228-97197B
Sep. 2022

Solvent Delivery Module for Shimadzu Liquid Chromatograph

LC-40D X3 CL
LC-40D XR CL

Instruction Manual

Read this manual thoroughly before you use the product.
Keep this manual for future reference.

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Introduction

Read this Instruction Manual thoroughly before using the product.

Thank you for purchasing this product.

This instruction manual describes the basic operation, and accessories and options for this product. Read this manual thoroughly before using the product and operate the product in accordance with the instructions in this manual.

The following instruction manuals are included with the product in booklet form or in PDF format. The PDF documentation is on the instruction manual DVD-ROM (Part No. 228-97193-41).

Document Name	Document No.	Description
Instruction Manual (PDF)	228-97197	This instruction manual.
System Guide (PDF)	228-97194	This manual provides details on how to use the system: system performance optimization, analysis procedure, troubleshooting, validation, installation, etc.
Safety Guideline (Booklet/PDF)	228-97195	Describes the precaution instructions to ensure safe operation.

Read "Safety Guideline" thoroughly before using the product.

"Safety Guideline" describes the information about the warranty, after-sales service, safety instructions and precautions to ensure safe operation of the instrument. Keep this manual for future reference.

Important

- If the user or usage location changes, ensure that this Instruction Manual is always kept together with the product.
- If this manual or a product warning label is lost or damaged, immediately contact your Shimadzu representative to request a replacement.
- To ensure safe operation, read the accompanying booklet "Safety Guideline" before using the product.
- To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, re-installation (after the product is moved), or repair is required.

Original version is approved in English.

Notice

- Information in this manual is subject to change without notice and does not represent a commitment on the part of the vendor.
- Any errors or omissions which may have occurred in this manual despite the utmost care taken in its production will be corrected as soon as possible, although not necessarily immediately after detection.
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Indications Used in This Manual

Precaution symbols are indicated using the following conventions:

Indication	Meaning
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or possibly death.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury or equipment damage.
NOTE	Emphasizes additional information that is provided to ensure the proper use of this product.

The following symbols are used in this manual:

Indication	Meaning
Prohibition	Indicates an action that must not be performed.
Instruction	Indicates an action that must be performed.
Hint	Indicates information provided to improve product performance.
Reference	Indicates the location of related reference information.

Electromagnetic Compatibility

Descriptions in this section apply only to the following models:

- 228-65076-55 LC-40D X3 CL
- 228-65000-55 LC-40D XR CL

This product complies with European standard EN61326, class B for electromagnetic interference (Emissions) and industrial electromagnetic environment (Immunity).

■ EN55011 Emissions (Electromagnetic Interference)

This is a class B product. When this product causes an electromagnetic disturbance to devices being used near this product, create an appropriate distance between those devices and this product in order to eliminate the disturbance.

Operating Nexera CL System

■ Intended Use

This system is designed to perform qualitative and quantitative analysis of target compounds in a sample matrix and can be used as a liquid delivery unit of the liquid chromatograph for general in vitro diagnostic applications. However, only personnel who have received appropriate training on use of the system can use it for these purposes.

IVD

■ Calibration

A calibration curve should be generated for each analyte in appropriate methods. At least four out of six non-zero standards should meet the appropriate criteria, including the calibration standard lower than the assumed LOQ and the calibration standard at the highest concentration.

■ Quality Control

Implement quality control of the instrument by routinely measuring at least one each of four types of quality-control samples (a sample with a normal concentration level, a sample with a concentration level higher than normal as well as a sample lower than normal, and a blank sample). Check the selectivity/specificity in the matrix used for the actual sample, the accuracy, correctness, recovery rate, dynamic range, linearity, and lower limit of quantitation.
Based on these assessment results, check that the results are within the permissible range. If the assessment results are out of range, the measured data may be invalid, so do not use analysis results obtained from the instrument in question until it can be confirmed that it is functioning normally. When, for example, analyzing samples that contain complex sample matrices such as serum, plasma or urine, it may be possible to obtain stabilized data by using an appropriate pre-treatment or an internal standard.

Contents

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1 Overview

This instrument is a liquid delivery unit for liquid chromatography using a parallel double plunger reciprocating-type pump developed to improve the precision and sensitivity of analysis.

By pumping alternately from two pump heads arranged in parallel, it can perform continuous pumping. The stepping motor's torque is transmitted to the cam, causing the plungers to perform a piston motion.

1.1 Features

■ Low Flow Pulsation and Pulsation Period Enable Precise Delivery

By reducing the discharge volume per plunger stroke to the microvolume level (10 µL), and applying high-speed drive, the flow pulsation and pulsation period have been reduced to levels significantly lower than those for other instruments.

■ Choice of Gradient Modes and Control Options

LC-40D X3 CL/LC-40D XR CL can be used in both low- and high- pressure gradient modes. The high-pressure gradient mode uses two pumps and is highly accurate with minimal time lag. In low-pressure gradient mode, a single pump unit plus the gradient unit provides a low cost option to combine up to four solvents.
There are two gradient modes available: fast LC mode or normal mode under control of the system controller.
The fast LC mode for binary high-pressure gradient delivery supports ultra high speed high separation analysis with minimized gradient control steps.

■ Automatic Plunger Rinsing

An automatic rinsing kit is provided as standard for LC-40D X3 CL/LC-40D XR CL . It can rinse the plunger in the back of the plunger seal. When high-salt-concentration buffer solutions are used, in particular, it prevents premature seal failure due to crystallization, extending the service life of plunger seals.

■ High-pressure Flow is Available

LC-40D X3 CL enables ultra high pressure solvent delivery up to 130 MPa supporting ultra fast high separation analysis in combination with Shim-pack XR-ODS III or other ultra fast high separation columns. For LC-40D XR CL, high-pressure solvent delivery up to 70 MPa is possible so high speed high separation analysis is supported in combination with Shim-pack XR-ODS II columns.

1.2 Component Parts

This instrument consists of the standard parts listed below. Check the parts against this list after unpacking.

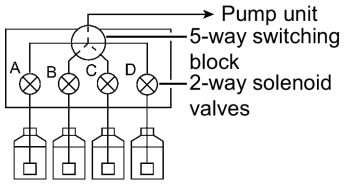
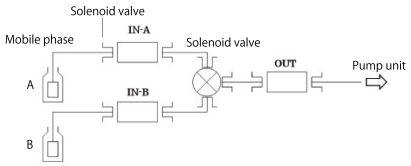
No.	Part Name	Part No.	Q'ty	Remark
-	Main Unit LC-40D X3 CL/LC-40D XR CL	-	1	
-	Safety Guideline (Booklet)*1	228-97195	1	
-	Instruction manual/ System Guide (CD-ROM)	228-97193-41	1	
-	Bottle, 250 mL	228-74372	1	
1	Suction Filter Assy	228-45708-91	1	Including a tube
2	REMOTE CABLE ASSY	228-28253-91	1	Not used in CL model.
3	DRAIN TUBE SI(L1000)	228-25162-03	1	
4	STOP JOINT ASSY,B,D	228-46054-91	1	
	SYRINGE TUBE ASSY,B,D	228-46055-91	1	
5	SYRINGE,SS-20ESZ	228-66048	1	
	NEEDLE ASSY,FOR SYRINGE	228-18216-91	1	
6	CLAMP,M9120	046-05522-02	1	
7	DRAIN ADAPTER	228-42204	1	
8	STANDARD OUT DRAIN	228-42205	1	
9	CTO OUT DRAIN	228-42206	1	
10	STRAIGHT JOINT	228-28163	1	
11	FITTING,L-TYPE 1253	035-61561-12	1	

*1 It contains cautions for use regarding the instrument.

1.3 Optional Parts

Optional units available for this instrument are listed below.
For information about other optional units listed below, contact your Shimadzu representative.

■ Common Optional Parts for LC-40D X3 CL/LC-40D XR CL

Option	Part No.	Features
Low pressure gradient kit	228-65016-58	Switches between up to 4 liquids of low-pressure gradient or mobile phase. It also can be used for auto rinsing of column flow lines. Installed inside of the instrument. 
Reservoir switching valve	228-65017-58	• Switches between 2 liquids (for example, switches between mobile phase and rinse solution) or two mobile phases. • Installed inside of the instrument. 
Mixer installation kit (MR40 LPGE, to be built in)	(w/ mixer recognition device) 228-65020-41	Gradient mixer (40 µL internal capacity) exclusively for low-pressure gradient analysis. Fixed inside of the instrument.
Mixer MR40 LPGE (fixed inside column oven)	(w/o mixer recognition device) 228-45210-41	Gradient mixer (40 µL internal capacity) exclusively for low-pressure gradient analysis. It can be installed inside of the CTO-40C CL.
Mixer MR300 LPGE	(w/ mixer recognition device) 228-72653-42 (w/o mixer recognition device) 228-45210-42	Gradient mixer (300 µL internal capacity) exclusively for low-pressure gradient analysis. It can be installed inside of the CTO-40C CL. This option can be used for solvents that are hard to mix, such as TFA (trifluoroacetic acid), or for reducing the baseline fluctuation of the photo diode array detector.
Gradient Mixer for High-Pressure Gradient Analysis	▶▶ Reference "Gradient Mixer for High-Pressure Gradient Analysis" P.5	

Option	Part No.	Features
RINSING PUMP XR	228-39625-42	The rinsing pump kit is intended for continuously rinsing the back part of the plunger seal with rinsing solution. The rinsing volume can be selected.
Tool Kit	228-57647-43	Kit containing the necessary tools for preparation, inspection, and maintenance.
SUS Pipe (0.3×600)	228-53184-54	Plumbing for the pump outlet. ID 0.3 mm ×600 mm, pre-bent
SUS Pipe HP (0.3×1,000)	228-53184-96	Plumbing for the pump outlet. ID 0.3 mm ×1000 mm
Plunger Seal GFP	228-52711-94	The maximum available pressure is 44MPa. When using a non-polar organic solvent such as hexane or a solvent of alkyl sulfonic acid with TFA, use the standard plunger seal.
SUCTION FILTER ASSY	228-61905-49	Suction filter with tube and fittings for the low pressure gradient kit or the degassing unit.

■ Optional Parts for LC-40D X3 CL

Option	Part No.	Features
MAINTENANCE KIT,LC-40D X3	228-53265-45	A set of consumable parts and plumbing parts for LC-40D X3 CL. ▶▶ Reference "Maintenance Kit for LC-40D X3 CL (Parts No. 228-53265-45)" P.133

■ Optional Parts for LC-40D XR CL

Option	Part No.	Features
MAINTENANCE KIT, LC-40D XR	228-45593-49	A set of consumable parts and plumbing parts. ▶▶ Reference "Maintenance Kit for LC-40D XR CL (Parts No. 228-45593-49)" P.133

■ Gradient Mixer for High-Pressure Gradient Analysis

The following gradient mixers for high-pressure gradient analysis are available for liquid chromatographs.

Part Name	Part No.
MIXER,MR 20 µL	(w/ mixer recognition device) 228-72652-41 (w/o mixer recognition device) 228-45209-41
MIXER,MR 40 µL	(w/ mixer recognition device) 228-72652-42 (w/o mixer recognition device) 228-45209-42
MIXER,MR 100 µL	(w/ mixer recognition device) 228-72652-43 (w/o mixer recognition device) 228-45209-43
MIXER,MR 180 µL II	(w/ mixer recognition device) 228-72652-44 (w/o mixer recognition device) 228-45209-44

Mixers described above are packaged in a set

Part Name	Part No.
Set of Two Mixers MR 40 µL and MR 180 µL II	228-45292-41
Set of Two Mixers MR 100 µL and MR 180 µL II	228-45292-42
Set of Three Mixers MR 40 µL, MR 100 µL and MR 180 µL II	228-45292-43

Recommended Mixers

The table below lists the mixers with the smallest volume among mixers that can be used in individual combinations of detectors and mobile phases.

		Mobile Phase		
		Solvent Containing Trifluoroacetic Acid (TFA)	Solvent Containing Formic Acid, Acetic Acid, etc.	Water (Including Buffer Solution), Organic Solvent, or Its Solvent Mixture
Detector	Photo Diode Array Detector	MR 180 µL	MR 180 µL	MR 180 µL
	UV Detector	MR 180 µL	MR 100 µL	MR 40 µL
	LCMS, LCMSMS	-	MR 20 µL	MR 20 µL

Using a mixer with a volume smaller than the recommendation shown above may cause excessive fluctuation of the baseline.

When connecting multiple detectors, use a mixer with the largest volume among the applicable mixers. For example, if using a Photo Diode Array and an LC/MS, the MR 180 µL II mixer is recommended.

A larger than recommended mixer can be used to improve mixing performance, but will also increase the gradient delay volume.

■ Automatic Rinsing Kit

The plunger can be rinsed with the automatic rinsing kit at the back part of the plunger seal. LC-40D X3 CL/LC-40D XR CL has the automatic rinsing kit as standard. When using buffer solution, be sure to attach the automatic rinsing kit.
See the table below for the necessity of the automatic rinsing kit and rinsing solution.

Mobile Phase	LC-40D X3 CL/LC-40D XR CL	
	Necessity	Recommended Rinsing Solution
Buffer Solution	Necessary	10 % 2-propanol water
Normal-phase solvent such as hexane	Not necessary	-
Other Solutions	Necessary	10 % 2-propanol water

Necessary: The rinsing kit is necessary.

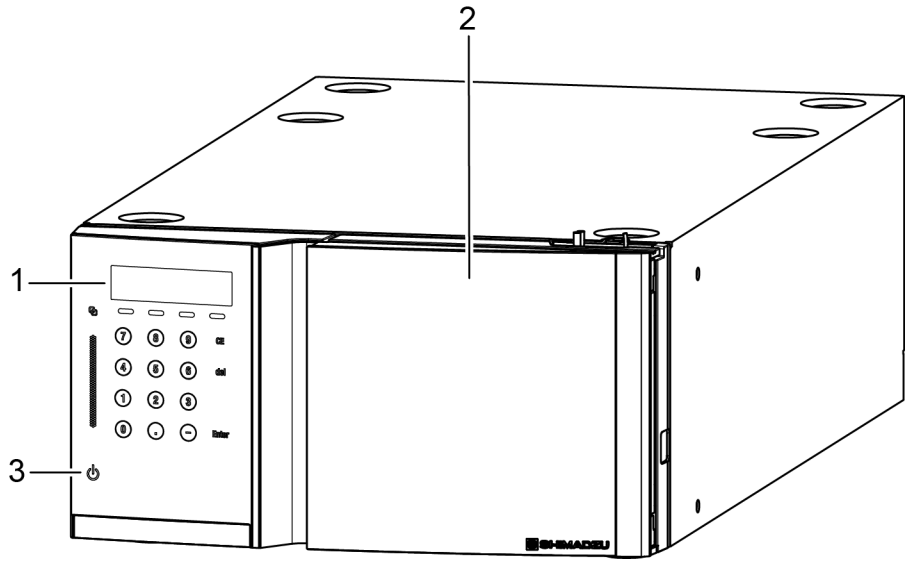
Not necessary: The rinsing kit should not be used.

NOTE

- For the application system, refer to the instruction manual of the application system.
- If the rinse solution is dirty, replace with new solution. If getting significantly dirty, replace with new solution once a day. Even if it does not appear dirty, replace with new solution once a week.
  If using distilled water as rinsing solution, replace it once a day.

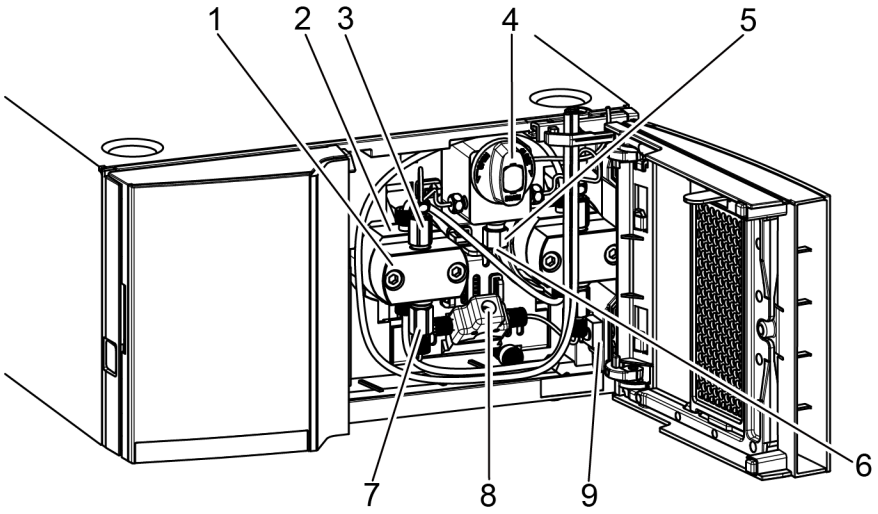
2 Parts Identification and Function

2.1 Front



No.	Name	Description
1	Operation Panel	Configure or operate the instrument with the operation keys. Touching the center part on the operation panel displays the operation keys.
2	Front Cover	This is the cover for the flow line.
3	(Power button)	Switches ON/OFF the power. Pressing the switch turns on the power and pressing it again turns off the power. The switch is enabled only when the main power switch on the back is on.

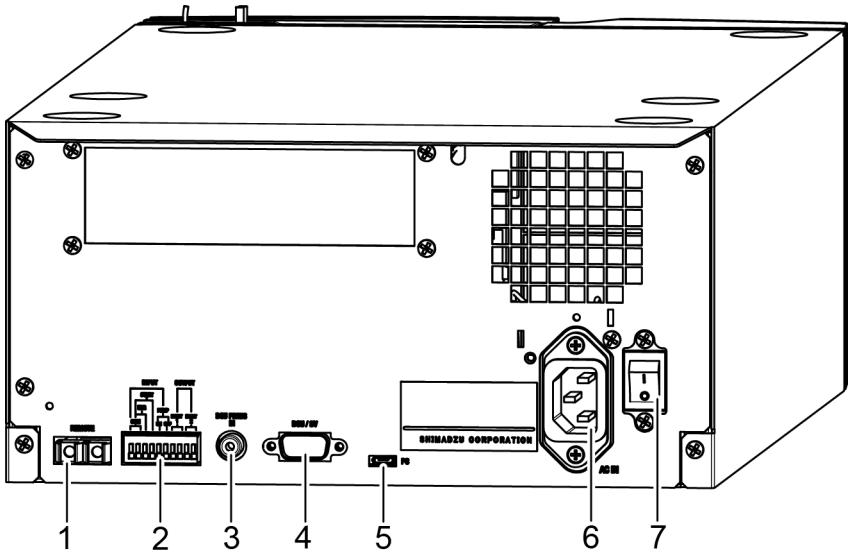
2.2 Behind Front Cover



No.	Name	Description
1	Pump Head*1	The plunger inside it reciprocates to deliver solvent.
2	Head Holder*1	It has the rinsing flow path of the plunger inside. The pump head is attached to this part.
3	Check Valve OUT*1	A check valve on the outlet side.
4	Drain Valve	It is used to replace mobile phase solvent or remove air from the flow path. It has an internal pressure sensor.
5	Line Filter	A column protection filter for removing contaminants from mobile phase solvent.
6	Pump Outlet	A connection port of the tube connected to the autosampler/manual injector.
7	Check Valve IN*1	A check valve on the inlet side.
8	Pump Inlet	A connection port of the tube from the suction filter.
9	Leak Sensor	It detects liquid leaks. If the leak sensor detects a leak, delivery automatically stops, causing an alarm and message on the display. ERROR LEAK DETECTED

*1 This is common to the right and left pump heads.

2.3 Back

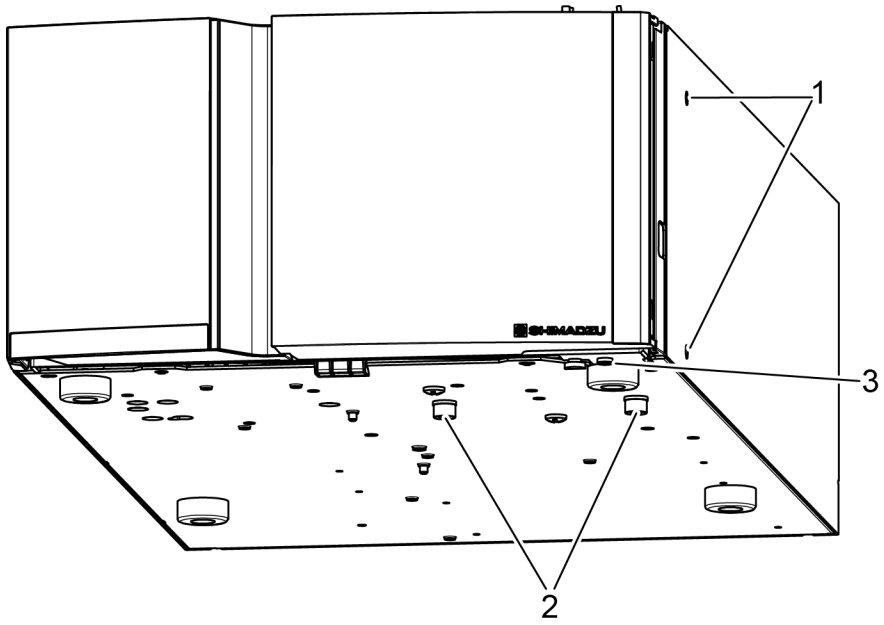


No.	Name	Description
1	[REMOTE] Connector	A connector for connecting the system controller.
2	External Input/Output Terminals	Connect to external equipment.
3	[DGU PRESS IN] Connector	To input the pressure signal from the external degassing unit.
4	[DGU/SV] Connector	A connector for connecting rinsing pump or degassing unit.
5	[PC] Connector	A connector for service personnel. Normally unused.
6	Power Cord Connector	Connect the power cord.
7	Main Power Switch	It turns ON/OFF the power to the instrument. Normally keep it on.*1

*1 Normally use ⏻ (power button) of the operation panel or system controller to turn ON/OFF the power. If the system controller is connected and the main power switch is on, the user can use ⏻ (power button) of the system controller to turn ON/OFF the power from the front of the instrument. If the instrument is not used for a long time, turn off the main power switch. Before turning off the main power switch, be sure to turn OFF the power using the power button.

