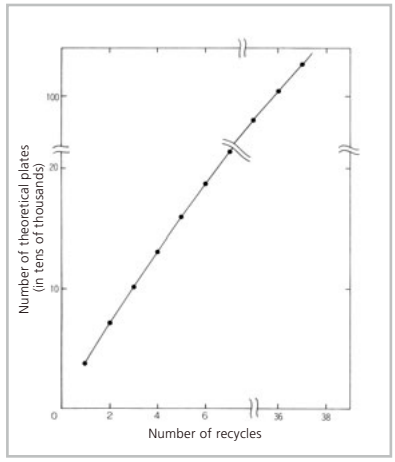
Improved Separation at a Low Cost

The cost of preparative columns increases with their size. In order to reduce costs, relatively cheap columns of lengths that are unlikely to produce a high level of separation are often used. Even in such cases, however, there is a method that can be used to improve the separation capacity: recycle separation (closed loop recycling). This method involves reintroducing an eluate band containing the target components eluted from the separation column into the column inlet, which makes it possible to achieve the same result that would be achieved by lengthening the column.

To effectively perform recycle separation, it is important to reduce the dispersion of the sample component band outside the column. With the Prominence preparative system, reducing the internal volume of the solvent delivery unit enables the creation of a high-efficiency system with the number of theoretical plates exceeding one million.



Flow Channels Used for Closed Loop Recycling



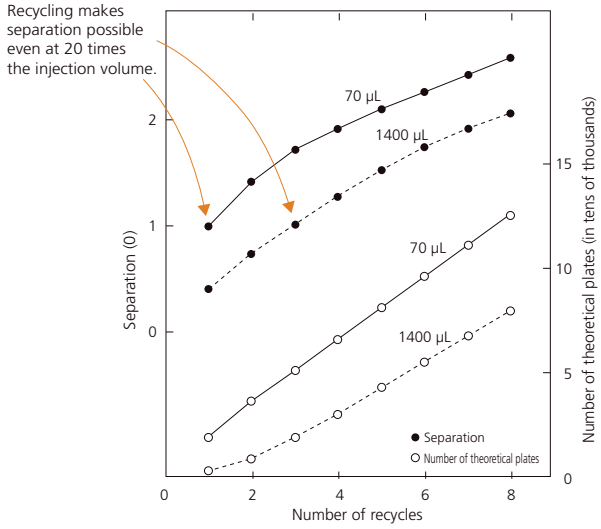
Example in Which One Million Theoretical Plates are Exceeded on the 36th Elution
(LC-6AD Semi-Preparative Recycle System)

Column:	STR ODS-II (250 mmL. × 20 mmI.D., 5 µm) × 2
Mobile phase:	Acetonitrile
Flow rate:	9.4 mL/min
Sample:	Phenyldecane

Increased Preparative Processing Speed

Although recycle separation is perceived as being a time-consuming technique, in the separation of neighboring components as shown in the example on the right, using recycle separation with a large sample volume may make it possible to increase the preparative processing speed.

For example, if n-butyl/n-propylbenzene is obtained using a Shim-pack GPC-2001C column with a resolution (Rs) of 1, then the sample injection volume does not exceed 70 µL. If the injection volume is increased by a factor of 20, although the resolution decreases to 0.4, it increases to 1 on the third recycle, and the processing speed is increased by a factor of 6. Also, the way that the number of theoretical steps initially improves by factors of 3 and 2, respectively, when the sample volume is 1,400 µL reflects the way that the adverse influence of band dispersion at the time of injection decreases as recycling progresses.



Example in Which Recycle Separation with a Semi-Preparative GPC Column Improves the Preparative Processing Speed
(LC-6AD Recycle System)

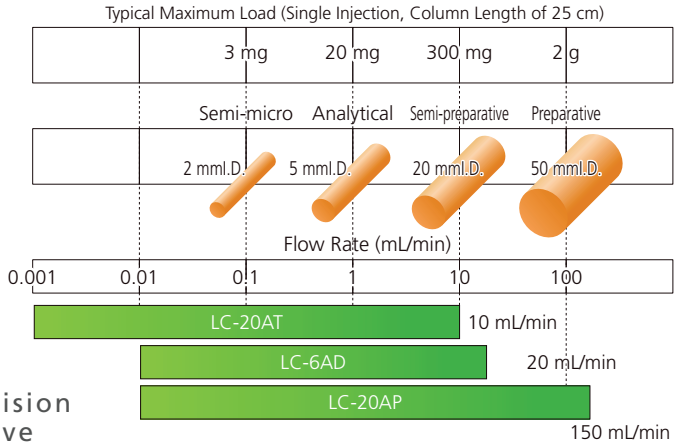
Column:	Shim-pack GPC-2001C (300 mmL. × 20 mmI.D.)
Mobile phase:	Chloroform
Flow rate:	3 mL/min
Sample:	n-Butyl/n-Propylbenzene

Solvent Delivery Units for a Wide Variety of Needs

While conducting high-precision analysis on a daily basis, I would like to perform semi-preparation when necessary…
I would like to scale up to high-volume preparation with one system…
The Prominence preparative system responds to these needs across a wide range of flow rates.

Typical Values for Maximum Load

Typical values of the total component weight for a single injection performed by a 250 mm column, where the target component is (1) highly soluble in the mobile phase, (2) separated from contaminating components, and (3) subjected to ion suppression, are indicated on the right. With isocratic elution, these values are basically proportional to the volume of the column.



Supports a Range of Applications from High-Precision Analytical to Semi-Preparative

LC-20AT

- This solvent delivery unit can handle flow rates ranging from those used in analytical scale to those used in semi-preparative (up to 10 mL/min).
- High-precision analysis is possible even in the semi-micro flow-rate range.

Supports Semi-Preparative and Recycle Preparative

LC-6AD

- This solvent delivery unit can handle flow rates as high as those used in semi-preparative scale (up to 20 mL/min).
- Using a recycle kit enables semi-preparative recycling.

Supports Large-Scale Preparative Fractionation

LC-20AP

- High flow rates (up to 150 mL/min) enable highly efficient, large-scale preparative fractionation.
- Large-scale preparation and superior of solvent delivery fully support the preparative fractionation workflow, including scaling up to large preparation or assessing purity after preparation.
- Combine with an FCV-200AL low-pressure gradient unit (*see* pages 11 to 13) to perform gradient analysis using up to four mobile phases.

Specifications (LC-20AT/6AD/20AP)

	LC-20AT (228-45001-xx)	LC-6AD (228-45068-xx)	LC-20AP (228-45150-xx)
Solvent delivery method	Parallel-type double plunger	Series-type double plunger	Series-type double plunger
Plunger capacity	Primary side: 47 µL, Secondary side: 23 µL	47 µL	250 µL
Maximum discharge pressure	40 MPa	49 MPa	42 MPa
Flow rate setting range	0.001 to 10.000 mL/min	0.01 to 20.00 mL/min	0.01 to 150.00 mL/min
Flow rate accuracy	No more than 2% or 2 µL/min, whichever is greater (0.01 to 5 mL/min)	No more than 1% or 10 µL/min, whichever is greater (0.1 to 5.0 mL/min)	No more than 1% (1 mL/min, 10 MPa)
Flow rate precision	0.3% max. (RSD: 0.1% max.)	0.3% max. (RSD: 0.1% max.)	No more than 0.1% RSD or 0.02 min SD, whichever is greater
Constant pressure solvent delivery	Supported	Supported	Supported
Plunger rinsing mechanism	Syringe or rinsing pump (228-45568-91)	Syringe or FCV-7AL (228-45077-91)	Syringe or rinsing pump (228-45078-91)
Operating temperature range	4 to 35°C	10 to 40°C	4 to 35°C
Dimensions, weight	W260 × D420 × H140 mm, 11 kg	W260 × D500 × H160 mm, 20 kg	W260 × D500 × H210 mm, 19 kg
Power requirements	AC 110 V, 230 V, 150 VA, 50/60 Hz	AC 110 V, 230 V, 200 VA, 50/60 Hz	AC 110 V, 230 V, 400 VA, 50/60 Hz

High Purity and a High Recovery Rate - Achieving High Levels to Meet Preparative LC Requirements [Fractionation Capability]

The FRC-10A - A Fraction Collector That Adapts to Changes in Chromatograms

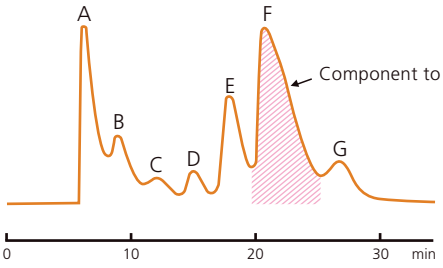
Meeting a Wide Range of Needs

This fraction collector can be used over a wide range of flow rates, covering small and large-scale preparative work. It adapts to various applications, such as simple manual preparation performed while viewing chromatograms, and automated continuous preparation performed in combination with an autosampler.

Reliable Tracking of Changes in Elution Patterns

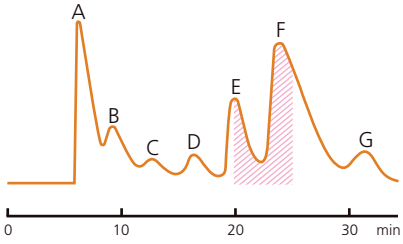
In continuous preparative work, the peak separation patterns and peak shapes may vary due to fluctuations in the ambient temperature, the composition of the mobile phase, or the sample load. In addition to time-based fractionation and peak-detection fractionation, by using unique fractionation functions such as the band method, the FRC-10A allows target components to be fractionated with high purity and a high recovery rate.

When the retention time is changed

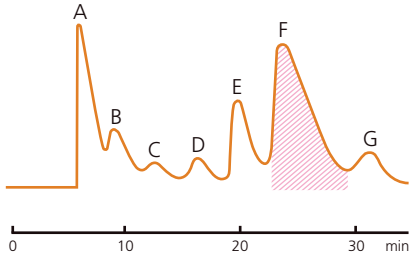


Original chromatogram

With time-based fractionation, the incorrect part is fractionated.



When the fractionation function of the FRC-10A is used, the target components can be reliably fractionated, even if the retention time varies.



Fraction Collector

FRC-10A

Specifications

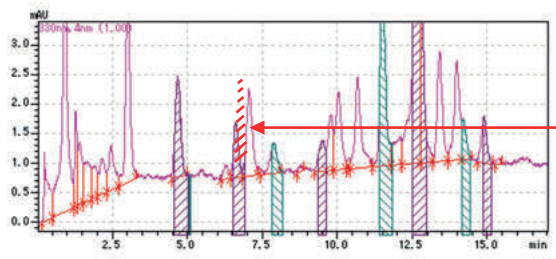
	FRC-10A (228-45070-xx)
Drive system	Arm-movement X-Y system
Maximum number of fractions	16 to 144 (depending on the type of rack used)
Collection method	Solenoid valve (fraction collector head with valve) or nozzle (fraction collector head)
Maximum flow rate	150 mL/min
Fractionation mode	Set as a combination of the basic mode (initial parameters) and time-program mode (14 parameters)
Cooling function	Possible with sample cooler L (228-45064-91)
Ambient temperature range	4 to 35°C
Dimensions, weight	W260 × D420 × H280 mm, 15 kg
Power requirements	AC 110 V, 230 V, 100 VA, 50/60 Hz

Fraction Collector Heads, Racks, and Collection Tubes (Optional)

See page 23 for details.

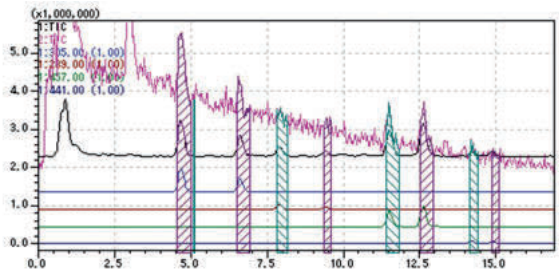
Preparative LCMS - High-Efficiency Preparation Based on a MS Trigger

With LCMS becoming increasingly common, a great deal of attention is being paid to fractionation and purification in which MS is used as a trigger to achieve the precise fractionation of target compounds. The high selectivity of the LCMS-2020 enables the highly efficient recovery of target components from samples containing a large number of contaminants, and makes it easy to scale up from analytical to preparative.



UV Chromatogram

Fractionation performed using UV chromatograms depends on retention times and peak integration. For this reason, not only are the fractionation conditions complex, but the peaks for components other than the target compounds are fractionated, and high-efficiency preparation may not be possible.

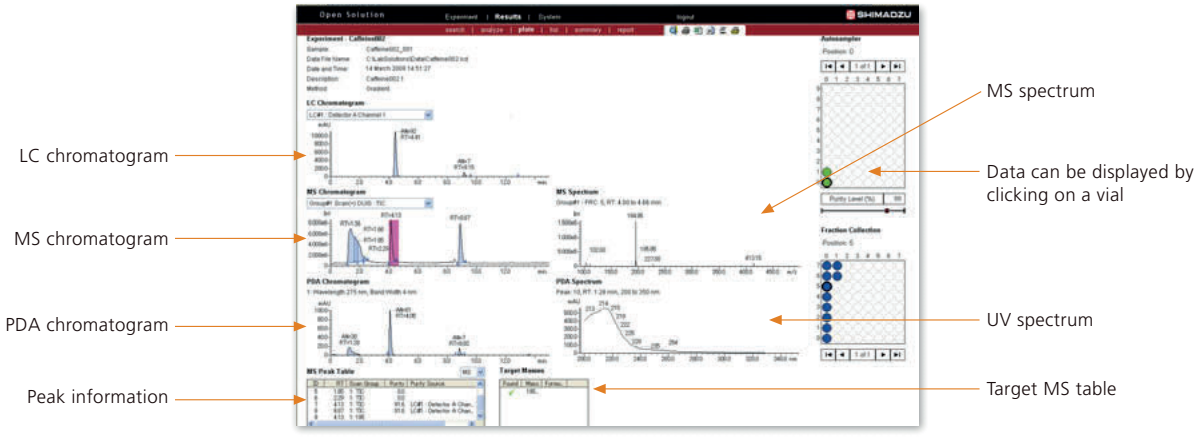


MS Chromatogram

In preparation based on MS chromatograms, because the masses of the target compounds are specified, reliable fractionation is possible with simple fractionation conditions.

All Steps from Fractionation to Data Display Possible with Optional "Open Solution" Preparative/Analytical Software

The open-access function of the optional Open Solution preparative/analytical software uses a Web browser, making it possible to execute analysis and fractionation with simple operations. Regarding fractionation results, the vials and collection tubes displayed visually are linked to data such as MS chromatograms and MS spectra. As a result, by just clicking on a vial for example, it is possible to quickly ascertain information related to fractionated compounds.



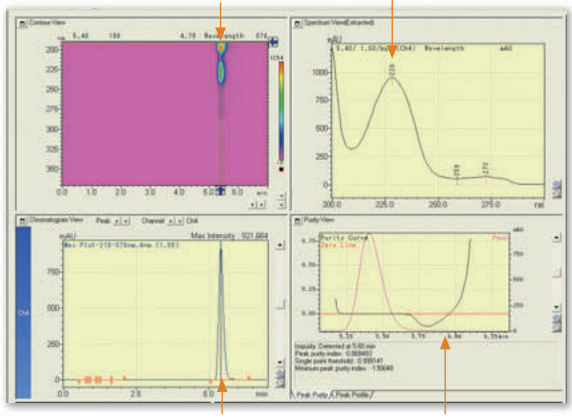
Detectors That Support High-Purity Preparation
[Detection Options]

Photodiode Array UV-VIS Detector
SPD-M20A

- A high-sensitivity 3D UV-VIS detector that is effective at detecting impurity peaks.
- While continuing the original analysis, it is possible to perform repeat analysis and library searches on the peak spectra that have been eluted by that stage.
- Automatic wavelength accuracy checks encompassing the UV region can be performed on four wavelengths, increasing the reliability of the acquired spectra.

Contour plots enable the estimation of peak overlaps and optimum wavelengths, which was not possible with a single-wavelength monitor.

Spectra corresponding to a specific time period can be analyzed.



Chromatograms for specific wavelengths can be selected and analyzed.

Peaks for minute quantities of impurities that are hidden by other peaks can be detected with a peak-purity curve.