Reference "2.5 Name and Functions of the Operation Panel" P.11

2.4 Right Side and Bottom

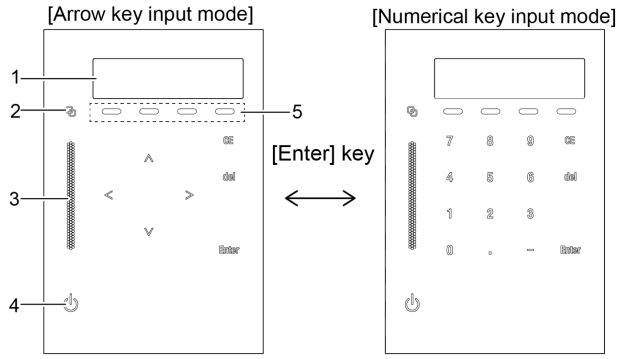


No.	Name	Description
1	Mixer Mounting Holes	Used to install mixer and column holder.
2	Shipping Screws (Red)	To prevent damage during transportation. LC-40D X3 CL has three screws, and LC-40D XR CL has two screws. NOTE Remove before installation.
3	Leakage Drain Outlet	Connect the provided drain tubing.

2.5 Name and Functions of the Operation Panel

This instrument is controlled through the keypad of the operation area. The display area allows verification of the instrument status.
The operation area has two input modes: [Arrow key input mode] to enable screen transfer, and [Numerical key input mode] to enable value input.
Pressing [Enter] switches between these input modes.

> **NOTE** When turning off the main power switch on the back of the instrument after changing the parameters via panel operation, be sure to turn OFF the power with the power button at the front of the instrument, and turn off the main power switch. Otherwise, some of the changed parameters may return to their original values.

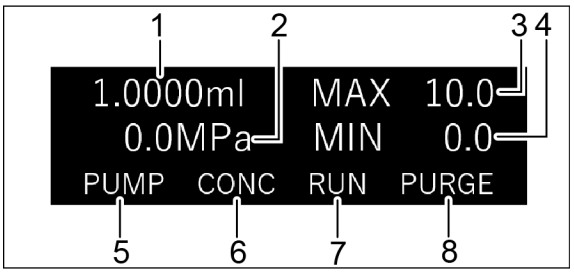


No.	Name	Description
1	Display Area	Displays various screens and settings.
2	Link LED	Illuminates when controlled by the system controller.
3	Status LED	• Green: analysis ready • Red: error • Blue: analysis in progress • Yellow: preparation for analysis in progress (The indicator normally lights in yellow while no solvent is delivered.) • Orange: sleep
4	(Power Button)*1	Switches ON/OFF the power. • To turn the power ON: Press and hold the power button for at least 3 seconds. • To turn the power OFF: Holding down the power button 3 seconds or more displays the confirmation screen as shown below. Holding it down again 1 second turns off the power. Press [CE] to cancel the operation. POWER : SHUTDOWN CE : CANCEL
5	Direct Key	Delivery start/stop, gradient concentration setting, timeprogram start and purge can be performed directly.

*1 If CBM-40 CL is used, pressing the power button of the pump turns off the power of the entire system.
Note, however, that the following will apply in the case of a system with multiple pumps.
- When using CBM-40 CL: The system power can be turned off using the power button of the pump with the lowest optical link number.

2.5.1 Display Area

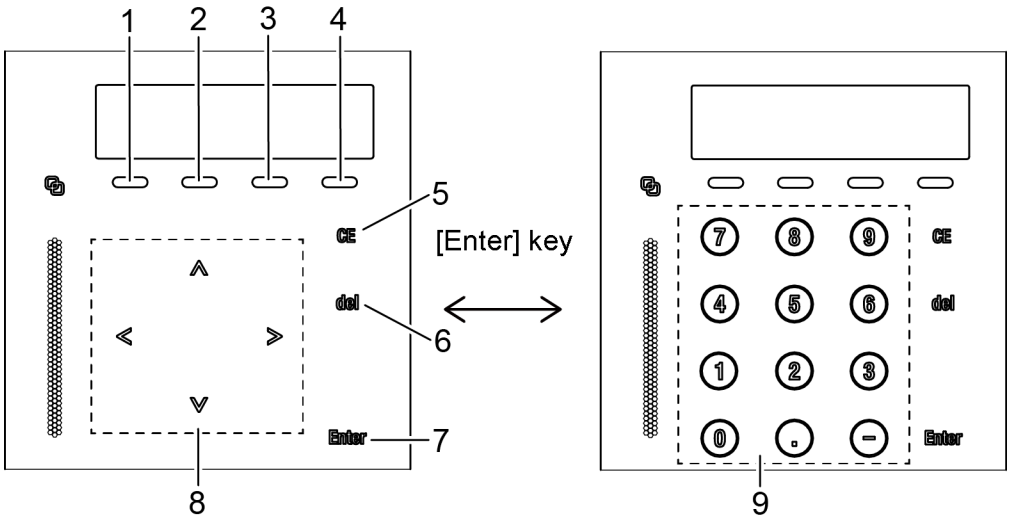
In this section the display on the initial screen is described.



No.	Name	Function
1	Flow/Press	In the constant flow delivery mode, the set flow rate (mL/min) is displayed. (Only for LC-40D XR CL) In the constant pressure delivery mode, the set pressure is displayed in the pressure unit set with the [PRESSURE UNIT] auxiliary function.
2	Pressure	Displays reading measured by pressure sensor, in units set with the [PRESSURE UNIT] auxiliary function.
3	P.MAX	The maximum pressure is displayed in the pressure unit set with the [PRESSURE UNIT] auxiliary function.
4	P.MIN	The minimum pressure is displayed in the pressure unit set with the [PRESSURE UNIT] auxiliary function.
5	PUMP	Highlighted during pump operation.
6	CONC	Highlighted in the low-pressure gradient mode or blinks in the high-speed LC mode.
7	RUN	Highlighted during execution of a time program or in the high-speed LC mode.
8	PURGE	Highlighted during purging.

2.5.2 Operation Area

Use the keys on the front to operate or configure the instrument. Touch the key to make the status LED brighter, accept input when you release the key.



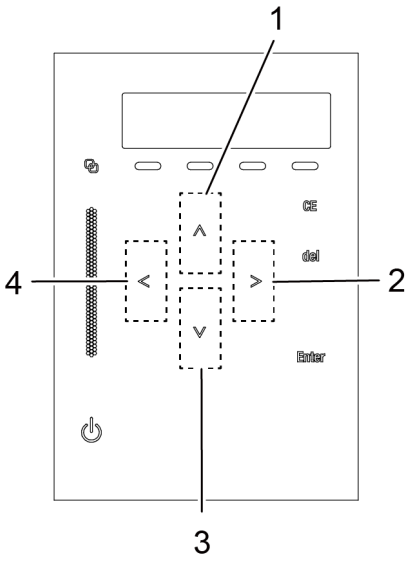
No.	Key	Name	Function
1	[PUMP]	Pump Key	Starts or stops the pump.
2	[CONC]	Concentration Key	Sets liquid concentrations in gradient analysis.
3	[RUN]	Run Key	Starts or stops a time program. (Key operation is ignored if a time program is not configured.)
4	[PURGE]	Purge Key	Starts or stops purging. Purging stops automatically 3 minutes after it begins. [PUMP] can also be used to stop purging. Purging time can be set with the [PURGE TIME] auxiliary function. **Hint** Refer "3.8 Delivery in the Low-Pressure Gradient Mode" P.76for the operation method on low -pressure gradient mode.
5	[CE]	Clear Key	This key is used for the following; • To initialize the screen • To clear the values input up to that time while entering the values. • To clear error message and cancel alarms.
6	[del]	Delete Key	Use in the following cases. • To delete input values. • To delete a line of the displayed time program while creating it.
7	[Enter]	Enter Key	Confirms input values of the setting items
8	[↑][→] [↓][←]	Arrow Keys	Moves the cursor or switches the screen
9	[·] to [9]	Numeric Keys	Inputs values for the setting items.

No.	Key	Name	Function
10	[-]	Minus Key	No use

Regarding the acceptable part of the arrow keys on the touch panel.

When operating the arrow keys, it responds by touching the part including the upper and lower range of each key indication on the operation panel.

No.	Description
1	Acceptable part of [↑] key input.
2	Acceptable part of [→] key input.
3	Acceptable part of [↓] key input.
4	Acceptable part of [←] key input.



3 Operation

3.1 Settings for the Basic Operation

Before operating this instrument, it is necessary to set the flow rate and the pressure limit to protect flow line parts such as columns.

See the product specifications before use.

Reference "5.1.1 LC-40D X3 CL Specifications" P.125
"5.1.2 LC-40D XR CL Specifications" P.126

3.1.1 Prior to Key Operation

Touching the central part of the operation panel displays the operation keys that the user can operate.

3.1.2 Setting Flow Rate

The following is the basic procedure for setting a flow rate [FLOW].

1 **Displays the initial screen (the screen that is displayed when the power is turned ON).**

If the initial screen is not displayed, press [CE] to display the initial screen.

2 **Press [Enter].**

The cursor blinks at the input position indicating that the flow rate [FLOW] can be input.

3 **Input the flow rate with the numeric keypad and press [Enter].**

The flow rate [FLOW] is set and the display returns to the initial screen.

Hint To cancel the input value, press [CE].

3.1.3 Setting Compressibility

1 **Press [→] twice on the initial screen.**

The FUNCTION setting group is displayed.

2 **Move the cursor to [PARAMETER], and press [→].**

The PARAMETER setting group is displayed.

3 **Press [↓] several times until [COMP] (compressibility correction) is displayed in the screen and press [Enter].**

The cursor blinks at the input position indicating that the compressibility [COMP] can be input.

4 **Input the compressibility [COMP] for the solvent to be used (0.45 for water) with the numeric keypad.**

Reference "Setting the compressibility of solvent《COMP》" P.32

3.1.4 Setting Maximum Pressure Limit

The maximum pressure limit is the pressure in the flow line that may not be exceeded.

If pressure exceeds the maximum limit, pumping stops automatically, and the error message will be displayed with the alarm sound.

■ Setting Procedure

The following is an example to set the maximum pressure [P.MAX] to 15.0 MPa.

1 **Press [→] three times on the initial screen.**

The PARAMETER setting group is displayed.

2 **Press [Enter].**

The cursor blinks at the input position indicating that [P.MAX] can be input.

3 **Press [1], [5], [.], [0] and [Enter].**
The maximum pressure is set to 15.0 MPa.

NOTE The allowable maximum pressure is 130 MPa for LC-40D X3 and 70 MPa for LC-40D XR CL. When connecting the instrument with other equipment, set the maximum pressure to the lowest allowable maximum pressure of the equipment.

Reference "Setting the maximum pressure limit during pumping《P.MAX》" P.31

3.1.5 Setting Minimum Pressure Limit

The purpose of the minimum pressure limit is to prevent a pressure drop which can occur as a result of the following situations:

- When the mobile phase runs out, air will be pumped through the flow lines resulting in a pressure drop.
- When a leak occurs in the flow lines, a pressure drop may be observed.

If the pressure is lower than the minimum pressure limit after one minute during pumping, the flow stops automatically.

Then the error message will be displayed with the alarm sound.

■ Setting example

The following is an example to set the minimum pressure [P.MIN] to 2.0 MPa.

1 **Press [→] three times on the initial screen.**
The PARAMETER setting group is displayed.

2 **Press [↓] once and on the [P.MIN] screen, press [Enter].**
The cursor blinks at the input position indicating that [P.MIN] can be input.

3 **Press [2], [.], [0] and [Enter].**

The minimum pressure is set to 2.0 MPa.

NOTE If [P.MIN] is set to "0", solvent delivery will not stop and an alarm will not sound even if the pressure has dropped. The minimum pressure can be set to 130 MPa max. for LC-40D X3 CL and 60 MPa max. for LC-40D XR CL.

Reference "Setting the minimum pressure during delivery《P.MIN》" P.31

3.2 Operation

3.2.1 Preparation before Operation

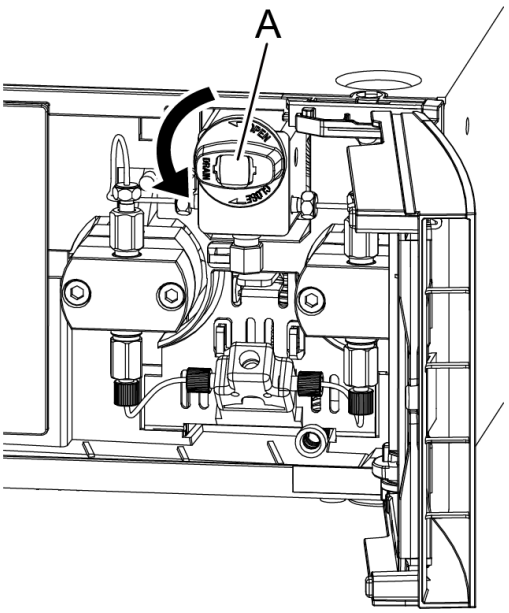
1 **Pour the mobile phase into the reservoir bottle.**

2 **Place a suction filter into the reservoir bottle.**

3 **Connect the tubing provided to the pump outlet.**

4 **Put the end of the drain tubing into the waste container.**

5 **Turn the drain valve knob 90°counterclockwise to open the drain valve.**



6 **Press [PURGE], and then [ENTER].**

Hint During delivery, first press [pump] and [ENTER] to stop the delivery, then press [purge] and [ENTER].

NOTE IF the drain valve knob is turned more than 180°, any mobile phase that drains out may contain air bubbles. This is normal.

3.2.2 Operation in Constant Flow Delivery Mode

There are two basic operating modes; one is in constant flow delivery mode and the other is in constant pressure delivery mode.

1 **Turn the drain valve knob clockwise as far as possible to close the drain valve.**

2 **Press [CE].**
The initial screen is displayed.

3 **Press [Enter] once and set the flow rate to be delivered.**

Hint To set 1 mL/min, press [1] and [Enter].

4 **Press [PUMP], and then [ENTER].**
[PUMP] on the display is highlighted and the pump starts operation.

5 **Check that the pump outlet pressure is increasing on the pressure indication display.**

6 **To stop operation, press [PUMP], and then [ENTER].**

[PUMP] on the display stops being highlighted and the pump stops operation.

⚠ CAUTION

Instruction

Close the drain valve when not draining through the drain path.

If the drain valve is left opened, a pressure difference may cause the mobile phase solvent to flow out of the drain outlet.

3.2.3 Operation in Constant Pressure Delivery Mode

NOTE This function is available only for LC-40D XR CL.

1 **Turn the drain valve knob clockwise as far as possible to close the drain valve.**

2 **Press [→] twice on the initial screen.**

The FUNCTION setting group is displayed.

3 **Press [↓] once, move the cursor to [CONTROL] and press [→].**

The CONTROL setting group is displayed.

4 **Press [↓] twice and on the [MODE CHANGE] screen, press [Enter].**

The numeric keypad becomes active allowing the user to input numbers.

5 **Press [1] and [Enter].**

The delivery mode changes from the constant flow delivery mode to the constant pressure delivery mode.

Reference "Switching the delivery mode《MODE CHANGE》(Only for LC-40D XR CL)" P.38

6 **After changing the mode, press [CE] once.**

The initial screen of the constant pressure delivery mode is displayed.

7 **Press [Enter].**

[press] becomes ready to accept input.

8 **Set the pressure with the numeric keypad.**

Hint To set 2.0 MPa, press [2], [.], [0] and [Enter].

9 **Press [PUMP], and then [ENTER].**

[PUMP] on the display is highlighted and the pump starts operation.

10 **Observe that the pump outlet pressure rises and pressure display stabilizes at about 2.0 MPa.**

Hint While monitoring the pressure, increase the flow rate until the pressure reaches the set value. If increasing the flow rate does not increase the pressure, stop increasing the flow rate at 1 mL/min.

11 **To stop operation, press [PUMP], and then [ENTER].**

[PUMP] on the display stops being highlighted and the pump stops operation.

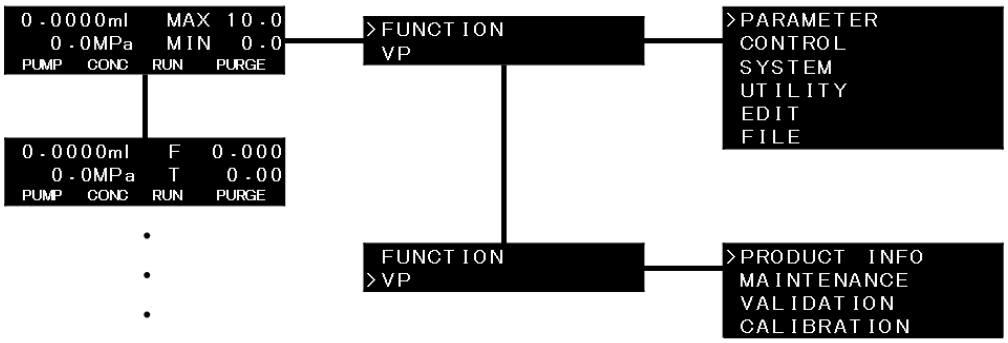
3.3 Types of Screens

Turning ON the power displays the initial screen.

By pressing the [↓] and [→] arrows on the initial screen, the screen can be switched from the initial screen to one of three screens below:

Displays Screen	Description
Monitor screen	View the status of the instrument. Reference "3.4 Monitoring Screens" P.24
Auxiliary functions screen	Configure various parameter settings and perform operations. Reference "3.5 Auxiliary Functions Screen (FUNCTION)" P.28
VP function screen	Supports the validation of the instrument with functions for viewing and checking instrument information. Reference "3.6 VP Functions Screen" P.47

Pressing [→] on the initial screen displays the screen to select the auxiliary functions screen [FUNCTION] or VP functions screen [VP]. Move the cursor to the desired option with [↓] or [↑] and press [→] to display the screen. Press [←] to return to the previous screen. And Press [CE] to return to the initial screen.



3.4 Monitoring Screens

This section describes the monitoring screens.

Press [↓] on the initial screen to show the various types of information.

Name	Description	Reference
MONITOR FLOW/TIME	To show the actual flow rate during delivery. The elapsed time is shown while a time program runs.	P.24
MONITOR ID/SV	To show the pump ID and the flow path of the flow path switching valve.	P.24
CONDITION	To show the Auto-Diagnostics result when Auto-Diagnostics is on. The delivery status of the pump is shown when Auto-Diagnostics is off. Reference "Turning on/off Auto-Diagnostics《AUTO DIAGNOSTICS》" Hint • Auto-Diagnostics can cause a warning when a delivery failure is detected. • This screen is not shown in the constant pressure delivery mode.	P.68
DEGAS PRESSURE	To show the vacuum pressure of the degassing unit.	P.26
PC/WS*1	To show the status of the connection between the instrument and the PC/WS.	P.27

*1 Shown only when CBM-40 CL is connected.

■ Monitoring Program Elapsed Time《MONITOR FLOW/TIME》

On the right side of the first line, the flow rate actually delivered is displayed in real time when the instrument is in the constant pressure delivery mode or while the flow rate is gradually increased with the [FLOW SLOPE] function. The elapsed time is displayed on the right side of the second line while a time program runs.

Reference "Setting the time to reach the set flow rate after the start of delivery《FLOW SLOPE》"

■ Displaying the pump ID and the port of the flow path switching valve connected to the instrument during remote control《MONITOR ID/SV》

When the system controller is connected, one of the pump connection addresses (A, B, C, or D) of the system controller is displayed on the lower left side of the screen.

On the right side of the screen, the open ports of the flow path switching valve connected to the instrument are displayed. In the previous figure, the connection address of the system controller is set to A. When the low-pressure gradient valve is used, the set ports open only during delivery. While delivery is stopped, the screen displays "OFF".

■ Displays of Condition《CONDITION》

The screen displays a delivery status Auto-Diagnostics result during analysis when the Auto-Diagnostics function is on. This screen is not displayed in the constant pressure delivery mode.

Reference "Switching the delivery mode《MODE CHANGE》(Only for LC-40D XR CL)" P.38

Display	Auto-Diagnostics Status	
Diag Off	The delivery status is not being judged. This is displayed while delivery is stopped or when not being analysed etc.	
Diag Monitoring	Judgment of the delivery status is in progress.	
Diag NotDetected	Delivery failure was not detected.	
Diag Detected	Delivery failure was detected.	

NOTE Auto-Diagnostics issues a warning if a pulse exceeds a specific threshold.
Note that very slight pressure variation may not be detected.

The table shows a guideline of the conditions under which the Auto-Diagnostics function can correctly detect a delivery failure.

Item	Specification
Pumping Methods	Constant flow pumping Reference "Switching the delivery mode《MODE CHANGE》(Only for LC-40D XR CL)" P.38
Flow Rate	0.1 to 2 mL/min * Pumps should satisfy the above flow rate range in the high -pressure gradient mode.

Item	Specification
Delivery Pressure	LC-40D X3 CL: 5 to 130 MPa LC-40D XR CL: 5 to 70 MPa
Pumping Modes	Isocratic, two-solvent high-pressure gradient, two-solvent low-pressure gradient

NOTE The Auto-Diagnostics function may not work in case of a significant pressure decrease, such as when a large bubble enters the pump head. For this reason, set the lower pressure limit P.MIN when using the function.

When Auto-Diagnostics is off, change in the pump pressure is detected and a delivery status is displayed.

Display	Delivery Status
Press Stable	Delivery is stable.
Press Dec Left	The pressure of the pump head that is on the left when viewed from the front is decreasing during discharge.
Press Dec Right	The pressure of the pump head that is on the right when viewed from the front is decreasing during discharge.
Press Increase	The pressure is at least 10 % higher than that 5 minutes ago.
Press Decrease	The pressure is at least 10 % lower than that 5 minutes ago.

NOTE [Press Increase] and [Press Decrease] are also displayed during normal operation, such as when the pumps start and stop.

If [Press Dec Right] is displayed, it may indicate one of the following:

- Air remains inside the right pump head.
- There is a leak in the right pump head's seal.
- The right pump head's inlet check valve or the left pump head's outlet check valve are not operating properly.

If [Press Dec Left] is displayed, it may indicate that conditions described above have occurred for the left pump head.

Reference "Turning on/off Auto-Diagnostics《AUTO DIAGNOSTICS》" P.68

■ Monitoring Vacuum Pressure in Degassing Unit《DEGAS PRESSURE》

The screen displays the vacuum pressure of the degassing unit connected to the instrument.

- [(OK)] is displayed when the vacuum pressure is at a normal value.
- [(NG)] is displayed when the vacuum pressure is at an abnormal value.

[Disconnected] is displayed when a degassing unit is not connected.

■ Displaying the status of connection with PC/WS《PC/WS》

The screen displays the status of connection with a PC/WS.

[Connected] is displayed when the instrument is connected with a PC/WS.

This screen is displayed only when the CBM-40 CL is connected.

[Disconnected] is displayed when the instrument is not connected with a PC/WS.

3.5 Auxiliary Functions Screen (FUNCTION)

The auxiliary functions screen has six setting groups. Switch the groups with [↑] or [↓] and press [→] to enter the screen of the desired setting group. Press [CE] to return to the initial screen.

Setting Group Name	Description
PARAMETER	The group allows the user to set analysis parameters.
CONTROL	The group enables specific operation.
SYSTEM	The group allows the user to set parameters related to the system such as parameters of connection with external equipment.
UTILITY	The group allows the user to set parameters not related to the analysis result such as display and buzzer parameters.
EDIT	Time programs can be edited.
FILE	Not used in CL model.

3.5.1 Auxiliary Functions (FUNCTION) List

■ [PARAMETER] settings group

Name	Description	Remark	Ref.
P.MAX	Sets the maximum pressure limit for solvent delivery.	Initial value: 10 Set value: (LC-40D X3 CL) 1.0 to 130.0 MPa (LC-40D XR CL) 1.0 to 70.0 MPa	P.31
P.MIN	Sets the minimum pressure limit for solvent delivery.	Initial value: 0 Set value: (LC-40D X3 CL) 0 to 130.0 MPa (LC-40D XR CL) 0 to 60.0 MPa	P.31
COMP	Makes fine adjustment of compressibility correction of solvent.	Initial value: 0.45 Set value: 0.00 to 3.00	P.32
INT.SV PORT	Sets the port of the internal low-pressure gradient kit or mobile phase switching valve.	Initial value: 1 Set value: 1: A 2: B 3: C 4: D	P.33
EXT.SV PORT CH1/CH2/CH3	Not used in CL model*	Initial value: 1	-
EVENT1	Not used in CL model*	Initial value: 0	-
EVENT2	Not used in CL model*	Initial value: 0	-
LPGE CYCLE	Sets the low-pressure gradient operation mode.	Initial value: 0 Set value: 0: Standard mode 2: 2, 4, and 8-cycle mode 4: 4-cycle mode 8: 8-cycle mode	P.35

Name	Description	Remark	Ref.
PURGE TIME	Sets a purge execution time.	Initial value: 3 Set value: 1 to 20 minutes	P.35
PURGE FLOW	Sets a purge flow rate.	Initial value: 4.0 Set value: 0.1 to 10.0 mL/min	P.35
PURGE P.MAX	Sets maximum pressure limit at purging.	Initial value: 10.0 Set value: 1.0 to 10.0 MPa	P.36
RINSING OPERATE	Sets the delivery amount of the optional rinsing pump when the pump is used.	Initial value: 0 (OFF) Set value: 0 to 4	P.36
FLOW SLOPE	Sets the time to reach the set flow rate during delivery.	Initial value: 0 Set value: 0 to 30.00 minutes	P.37

* Do not change the factory default value.

■ [CONTROL] settings group

Name	Description	Remark	Ref.
PLUNGER SET	Moves the plunger position. Replace the plunger or the plunger seal.	Initial value: 0 Set value: 0: Stop 1: L 2: R 3: M	P.37
ZERO ADJUST	Performs zero adjustment of pressure screen.	-	P.37
MODE CHANGE	(Only for LC-40D XR CL) Switches between the constant flow delivery mode and the constant pressure delivery mode.	Initial value: 0 Set value: 0: Constant flow 1: Constant pressure	P.38

■ [SYSTEM] setting group

Name	Description	Remark	Ref.
LOCAL MODE	Selects independent operation or control via system controller.	Initial value: 0 Set value: 0: Remote 1: Local	P.38
LINK ADDRESS	Sets address of the instrument for control via system controller.	Initial value: 4 Set value: 1 to 12	P.38
CONTROLLER LINK	Selects the type of the connected system controller.	Initial value: 1 Set value: 0: Int 1: Ext	P.39
SELECT EVENT1	Not used in CL model.*	Initial value: 0	-
SELECT EVENT2	Not used in CL model.*	Initial value: 0	-
PUMP CONFIG (SYS)	Input values according to the system used.	Initial value: 1 Set value: 1: Standard 4: Low-pressure gradient mode	P.40
SYSTEM PROTECT	Reduces the flow rate without stopping the pumping when the pressure exceeds the P.MAX value.	Initial value: 0 Set value: 0: Clear 1: Set	P.40

Name	Description	Remark	Ref.
EXT.SV TYPE	Not used in CL model.*	Initial value: 0	-
EXT.SV SERIAL	Not used in CL model.	Initial value: -	-
EXT.SV CHANNEL	Not used in CL model.*	Initial value: 0	-
PRESSURE UNIT	Sets the unit of the displayed pressure.	Initial value: 0 Set value: 0: MPa 1: kgf/cm^2 2: bar 3: psi	P.42
INNER VOLUME	Input the tube volume.	Initial value: 0 Set value: 0 to 9999.9	P.43

* Do not change the factory default value.

■ [UTILITY] setting group

Name	Description	Remark	Ref.
KEY CLOSE	Disables the key input.	-	P.44
BRIGHTNESS	Sets the brightness of display screen.	Initial value: 4 Set value: 1 to 4	P.44
BEEP MODE	Sets the operation of buzzer.	Initial value: 0 Set value: 0: ON 1: Alarm 2: OFF	P.44
VOLUME	Sets the buzzer volume.	Initial value: 2 Set value: 1 to 3	P.44
DISP OFF TIME	The operation panel turns off after the time set here elapses.	Initial value: 1 Set value: 0 to 10 min	P.44
DIRECT KEY MODE	Specifies whether to display the confirmation screen when the direct key is operated.	Initial value: 0 Set value: 0: Confirm 1: Direct	P.45

■ [EDIT] group

Use this group to create a time program. For details, see "3.7 Creating Time Program" P.69.

■ [FILE] operation group

⚠ CAUTION

This function is not used because events are not used in the CL model.

Name	Description	Remark
FILE NUMBER	Selects a program file No.	Initial value: 0 Set value: 0 to 9

Name	Description	Remark
FILE COPY	Copies a file.	Initial value: 0 Set value: 0 to 9
FILE DELETE	Deletes a time program from a file.	-

About files:

The instrument can store up to 10 files of flow rate and other parameter values, and time programs in memory. File No. 0 to 9 are assigned to each file. The auxiliary functions except [INT.SV PORT] and [EXT.SV PORT] are common functions.
Use [FILE NUMBER] of the file operation group to switch the files.

3.5.2 [PARAMETER] Setting Group

This setting group is relevant to solvent delivery parameters.

■ Setting the maximum pressure limit during pumping《P.MAX》

When the delivery pressure exceeds the set value, an error will occur and stop delivery.

Input the value with the numeric keypad and press [Enter].

Setting Range		Setting Step
LC-40D X3 CL	LC-40D XR CL	
1.0 to 130.0 MPa	1.0 to 70.0 MPa	0.1 MPa
10 to 1326 kgf/cm	10 to 714 kgf/cm	1 kgf/cm
10 to 1300 bar	10 to 700 bar	1 bar
142 to 19000 psi	142 to 10157 psi	1 psi

1 kgf/cm^2 = 0.098 MPa = 0.98 bar = 14.2 psi

■ Setting the minimum pressure during delivery《P.MIN》

When the delivery pressure falls below the set value for a specific time, an error will occur and stop delivery.

Input the value with the numeric keypad and press [Enter].

Setting Range		Setting Step
LC-40D X3 CL	LC-40D XR CL	
0 to 130.0 MPa	0 to 60.0 MPa	0.1 MPa
0 to 1326 kgf/cm^2	0 to 612 kgf/cm^2	1 kgf/cm^2
0 to 1300 bar	0 to 600 bar	1 bar
0 to 19000 psi	0 to 8706 psi	1 psi

1 kgf/cm^2 = 0.098 MPa = 0.98 bar = 14.2 psi

■ Setting the compressibility of solvent《COMP》

Although the instrument corrects the compressibility to suppress pulse increase caused by the effect of the compressibility of the solvent, setting a compressibility suitable for the solvent used enables more accurate correction.
Input the compressibility (GPa)$^{-1}$ with the numeric keypad and press [Enter]. The initial value is 0.45.

Mobile Phase	compressibility (GPa)$^{-1}$
Water	0.45
Acetonitrile	1.20
Methanol	1.25
Ethanol	1.20
2-propanol	1.20
Hexane	1.60
Heptane	1.25
Cyclohexane	1.25
Ethyl Acetate	1.10
Chloroform	1.10
Benzene	1.00

Single solvent

Set the compressibility according to the table.

Mixture of water and organic solvent

If the concentration of the organic solvent is 50 % or less, "0.45" is recommended for the compressibility of water. If the concentration is more than 50 %, make the value closer to the compressibility of organic solvent according to the mixture ratio.

Example) When the ratio between water and acetonitrile is 50 : 50, set "0.45".

When the ratio between water and acetonitrile is 30 : 70, set "0.75".

In other cases or when rigorous adjustment is required

1 **Connect a resistance tube (or column) that can create pressure similar to the desired delivery pressure at 1.0 mL/min or less and wait until delivery becomes stable.**

2 **While monitoring fluctuation on the pressure monitor of the instrument, gradually increase the set value of [COMP] from 0.45 in 0.05 increments to find the COMP value with the minimum fluctuation on the pressure monitor.**

In the low-pressure gradient mode, the setting screen will be as shown in the figure.
Press [→] to enter the [COMP A] (mobile phase A compressibility) setting screen.
Press [↓] or [↑] to set the compressibilitys of the four solvents (A, B, C, and D).
Solvents are delivered at the compressibility optimized according to the set mixture ratio.

■ Setting the port of the internal solenoid valve《INT.SV PORT》

Select the mobile phase port used for delivery when the optional low-pressure gradient kit is used as a mobile phase switching valve or when the internal reservoir switching valve is used. Input the value (the set value in the table) of the desired mobile phase port with the numeric keypad and press [Enter].

(Default screen)

(Screen for low-pressure gradient kit)

Solenoid Valve Type	Set value	Mobile Phase Port
Low-Pressure Gradient Kit	1	Solvent A
	2	Solvent B
	3	Solvent C
	4	Solvent D
Reservoir Switching Valve	1	Solvent A
	2	Solvent B

Hint The value cannot be input if the instrument has no internal solenoid valve.

■ Setting the flow path of the mobile phase switching valve connected to the back of the instrument《EXT.SV PORT CH1 / CH2 / CH3》

⚠ CAUTION

Prohibition

Not used in CL model.
Do not change the factory default value.

■ Setting the EVENT1 output terminal《EVENT1》

⚠ CAUTION

Prohibition

Not used in CL model.
Do not change the factory default value.

Set "ON" (close) / "OFF" (open) of the [EVENT1] output (relay contact) on the back of the instrument.

Set Value	EVENT1 Output
0	Relay 1 OFF
1	Relay 1 ON

■ Setting the EVENT2 output terminal《EVENT2》

⚠ CAUTION

Prohibition

Not used in CL model.
Do not change the factory default value.

Set "ON" (close) / "OFF" (open) of the [EVENT2] output (relay contact) on the back of the instrument.

Set Value	EVENT2 Output
0	Relay 2 OFF
1	Relay 2 ON

■ Setting the low-pressure gradient mode《LPGE CYCLE》

Set the operation mode of low-pressure gradient.

Set Value	Low-Pressure Gradient Mode
0 (Standard)	The mode is automatically selected according to the flow rate. 2.0000 mL/min or less: 4-cycle mode 2.0001 mL/min or more: 8-cycle mode
2	2-cycle mode Select this mode when using a low-capacity mixer with 300 µL or less internal capacity. In any other mode, concentration will be more uneven resulting in a wavier baseline on the detector.
4	4-cycle mode This mode is suitable for a mixer with approximately 0.5 mL internal capacity.
8	8-cycle mode This mode is suitable for a mixer with a 1.5 mL or higher internal capacity.

■ Setting the purging time《PURGE TIME》

Set the purging time.

The value can be set in the range from 1 minute to 20 minutes in one minute increments.

■ Setting the purging flow rate《PURGE FLOW》

Set the purging flow rate. This setting is effective for both purging with the [PURGE] operation in the instrument and auto purging with the system controller.

The value can be set in the range from 0.1 mL/min to 10.0 mL/min in 0.1 mL/min increments.

> **NOTE** The flow rate set here is approximate for replacing the mobile phase in the pump.

■ Setting the maximum pressure during purging《PURGE P.MAX》

Set the maximum pressure during auto purging.

For a purging operation started by the [PURGE] key of the instrument, the maximum pressure limit function works at 2.0 MPa and displays the error shown in the figure as well as stopping delivery.

Setting Range	Setting Step
1.0 to 10.0 MPa	0.1 MPa
10 to 102 kgf/cm^2	1 kgf/cm^2
10 to 100 bar	1 bar
142 to 1451 psi	1 psi

1 kgf/cm^2 = 0.098 MPa = 0.98 bar = 14.2 psi

■ Setting the delivery amount of the rinsing pump《RINSING OPERATE》

Set the delivery amount of the optional rinsing pump.

During delivery or purging operation, if the setting is "standard", the rinsing pump starts with 6-second delivery and then delivers rinsing solution for 2 seconds at intervals of 1 minute. The other settings double or triple the 2-second delivery time.

The user can set the delivery amount to one of the four levels below.
Selecting "0" disables the rinsing pump.
Based on the delivery amount per hour in the following table, prepare necessary the amount of the rinse solution for the analysis time.

NOTE
- The delivery amount in the table is approximate for rinsing.
- Select "0" when not using the rinsing pump.

Hint
- The approximate delivery amount necessary for replacing the rinse solution in the rinsing flow path is approximately 10 mL.
- To replace the rinse solution in the rinsing flow path, select "4" and operate the pump approximately 3 minutes.

Set Value	Delivery Amount per Hour (mL/h)	Remark
0	0	The rinsing pump is disabled.
1	30	Half of standard
2	60	Standard
3	120	Twofold amount of standard
4	240	Fourfold amount of standard

■ Setting the time to reach the set flow rate after the start of delivery《FLOW SLOPE》

Set the time to reach the set flow rate after the start of delivery.

The value can be set in the range from 0 minutes to 30.00 minutes in 0.01 minute increments.

Selecting "0" disables this function.

3.5.3 [CONTROL] Setting Group

■ Setting the plunger stop position《PLUNGER SET》

Set the plunger stop position. This setting is used for maintenance.

[PUMP] on the display is highlighted and the plunger starts moving. [PUMP] on the display stops being highlighted after the plunger finishes moving.

Set Value	Function
0	The plunger stops moving.
1	The plunger on the left when viewed from the front is retracted. In this state, the left pump head is removed.
2	The plunger on the right when viewed from the front is retracted. In this state, the right pump head is removed.
3	The plunger stops at the middle position.

■ Zero adjustment of pressure sensor《ZERO ADJUST》

Set the reference value for the zero point of the pressure sensor.

1 **Open the drain valve to remove pressure completely.**

2 **Press [Enter].**

■ Switching the delivery mode《MODE CHANGE》(Only for LC-40D XR CL)

Switch between the constant flow delivery mode and the constant pressure delivery mode.

NOTE Stop the pump before switching the delivery mode. Switching the delivery mode while the pump is operating is not possible.

3.5.4 [SYSTEM] Setting Group

This group is relevant to the system configuration such as connection with external equipment.

■ Selecting the local/remote mode《LOCAL MODE》

When the system controller is connected, the user can select whether to operate the instrument independently or with the system controller.

Set Value	Mode	Function
0	Remote	The instrument is operated with the system controller.
1	Local	The instrument is operated independently (local mode).

■ Setting the link address《LINK ADDRESS》

Set the address (channel No.) used to connect with the system controller.

Address	Function
1 to 12	A channel number for connecting with the system controller

■ Setting the link destination of the system controller《CONTROLLER LINK》

Select the type of the connected system controller.

Set Value	Function
0	Not used in CL model.
1	The instrument is connected to an external system controller (CBM-40 CL) via an optical cable connected to the [REMOTE] connector.

■ Setting the function of the EVENT1 output terminal《SELECT EVENT1》

⚠ CAUTION

Prohibition

Not used in CL model.
Do not change the factory default value.

Set the mode of controlling external equipment via the [EVENT1] output (relay 1).

Set Value	Function
0	The relay contact is controlled with the [EVENT1] set value.
1	The relay contact 1 [EVENT1] is used as a start signal of a time program.

NOTE If the SELECT EVENT1 function is used, the corresponding EVENT parameter is disabled.

■ Setting the function of the EVENT2 output terminal《SELECT EVENT2》

⚠ CAUTION

Prohibition

Not used in CL model.
Do not change the factory default value.

Set the mode of controlling external equipment via the [EVENT2] output (relay 2).

Set Value	Function
0	The relay contact is controlled with the [EVENT2] set value.
1	The relay contact 2 [EVENT2] is used as an error output signal.

NOTE If the SELECT EVENT2 function is used, the corresponding EVENT parameter is disabled.

■ Setting the system parameter《PUMP CONFIG (SYS)》

Input values according to the status of the system used.

Set Value	Function
1	The instrument is controlled independently or with external equipment
4	The instrument is used as a low-pressure gradient system

NOTE The system functions normally only with the above values. Values other than the above cannot be set.

Setting the set value to "4" (low-pressure gradient system) highlights [CONC] on the display allowing the user to set a concentration.

■ Setting the system protection《SYSTEM PROTECT》

When [P.MAX] is active, the flow rate is reduced in increments of a half rate while delivery is continued until the pressure falls below [P.MAX].

Set Value	Function
0	Do not use system protection.
1	Use system protection.

Hint To clear a [P.MAX] error, press [CE]. The alarm stops and the flow rate returns to that before the error.

■ Selecting the type of external solenoid valve《EXT.SV TYPE》

⚠ CAUTION

Prohibition

Not used in CL model.
Do not change the factory default value.

Select the type of flow switching valve (optional) connected to the [SV] connector on the back of the instrument.

Set Value	Function
0	Do not use FCV.
1	Not used in CL model.
2	Not used in CL model.

■ Inputting the serial number of the external flow path switching valve《EXT.SV SERIAL》

⚠ CAUTION

Prohibition

Not used in CL model.

Input the serial number of the flow path switching valve connected to the SV connector on the back of the instrument.

■ Selecting the flow path of the solenoid valve unit《EXT.SV CHANNEL》

⚠ CAUTION

Prohibition

Not used in CL model.

Do not change the factory default value.

Set Value	Port
0	The port does not pass through a flow path of FCV-11AL/FCV-11ALS
1	Not used in CL model.
2	Not used in CL model.
3	Not used in CL model.

■ Setting the unit of the displayed pressure《PRESSURE UNIT》

Set the unit of the displayed pressure.