UV-VIS Detector
SPD-20A/20AV

- A UV-VIS detector designed for high sensitivity, with a noise of level of 0.5 × 10^{-5} AU max.
- Superior linearity allows use across a wide range of concentrations, covering analytical and preparative work.

Specifications

	SPD-20A (228-45003-xx)	SPD-20AV (228-45004-xx)	SPD-M20A (228-45005-xx)
Light source	Deuterium (D_2) lamp	Deuterium (D_2) lamp, tungsten (W) lamp	
Wavelength range	190 to 700 nm	190 to 900 nm	190 to 800 nm
Bandwidth, slit width	8 nm		1.2 nm (high-resolution mode) 8 nm (high-sensitivity mode)
Wavelength accuracy	1 nm max.		
Wavelength precision	0.1 nm max.		
Noise	0.5 × 10^{-5} AU (under specified conditions)		0.6 × 10^{-5} AU (under specified conditions)
Drift	1 × 10^{-4} AU/h (under specified conditions)		5 × 10^{-4} AU/h (under specified conditions)
Linearity	2.5 AU (ASTM standard)		2.0 AU (ASTM standard)
Functions	Dual-wavelength detection in the range of 190 nm to 370 nm or upwards of 371 nm, ratio-chromatogram output, wavelength scanning		Contour output, spectrum library, MAX plotting
Cell	Optical path length: 10 mm; Capacity: 12 µL; Withstand pressure: 12 MPa		Optical path length: 10 mm; Capacity: 10 µL; Withstand pressure: 12 MPa
Cell temperature-control range	5°C above room temperature to 50°C		
Dimensions, weight	W260 × D420 × H140 mm, 13 kg		W260 × D420 × H140 mm, 12 kg
Power requirements	AC 110 V, 230 V, 160 VA, 50/60 Hz		AC 110 V, 230 V, 150 VA, 50/60 Hz

Preparative Flow Cells (Optional)

Type	Optical path length	SPD-20A/20V	SPD-M20A
Variable optical path length	0.5 mm	228-23405-91	228-34189-91
	0.2 mm	228-23405-92	228-34189-92
	0.1 mm	228-23405-93	228-34189-93
Fixed optical path length	0.5 mm	228-23406-91	228-34188-91

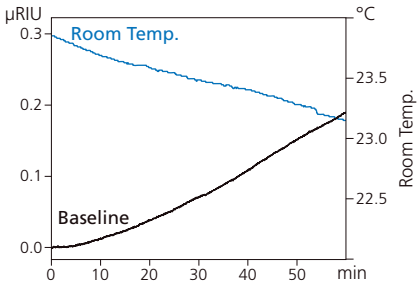
Refractive
Index Detector

RID-20A

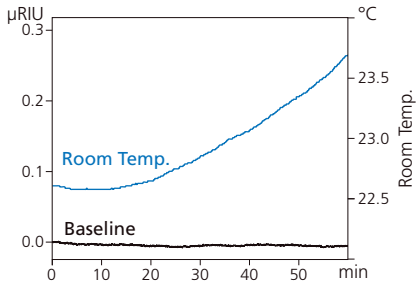
The RID-20A incorporates an auto purge function of the reference cell and a validation support function, inheriting the stability and expandability of Prominence HPLC series.

Superior stability even with a small change in room temperature

Generally, the performance of refractive index detectors is influenced by room temperature changes. However, the dual-temperature control of the RID-20A's optical system absorbs the influence of a room temperature change to ensure and maintain superior stability.



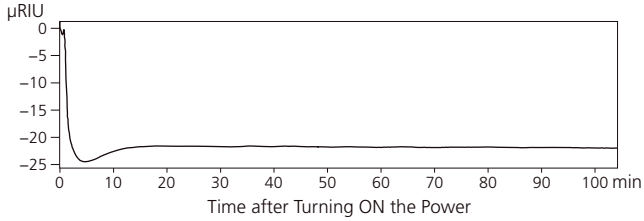
RID-20A Without Cell Temp. Control



RID-20A With Cell Temp. Control at 40°C

Shorter stabilization time

The RID-20A achieves shorter baseline stabilization time after turning ON the power through improved dual-temperature control of the optical system and superior lamp performance. The stable baseline ensures reliable molecular weight distribution analysis.

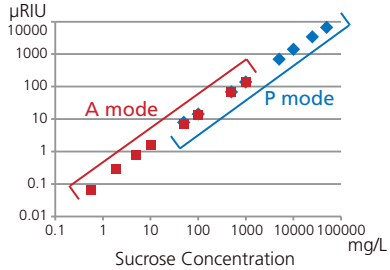


Time after Turning ON the Power

From high-sensitivity analysis to preparative work

Handles all applications from high-sensitivity analysis to preparative LC via the three measurement modes incorporated in the 4-partition detector element:

A (Analytical) mode	From high-sensitivity analysis to general-purpose analysis
P (Preparative) mode	High-concentration analysis and semi-preparative analysis (up to 20 mL/min)
L (Large-scale prep.) mode	Flow selection block *Large-scale preparative analysis (150 mL/min)



Sucrose Concentration

Specifications

	RID-20A (228-45104-xx)		
Refractive index range	1 to 1.75 RIU	Maximum operating flow rate	20 mL/min (150 mL/min with option)
Noise level	2.5 × 10^{-9} RIU max.	Temperature control of cell unit	30 to 60°C
Drift	1 × 10^{-7} RIU/h max.	Cell volume	9 μL
Range	A mode: 0.01 × 10^{-6} to 500 × 10^{-6} RIU	Cell withstand pressure	2 MPa (cell unit)
	P and L modes: 1 × 10^{-6} to 5,000 × 10^{-6} RIU	Operating temperature range	4 to 35°C
Response	0.05 to 10 sec, 10 steps	Dimensions, weight	W260 × D420 × H140 mm, 12 kg
Polarity switching	Supported	Power requirements	AC 110 V, 230 V, 150 VA, 50/60 Hz
Zero adjustment	Auto zero, optical zero, fine zero		

* Hexafluoroisopropanol (HFIP) cannot be used as the mobile phase.

Injector and Valve Lineup

Autosampler

SIL-10AP

	SIL-10AP (228-45057-xx)
Injection method	Loop injection, variable injection volume
Injection-volume setting range	1 to 5,000 mL (standard) 1 to 400 mL (option) 1 to 2,000 mL (option)
Number of processed samples	1.5 mL vials: 100 (60 with cooler installed) 4 mL vials: 80 (50 with cooler installed) 13 mL vials: 25
Number of repeated injections	30 max. per sample
Needle rinsing	Set freely before and after sample injection.
Operating pH range	pH1 to 10
Operating temperature range	4 to 35°C
Dimensions, weight	W260 × D150 × H280 mm, 19 kg
Power requirements	AC 110 V, 230 V, 100 VA, 50/60 Hz

Sample Racks

- Sample rack S (228-21046-91) for 1.5 mL vials
- Reagent bottle rack (228-20905) for 15 mL reagent bottles
- Sample rack L (228-21046-92) for 4.0 mL vials
- Sample rack LL (228-39384-91) for 13 mL vials*1
- Sample rack MTP2 (228-40460-91)*2

*1 Sample rack LL is a standard accessory of the SIL-10AP.
*2 For 96-well microtiter/deep-well plates.

Sample Coolers (Block Cooling/Heating: 4 to 70°C)

- S (228-45063-91)
- L (228-45064-91)

Manual Injector

Rheodyne 7725 (228-32210-91)

Optional Sample Loops

Volume	Material	Part Number
100 µL	SUS	228-32211-16
200 µL	SUS	228-32211-17
500 µL	SUS	228-32211-18
1 µL	SUS	228-32211-19

Column Holder (228-45079-91) / Column Holder, SLIM (228-45023-41)

- Capable of holding three columns: two with inner diameters in the range of 20 mm to 50 mm (SLIM: second column is optional*1) and one analytical column.
- Capable of holding four manual selection valves (SLIM: five valves).
- Column Holder Dimensions: W250 × D400 × H465 mm
- Column Holder, SLIM Dimensions: W110 × D500 × H625 mm*2

*1 To attach two preparative columns using the SLIM column holder, the optional column clamp assembly (228-17701-94) is required.
*2 The SLIM column holder is compatible with the system configurations indicated on pages 16 to 19. For other configurations, contact your Shimadzu sales representative.