Set Value	Unit of Displayed Value
0	MPa
1	kgf/cm^2
2	bar
3	psi

1 kgf/cm^2 = 0.098 MPa = 0.98 bar = 14.2 psi

■ Inputting the tube volume《INNER VOLUME》

Inputting a value in a low-pressure gradient system enables the system controller to calculate the system volume. Refer to the table to input an appropriate value according to the tubes used.

Input "0" in any mode other than the low-pressure gradient mode.

Tubing Between Solenoid Valve and Pump Inlet	Tubing Between Pump Outlet and Mixer Inlet	Set Value
Standard tube (OUT tube, 310 mm)	SUS Tubing (ID 0.3 x 600)	200 µL
	SUS Tubing (ID 0.3 x 300)	180 µL
Tube for buffer solution (OUT tube, 400 mm)	SUS Tubing (ID 0.3 x 600)	355 µL
	SUS Tubing (ID 0.3 x 300)	335 µL
Use the Mixer installation kit (228-65020-41)	SUS Tubing (ID 0.3 x 185)	0 µL

Hint

- The values above are intended when using the mixer recognition device. When the mixer recognition device is not used, add the capacity depending on the mixer.
  The column oven automatically recognise the capacity of the mixer when using the mixer recognition device.
- The values above are intended for the recommended tubes. When using a tube not listed above, increase or decrease the capacity depending on the tube.

Example

1) Use the standard tube + SUS Tubing (ID 0.3 x 600) + Mixer MR40 LPGE (without the mixer recognition device)
→Set value: 240 (200 µL （from the table above） + 40 µL (mixer capacity))

2) Using the tube for buffer solution + SUS Tubing (ID 0.3 x 600) + Mixer MR40 LPGE (with the mixer recognition device)
→Set value: 355（from the table above） (The capacity of the mixer will be automatically recognised by the column oven)

3) Use the mixer instllation kit (without the mixer recognition device)
→Set value: 40 (0 µL （from the table above） + 40 µL (mixer capacity))

3.5.5 [UTILITY] Setting Group

This setting group is relevant to the display monitor.

■ Disables the key entry《KEY CLOSE》

Press [Enter] to disable key input.
From this point, keypad input is disabled.

Hint To release this function, press [Enter] while pressing [CE].

■ Setting the brightness of display screen《BRIGHTNESS》

Sets the brightness of the display screen.
The value range is 1 to 4, and 4 is the brightest.

■ Setting the operation of buzzer《BEEP MODE》

Sets the buzzer sound.

Set Value	Function
0	The key input sound, as well as the alarm sound to go off when an error occurs, are activated. (Default setting)
1	Only the alarm sound that goes off when an error occurs is activated.
2	All the buzzer sounds are deactivated.

■ Setting the operation of buzzer volume《VOLUME》

Set the buzzer sound level. A larger setting value increases the sound level.

■ Setting the time to turn off the operation panel automatically《DISP OFF TIME》

Sets the time elapsed before the operation panel automatically turns to the sleep mode, when no operations are performed on the instrument.

The setting range is from 0 to 10 (min), in which the step can be set by minute.

If 0 (min) is input, the operation panel remains on.

> **NOTE** Setting "0" minutes causes the display screen to be always on. If the display screen is always on, some dots frequently lighting will deteriorate in brightness in a shorter time.

■ Setting the direct keys《DIRECT KEY MODE》

To prevent unintended operation, a confirmation screen can be displayed when a direct key ([PUMP], [RUN], or [PURGE]) is pressed.

For example, setting this function to "0" (Confirm) and then pressing [PUMP] displays the confirmation screen shown in the figure. Pressing [Enter] starts the operation.

> **Hint** When the optional low-pressure gradient kit or reservoir switching valve is installed inside, pressing [PURGE] when starting purging does not display the confirmation screen. The confirmation screen, however, is displayed when purging is stopped.

3.5.6 [FILE] Operation Group

⚠ CAUTION

Prohibition

This function is not used because events are not used in the CL model.

■ Specifying the file number《FILE NUMBER》

The instrument allows the user to create and store a maximum of ten time programs. The program files can be selected with the parameter.

Hint Select the file number from 0 to 9.

Input the file number with the numeric keypad and press [Enter].

■ Specifying the file copy destination《FILE COPY》

The program content of the currently selected file (indicated by the number of [FILE NUMBER] above) is copied to the file of a specified number.

Input a file number with the numeric keypad and press [Enter].

■ Deleting a file《FILE DELETE》

The time program of the currently selected file is deleted.

Press [Enter].

3.6 VP Functions Screen

The VP functions screen has four setting groups. Switch the groups with [↑] or [↓] and press [→] to enter the screen of the desired setting group. Press [CE] to return to the initial screen.

Setting Group Name	Description
PRODUCT INFO	The group is relevant to information of the instrument.
MAINTENANCE	The group is relevant to maintenance of the instrument.
VALIDATION	The group allows the user to check whether the instrument is operating correctly.
CALIBRATION	The group is for calibration of the instrument.

3.6.1 List of VP Functions

■ Product information group [PRODUCT INFO]

Name	Function	Ref.
SERIAL NUMBER	Displays the serial number of the instrument.	P.49
S/W ID	Displays the S/W version number.	P.49

■ Maintenance information group [MAINTENANCE]

Name	Function	Ref.
TOTAL OP TIME	Displays the total operation time of the instrument.	P.49
L SEAL USED	Displays or reset the total delivery amount of the currently used plunger seal and the delivery amount that requires replacement (for the left seal).	P.49
R SEAL USED	Displays or reset the total delivery amount of the currently used plunger seal and the delivery amount that requires replacement (for the right seal).	P.49
MOBILE PHASE*1	Displays the remaining amount of mobile phase and set an amount.	P.50
ALARM LEVEL	Specifies a threshold to cause an alarm of low mobile phase level.	P.50
PART REPLACEMENT	Input the part number of the replaced part when replacing the part.	P.51
MAINTENANCE LOG	Displays the maintenance log.	P.51
OPERATION LOG	Displays the log of password change, parameter reset, etc.	P.51
ERROR LOG	Displays the error log.	P.52
DGU OP TIME	Displays or reset the operation time of the degassing unit connected to the instrument.	P.52

*1 Normally one solvent can be set for the mobile phase level monitoring function. Only in the low-pressure gradient mode, four solvents (A to D) can be set.

■ Validation support information group [VALIDATION]

Name	Function	Ref.
DATE	Displays or set the date.	P.53
TIME	Displays or set the time.	P.53
MEMORY CHECK	Checks ROM/RAM.	P.54
LEAK SENSOR CHECK	Checks operation of the leak sensor.	P.54
PULSE CHECK	Checks the pulse.	P.55
FLOW CHECK	Checks the flow rate.	P.56
PRESS LIMIT CHECK	Checks that the maximum and minimum pressure functions work correctly.	P.60

■ Calibration support information group [CALIBRATION]

Name	Function	Ref.
Input PASSWORD*1	Input a password.	P.61
OPERATION MODE	Not used in CL model.*2	-
DATE FORMAT	Changes the displayed order of year, month and day.	P.62
INITIALIZE PARAM	Initializes parameters.	P.62
PARAMETER LOCK	To prohibit change of parameters.	P.62
PARTS MGMT TOOL	Sets the usage of the parts management tool.	P.63
PASSWORD SETTING	Changes the password.	P.63
CBM PARAMETER	Displays or set the parameters of the connected system controller.	P.64
LEAK THOLD	Sets the operation level of the leak sensor.	P.66
FLOW COMP FACTOR	Not used in CL model.*2	-
PRESS COMP FACTOR	Not used in CL model.*2	-
PLUNGER SEAL	Sets the time to replace the plunger seal.	P.68
P.MAX OVERRIDE	Sets override of the maximum pressure.	P.68
SV SELECT	Not used in CL model.*2	-
AUTO DIAGNOSTICS	Turns on/off Auto-Diagnostics.	P.68

* 1 In the calibration support group, an invalid password prevents the user from going further than [OPERATION MODE] even if the user presses [Enter].

* 2 Do not change the factory default value.

3.6.2 Product Information Group (PRODUCT INFO)

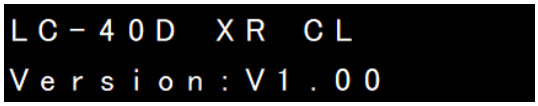
The group is relevant to information of the instrument.

■ Showing the serial number 《SERIAL NUMBER》

Displays the serial number of the instrument.

■ Displaying the S/W version number 《S/W ID》

The screen displays the S/W name (model name) and version.



3.6.3 Maintenance Information Group (MAINTENANCE)

The group is relevant to maintenance information of the instrument.

■ Showing the total operation time 《TOTAL OP TIME》

Displays the total cumulative operating time of the instrument.

■ Displaying the delivery amount of the left plunger seal 《L SEAL USED》

The screen displays the total delivery amount of the currently used plunger seal and the delivery amount that requires replacement (unit: L).

If the parts management tool (PARTS MGMT TOOL) is not used, press [del] after replacing the seal. The total delivery amount is reset to "0" and the reset date is recorded in the maintenance log.

Hint

- The plunger seal on the left when viewed from the front is shown as "L".
- When PARTS MGMT TOOL is active, the delivery amount cannot be reset on the operation panel. Reset it from PARTS MGMT TOOL. For the operation procedure, refer to the PARTS MGMT TOOL instruction manual.

■ Displaying the delivery amount of the right plunger seal 《R SEAL USED》

The screen displays the total delivery amount of the currently used plunger seal and the delivery amount that requires replacement (unit: L).

If the parts management tool (PARTS MGMT TOOL) is not used, press [del] after replacing the seal. The total delivery amount is reset to "0" and the reset date is recorded in the maintenance log.

Hint

- The plunger seal on the right when viewed from the front is shown as "R".
- When PARTS MGMT TOOL is active, the delivery amount cannot be reset on the operation panel. Reset it from PARTS MGMT TOOL. For the operation procedure, refer to the PARTS MGMT TOOL instruction manual.

■ Displaying and setting the remaining amount of mobile phase《MOBILE PHASE》

The screen displays the remaining amount and set amount of the current mobile phase.

When replacing the mobile phase, input the set amount of the mobile phase in the unit of mL and press [Enter].

The remaining amount is automatically calculated when solvent is delivered.

Normally only one solvent is supported. In the low-pressure gradient mode, four solvents (A to D) are supported.

A1, A2, B1, B2 etc. are shown if the low-pressure gradient kit and external mobile phase switching valve are used together.

■ Setting a threshold to cause an alarm of low mobile phase level《ALARM LEVEL》

The warning screen is displayed when the mobile phase level has fallen to the set percentage. Note that delivery continues.

Input the set value with the numeric keypad and press [Enter]. Setting the value to 0 % disables the low mobile phase level alarm.

■ Inputting a replacement part number《PART REPLACEMENT》

When the parts management tool (PARTS MGMT TOOL) is not used, input the part number when replacing a general part.

The input part number is stored in the maintenance log.

Hint When PARTS MGMT TOOL is active, the delivery amount cannot be reset on the operation panel. Reset it from PARTS MGMT TOOL.
For the operation procedure, refer to the PARTS MGMT TOOL instruction manual.

Reference "Displaying the maintenance log《MAINTENANCE LOG》" P.51

■ Displaying the maintenance log《MAINTENANCE LOG》

This displays twenty records of previously replaced parts with the dates of their replacement. After press [→], press [↓] several times to display the replaced parts in order.

The figure shows an example that "part number 228-48249-96 was replaced on April 1, 2019".

The table shows the messages displayed in the second row of a maintenance log.

Message	Description	Ref.
L SEAL REPLACED	The left plunger seal was replaced.	P.49
R SEAL REPLACED	The right plunger seal was replaced.	P.49
P/N: XXX-XXXXX-XX	The displayed part number was replaced.	P.51
DGU OP TIME: ******	The setting value (******) was entered in DGU OP TIME.	P.52

■ Displaying the operation log《OPERATION LOG》

This displays ten records of previous modifications such as password change and parameter reset with the dates of the modifications. After press [→], press [↓] several times to display the operation log records in order.

The figure shows an example that "the password was changed on April 1, 2019".

The table shows the messages displayed in the second row of a maintenance log.

Message	Description	Ref.
INITIALIZE PARAM	The parameters were initialized.	P.62
PARAM LOCK ON	The parameter lock function was turned ON.	P.62
PARAM LOCK OFF	The parameter lock function was turned OFF.	
PARAM LOGIN	When the parameter lock function was ON, a user entered the password and moved on to the next screen.	
CHANGE PASSWORD	The password was changed.	P.63
USE PARTS MGMT	The PARTS MGMT TOOL was set to "Use".	P.63
NOT USE PARTS MGMT	The PARTS MGMT TOOL was set to "NotUse".	

■ Displaying the error log《ERROR LOG》

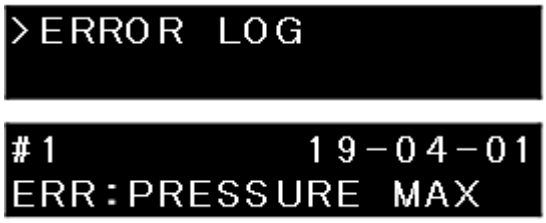
This displays ten records of previous errors with the dates of the errors.

After press [→], press [↓] several times to display the error log records in order.

The figure shows an example that "a maximum pressure error occurred on April 1, 2019".

For the messages displayed in [ERROR LOG], refer to the System Guide.

▶▶ Reference System Guide "5.4 Error Log List"



■ Displaying the operation time of the degassing unit《DGU OP TIME》

The screen displays the operation time of the degassing unit connected to the instrument.

When the operation time is input, count of the operation time of the degassing unit starts from the input time. The input set value is stored in the maintenance log.

If [999999 h] is set, the display shows "******" and the operation time will not be counted.

NOTE

- To activate this function, supply power from the instrument to the degassing unit and make sure that the pressure signal cable is connected correctly. If more than one pump is used, be sure to connect the power cable and pressure signal cable to the same pump. For how to connect, refer to the System Guide.
- The shutdown function of CBM-40 CL or LC-Workstation can stop the degassing unit. For details, refer to the instruction manual of the system controller or LC-Workstation.
- Approximate time to replace the vacuum pump of the degassing unit is 3 years or 8000 hours of operation time. Contact your Shimadzu representative if you need to replace the vacuum pump.

3.6.4 Validation Support Information Group (VALIDATION)

The group allows the user to check whether the equipment is operating correctly.

■ Entering date《DATE》

This allows the user to view or input the date in this screen. The value is reset to the default "00-00-00" if the power switch on the back is turned off. The value is transmitted when the system controller is connected for control.
To delete the input value, press [del].

Hint The figure is an example of April 1, 2019.

■ Entering time《TIME》

This allows the user to view or input the time in this screen. The value returns to the initial value "00:00:00" when the power is turned off. The value is transmitted when the system controller is connected for control.
To delete the input value, press [del].

Hint The figure is an example of 3:01:01 p.m.

■ Checking the memory《MEMORY CHECK》

Runs the memory check on ROM and RAM.
Pressing [Enter] starts the memory check.
After the check, the result is displayed.

■ Checking the leak sensor《LEAK SENSOR CHECK》

Performs the operation test for the leak sensor.

1 **Use a syringe filled with water to wet the sensor unit at the bottom of the leak sensor.**

2 **Wait about 10 seconds and then press [Enter].**
If the sensor detects a leakage, [Good] will be shown.
If not, [No Good] will be shown.

3 **Press [CE].**
The result display will be cleared.
If the result is [No Good], adjust the detection level with [LEAK THOLD] function in the Calibration Support Group.

Reference "Setting the operation level of leak sensor《LEAK THOLD》" P.66

NOTE After wetting and testing the leak sensor, wipe away the water on the tray completely. When wiping away the water, do not apply pressure to the leak sensor, the sensitivity decreases if the sensor unit touches the wall.

Reference "4.14 Cleaning of the Leak Tray" P.122

■ Checking the pulse《PULSE CHECK》

When checking operation, connect a resistance tube to the pump outlet to create 5 MPa to 10 MPa pressure at 1 mL/min during delivery.

1 **Press [Enter].**

2 **Set the acceptance criterion (MPa) of pressure variation (pulse).**

Input the set value with the numeric keypad and press [Enter]. Start delivery at 1 mL/min.
The value range is 0.05 to 1.00 MPa.

Hint

- When setting 0.20 MPa as the acceptance criterion, input a value as shown in the figure.

  Standard of the acceptance criterion (MPa) : 0.20 MPa or less (When connecting the resistance tube 4 m x 0.1 mm I.D and delivery of water at 1 mL/min.)

The measurement starts after 1 minute during pumping. During measurement, the set flow rate (1 mL/min), measured pressure, pressure variation, and remaining time are displayed.

After measurement, the panel displays the measured pressure variation with pass or fail, and then the results and the measurement date and time are stored in the memory of the instrument.

NOTE Before measurement, make sure that the compressibility correction parameter of the solvent is correctly set.

Reference "Setting the compressibility of solvent《COMP》" P.32

■ Checking the flow rate《FLOW CHECK》

When checking operation, connect a resistance tube to the pump outlet to create 5 MPa to 10 MPa pressure during delivery.
According to your measurement method, measure the flow rate by following the instructions below.

Set Value	Measurement Method
0	The flow rate is measured based on the time that was required to deliver the specified volume. (volumetric method)
1	The flow rate is measured based on the weight of water delivered in the specified time. (gravimetric method)
2	A flow meter is used for measurement

NOTE Before measurement, make sure that the compressibility correction parameter of the solvent is correctly set.

Reference "Setting the compressibility of solvent《COMP》" P.32

To use the volumetric method

1 **Set the flow rate and start delivery.**

2 **After confirming the delivery stabilizes, measure the time required for the solvent to accumulate to 5 mL in a measuring flask.**

3 **In the [FLOW CHECK] screen, press [Enter].**

4 **In the measurement method selection screen, input "0".**

5 **Input the measured flow rate.**
The value can be set between 0.1 mL/min and 3.0 mL/min.

6 **Set the acceptance criterion of the flow rate accuracy in "ML".**

The value can be set between 0.001 mL and 1.000 mL.

Hint For example, if the set flow rate is 1 mL/min and the criterion is ±2 %, input 0.02 mL.

7 **Input the measurement time (seconds).**

The flow rate accuracy (%) and pass/fail result are displayed.

To use the gravimetric method

1 **Measure the weight (g) before delivery.**

2 **Set the flow rate and start delivery.**

3 **After confirming the delivery stabilizes, accumulate water in a measuring flask for a specific time.**

4 **Measure the weight (g) before delivery.**

5 **In the [FLOW CHECK] screen, press [Enter].**

6 **In the measurement method selection screen, input "1".**

7 **Input the measured flow rate.**

The value can be set between 0.1 mL/min and 3.0 mL/min.

8 **Set the acceptance criterion of the flow rate accuracy in mL.**

The value can be set between 0.001 mL and 1.000 mL.

Hint For example, if the set flow rate is 1 mL/min and the criterion is ±2 %, input 0.02 mL.

9 **Input the weight (g) measured before delivery.**

10 **Input the measurement time (seconds).**

11 **Input the weight (g) measured after delivery.**

The flow rate accuracy (%) and pass/fail result are displayed.

To use a flow meter

1 **Set the flow rate and start delivery.**

2 **After confirming the delivery stabilizes, measure the flow rate.**

3 **In the [FLOW CHECK] screen, press [Enter].**

4 **In the measurement method selection screen, input "2".**

5 **Input the measured flow rate.**

The value can be set between 0.1 mL/min and 3.0 mL/min.

6 **Set the acceptance criterion of the flow rate accuracy in mL.**

The value can be set between 0.001 mL and 1.000 mL.

Hint For example, if the set flow rate is 1 mL/min and the criterion is ±2 %, input 0.02 mL.

7 **Input the flow rate measured with a flow meter.**

The flow rate accuracy (%) and pass/fail result are displayed.

■ Checking operation of the maximum and minimum pressure functions 《PRESS LIMIT CHECK》

When checking operation, connect a resistance tube to the pump outlet to create 5 MPa to 10 MPa pressure at 1 mL/min during delivery.

1 **Press [Enter].**

Start delivery at 1 mL/min. The pressure is monitored for 1 minute and the maximum pressure (P.MAX) and minimum pressure (P.MIN) are automatically set.

Then the flow rate is automatically set to 1.5 mL/min and 0.5 mL/min, and whether the P.MAX and P.MIN functions work correctly is checked.

The result is displayed after checking is completed.

3.6.5 Calibration Support Information Group (CALIBRATION)

The group is for calibration of the instrument.

> **NOTE** The instrument is tuned before shipment. Do not modify values unnecessarily.

■ Inputting the password《Input PASSWORD》

The password must be input by the system administrator.

Input the five-digit numbers by using the numeric keypad, and press [Enter].

Hint Be sure to input the five numbers. The default password is [00000].
When the password matches, the [OPERATION MODE] screen below appears on the screen.
If the password does not match, the user cannot go further.

■ Setting the operation mode《OPERATION MODE》

⚠ CAUTION

Prohibition

This function is not used in the CL model.
Do not change the factory default value.

The factory default value : 0

■ Changing the displayed order of year, month and day《DATE FORMAT》

Change the displayed order of year, month and day.
Input the value by using the numeric keypad, and press [Enter].

Set value	Display
0	Year, month, and day (YMD)
1	Day, month, and year (DMY)
2	Month, day, and year (MDY)

■ Initializing the parameters《INITIALIZE PARAM》

Initialize the parameters and the time programs.

Press [Enter] to return to the default values of the parameters and to delete the time programs.
After the parameter initialization completes, the instrument is automatically restarted.

■ Setting the parameter lock《PARAMETER LOCK》

This prevents users other than the administrator from changing parameters except the flow rate by prohibiting screen transition to the auxiliary functions screen and VP functions screen.

If [1] (On) is set, a password input screen is displayed when the user enters the setting screen. If the user modifies the setting or inputs the password to enter the setting screen, the operation is recorded in the operation log.

▶▶ Reference "Displaying the operation log《OPERATION LOG》" P.51

■ Setting the usage of the parts management tool《PARTS MGMT TOOL》

Sets the usage of the parts management tool.

For details on the parts management tool (PARTS MGMT TOOL), refer to the PARTS MGMT TOOL instruction manual.

Set value	Description
0	Do not use PARTS MGMT TOOL.
1	Use PARTS MGMT TOOL.

When the setting is changed, the change is recorded in the operation log.

Reference "Displaying the operation log《OPERATION LOG》" P.51

■ Changing the password《PASSWORD SETTING》

Enables to change the password.

1 **Press [Enter].**

The input screen is displayed.

2 **Input the five-digit number by using the numeric keypad, and press [Enter].**

3 **To confirm, input the same password that was input in step 2 again.**

When the input is completed and the password is changed, the message "PASSWORD CHANGED" is displayed. Then, the password change is recorded in the operation log.

If the password input is not correct, the message "PASSWORD WRONG" is displayed. At this stage, the password has not been changed yet.

4 **Press [Enter] to return to the title screen.**

■ Showing/setting CBM parameter《CBM PARAMETER》

This allows the user to view or set the parameters of CBM-40 CL that controls the instrument.

Press [→] to enter the CBM parameter setting screen.

Press [↓] or [↑] several times to select the desired item.

Pressing [←] at an item in the screen returns the display to the screen as shown in the figure.

Hint If CBM-40 CL is not connected (it is not set the link address), pressing [→] does not bring the user to the CBM parameter setting screen.

Reference "Setting the link address《LINK ADDRESS》" P.38
"Setting the link destination of the system controller《CONTROLLER LINK》" P.39

List of CBM Parameters

Display	Description
SERIAL NUMBER	Displays the serial No. of CBM.
S/W ID	Displays the program version No. of CBM.
INTERFACE	Sets the transmitting protocol to data processing unit.
ETHERNET SPEED	Sets the transmitting speed of Ethernet.*1
USE GATEWAY	Sets usage of default gateway or DHCP server.*1
IP ADDRESS	Sets IP address of CBM.*1
SUBNET MASK	Sets subnet mask.*1
DEFAULT GATEWAY	Sets default gateway.*1, *2
TRS MODE	Select the communication distribution when connecting to an LC workstation or a Chromatopac.

*1 Available only to show, when not allowed to change on CBM-40 CL.

*2 Not available when [USE GATEWAY] is set to "Do not use Default Gateway".

NOTE Each parameter is activated after the system controller is restarted.

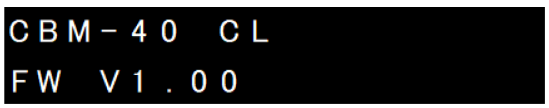
Reference Refer to CBM-40 CL instruction manual for details of each parameter.

Showing the serial number《SERIAL NUMBER》

Displays the serial number of the system controller which controls the instrument.

Showing the S/W version number《S/W ID》

Displays the S/W name (the same name as the model name) and version of CBM which controls the instrument.



Setting the transmitting protocol to data processing unit《INTERFACE》

Sets the transmitting protocol between the data processing unit and the system controller which controls the instrument.

Enter the value using the numeric keypad and press [Enter].

Set Value	Transmitting Protocol
0	To connect with optical cable.
1	To connect with serial transmission. (RS-232C)
2	To connect with Ethernet.

Setting the transmitting speed of Ethernet《ETHERNET SPEED》

Sets transmitting speed of the system controller Ethernet which controls the instrument.

Enter the value using the numeric keypad and press [Enter].

Set Value	Transmitting Speed
0	Auto Detect
1	10 Mbps, Half Duplex
2	10 Mbps, Full Duplex
3	100 Mbps, Half Duplex
4	100 Mbps, Full Duplex

Setting the usage of default gateway or DHCP server《USE GATEWAY》

Sets usage of default gateway or DHCP server of the system controller which controls the instrument.

Enter the value using the numeric keypad and press [Enter].

Set Value	Description
0	Do not use Default Gateway.
1	Use Default Gateway.
2	Automatic acquisition of IP address from DHCP server.

Setting IP address《IP ADDRESS》

Sets IP address of the controller which controls the instrument.

Enter the value using the numeric keypad and press [Enter].

Setting the subnet mask《SUBNET MASK》

Sets subnet mask of the controller which controls the instrument.

Enter the value using the numeric keypad and press [Enter].

Setting the default gateway《DEFAULT GATEWAY》

Sets the default gateway of the controller which controls the instrument.

Enter the value using the numeric keypad and press [Enter].

Setting the transmission mode《TRS MODE》

Select the communication distribution when the controller is connected to an LC workstation.

Enter the value using the numeric keypad and press [Enter].

Set Value	Description
0	Connects in manual setting at the system controller.
2	Can not be used.
3	Connects to LabSolutions.

NOTE Do not set values other than the set value above. Otherwise the instrument will not work properly.

■ Setting the operation level of leak sensor《LEAK THOLD》

Enables to set the threshold value for the leak sensor.

When an error occurs in the leak sensor check, set the value again.

NOTE Calibration of the leak sensor must be performed by the system administrator. The leak sensor detects liquid drops when the mobile phase leaks from the plunger seal or tubes. When the sensor output value exceeds the predetermined "threshold," the sensor issues an error and stops pumping.

1 **Dip the sensor unit at the bottom of the leak sensor into water.**

Upon detection of water, the leak sensor value (Actual Level) in the screen increases.

2 **Read the maximum value of the leak sensor value (Actual Level).**

Example) The maximum value here is "160".

3 **Wipe off the water near the leak sensor.**

The leak sensor value (Actual Value) will decrease.

> NOTE When wiping away the water, do not apply pressure to the sensor unit of the leak sensor. The sensitivity decreases if the sensor unit touches the instrument wall surface.

4 **Calculate the threshold of the leak sensor based on the value read in step 2.**

Formula to calculate the leak sensor threshold:
Threshold = (Max. value-100)×0.7+100
Example) The value obtained here is "142".

5 **Press [Enter], input the value obtained in step 4, and press [Enter].**

The new "threshold" is stored.

■ Setting the flow rate correction parameter (ALPHA) 《FLOW COMP FACTOR》

⚠ CAUTION

Prohibition

Not used in CL model.

Recalibration operation is executed by service personnel.

This allows the service personnel to set the flow rate correction parameter.

■ Setting the pressure sensor sensitivity correction factor 《PRESS COMP FACTOR》

⚠ WARNING

Prohibition

Not used in CL model.

Do not change the factory default value.

This allows service personnel to set the pressure sensor sensitivity correction factor.

■ Setting the time to replace the plunger seal《PLUNGER SEAL》

This allows the user to set the time to replace the plunger seal (unit: L).

Reference "Displaying the delivery amount of the left plunger seal《L SEAL USED》" P.49
"Displaying the delivery amount of the right plunger seal《R SEAL USED》" P.49

■ Selecting how to set the maximum pressure《P.MAX OVERRIDE》 (LC-40D XR CL only)

This allows the user to set the maximum pressure with keys on the pump even if [OPERATION MODE] is set to "1" and the instrument is controlled with the system controller.

If [OPERATION MODE] is set to "0", the set value will be "0".

Reference "Setting the operation mode《OPERATION MODE》" P.61

Set Value	Setting Method
0	To set the value with the system controller.
1	To set the value on the pump.

■ Selecting the flow path switching valve《SV SELECT》

⚠ CAUTION

Prohibition

Not used in CL model.

This allows the user to select the valve to use when [OPERATION MODE] is set to "1" (compatible mode) and the instrument is controlled with the system controller.

■ Turning on/off Auto-Diagnostics《AUTO DIAGNOSTICS》

This allows the user to turn on/off Auto-Diagnostics.

Set Value	Setting Method
0	Auto-Diagnostics is off.

Set Value	Setting Method
1	Auto-Diagnostics is on.

Reference "Displays of Condition《CONDITION》" P.25

3.7 Creating Time Program

NOTE
- The function of the time program is not available when controlled by the system controller. Configure from the workstation. See " system guide 2.2 Editing Methods"
- Refer to the following procedure when using this function in local mode.

The instrument can run a time program with a flow rate and other parameters. A created time program is saved in a file. Check for file numbers in use before creating a time program.

See "Specifying the file number《FILE NUMBER》" P.46 of the auxiliary function to view or specify file numbers.

3.7.1 Time Program Command List

The commands for the time program are listed below.

Com-mand	Description	Setting Range	Remark	Ref.
FLOW	Sets flow rate (Available only in constant flow solvent delivery mode)	0 to 10.0000 mL/min	Minimum unit: 0.0001 mL/min	P.20
PRESS	Sets delivery pressure. (Available only in constant pressure solvent delivery mode. This can be set only for LC-40D XR CL)	10 to 60.0 MPa 10 to 612 kgf/cm^2 10 to 600 bar 142 to 8706 psi	Minimum units: 0.1 MPa 1 kgf/cm^2 1 bar 1 psi	P.21
BCONC	Specifies concentration of mobile phase B Only active when [PUMP CONFIG(SYS)] = 4*1	0 to 100 %	Minimum unit: 0.1 %	*2
CCONC	Specifies concentration of mobile phase C Only active when [PUMP CONFIG(SYS)] = 4*1	0 to100 %*2	Minimum unit: 0.1 %	
DCONC	Specifies concentration of mobile phase D Only active when [PUMP CONFIG(SYS)] = 4*1	0 to100 %*2	Minimum unit: 0.1 %	

Com-mand	Description	Setting Range	Remark	Ref.
INT.SV	Opens or closes the solenoid valve of the low-pressure gradient unit or internal reservoir switching valve (optional)	1, 2, 3, 4	-	P.32
EXT.SV	Opens or closes the solenoid valve of FCV-11A/FCV-11ALS	0, 1, 2, 3, 12, 13, 23, 123	Not used in CL model.	-
EVENT	Sets ON/OFF of the event output (relay contact) on the back of the instrument	0, 1, 2, 12	Not used in CL model.	-
LOOP	Repeats program	0 to 255 * 0 means 256 times.	-	P.75
STOP	Stops program	N/A	-	P.75
GOTO	Switches to other programs (up to 10 files)	0 to 9	Not used in CL model.	-

*1 "Setting the system parameter《PUMP CONFIG (SYS)》" P.40

*2 The total of the settings for [BCONC], [CCONC], [DCONC] may not exceed 100 %.
That is: [BCONC] + [CCONC] + [DCONC] ≤ 100.
The concentration of mobile phase A will be the value subtracted from the total value of the other concentrations from 100 (%).,
For example: Concentration A = 100 – ([BCONC] + [CCONC] + [DCONC])

Reference "3.7.4 Creating a Low-Pressure Gradient Program" P.73

3.7.2 Time Program Setting Screen

To create a time program, access the edit screen as described below.

1 **Press [CE].**

The initial screen is displayed.

2 **Press [→] twice.**

The auxiliary functions screen [FUNCTION] is displayed.

3 **Press [↓] several times until [EDIT] is displayed in the screen, move the cursor to [EDIT], and press [→].**

The time program editing screen is displayed. The figure shows an example of a time program that has ten steps already created and 310 steps left available.

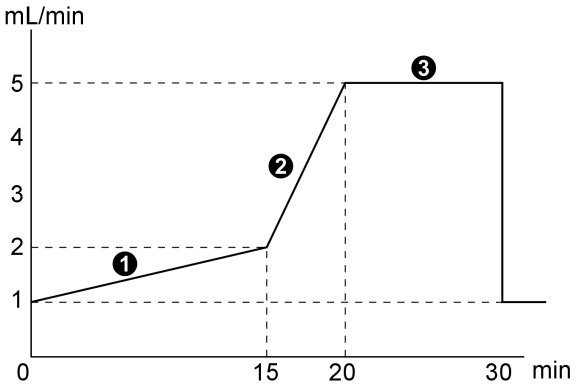
Display	Description
USED	The number of created steps in the selected file
LEFT	The number of steps left available

4 **Press [Enter] again to edit steps of the time program.**

Displays	Description
TIME	Time (minute) that elapsed from the start of the step
FUNC	Command name
VALUE	Set value

3.7.3 Creating a Time Program

The table below shows an example of a time program that changes the flow rate as shown in the figure (initial flow rate: 1 mL/min).



Step	TIME (minute) Setting	FUNC Command Option	VALUE(mL/min) Input a Command Value
❶	15.00	FLOW	2.0000
❷	20.00	FLOW	5.0000
❸	30.00	STOP	-

1 **Displays the time program setting screen.**

Reference "3.7.2 Time Program Setting Screen" P.70

2 **Press [Enter].**

The time (minute) setting screen is displayed.

To set step 1

3 **Press [1], [5], and [Enter].**

4 **Press [Enter].**

The [FLOW] command is selected, which enables the user to input the flow rate.

5 **Press [2] and [Enter].**

The flow rate is set to 2 mL/min and editing step 1 is completed.

To set step 2

6 **Press [2], [0], and [Enter] to set the time.**

7 **Press [Enter].**

The [FLOW] command is selected, which enables the user to input the flow rate.

8 **Press [5] and [Enter] to set the flow rate.**

To set step 3

9 **Press [3], [0], and [Enter].**

10 **Press [↓] several times until [STOP] is displayed in the command selection screen.**

11 **Press [Enter].**

12 **Press [CE] to save the time program. Then the initial screen is displayed.**

Hint When inputting multiple steps, the user does not need to input the data in order of time because they are automatically sorted.

3.7.4 Creating a Low-Pressure Gradient Program

Setting the concentrations of solvents B, C, and D at individual time points in a time program can change the concentrations of solvents A, B, C, and D with time.

The concentration of solvent A in this case will be as below.

Solvent A (%) = 100 (%) - Solvent B (BCONC) (%) - Solvent C (CCONC) (%) - Solvent D (DCONC) (%)

Note that the solvent B (BCONC), solvent C (CCONC), and solvent D (DCONC) parameters can be set in the range from 0 % to 100 % with the minimum unit of 0.1 %.

■ Example of time program setting

1 **Displays the time program setting screen.**

Reference "3.7 Creating Time Program" P.69

2 **Press [Enter] and input the time with the numeric keypad.**

3 **Press [↓] several times until [BCONC] is displayed in the setting screen.**

Hint Press [↓] several times in the same manner to display [CCONC] and [DCONC].

4 **Move the cursor to [BCONC] and press [Enter].**

The [BCONC] command is selected, which enables the user to set the solvent B concentration.

5 **Input the concentration with the numeric keypad and press [Enter].**

3.7.5 Deleting a Step

To delete a step, display it and press [del].

See the following example of deleting the first step of the program created in "3.7.3 Creating a Time Program" P.71.

1 **In the same manner as creating the program, display the desired step.**

Hint To display the second or subsequent lines, press [↓] several times until the desired step is displayed.

2 **Press [del].**

The first step of the program is deleted and the second step is displayed.

3.7.6 Starting and Stopping a Time Program

■ Starting a Time Program

To start a time program after setting it, perform the following.

Press [RUN] to start the program.

[RUN] on the display is highlighted.

■ Stopping a Time Program

There are two ways to stop the program.

• Forcibly stopping a program being executed

Press [RUN] to stop the program.
[RUN] on the display stops being highlighted and the program stops.

• Stopping a program with the [STOP] command

Reference "Setting a [STOP] command for a time program《STOP》" P.75

3.7.7 Commands Used for Time Programs Only

This section explains about the commands that can be set for time programs only.

■ Setting a loop count for a time program《LOOP》

A [LOOP] command can repeat a program the specified number of times.

Settings shown in the table repeat steps ❶ and ❷ three times at intervals of 30 minutes.

Step	TIME (Minute)	FUNC	VALUE (mL/min)
❶	15.00	FLOW	2.0000
❷	20.00	FLOW	5.0000
❸	30.00	LOOP	3

NOTE
- After [LOOP] is repeated the specified number of times, the program automatically stops.
- The [LOOP] command can be set to a maximum of 255. Note that if it is set to "0", LOOP is executed 256 times.

■ Setting a [STOP] command for a time program《STOP》

This allows the user to set the time to stop a time program. Input the time in the last step of a time program and press [↓] several times until [STOP] is displayed.

Press [Enter] to set a [STOP] command.

NOTE When the time program is executed continuously, do not set a [STOP] command at the end of the program.

3.8 Delivery in the Low-Pressure Gradient Mode

3.8.1 Set Value

1 **Input "4" in the [PUMP CONFIG(SYS)] of [SYSTEM] setting group.**

Reference "Setting the system parameter《PUMP CONFIG (SYS)》" P.40

2 **Set the [P.MAX] and [P.MIN] of [PARAMETER] setting group.**

Reference "Setting the maximum pressure limit during pumping《P.MAX》" P.31
"Setting the minimum pressure during delivery《P.MIN》" P.31

3.8.2 Preparation for Delivery

1 **Press [Enter] once on the initial screen.**

2 **Input a flow rate as the [FLOW] set value with the numeric keypad.**

3 **Set solvent concentrations.**

1 Press [CONC].
The concentration setting screen is displayed.

2 Input the solvent B concentration (%) and press [Enter].

3 Input the solvent C and D concentrations (%).
The concentration of solvent A in this case will be as below.

Solvent A concentration (%) = 100 (%) - Solvent B concentration (%) - Solvent C concentration (%) - Solvent D concentration (%)

For example, when setting the solvent A to D concentrations to 25%, input values as shown in the figure.

4 Set the compressibility.

1 Displays [COMP] of [PARAMETER] setting group.

2 Press [→].
The compressibility setting screen is displayed.
Press [↓] several times to display the [COMP B], [COMP C], and [COMP D] setting screens.

3 Set the compressibilitys of solvents A to D.

5 Purge flow paths.

1 Open the drain valve by turning it 90 degrees counterclockwise.

2 Press [PURGE].
The flow path selection screen is displayed.

3 Select the flow path to purge with the numeric keypad and press [Enter].
[PUMP] on the display is highlighted and purging starts.

Set Value	Description
0	Solvent is purged at the concentration set on the concentration setting screen.
1	Solvent A is purged.
2	Solvent B is purged.
3	Solvent C is purged.
4	Solvent D is purged.

6 Close the drain valve and start delivery.

3.9 Connection with the System Controller or Workstation

3.9.1 Setting the Instrument

To control the instrument from CBM-40 CL set the parameters as follows:

Setting Parameter	Set Value	Remark
LOCAL MODE	0: Remote	▶▶ Reference "Selecting the local/remote mode《LOCAL MODE》" P.38
LINK ADDRESS	Link address	▶▶ Reference "Setting the link address《LINK ADDRESS》" P.38
CONTROLLER LINK	0: Int 1: Ext	▶▶ Reference "Setting the link destination of the system controller《CONTROLLER LINK》" P.39
OPERATION MODE	(LC-40D X3 CL) 0: 40D X3 CL (LC-40D XR CL) 0: 40D XR CL	Not used in CL model. Do not change the factory default value.

3.9.2 Basic Parameters

A max. of 4 pump units can be connected to CBM-40 CL. Workstation can set flow rate (pressure), maximum pressure limit, minimum pressure limit, solenoid valves, pumping ON/OFF, time program, etc., and can control binary and ternary high-pressure gradient analysis depending on the system configuration. Also, by combining the SIL-40 CL series autosampler, the auto purging function is available. For details, refer to the system guide.

3.10 Connection to External Input/Output Terminals

⚠ CAUTION

Prohibition

In the CL model, do not connect another external device with the black-white event cable.

Wiring is done by service personnel during installation.

4 Maintenance

4.1 Periodic Inspection and Maintenance

It is necessary to perform periodic inspections of this instrument to ensure its safe use. It is possible to have these periodic inspections performed by Shimadzu service personnel on a contractual basis.
For information regarding the maintenance inspection contract, contact your Shimadzu representative.

⚠ WARNING

Instruction

Turn off the main power switch on the back of the instrument and unplug the power cable prior to maintenance when instructed.
Fire, electric shock or malfunction may occur.

⚠ CAUTION

Instruction

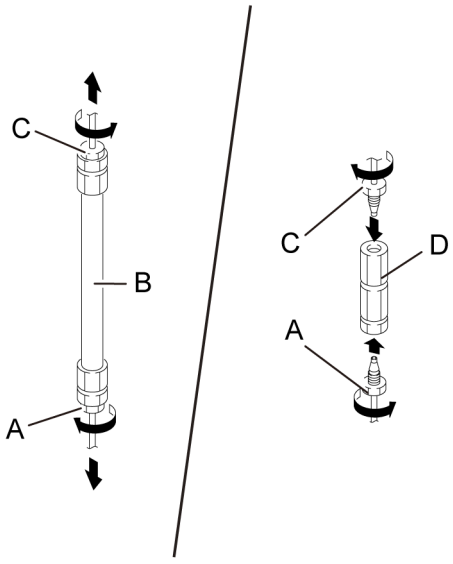
For parts replacement, use parts and tools listed in "1.2 Component Parts" P.2 and "5.2 Maintenance Parts" P.130.
If any other parts or tools are used, part damage, injury, and malfunction may occur.