Column Holder

Column Holder, SLIM

Reservoir Selection Valve

FCV-230AL (228-45163-41) / FCV-7AL (228-45077-91)

- Capable of switching between two solvents using a solenoid valve.
- FCV-230AL can be controlled from the LC-20AP.
- FCV-7AL can be controlled from the LC-6AD, or from a system controller or workstation connected via the LC-6AD.
- Column Holder Dimensions: W250 × D400 × H465 mm

FCV-230AL

FCV-7AL

Low-Pressure Gradient Unit

FCV-200AL (228-45211-41)

- Low-pressure gradient unit for LC-20AP systems
- Up to four mobile phases can be set up for each solvent delivery unit.
- Also usable as a four-solution solvent switching unit.

FCV-200AL

High-Pressure Flow-Line Selection Valve

FCV-20AH2 (228-45015-xx) / FCV-12AH (228-45013-91)

- The valve position is controlled by event signal input.
- Valve type: 2-position/6-port rotary valve (recycle valve: 2-position/3-port valve)
- Maximum operating pressure: 34.3 MPa
- Operating pH range: pH1 to 10
- Operating temperature range: 4 to 35°C
- Storing the FCV-12AH in the optional VP box (228-45060-XX) is useful for reducing the volume of preparative piping, including the recycling flow lines.

FCV-20AH2

FCV-12AH

Degassing Unit

DGU-20A3R (228-45018-XX) / DGU-20A5R (228-45019-XX)

- A low-capacity degassing unit that uses a special fluororesin membrane. (20A3R: 3-flow lines, 20A5R: 5-flow-lines)
- The maximum operating flow rate per flow line is 10 mL/min.
- Designed for use in analysis and preparative fractionation, this unit is used only when retention time reproducibility needs to be improved during analysis.
- When connecting to an LC-20AP, a connection kit must be obtained separately.
- When using this unit with the LC-6AD, a power supply unit (228-45110-xx) must be obtained separately.

DGU-20A5R

Helium Degassing Unit

DGU-10B (228-45067-91)

- Eliminates air bubbles, baseline undulation, drifting, etc. by purging dissolved air from mobile phases.
- The DGU-10B can be used to degas up to four mobile phase solutions with helium gas.
- This unit is switched ON/OFF from the solvent delivery unit or system controller.

DGU-10B

LC-20AP
High-Pressure/Low-Pressure Gradient Preparative System

A high-pressure gradient preparative system with outstanding flow rate precision!

- With a maximum flow rate of 150 mL/min, this system is capable of automatic continuous fractionation using preparative columns with 50 mm internal diameters.

Example of High-pressure Gradient Preparative System

Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-20AP (2 units)	228-45150-4X
3	Gradient mixer for prep	Mixer 14 mL	228-20600-91
4	Reservoir tray		228-45041-91
5	Autosampler	SIL-10AP	228-45057-XX
6	Column holder	Column holder	228-45079-91
7	UV-VIS detector	SPD-20A	228-45003-XX
8	Flow cell for prep	Variable optical path length cell for prep (0.5 mm)	228-23405-91
9	Fraction collector	FRC-10A	228-45070-XX
10	Fraction-collector head with valve		228-24105-91
11	LC workstation	LabSolutions LC Multi LC-PDA	—
12	PC, Monitor and Printer		Local supply

*Sample vials, a sample rack, fraction tubes, a fraction collector rack, columns, a large-volume sample loop and printer must be obtained separately.

A low-pressure gradient preparative system with outstanding performance for the cost!

- With a maximum flow rate of 50 mL/min, this system is capable of automatic continuous fractionation using preparative columns with 30 mm internal diameters.

Example of Low-pressure Gradient Preparative System

Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-20AP	228-45150-4X
3	Gradient mixer for prep	Mixer 14 mL	228-20600-91
4	Low-pressure gradient unit	FCV-200AL	228-45211-41
5	He degassing unit	DGU-10B	228-45067-XX
6	Bottle cap kit		228-45212-41
7	Reservoir tray		228-45041-91
8	Autosampler	SIL-10AP	228-45057-XX
9	Column holder	Column holder	228-45079-91
10	UV-VIS detector	SPD-20A	228-45003-XX
11	Flow cell for prep	Variable optical path length cell for prep (0.5 mm)	228-23405-91
12	Fraction collector	FRC-10A	228-45070-XX
13	Fraction-collector head with valve		228-24105-91
14	LC workstation	LabSolutions LC Multi LC-PDA	—
15	PC, Monitor and Printer		Local supply

*Sample vials, a sample rack, fraction tubes, a fraction collector rack, columns, a large-volume sample loop and printer must be obtained separately.

Low-Pressure Gradient Unit Capable of Gradients Using up to Four Solutions Per Unit

LC-20AP Quaternary System Forms Gradients with Maximum Four Solutions Per Unit

Achieves Gradient Preparative Fractionation at a Low Cost

Including an FCV-200AL low-pressure gradient unit, designed specifically for LC-20AP systems, enables using a single unit to achieve preparative gradient fractionation, which minimizes initial instrument costs.

Capable of Low-pressure Gradient for Preparative Flow Rates

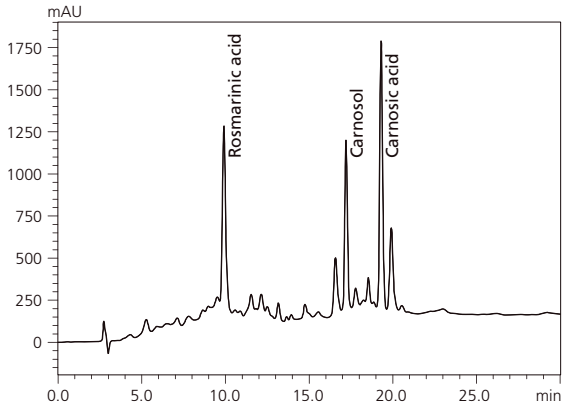
LC-20AP Quaternary is capable of low-pressure gradient for preparative flow rates to 50 mL/min and is suitable for gradient preparative fractionation for semi-preparative analysis.

Superior Delivery Precision Ensures Reliable Preparative Data

Provides excellent reproducibility and accuracy for reliable high preparative fractionation.

Enables Easier Determination of Mobile Phase Parameters for Method Analysis

Using an LC-20AP Quaternary system, which is capable of forming gradients using up to four solutions per unit, allows efficiently determining mobile phase parameters by trying various mobile phase combinations.



Column:	Shim-pack PREP-ODS 250 mmL. × 20 mmI.D., 15 µm
Mobile phases:	A: Water B: Methanol C: 2 % aqueous formic acid solution
Gradient program:	B Conc. 30 % (0 min) to 95 % (15 to 30 min) C Conc. 5 %
Column temperature:	Room temperature
Injection volume:	200 µL
Flow rate:	20.0 mL/min
Detection:	UV 230 nm
Sample:	Rosemary extract

LC-20AP Quaternary

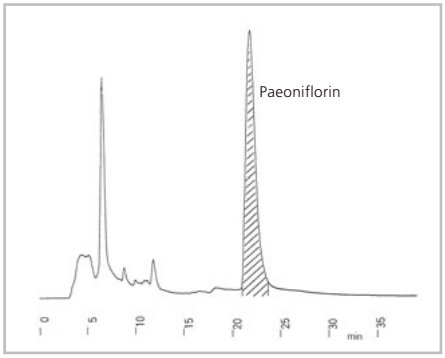
Specifications

	LC-20AP Quaternary (LC-20AP + FCV-200AL)
Flow rate setting range	0.01 to 50.00 mL/min
Max. number of mobile phases	Four solutions per delivery unit
Gradient type	Low-pressure gradient
Flow rate accuracy	±1.0 % (given specified conditions)
Concentration accuracy	±2.0 % (given specified conditions)

LC-20AP Large-Scale Preparative System for Laboratory Use
[System]

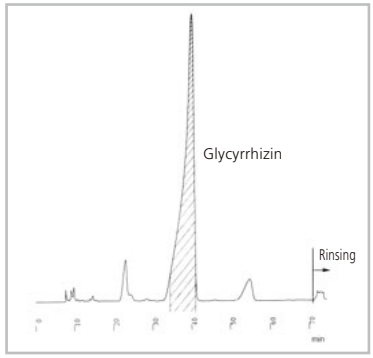
Achieves Both Gradient Analysis and Gradient Fractionation

- This system enables automated continuous preparation with a maximum flow rate of 150 mL/min and a preparative column with an inner diameter of up to 50 mm.
- It is also possible to consider the separation conditions and the load, and evaluate the purity of the fractionated liquid using an analytical column.