Prohibition

Never remove the cover.
This may cause injury or a malfunction of the device.
Contact your Shimadzu representative if the cover must be removed.

4.1.1 Prior to Inspection and Maintenance

- Loosen the male nuts (A and C) on the column inlet and outlet with an 8-mm wrench and then remove the column (B) from the flow path. Attach the coupling (D) to the male nut (A and C), and tighten it with an 8 mm wrench.
- Replace the mobile phase in the flow lines with at least 20mL of water. When normal phase solvent was used, replace the internal channel with 2-propanol and then with water.
- Wipe away any dirt from the front panel and the main cover.
- Remove the right panel cover and filter holder before starting the work. Release



the tubes bound at the front right from the tube holder to prevent them from interfering with the work.

Reference "4.2 Removing the Right Panel Cover and the Filter Holder" P.84

■ Standard Reagents for Maintenance

Solvent	Description	Inspection/Maintenance Item
2-propanol	Used for cleaning parts.	"4.4 Replacing the Plunger Seal" P.92 "4.5 Cleaning/ Replacing the Plunger and Diaphragm" P.100 "4.6 Rinsing the Check Valve" P.107 "4.7 Performing an Ultrasonic Cleaning of the Check Valve" P.110 "Gradient Mixer for High-Pressure Gradient Analysis" "4.12 Replacing the Drain Valve" P.119 "4.16 Cleaning of the Automatic Rinsing Kit" P.123

■ Hardware Maintenance Supplies

Note that in addition to the following tools and parts are also required. The tools and parts required for the maintenance of each part are listed at the beginning of each section.

Item	Description	Inspection/Maintenance Item
Protective glasses	Glasses and gloves before the maintenance.	ALL Inspection/Maintenance
Gloves		
Wiping paper	Used for wiping and cleaning parts.	"4.4 Replacing the Plunger Seal" P.92 "4.5 Cleaning/ Replacing the Plunger and Diaphragm" P.100
Beaker	Used for cleaning parts.	"4.4 Replacing the Plunger Seal" P.92
Ultrasonic bath	Used for cleaning parts.	"4.4 Replacing the Plunger Seal" P.92 "4.7 Performing an Ultrasonic Cleaning of the Check Valve" P.110 "Gradient Mixer for High-Pressure Gradient Analysis" "4.16 Cleaning of the Automatic Rinsing Kit" P.123

Item	Description	Inspection/Maintenance Item
Tweezers	Used for gripping the plunger seal and backup ring.	"4.4 Replacing the Plunger Seal" P.92

4.1.2 List of Periodic Inspection and Maintenance

NOTE The maintenance and replacement periods listed in this table are presented only as guidelines. These are not guarantee periods.
These will vary depending on usage conditions.

<table>
<tr><th>Inspection/Maintenance Item</th><th>Replacement Periods</th><th>Remark</th><th>Ref.</th></tr>
<tr><td>Replacement of Plunger Seal</td><td>1 year</td><td>• Sealing efficiency decreases when seals are worn.
• As a guideline, seals should be replaced after delivery of the respective volumes listed below. (VP fuction, [L(R)SEAL USED], shows the total delivered volume.)
(LC-40D X3 CL)<table><tr><th>Pumping Pressure</th><th>Total Delivery</th></tr><tr><td>80 MPa (816 kgf/cm^2)</td><td>30 L</td></tr></table>Repeating high-pressure (above 100 MPa) and low-pressure (below 10 MPa) pumping could shorten the life of seals.
(LC-40D XR CL)<table><tr><th>Pumping Pressure</th><th>Total Delivery</th></tr><tr><td>30 MPa (306 kgf/cm^2)</td><td>60 L</td></tr><tr><td>60 MPa (612 kgf/cm^2)</td><td>30 L</td></tr></table>Repeating high-pressure (above 60 MPa) and low-pressure (below 10 MPa) pumping could shorten the life of seals.</td><td>P.92</td></tr>
<tr><td>Replacement of Plunger</td><td>1 year</td><td>Replace the plunger seal and the diaphragm when the plunger is replaced.</td><td rowspan="2">P.100</td></tr>
<tr><td>Replacement of Diaphragm</td><td>1 year</td><td>-</td></tr>
<tr><td>Replacement of Outlet Check Valve</td><td>1 year</td><td>-</td><td>P.112</td></tr>
<tr><td>Replacement of Inlet Check Valve</td><td>1 year</td><td>-</td><td>P.112</td></tr>
<tr><td>Replacement of Line Filter</td><td>2 years</td><td>Replace when particulates in mobile phase clog the filter.</td><td>P.114
P.115</td></tr>
<tr><td>Replacement of Suction Filter</td><td>2 years</td><td>Replace when particulates in mobile phase clog the filter.</td><td>P.117</td></tr>
<tr><td>Replacement of Drain Valve</td><td>3 years</td><td>Replace when there is a fluid leak from the drain valve.</td><td>P.119</td></tr>
</table>

Inspection/Maintenance Item	Replacement Periods	Remark	Ref.
Replacement of Air Filter (for Right Panel)	1 year	-	P.120
Replacement of Air Filter (for FAN)	1 year	Contact your Shimadzu representative.	-
Pump ASSY lubrication	3 years	Contact your Shimadzu representative.	-
Replacement of Fuse	3 years	Contact your Shimadzu representative.	-
Cleaning of the Automatic Rinsing Kit	1 year	-	P.123
Replacement of Pump Head	(2 years)	Pumping mobile phase mixtures containing acids such as trifluoroacetic acid or formic acid can cause leakage due to internal damage in the pump head. In such cases, replace the pump head every two years, as a general guideline. (Pump heads do not need to be replaced if only mobile phases without acid are pumped.)	-
Inspection of Leak Sensor	1 year	-	P.54

■ Optional Parts

Inspection/Maintenance Item	Replacement Periods	Remark	Ref.
Replacing the Air Filter of Low Pressure Gradient Kit	1 year	Contact your Shimadzu representative.	-

4.1.3 Check after Inspection and Maintenance

- After inspection and maintenance, check any leakage during pumping.
- Return the right panel cover, filter holder and tubes after completing the work.

NOTE When the parts management tool (PARTS MGMT TOOL) is not used, input the part number when replacing a part not registered in the PARTS MGMT TOOL.

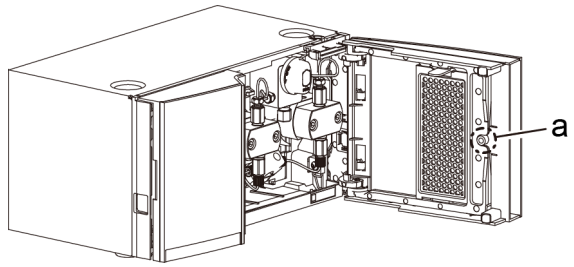
Reference "Inputting a replacement part number《PART REPLACEMENT》" P.51

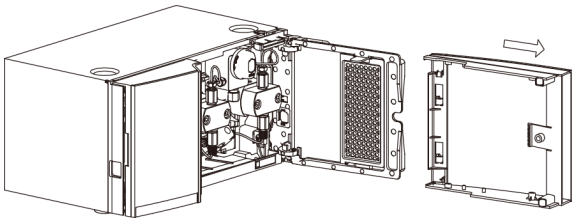
4.2 Removing the Right Panel Cover and the Filter Holder

1 **Open the right panel.**

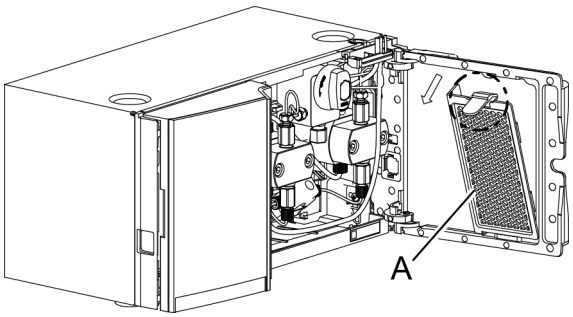
2 **Remove the right panel cover.**

While lightly pressing the cylinder-shaped projection (a) inside the right panel cover, slide the cover to the front.





3 **While pressing the knob at the top of the filter holder (A), remove it toward the front.**



4.3 Removing/Installing the Pump Heads

This section will explain how to remove and re-attach the right-side pump head. Removing and re-attaching the left-side pump head is also the same procedure.

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002
Allen wrench (M5)	1	086-03805
Syringe	1	046-00038-01
Syringe needle	1	228-18216-91

■ Prior to the maintenance Perform the preparatory work.

Reference "4.1.1 Prior to Inspection and Maintenance" P.79

■ Removing the pump head

1 **Perform either of the following to prevent the mobile phase solvent from flowing out of the suction tube or pump head when removing the tubes around the pump.**

- Place the reservoir bottle at a position lower than the pump inlet.
- Empty the reservoir bottle and suction tube of the mobile phase solvent, loosen the bushing of the suction filter, and remove it from the pump inlet.

2 **Press [CE] to display the initial screen.**

3 **Press [→] twice.**

4 **Press [↓] once, move the cursor to [CONTROL], and press [→].**

[PLUNGER SET] menu is displayed.

5 **Press [Enter].**

The cursor blinks at the input position.

6 **Press [2] and [Enter]. (To replace the left plunger seal, press [1] and [Enter].)**

[PUMP] on the display is highlighted and after a while stops being highlighted. The right plunger is now at the backmost position.

In the conditions, remove the right pump head.

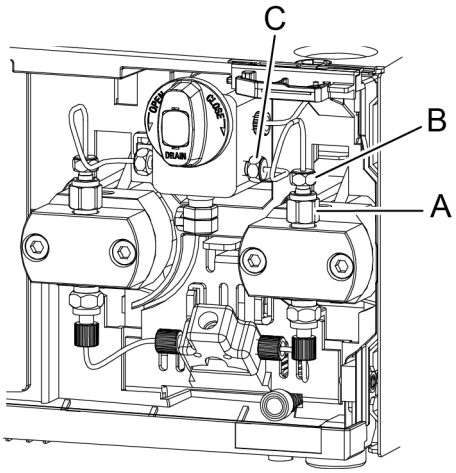
Before attaching the right pump head, perform steps 2 to 6 as well.

7 **Follow the instructions below to remove the tube (SUS pipe R) connecting the check valve OUT and the pressure sensor.**

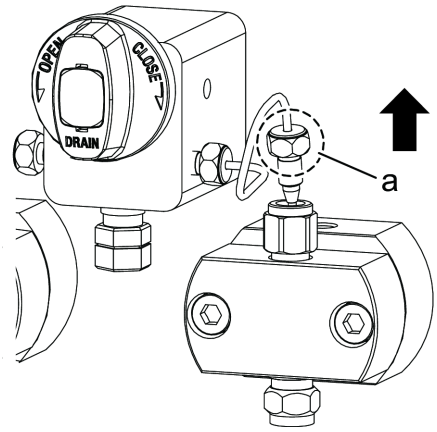
(LC-40D X3 CL)

1 While holding the check valve OUT (A) with a 10-mm wrench, loosen the check valve OUT side male nut (B) of the SUS pipe R with an 8-mm wrench.

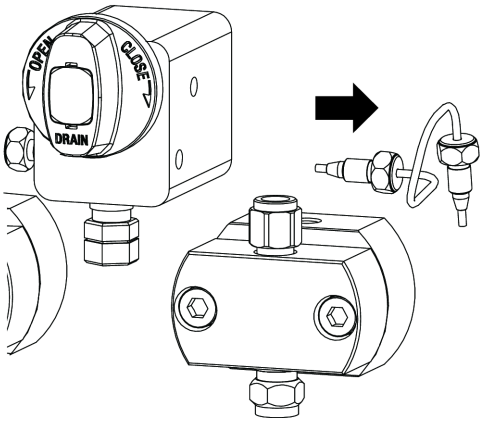
2 Loosen the pressure sensor side male nut (C) of the SUS pipe R with an 8-mm wrench.



3 Hold the check valve OUT side male nut ("a" in the figure) of the SUS pipe R and then slightly lift and pull out the SUS pipe R.



4 Pull the SUS pipe R to the right to remove it from the pressure sensor.

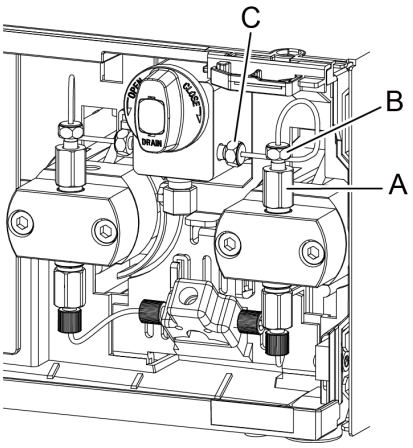


Hint Though the orientation is opposite to the right one (SUS pipe R), remove the left tube (SUS pipe L) in the same procedure.

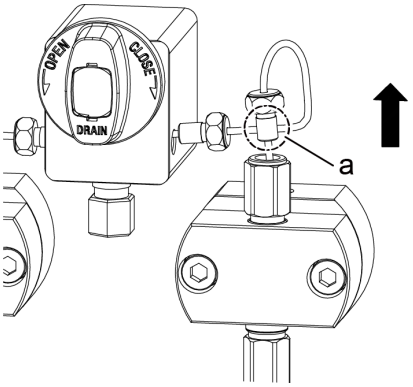
(LC-40D XR CL)

1 While holding the check valve OUT (A) with a 10-mm wrench, loosen the check valve OUT side male nut (B) of the SUS pipe R with an 8-mm wrench.

2 Loosen the pressure sensor side male nut (C) of the SUS pipe R with an 8-mm wrench.

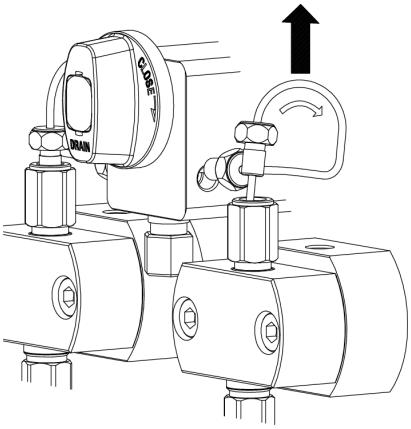


3 Hold the check valve OUT side male nut ("a" in the figure) of the SUS pipe R and then slightly lift the SUS pipe R.

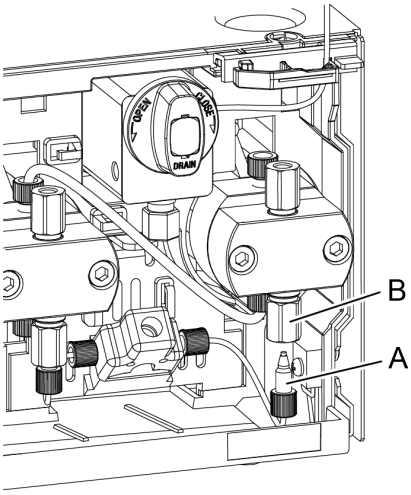


4 Slightly lean backwards the SUS pipe R to pull it out upward.

Hint Though the orientation is opposite to the right one (SUS pipe R), remove the left tube (SUS pipe L) in the same procedure.

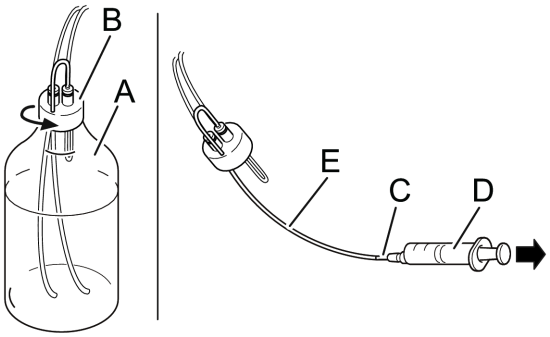


8 **Loosen the male nut PEEK (A) of the inlet tube by hand and remove it from the check valve IN (B).**



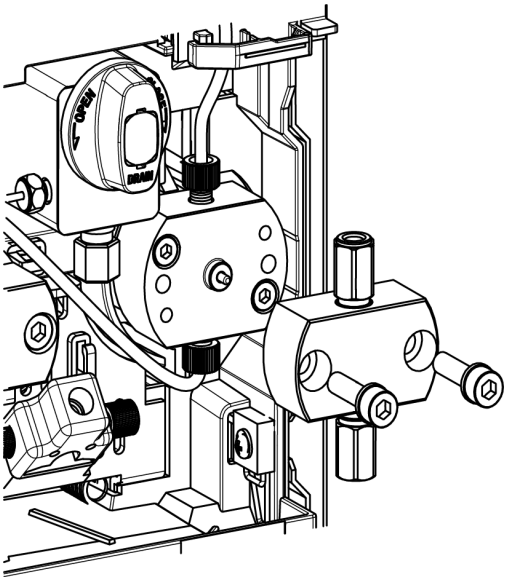
9 **If the seal rinsing kit is attached, remove the cap (B) of the seal rinsing kit from the rinse solution bottle (A).**

10 **Attach the syringe needle (C) to the end of the outlet FEP tubing (E) (upward U-shape), and use the syringe (D) to suction out the rinse fluid from the rinse flow line.**



11 **Place the removed cap (B) and rinse solution bottle on the reservoir tray on the top of the instrument.**

12 **Gradually loosen the 2 hexagonal socket screws using an Allen wrench (M5) by alternating between the left and right screw, and remove the pump head.**



⚠ CAUTION

Instruction

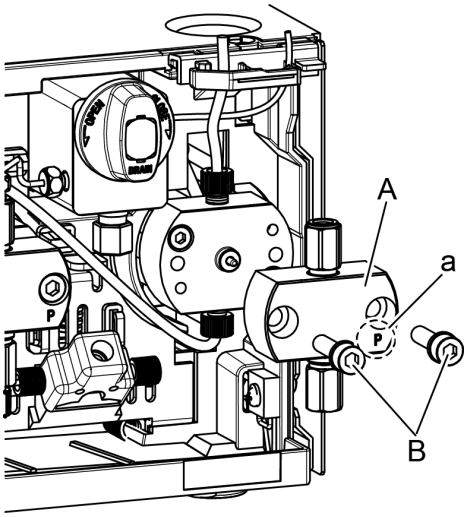
Gently pull the pump head horizontally along the plunger.

The plunger may be damaged if the pump head is forcefully removed.

■ Installing the pump head

1 **Set the plunger position by following steps 2 to 6 in "Removing the pump head" P.85.**

2 **Hold the pump head with the mark (a) coming at the bottom right, tighten the 2 hexagonal socket screws (B) with an Allen wrench (M5) by tightening the right and left screws alternately, and attach the pump head (A).**



⚠ CAUTION

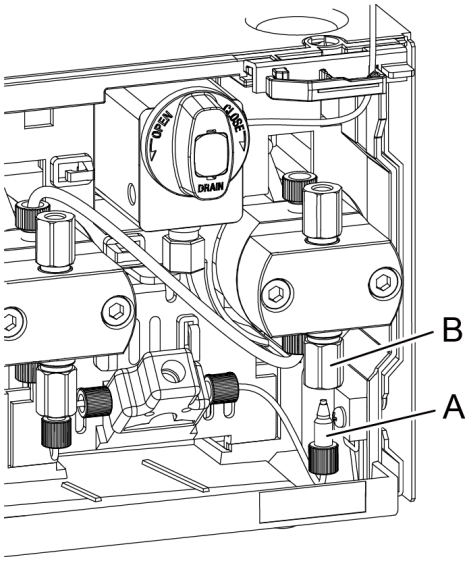
Instruction

Gently inset the pump head horizontally along the plunger.

The plunger may be damaged if the pump head is forcefully inserted.

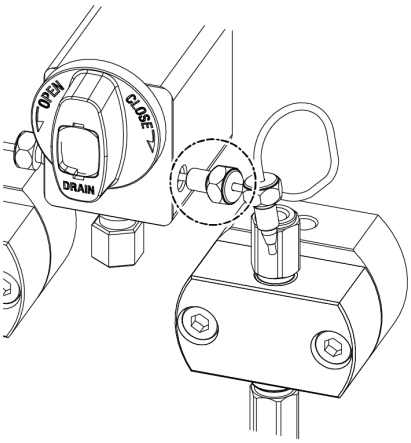
NOTE Tighten the left and right hexagonal socket screws 90 degrees at a time, and then firmly tighten using the long side of the Allen wrench.