Fractionation of Paeoniflorin in Peony

Column:	Shim-pack PREP-ODS (250 mmL. × 50 mmI.D., 15 µm)
Mobile phase:	Acetonitrile/water = 6/1
Flow rate:	100 mL/min
Sample:	200 mL of peony powder extract (equivalent to 2 g of powder), injected by pump



Refinement of Glycyrrhizin Used for Food Additive Tests

Column:	Shim-pack PREP-ODS (250 mmL. × 50 mmI.D., 15 µm)
Mobile phase:	2% (v/v) acetic acid/acetonitrile = 65/35
Flow rate:	70 mL/min
Sample:	1 g/100 mL of ammonium glycyrrhizate used for food additive tests, injected by pump

Example of High-Pressure Gradient System

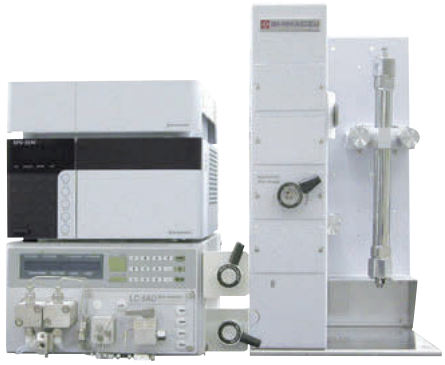
Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-8A (2 units)	228-45069-XX
3	Gradient mixer	For preparation using 8A column holder	228-20600-91
4	Gradient mixer	For analysis, 8A	228-20601-91
5	Reservoir selection valve	FCV-130AL	228-45078-91
6	Autosampler	SIL-10AP	228-45057-XX
7	Sample injector	7725	228-32210-91
8	Column holder	Column holder, 8A	228-45079-91
9	Photodiode array UV-VIS detector	SPD-M20A	228-45005-XX
10	Preparative cell	Preparative flow cell with variable optical path length (0.5 mm)	228-34189-91
11	Manual column switching valve		228-13000-95
12	Fraction collector	FRC-10A	228-45070-XX
13	Fraction collector head with FRC valve		228-24105-91
14	FRC large-volume kit		228-45116-91
15	LC workstation	LabSolutions LC Multi-PDA	—
16	PC, Monitor and Printer		Local Supply

* Sample vials, sample racks, collection tubes, preparative racks, columns, preparative sample loops, printers, and other items must be obtained separately.

LC-6AD Simple Semi-Preparative Recycle System

Easily Perform Semi-Preparative Recycling



- This is a simple semi-preparative recycle system with no autosampler or fraction collector.
- Perform manual fractionation using a switching valve while viewing the chart.
- Perform fractionation without concern over the size of the collection tube.
- Achieves stable performance as an HPLC for a variety of analyses, such as confirmation of the purity of the fractionated substances, etc.
- Can be upgraded to an automated system by adding components.

* The fractionation column size is up to 20 mm internal diameter. The recommended flow rate range is 0.1 – 15 mL/min.

Example of Simple Semi-Preparative Recycle System

Main Components

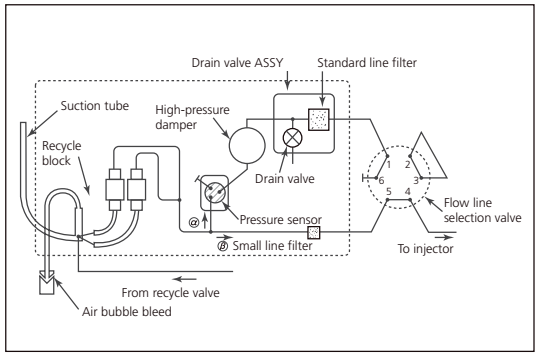
	Product Name	Model Name	P/N
1	Solvent delivery unit	LC-6AD	228-45068-XX
2	6AD recycle kit		228-28711-92
3	Manual recycle bulb		228-20401-91
4	Column holder	Column holder	228-45079-91
5	Reservoir tray		228-45041-91
6	Manual injector	7725i	228-32210-93
7	Injector holder		228-35657-91
8	UV-VIS detector	SPD-20A	228-45003-XX
9	Standard flow cell		228-23400-91

* Sample vials, sample racks, collection tubes, preparative racks, columns, preparative sample loops, printers, and other items must be obtained separately.

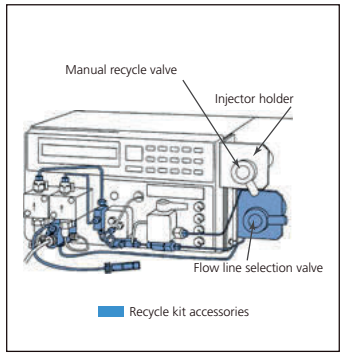
* When performing the recycling operation, place a mobile-phase bottle directly beside the solvent delivery pump.
  Since additional space is required for the reservoir tray or mobile-phase bottle, the actual installation space will be slightly larger than in the photograph.

6AD Recycle Kit

- When recycling, short cutting the pump pressure and the damper can prevent diffusion of the peak.
- Can be used as the flow line for analysis without recycling by column switching selection.



Flow Line Diagram of a Recycle Kit



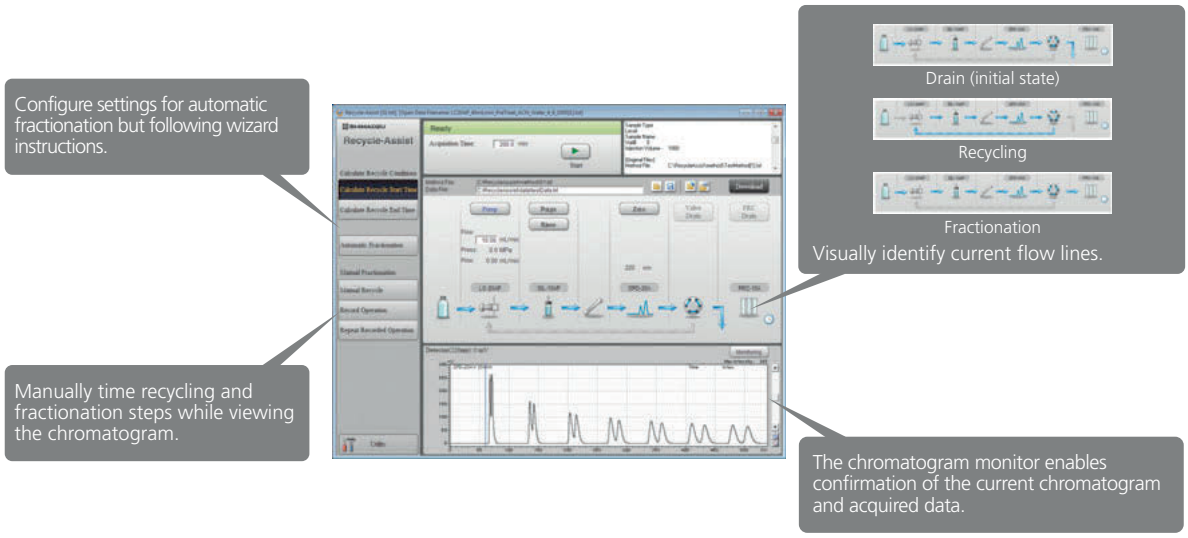
Example of Recycle Kit Mounted

Recycle-Assist — Special Prominence Preparative Recycling Software

This software is ideal for use with the LC-20AP/LC-6AD preparative recycle systems.

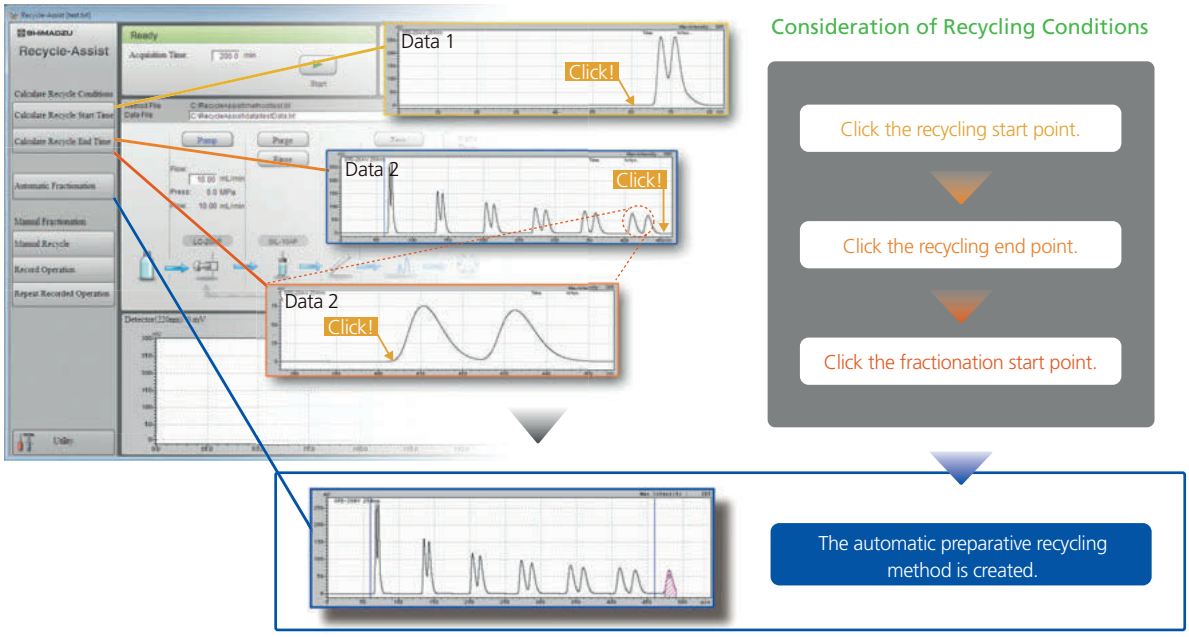
Perform Automatic Preparative Recycling with a Simple GUI-Based Operating Environment

The graphical user interface (GUI) provides an environment where even novices to preparative recycling can perform operations simply and reliably. Furthermore, only a single main window is used for the workflow from recycling to fractionation, thus reducing the risk of wasting precious samples through setting mistakes.



Complete Automatic Preparative Recycle Settings in Only a Few Steps

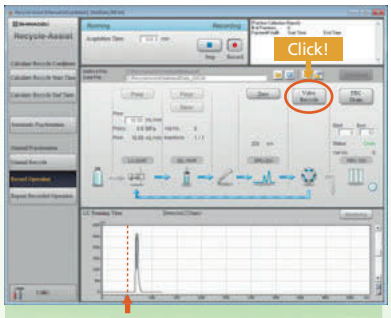
Specify the start and end points for recycling, and even the start point for automatic fractionation, without worrying about complicated settings. Furthermore, the software automatically sets valve switching timing for starting and stopping recycling, which eliminates the need to use complicated time programs. Consequently, even analysts who are inexperienced with fractionation can operate the software with confidence.



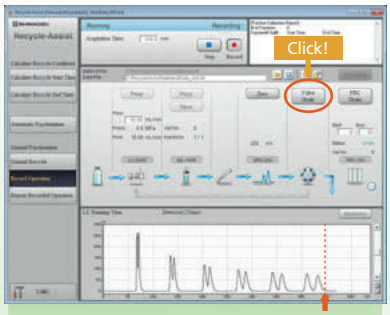
Seamless Transition from Manual to Automatic Preparative Recycling

Recycle-Assist allows the user to perform preparative recycling according to specified settings and to monitor chromatograms in order to perform recycling and fractionation at the desired timing.

By recording operations during manual fractionation, the software can save valve switching timing and other user operations in a method file for use in subsequent automatic preparative recycling.

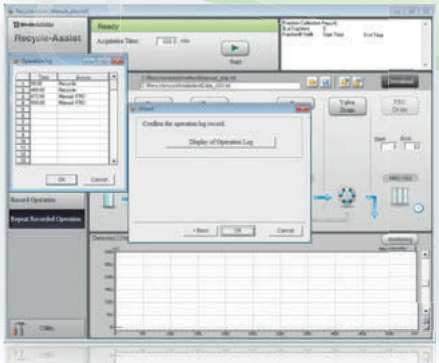


Switch the valve to "Recycle" at the recycling start point.



Switch the valve to "Drain" at the recycling end point.

Switch ON "FRC Fraction" at the fractionation start point. (Switch it OFF at the end point.)



The operation timing is recorded in a method file for use in automatic preparative recycling.

To check the valve switching and fractionation timing, play the recorded operations.

Sample System Configuration

Recycle-Assist is special software for the LC-6AD semi-preparative and LC-20AP large-scale preparative recycle systems, based on the following four systems:

- LC-20AP preparative recycle system (manual injector)
- LC-20AP fully automatic preparative recycle system
- LC-6AD preparative recycle system (manual injector)
- LC-6AD fully automatic preparative recycle system

Details and required parts for the respective systems are indicated on the following pages.

*Note: Recycle-Assist is only compatible with a single detector channel. Detectors cannot be connected to two or more channels.
Also, this software is intended only for system control, and does not provide any data processing functions.
Chromatogram data is output in ASCII format, so for data processing, spreadsheet software or the special LabSolutions Postrun PC set is required.

Recycle-Assist

LC-20AP Preparative Recycle System (Manual Injector)

Standard System for Large-Scale Preparative Recycling!

- Equipped with a manual injector, this recycle system offers a maximum flow rate of 150 mL/min and utilizes large-scale preparative columns with an inner diameter of approx. 50 mm.
- If the elution quantity is 100 mL or more, recycling effectiveness is demonstrated even with semi-preparative columns with an inner diameter of approx. 20 mm.

Example of a Large-Scale Preparative Recycle System (Manual Injector)

Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-20AP	228-45150-XX
3	Line filter assembly	(For LC-20AP recycling)	228-35871-96
4	Line filter joint	(For LC-20AP recycling)	228-50707
5	Reservoir tray		228-45041-91
6	Column holder	Column holder, SLIM	228-45203-41
7	Optional box, VP		228-45060-91
8	High-pressure flow line switching valve (recycling valve)	FCV-12AH	228-45013-91
9	(FCV-12AH replacement part)	Rotor assembly, 3-port valve (1 mm groove)	228-21217-96
10	(FCV-12AH replacement part)	Stator assembly, 3-port valve	228-21220-92
11	Manual injector	7725	228-32210-91
12	UV-VIS detector (Note 1)	SPD-20A	228-45003-XX
13	Preparative cell	Preparative cell with variable optical path length (0.5 mm)	228-23405-91
14	Fraction collector	FRC-10A	228-45070-XX
15	Fraction collector head with valve		228-24105-91
16	Special preparative recycling software	Recycle-Assist	228-45192-91

Note 1: Connect to one detector such as the SPD-20A UV-VIS detector or the RID-20A differential refractive index detector.
(Chromatogram data from non-Shimadzu detectors can also be read in by inserting an A/D board (223-04202-91) into the CBM-20A.)
*Sample vials, sample racks, preparative tubes, preparative racks, columns, preparative sample loops, a PC, and a printer are separately required.
(For details on the respective specifications, contact your Shimadzu sales representative.)
*When performing the recycling operation, place a mobile-phase bottle directly beside the solvent delivery pump.
Since additional space is required for the reservoir tray or mobile-phase bottle, the actual installation space will be slightly larger than in the photograph.

LC-20AP Fully Automatic Preparative Recycle System

Fully Automatic System for Large-Scale Preparative Recycling!

- This fully automatic recycle system offers a maximum flow rate of 150 mL/min and utilizes large-scale preparative columns with an inner diameter of approx. 50 mm. It is capable of highly cost-efficient separation and purification.
- If the elution quantity is 100 mL or more, recycling effectiveness is demonstrated even with semi-preparative columns with an inner diameter of approx. 20 mm.