3 **Tighten the male nut PEEK (A) of the inlet tube to the inlet check valve (B) by hand.**

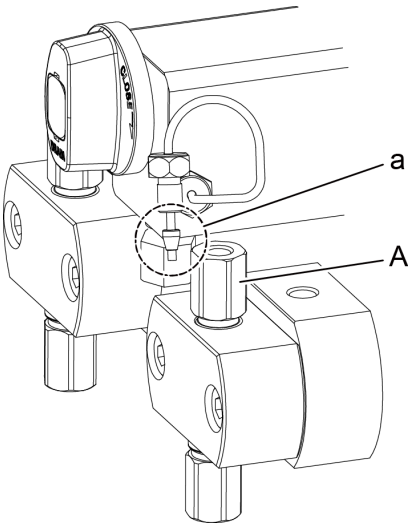


4 **Follow the instructions below to attach the tube (SUS pipe R) connecting the check valve OUT and the pressure sensor.**

1 Insert the end of the SUS pipe R into the hole of the pressure sensor.



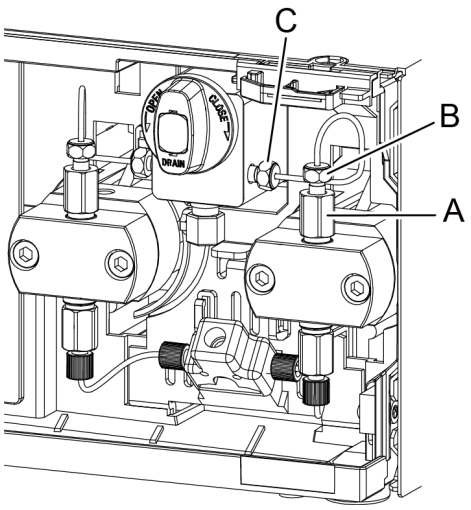
2 Hold the check valve side end of the SUS pipe R ("a" in the figure) and then insert the male nut into the check valve OUT (A).



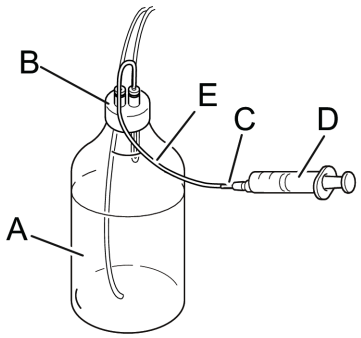
3 While holding the check valve OUT (A) with a 10-mm wrench, tighten the SUS pipe R male nut on the check valve OUT side with an 8-mm wrench (B).

4 Tighten the pressure sensor side male nut (C) of the SUS pipe R with an 8-mm wrench.

Hint Though the orientation is opposite to the right one (SUS pipe R), attach the left tube (SUS pipe L) in the same procedure.



5 **Attach the original rinsing kit cap (B) to the rinse solution bottle (A), and then remove the outlet FEP tubing (E) (upward U-shape) from the rinse solution bottle.**



6 **Attach the syringe needle (C) to the end of the FEP tubing (E) (upward U-shape), and use the syringe (D) to suction out the rinse solution from the rinse flow line.**

7 **Return the rinsing kit to the reservoir tray.**

4.4 Replacing the Plunger Seal

A plunger seal and backup ring are attached inside the left and right pump heads. The following section will explain the method for replacing the plunger seal and backup ring on the right side (when viewed from the front).
Replacing the plunger seal and backup ring on the left side are also the same procedure.

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002
Allen wrench (M5)	1	086-03805
Seal Installer/Remover	1	228-62458-41

Necessary parts

Part Name	Part Type	Part No.
Plunger Seal (UHP) (supplied with backup ring)	Consumable part	228-52711-93

■ **Prior to the maintenance Perform the preparatory work.**

Reference "4.1.1 Prior to Inspection and Maintenance" P.79

4.4.1 Replacing the Plunger Seal and Backup Ring

1 **Remove the pump head, SUS pipe, and inlet tube by following the instructions in "Removing the pump head" P.85.**

2 Perform the following steps to replace the plunger seal and backup ring.

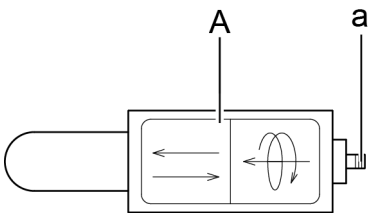
The plunger seal and the backup ring are installed inside the pump head. Use the provided seal installer/remover to remove them.

⚠ CAUTION

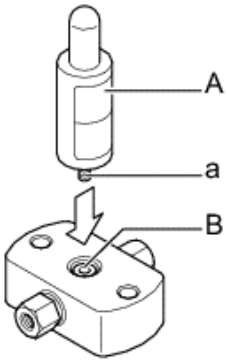
Prohibition

Do NOT drop the seal installer/remover when using it.
Seal installer/remover may be damaged.

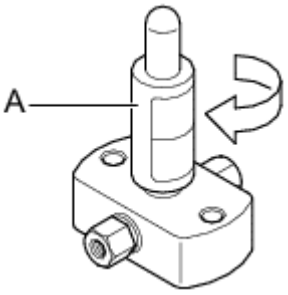
1 Wipe off the threaded tip on the metal part (a) of the seal installer/remover (A) with a wiping paper soaked in 2-propanol.



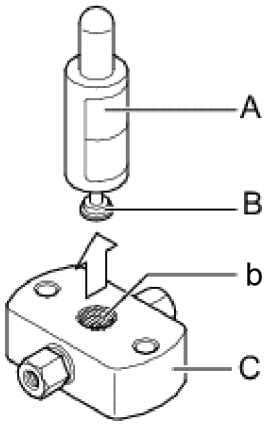
2 With the metal part (a) of the seal installer/remover (A) facing downward, insert the seal installer/remover (A) vertically into the backup ring (B).



3 Turn the seal installer/remover (A) 180 degrees to 360 degrees clockwise.

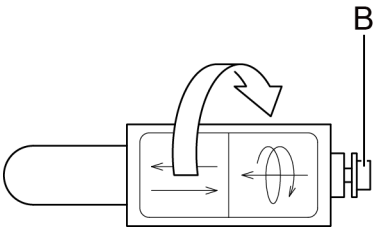


4 Pull out the seal installer/remover (A) upward.
The backup ring (B) will come off from the plunger seal hole (b) of the pump head (C).



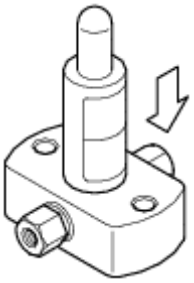
> **NOTE** If the backup ring is still stuck, return to step 3 and turn the seal installer/remover 180 degrees more, then retry this step.

5 Grip the backup ring (B) with two fingers and turn the seal installer/remover counterclockwise, then remove the backup ring from the seal installer/remover.

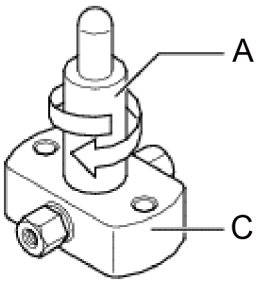


6 Wipe off the threaded tip on the metal part of the seal installer/remover with a wiping paper soaked in 2-propanol.

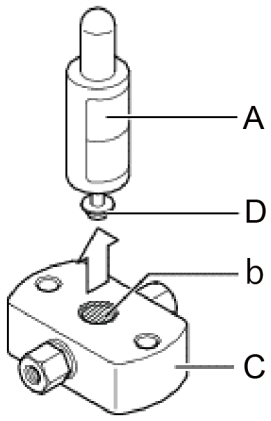
7 With the metal part of the seal installer/remover facing downward, place the seal installer/remover vertically above the plunger seal and push it slightly into the seal.



8 Turn the seal installer/remover (A) clockwise until it comes into contact with the pump head (C).

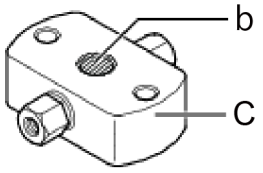


9 Pull out the seal installer/remover (A) upward.
The plunger seal (D) will come off from the plunger seal hole (b) of the pump head (C).



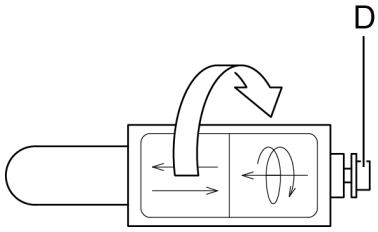
10 Place the pump head into a clean beaker containing 2-propanol, and clean it for 10 minutes using an ultrasonic bath.

11 Use a piece of wiping paper soaked in 2-propanol to wipe the plunger attachment portion (b) inside the pump head (C).



NOTE
- If seal material adheres to the plunger attachment portion of the pump head, the airtightness cannot be maintained.
- If any scratches are found on the plunger attachment portion of the pump head, replace the pump head.

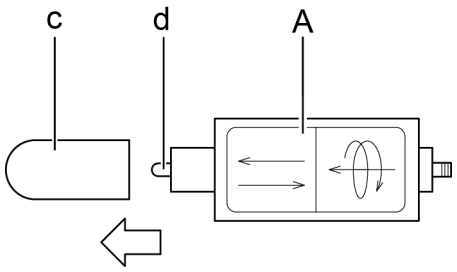
12 Grip the plunger seal (D) with two fingers and turn the seal installer/remover counterclockwise, then remove the plunger seal from the seal installer/remover.



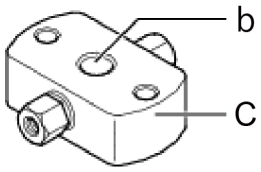
13 Wipe off the threaded tip on the metal part of the seal installer/remover with a wiping paper soaked in 2-propanol.

14 Remove the cap (c) from the seal installer/remover (A).

15 Wipe off the white protrusion (d) and the surrounding area of the seal installer/remover (A) with a wiping paper soaked in 2-propanol.



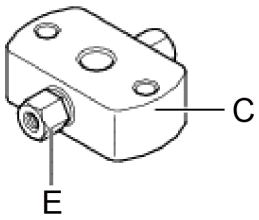
16 Put some drops of 2-propanol in the plunger seal hole (b) of the pump head (C) while paying attention to spillage of 2-propanol.



⚠ CAUTION

Instruction

Before putting in 2-propanol, screw the check valves (E) into the pump head (C) so that 2-propanol does not leak from the holes for the check valve.

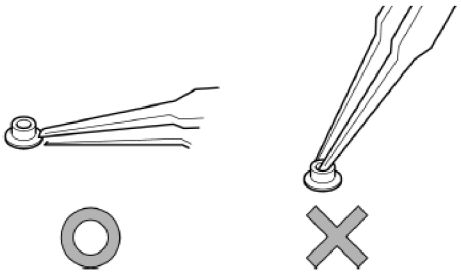


17 Soak a new plunger seal and a new backup ring in 2-propanol in a clean beaker.

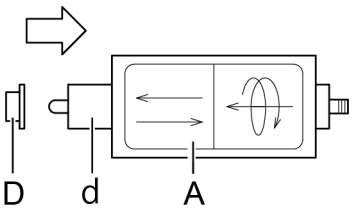
⚠ CAUTION

Prohibition

When gripping the plunger seal with tweezers, do NOT touch the internal hole surface. Also, to prevent damage, do NOT grip the plunger seal and the backup ring tightly with tweezers.



18 Take the new plunger seal (D) out of the beaker and put it on the white protrusion (d) of the seal installer/remover (A).

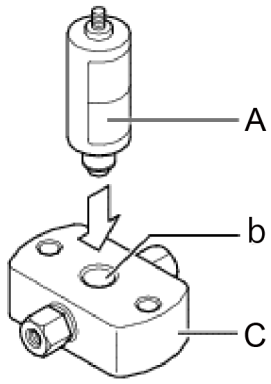


⚠ CAUTION

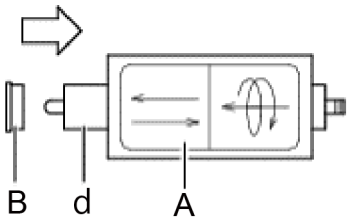
Instruction

Be sure that the plunger seal is moistened with 2-propanol when putting it on the seal installer/remover.

19 Insert the seal installer/remover (A) vertically all the way into the plunger seal hole (b) of the pump head (B) and slowly pull out the seal installer/remover upward. The plunger seal will be installed in the pump head.



20 Take the new backup ring (B) out of the beaker and, with the smaller diameter side facing the seal installer/remover (A), put the backup ring on the white protrusion (d).

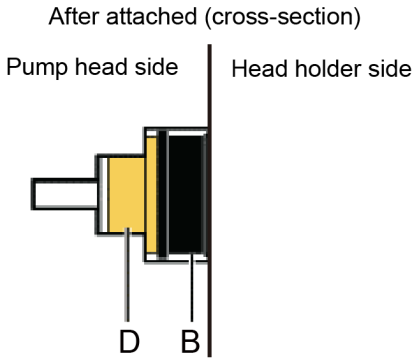


⚠ CAUTION

Instruction

Be sure to attach the backup ring with the correct orientation.

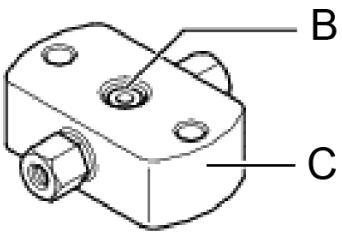
When the backup ring (B) is attached correctly to the pump head, the larger diameter side comes into contact with the plunger seal (D).



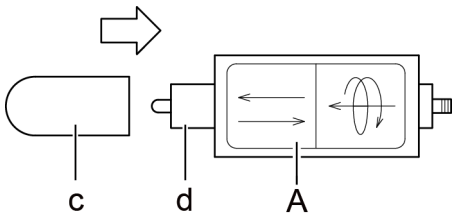
Instruction

Be sure that the backup ring is moistened with 2-propanol when putting it on the seal installer/remover.

21 Insert the seal installer/remover vertically all the way into the plunger seal and slowly pull out the seal installer/remover upward. The new backup ring (B) will be installed into the pump head (C).



22 Put the cap (c) on the white protrusion (d) of the seal installer/remover.



3 **Attach the pump head, SUS pipe, and inlet tube by following the instructions in "Installing the pump head" P.89.**

4.4.2 Resetting the Delivery Amount

> **NOTE** When PARTS MGMT TOOL is active, the delivery amount cannot be reset on the operation panel. Reset it from PARTS MGMT TOOL.

1 **Display the [MAINTENANCE] information group of the VP function.**

Reference "3.3 Types of Screens" P.23

2 **Press [↓] several times until [R SEAL USED] is displayed.**

3 **Press [del].**

The delivery amount of the plunger seal before replacement is reset and the reset date is recorded in the maintenance log.

Reference "Displaying the delivery amount of the right plunger seal《R SEAL USED》" P.49

Hint To replace the left plunger seal, display [L SEAL USED] and press [del].

4.4.3 Check after Replacement

After replacing the plunger seal, check the following:

- Is the pumping (pressure) stable?
- Is fluid leaking from the gap between the pump head and the head holder?
- Is fluid leaking from the rinse flow line?

> **NOTE** If the above occurs even after replacing the plunger seal, it is possible that there are scratches on the surface of the plunger. If there are scratches on the plunger, replace it with a new plunger.

Reference "4.5 Cleaning/ Replacing the Plunger and Diaphragm" P.100

4.5 Cleaning/ Replacing the Plunger and Diaphragm

A plunger and a diaphragm are attached to the left and right pump body. The following section will explain the method for cleaning/ Inspection (replacing) the plunger and the diaphragm on the right side (when viewed from the front). Replacing the plunger and a diaphragmthe on the left side are also the same procedure.

When replacing the plunger, be sure to also replace the plunger seal and the diaphragm.

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002
Allen wrench M4	1	086-03804
Allen wrench M5	1	086-03805
Box driver	1	228-28767-91
Diaphragm jig	1	228-54852
Plunger press plate	1	228-70388

Necessary parts

Part Name	Part Type	Part No.	Remark
Plunger Holder Assy	Consumable part	228-52069-44	Supplied with a diaphragm

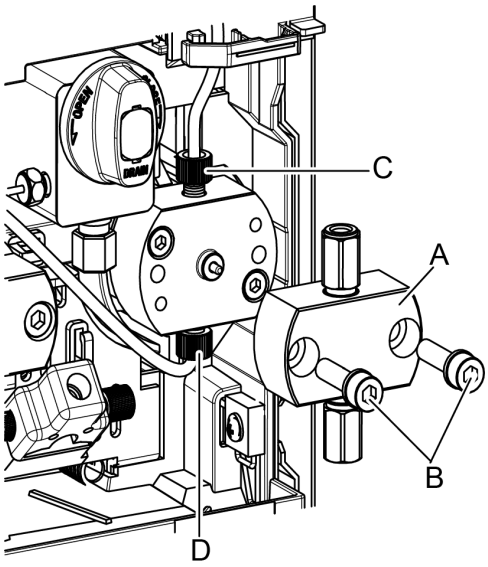
■ **Prior to the inspection and the maintenance Perform the preparatory work.**

Reference "4.1.1 Prior to Inspection and Maintenance" P.79

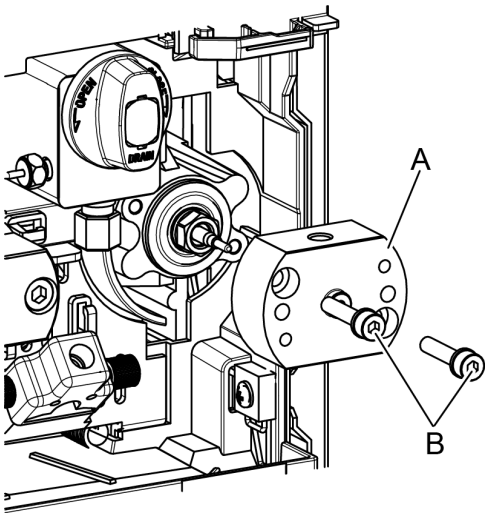
4.5.1 Removing the Pump Head and the Head Holder

1 **Remove the pump head, SUS pipe, and inlet tube by following the instructions in "Removing the pump head" P.85.**

2 **Loosen the head holder top and bottom fittings (C and D), and remove the rinse tube.**



3 **Gradually loosen the 2 hexagonal socket screws (B) of the head holder (A) using an Allen wrench (M4) by alternating between the left and right screw.**



4 **Remove the head holder.**

⚠ CAUTION

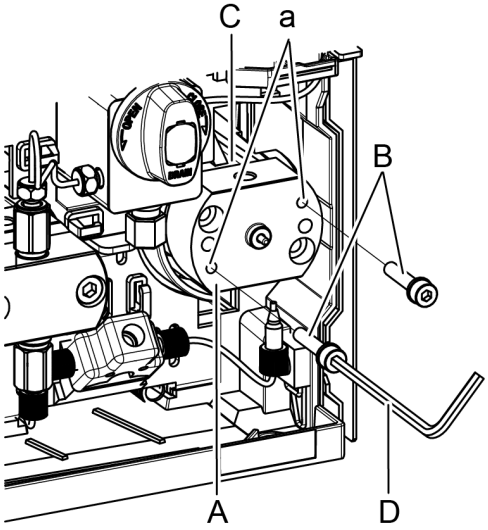
Instruction

Gently pull the head holder horizontally along the plunger.
If the head holder is not removed carefully, the plunger may become damaged.

■ In the case the head holder is difficult to remove

Insert into the head holder M4 bolt hole (a) the 2 hexagonal socket screws (B) that were removed, and tighten the left and right sides gradually using an Allen wrench (M4) (D).

The head holder (A) can be loosened by pushing the pump body (C) using the 2 hexagonal socket screws (B).



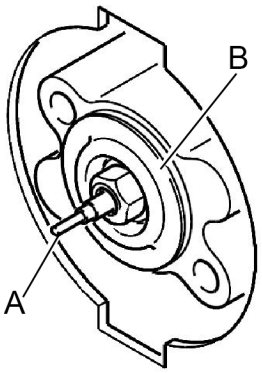
4.5.2 Cleaning and Replacement of the Plunger and the Diaphragm

> **NOTE** When replacing the plunger, be sure to replace the plunger seal and the diaphragms.

1 **Perform the following steps to clean or replace the plunger and diaphragm.**

1 Wipe plunger with a sheet of wiping pape soaked with 2-propanol to remove any portion of the seal or dirt attached to the plunger (A).

> **NOTE** If small pieces of the plunger seal material adheres to the surface, the airtightness cannot be maintained.



2 Check that there are no visible scratches on the plunger (A) or the diaphragm (B).

- If scratches are found through visual inspection, replace with a new plunger. Proceed to the next procedure 3.
- If no scratches are found through visual inspection, proceed to step 2.

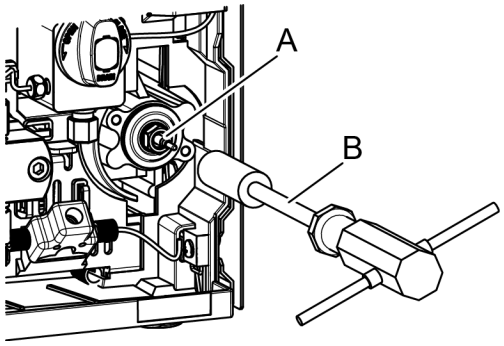
⚠ CAUTION

Prohibition

Do NOT allow foreign particles or crystals into the head holder.

Foreign particles from the mobile phase solution or crystals from the buffer solution getting into the head holder may cause scratches on the surface of the plunger.

3 Insert the box driver (B) to the plunger holder (A), then rotate counter-clockwise to remove the plunger holder with the diaphragm.



⚠ CAUTION

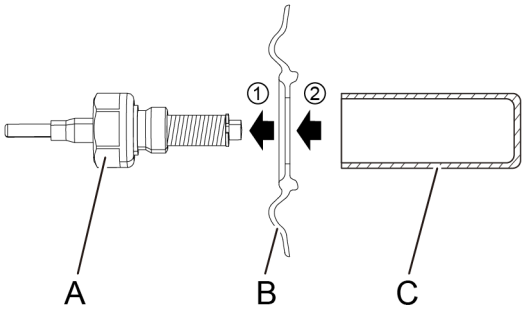
Instruction

Gently insert the box driver to the plunger holder.