Example of Fully Fully Automatic for Large-Scale Preparative Recycling

Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-20AP	228-45150-XX
3	Line filter assembly	(For LC-20AP recycling)	228-35871-96
4	Line filter joint	(For LC-20AP recycling)	228-50707
5	Reservoir tray		228-45041-91
6	Column holder	Column holder, SLIM	228-45203-41
7	Optional box, VP		228-45060-91
8	High-pressure flow line switching valve (recycling valve)	FCV-12AH	228-45013-91
9	(FCV-12AH replacement part)	Rotor assembly, 3-port valve (1 mm groove)	228-21217-96
10	(FCV-12AH replacement part)	Stator assembly, 3-port valve	228-21220-92
11	Manual injector	7725	228-32210-91
12	UV-VIS detector (Note 1)	SPD-20A	228-45003-XX
13	Preparative cell	Preparative cell with variable optical path length (0.5 mm)	228-23405-91
14	Fraction collector	FRC-10A	228-45070-XX
15	Fraction collector head with valve		228-24105-91
16	Special preparative recycling software	Recycle-Assist	228-45192-91

Note 1: Connect to one detector such as the SPD-20A UV-VIS detector or the RID-20A differential refractive index detector.
(Chromatogram data from non-Shimadzu detectors can also be read in by inserting an A/D board (223-04202-91) into the CBM-20A.)
*Sample vials, sample racks, preparative tubes, preparative racks, columns, preparative sample loops, a PC, and a printer are separately required.
(For details on the respective specifications, contact your Shimadzu sales representative.)
*When performing the recycling operation, place a mobile-phase bottle directly beside the solvent delivery pump.
Since additional space is required for the reservoir tray or mobile-phase bottle, the actual installation space will be slightly larger than in the photograph.

LC-6AD Semi-Preparative Recycle System (Manual Injector)

Standard Semi-Preparative System!

- This recycle system offers a maximum flow rate of 20 mL/min and utilizes semi-preparative columns with an inner diameter of up to 20 mm.
- The effective recycling elution volume is typically 35 mL or greater.
- The 6AD Recycle Kit minimizes the dispersion of sample components from the column (*see* page 15).

Example of a Semi-Preparative Recycle System (Manual Injector)

Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-6AD	228-45068-XX
3	Interface board	PC-31L	228-31103-91
4	6AD recycle kit		228-28711-92
5	Reservoir tray		228-45041-91
6	Column holder	Column holder, SLIM	228-45203-41
7	Optional box, VP		228-45060-91
8	High-pressure flow line switching valve (recycling valve)	FCV-12AH	228-45013-91
9	(FCV-12AH replacement part)	Rotor assembly, 3-port valve (0.5 mm groove)	228-21217-95
10	Manual injector	7725	228-32210-91
11	UV-VIS detector (Note 1)	SPD-20A	228-45003-XX
12	Preparative cell	Preparative cell with variable optical path length (0.5 mm)	228-23405-91
13	Fraction collector	FRC-10A	228-45070-XX
14	Fraction collector head with valve		228-24105-91
15	Software for Prominence Recycling Preparative HPLC Systems	Recycle-Assist	228-45192-91

Note 1: Connect to one detector such as the SPD-20A UV-VIS detector or the RID-20A differential refractive index detector.
(Chromatogram data from non-Shimadzu detectors can also be read in by inserting an A/D board (223-04202-91) into the CBM-20A.)
*Sample vials, sample racks, preparative tubes, preparative racks, columns, preparative sample loops, a PC, and a printer are separately required.
(For details on the respective specifications, contact your Shimadzu sales representative.)
*When performing the recycling operation, place a mobile-phase bottle directly beside the solvent delivery pump.
Since additional space is required for the reservoir tray or mobile-phase bottle, the actual installation space will be slightly larger than in the photograph.

LC-6AD Fully Automatic Semi-Preparative Recycle System

- This recycle system offers a maximum flow rate of 20 mL/min and utilizes semi-preparative columns with an inner diameter of up to 20 mm. It is capable of highly cost-efficient separation and purification.
- The effective recycling elution volume is typically 35 mL or greater.
- The 6AD Recycle Kit minimizes the dispersion of sample components from the column (*see* page 15).

Example of a Fully Automatic Semi-Preparative Recycle System

Main Components

	Product Name	Model Name	P/N
1	System controller	CBM-20A	228-45012-XX
2	Solvent delivery unit	LC-6AD	228-45068-XX
3	Interface board	PC-31L	228-31103-91
4	6AD recycle kit		228-28711-92
5	Reservoir tray		228-45041-91
6	Column holder	Column holder, SLIM	228-45203-41
7	Optional box, VP		228-45060-91
8	High-pressure flow line switching valve (recycling valve)	FCV-12AH	228-45013-91
9	(FCV-12AH replacement part)	Rotor assembly, 3-port valve (0.5 mm groove)	228-21217-95
10	Autosampler	SIL-10AP	228-45057-XX
11	UV-VIS detector (Note 1)	SPD-20A	228-45003-XX
12	Preparative cell	Preparative cell with variable optical path length (0.5 mm)	228-23405-91
13	Fraction collector	FRC-10A	228-45070-XX
14	Fraction collector head with valve		228-24105-91
15	Software for Prominence Recycling Preparative HPLC Systems	Recycle-Assist	228-45192-91

Note 1: Connect to one detector such as the SPD-20A UV-VIS detector or the RID-20A differential refractive index detector.
(Chromatogram data from non-Shimadzu detectors can also be read in by inserting an A/D board (223-04202-91) into the CBM-20A.)
*Sample vials, sample racks, preparative tubes, preparative racks, columns, preparative sample loops, a PC, and a printer are separately required.
(For details on the respective specifications, contact your Shimadzu sales representative.)
*When performing the recycling operation, place a mobile-phase bottle directly beside the solvent delivery pump.
Since additional space is required for the reservoir tray or mobile-phase bottle, the actual installation space will be slightly larger than in the photograph.

Preparative LC System Selection Guide [System]

A wide variety of systems is available to suit the fractionation scale

Max. quantity of test sample (as a guide)

Large-scale fractionation for laboratory use (approx. 2000 mg max.)

LC-20AP base

- Simple system
- Basic specifications (recycling not required)
- For both analysis and fractionation
- Recycling also required (elution volume 200 mL min.)

Semi-preparative scale for laboratory use (approx. 300 mg max.)

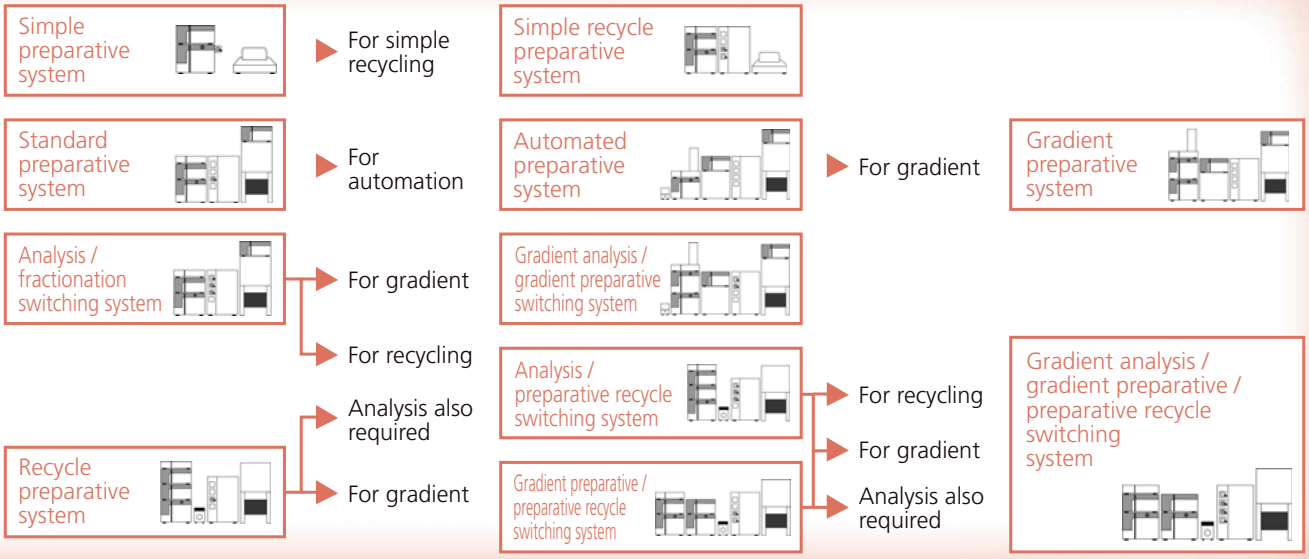
LC-6AD base

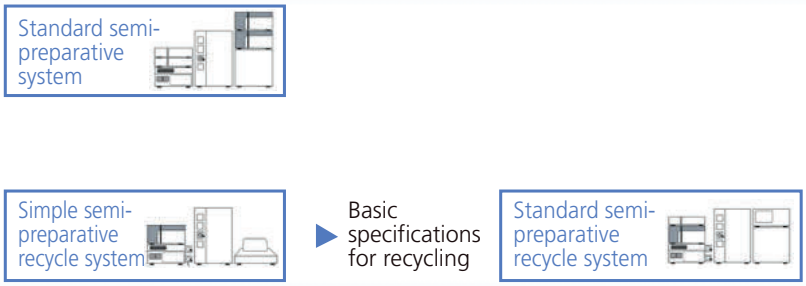
- Basic specifications (recycling not required)
- Standard specifications for recycle fractionation (elution volume 35 mL min.)

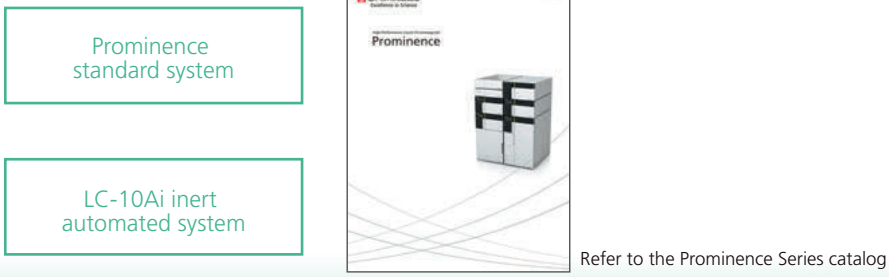
Conventional scale (approx. 20 mg max.)

LC-20AT/10Ai base

- Basic specifications
- Inert specifications







Refer to the Prominence Series catalog

Contact your Shimadzu sales representatives for details about configurations, specifications, etc.

Scale-Up Columns [Columns]

Shim-pack PRC/MRC/HRC Series

Shim-pack Name	Stationary Phase	Length × Inner Diameter (mm), Particle Diameter (mm)	P/N
MRC-ODS	Octadecyl	250 × 6, 15	228-23464-92
PRC-ODS	Octadecyl	250 × 20, 15	228-23464-93
PRC-ODS(K)	Octadecyl	250 × 30, 15	228-23464-94
PRC-ODS(L)	Octadecyl	250 × 50, 15	228-23464-95
HRC-ODS	Octadecyl	250 × 4.6, 5	228-23463-92
PRC-ODS(H)	Octadecyl	250 × 20, 5	228-23464-91
MRC-SIL	Silica	250 × 6, 15	228-23461-92
PRC-SIL	Silica	250 × 20, 15	228-23461-93
PRC-SIL(K)	Silica	250 × 30, 15	228-23461-94
PRC-SIL(L)	Silica	250 × 50, 15	228-23461-95
HRC-SIL	Silica	250 × 4.6, 5	228-23461-92
PRC-SIL(H)	Silica	250 × 20, 5	228-23461-91

* C_8 (octyl), TMS (trimethyl), NH_2 (aminopropyl), and CN (cyanopropyl) stationary phases and guard columns are also available. Contact your Shimadzu representative for details.

Shim-pack PREP Series

Shim-pack Name	Stationary Phase	Length × Inner Diameter (mm), Particle Diameter (mm)	P/N
PREP-ODS(H)kit	Octadecyl	250 × 20, 5	228-17888-91
		250 × 4.6, 5	
PREP-ODS	Octadecyl	250 × 20, 15	228-00815-91
PREP-ODS(K)	Octadecyl	250 × 30, 15	228-18319-91
PREP-ODS(L)	Octadecyl	250 × 50, 15	228-18320-91
PREP-SIL(H)kit	Silica	250 × 20, 5	228-17887-91
		250 × 4.6, 15	
PREP-SIL	Silica	250 × 20, 15	228-00814-91
PREP-SIL(K)	Silica	250 × 30, 15	228-18273-91
PREP-SIL(L)	Silica	250 × 50, 15	228-18274-91

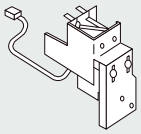
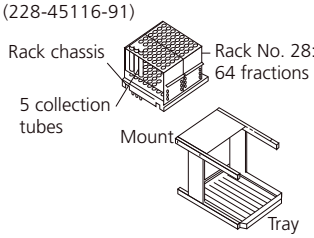
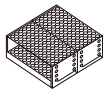
* C_8 (octyl), TMS (trimethyl), NH_2 (aminopropyl), CN (cyanopropyl), and Ph (phenyl) stationary phases and guard columns are also available. Contact your Shimadzu representative for details.

Shim-pack GPC Series (Non-aqueous Size Exclusion)

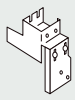
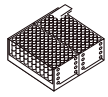
Shim-pack Name	Exclusion Limit Molecular Weight	Length × Inner Diameter (mm)	P/N
GPC-2003C	70,000	300 × 20	228-23343-94
GPC-20025C	20,000	300 × 20	228-23343-93
GPC-2002C	5,000	300 × 20	228-23343-92
GPC-2001C	1,500	300 × 20	228-23343-91
GPC-2000CP	Guard column	50 × 8	228-20812-95

* The GCP-2000C series is used with chloroform mobile phases. The GPC-2000 series is available for use with THF mobile phases.

Fraction Collector Heads, Racks, and Collection Tubes for the FRC-10A Fraction Collector (Optional)

<table>
<tr><th></th><th>Fraction Collector Head</th><th>Rack</th><th>Collection Tubes</th></tr>
<tr><td>Large-scale fractions</td><td rowspan="6">Fraction collector head with valve (228-24105-91)
  </td><td>Large-volume kit
(includes the items shown below)
(228-45116-91)
 
</td><td colspan="2">Commercial reagent bottles (500 mL to 1,000 mL) can be used.
  </td></tr>
<tr><td rowspan="2">Semi-large fractions</td><td>Rack No. 3: 16 fractions
(228-25313-91)
  </td><td>50-mL vials (glass)
(228-25318-91)
(78 (length) × 35 (outer diameter) mm)
 
20 per set</td><td>50-mL vials (polypropylene)
(228-25321-91)
(75 (length) × 35 (outer diameter) mm)
 
20 per set</td></tr>
<tr><td>Rack No. 2A: 64 fractions
(228-25311-91)
  </td><td>20-mL test tubes (glass)
(228-25316-91)
(105 (length) × 18 (outer diameter) mm)
 
100 per set</td><td>32-mL test tubes (glass)
(228-25317-91)
(165 (length) × 18 (outer diameter) mm)
 
100 per set
25-mL test tubes (PP)
(228-25320-91)
(150 (length) × 18 (outer diameter) mm)
 
100 per set</td></tr>
<tr><td rowspan="3">Small fractions</td><td>Sample cooler L: 50 fractions
(228-45064-91)
  </td><td>4-mL vials (glass)
(228-21287-91)
(45 (length) × 15 (outer diameter) mm)
 
100 per set</td><td>5-mL vials (polypropylene)
(228-25322-91)
(45 (length) × 15 (outer diameter) mm)
 
100 per set</td></tr>
<tr><td>Rack No. 1: 144 fractions
(228-25310-91)
  </td><td rowspan="2">3.5-mL test tubes (glass)
(228-25315-91)
(75 (length) × 10 (outer diameter) mm)

350 per set</td><td rowspan="2">4.5-mL test tubes (polypropylene)
(228-25319-91)
(75 (length) × 10 (outer diameter) mm)

250 per set</td></tr>
<tr><td>Fraction collector head
(228-25169-91)
  </td><td>Rack No. 5: 120 fractions
(228-25314-91)
  </td></tr>
</table>

- A "fraction collector head with valve" allows the eluate to be switched between the fraction side and the drain side using a 3-way solenoid valve. Use this model with standard fractionation to make full use of the FRC-10A's functionality.
- A "fraction collector head" (i.e., without a valve) continuously directs the eluate to the fraction side without using a solenoid valve. It is used for micro-volume fractionation.

Shimadzu Corporation

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