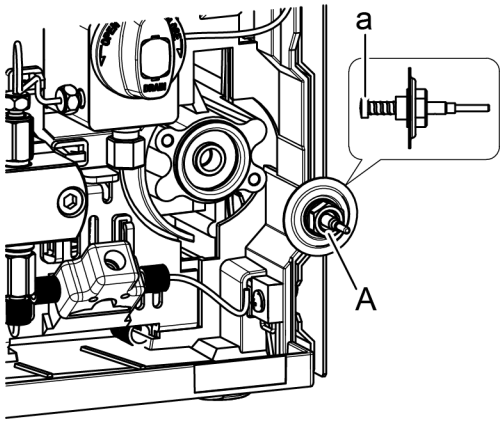
The plunger may become damaged if the box driver is forcefully inserted.

4 Attach a new diaphragm (B) to the new plunger holder (A) using the diaphragm jig (C).

NOTE Confirm the direction of the diaphragm when attaching.



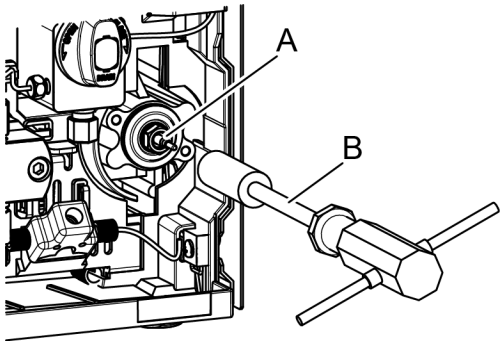
5 After applying the grease (black: approximately 5 mm square size) provided with the plunger holder ASSY to the rear end surface of the plunger (a), insert the plunger holder (A) to which the diaphragm was attached in Procedure 4 into the pump body.



NOTE
- Be careful not to get any grease on the diaphragm or the body.
- Attach the diaphragm so that it will not become detached from the plunger holder. If the diaphragm becomes detached, wipe away any grease and perform from Procedure 4 again.

6 Tighten the plunger holder (A) using the box driver (B).

7 Pinch the end of the plunger with your two fingers, move it up, down, right, left, clockwise, and counterclockwise five times each so that the grease applied to the rear end of the plunger holder can spread evenly. Then wipe off the plunger surface with wiper paper soaked in 2-propanol to clean it.



2 In the [PLUNGER SET] screen of the control setting group, press [2] and [Enter]. (To replace the left plunger, press [1] and [Enter].)

[PUMP] on the display is highlighted and after a while stops being highlighted. The right plunger is now at the backmost position.

Reference "Setting the plunger stop position《PLUNGER SET》" P.37

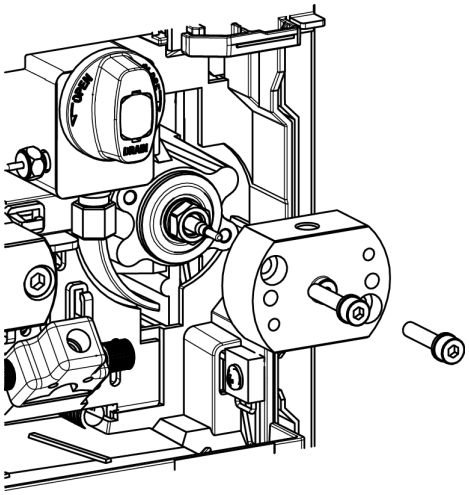
3 Attach the head holder to the pump body.

⚠ CAUTION

Instruction

Slowly push in the head holder along the plunger.

Pushing in the head holder forcibly may break the plunger.



4 Attach the 2 hexagonal socket screws to the head holder and tighten them with an Allen wrench.

NOTE Tighten the right and left hexagon socket screws alternately in 90° increments. Finally hold the longer part of the hex wrench and tighten them securely.

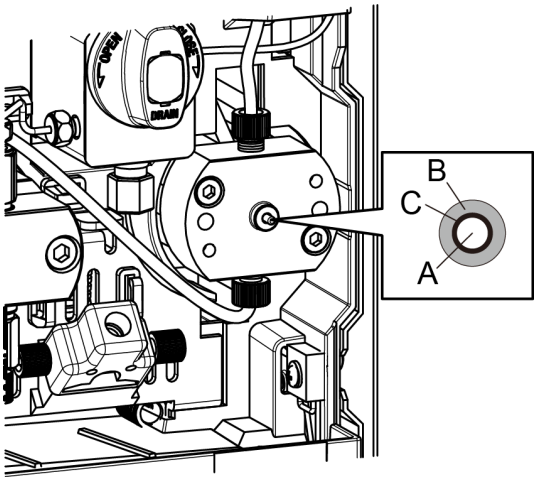
5 Attach rinse tubes to the top and bottom of the head holder.

6 In the [PLUNGER SET] screen, press [1] and [Enter]. (To replace the left plunger, press [2] and [Enter].)

[PUMP] on the display is highlighted and after a while stops being highlighted. The right plunger is now at the frontmost position.

Reference "Setting the plunger stop position《PLUNGER SET》" P.37

7 **Pinch the end of the plunger that is projecting from the head holder with your fingers and adjust its position to make the gap (C) around the plunger (A) inside the hole of the projection (B) of the head holder even. While keeping the plunger in place, wipe off the plunger surface with clean wiper paper soaked in 2-propanol.**



⚠ CAUTION

Instruction

Move the plunger gently.

Moving the plunger too abruptly could scratch the plunger surface or cause it to break off.

8 **In the [PLUNGER SET] screen, press [2] and [Enter]. (To attach the left plunger seal, backup ring and pump head, press [1] and [Enter].)**

[PUMP] on the display is highlighted and after a while stops being highlighted. The right plunger is now at the backmost position.

Reference "Setting the plunger stop position《PLUNGER SET》" P.37

NOTE When replacing the plunger, be sure to replace the plunger seal and the diaphragms."4.4 Replacing the Plunger Seal" P.92.

9 **Attach the pump head, SUS pipe, and inlet tube and set the seal rinsing kit back in place by following the instructions in "Removing the pump head" P.85.**

4.6 Rinsing the Check Valve

This section will explain how to pump 2-propanol to rinse the check valve.

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002

Necessary parts

Part Name	Part Type	Part No.	Quantity
RESISTANCE TUBE,COIL FOR CLEANING	Replacement part	228-57908-41	1

1 After using buffer solution as the mobile phase, replace the solvent in the reservoir bottle with water.

⚠ CAUTION

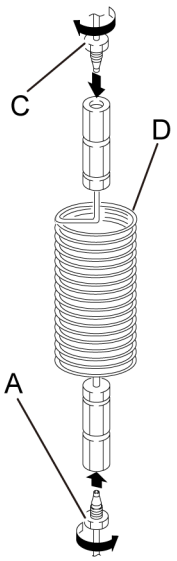
After using buffer solution as the mobile phase, do NOT replace with an organic solvent such as 2-propanol without first replacing with water.

When using a buffer solution in the reservoir bottle, replace with distilled water or purified water, and after pumping at least 20 mL into the instrument, replace with new 2-propanol. If the buffer solution is directly replaced with 2-propanol, crystals will be precipitated, which can cause damage to the plunger seal or cause problems with the check valve.

▶▶ Reference System Guide "Precautions When Replacing the Mobile Phase"

2 Replace the solvent in the reservoir bottle with 2-propanol.

3 **Loosen the male nuts on the column inlet and outlet with an 8-mm wrench and then remove the coupling from the flow path.**



4 **Attach the male nut (A and C) of the coupling inlet and outlet that was removed to the resistor tube (D), and tighten it with an 8 mm wrench.**

5 **Press [CE] to display the initial screen.**

6 **Press [Enter] once.**

The cursor blinks at the [FLOW] input position.

7 **Press [2], [.], [0] and [Enter].**

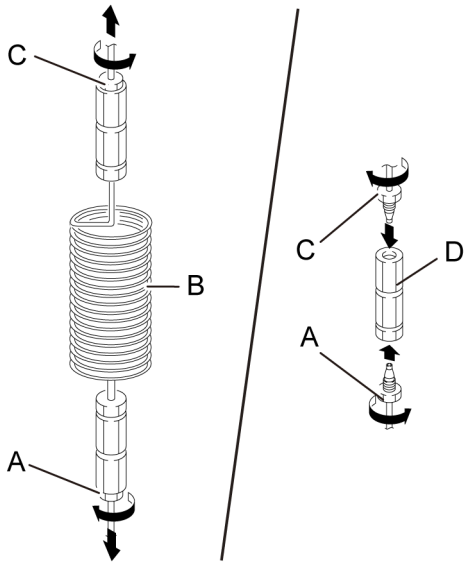
[FLOW] is set to "2.0000" and confirmed.

8 **Press [PUMP].**

[PUMP] on the display is highlighted and delivery of 2-propanol starts at 2 mL/min. Continue delivery at least 1 hour.

9 **Loosen the male nut (A and C) of the resistor tube inlet and outlet with an 8 mm wrench, and remove the resistor tube (B) from the flow line.**

10 **Attach the removed male nut (A and C) of the resistor tube inlet and outlet to the coupling (D) with an 8 mm wrench and tighten it with the 8 mm wrench.**



11 **Check the pumping stability after cleaning the check valves.**

Reference "Checking the pulse《PULSE CHECK》" P.55

12 **Replace the solvent in reservoir bottle with the original mobile phase.**

Reference System Guide "Precautions When Replacing the Mobile Phase"

4.7 Performing an Ultrasonic Cleaning of the Check Valve

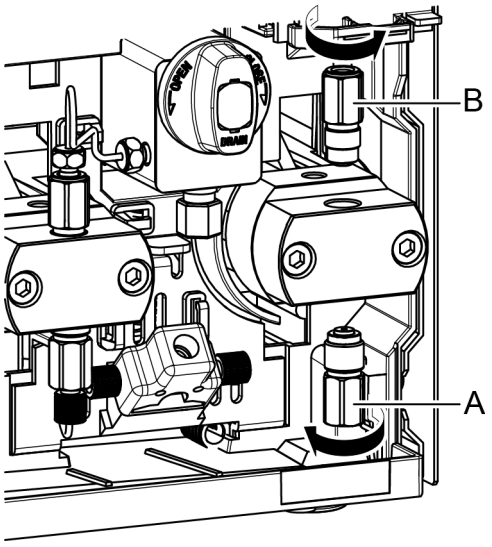
Check valves are attached to the left and right pump heads. The following section will explain the method for performing an ultrasonic cleaning of the check valves on the right side (when viewed from the front). Performing an ultrasonic cleaning of the check valves on the left side are also the same procedure.

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002

1 **Remove the SUS pipe and inlet tube by following the instructions in "Removing the pump head" P.85.**

2 **Use a 10 mm wrench to remove the inlet check valve (A) and the outlet check valve (B).**



⚠ CAUTION

Prohibition

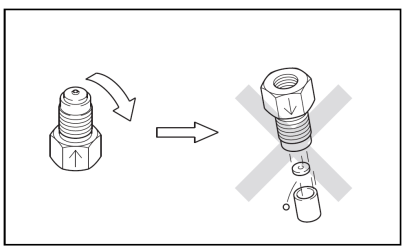
Never disassemble the check valve.

Performance cannot be guaranteed if disassembled.

Prohibition

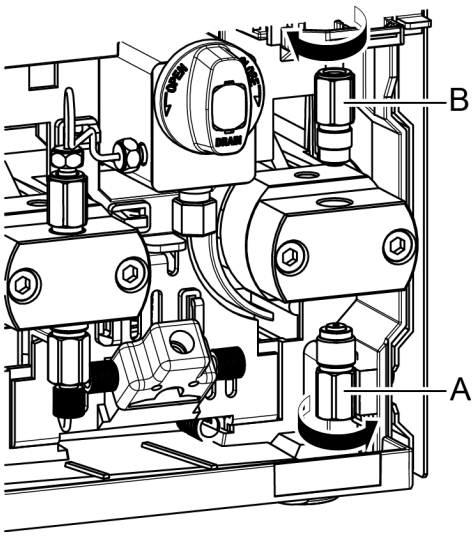
(For LC-40D X3 CL) Do NOT turn the inlet check valve (A) upside down.

If you do, the internal parts will fall out.



3 **Immerse the inlet check valve (A) and outlet check valve (B) into 2-propanol, and clean for 5 minutes using an ultrasonic bath.**

4 **Rotate the inlet check valve (A) and the outlet check valve (B) clockwise to attach them to the pump head, and after tightening by hand, use a 10 mm wrench to tighten them as follows.**



- Inlet check valve
  - LC-40D X3 CL:
    Hand tightening and 120° with wrench
  - LC-40D XR CL:
    Hand tightening and 90° with wrench
- Outlet check valve
  - LC-40D X3 CL:
    Hand tightening and 60 to 90° with wrench
  - LC-40D XR CL:
    Hand tightening and 90° with wrench

5 **Attach the SUS pipe and inlet tube by following the instructions in "Installing the pump head" P.89.**

4.8 Replacing the Check Valve

Check valves are attached to the left and right pump heads. The following section will explain the method for Inspection (Replacing) of the check valves.
Inspection (Replacing) of the check valves on the left side are also the same procedure.

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002

Necessary parts

Target Model	Part Name	Part Type	Part No.
LC-40D X3 CL	Inlet check valve ASSY	Consumable parts	228-52964-42
LC-40D XR CL			228-48249-96
LC-40D XR CL	Inlet check valve ASSY, 2 pieces		228-48249-97
LC-40D X3 CL	Outlet Check Valve ASSY		228-53334-96
LC-40D XR CL			228-45705-43

1 **Check the pumping stability.**

Reference LC-40D CL Series Instruction Manual "3.6.4 Validation Support Information Group (VALIDATION)/Checking the pulse《PULSE CHECK》 "

If the result of the system check is "Pass", it is considered normal.

If the result of the system check is "Fail", "4.6 Rinsing the Check Valve" P.107 . If the pumping (pressure) is still unstable, "4.7 Performing an Ultrasonic Cleaning of the Check Valve" P.110, and then check the pumping stability again. If the result of the system check is "Fail", proceed to the following procedure.

2 **Remove the check valve and install a new one by following the instructions in Step 2 of "4.7 Performing an Ultrasonic Cleaning of the Check Valve" P.110.**

3 **Attach the SUS pipe and inlet tube by following the instructions in "Installing the pump head" P.89.**

4 **Turn the drain valve counterclockwise to open it.**

5 **Press [Enter] once.**

The cursor blinks at the [FLOW] input position.

6 **Press [2], [.], [0], and [Enter].**

[FLOW] is set to "2.0000" and confirmed.

7 **Press [PUMP] and confirm the solvent continues to flow out from the drain valve.**

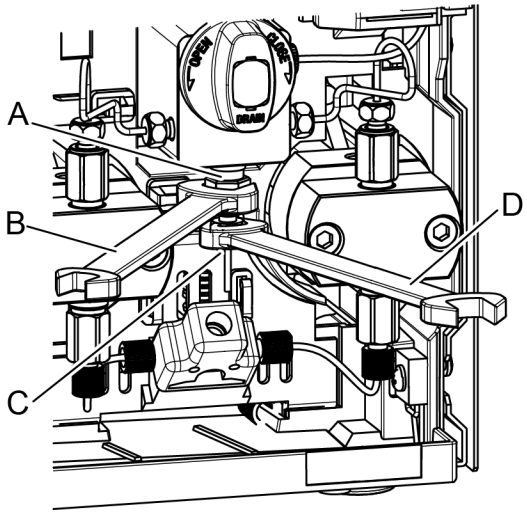
[PUMP] on the display is highlighted and the solvent flows out of the drain tube. There is no problem with the valve if the solvent continues to flow out.

4.9 Inspecting the Line Filter

Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002

1 **Fix the line filter (A) with a 10 mm wrench (B) and loosen the male nut (C) of the pump outlet tube with an 8 mm wrench (D) to remove it.**



2 **Pour water into a reservoir bottle and set the flow rate to 1 mL/min.**

3 **In a no load state, pump water at a rate of 1 mL/min.**

- If the pressure is 0.3 MPa or less, it is considered normal.
- If the pressure is more than 0.3 MPa, replace the line filter.

NOTE

When a mobile phase additive such as trifluoroacetic acid is used, a ghost peak may be generated from the line filter. In this case, perform the following procedure to rinse the line filter.

- Deliver a 17% phosphoric acid solution at a flow rate of 1 mL/min for about 30 minutes. (Pumping pressure: 1 MPa to 5 MPa)
  For example, attach a stainless tube with ID0.1 x 2000mm (Part No.: 228-57908-41).
- Deliver purified water at a flow rate of 10 mL/min for about 30 minutes. (Pumping pressure: 1 MPa to 5 MPa)
  For example, attach a stainless tube with ID0.3 x 2000mm*[1].
  *1: Stainless tubing ID0.3 x 1000mm (Part No.: 228-53184-96) 2pc and Coupling (Part No.: 228-16004-13) 1pc can be substituted.

4.10 Replacing the Line Filter

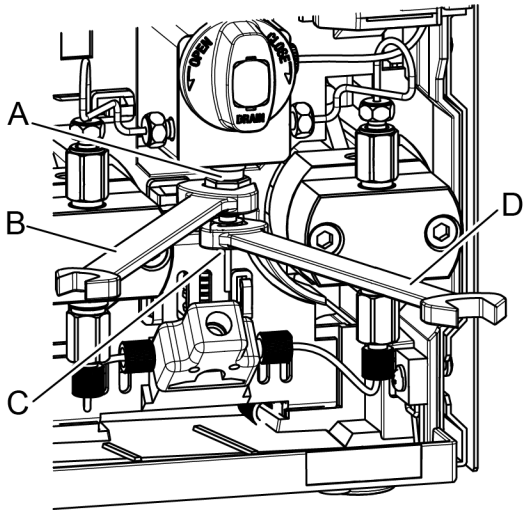
Necessary tools

Part Name	Quantity	Part No.
Wrench (8 mm and 10 mm)	2	086-03002

Necessary parts

Target Model	Part Name	Part Type	Part No.
LC-40D X3 CL	Line Filter	Consumable part	228-57501-92
LC-40D XR CL			228-35871-96

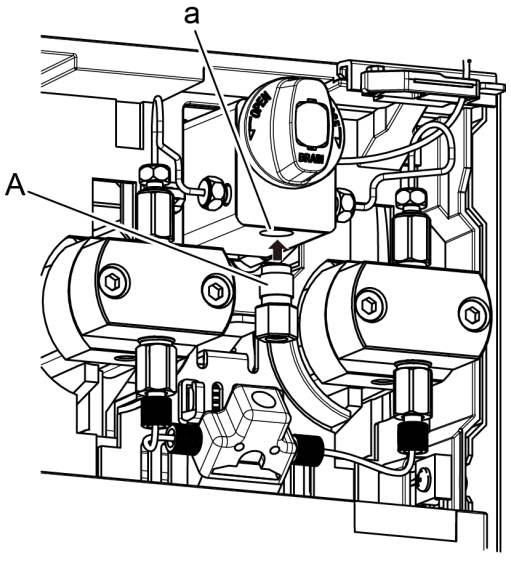
1 **Fix the line filter (A) with a 10 mm wrench (B) and loosen the male nut (C) of the pump outlet tube with an 8 mm wrench (D) to remove it.**



2 **Loosen the line filter (A) with 10 mm wrench to remove it.**

3 **Wipe with a cotton swab, etc., to wipe away any dirt from the line filter port (a).**

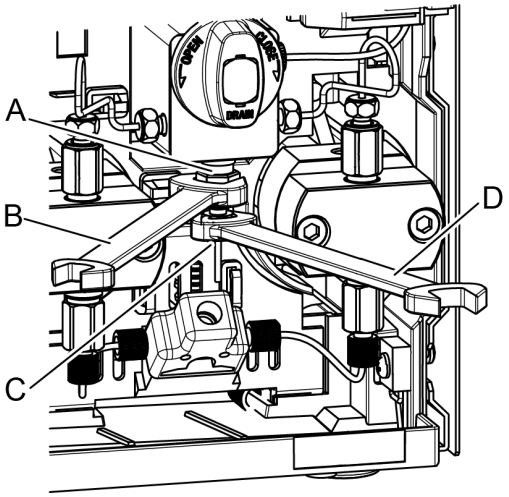
4 **Attach the new line filter (A) to the line filter port (a) by hand, and tighten it 45° using a 10 mm wrench.**



5 **Attach the male nut (C) of the pump outlet tube to the line filter (A) by hand.**

6 **Fix the line filter (A) with a 10 mm wrench (B) and tighten the male nut (C) of the pump outlet tube with an 8 mm wrench (D).**

NOTE When using in the front end of LC-MS, carry out the cleaning process described as follows to reduce background noise. Pump 50% methanol solution at a pressure of approx.10 MPa for approx. 30 min. (For example, attach a stainless steel tube with ID 0.1 x 2000 mm (Part No.: 228-57908-41) and adjust the flow rate.)



4.11 Cleaning/Replacing the Suction Filter

Necessary Parts

Part Name	Part Type	Part No.	Quantity
SUS Filter Element, w/PTFE Fitting	Consumable part	228-45707-91	1

Hint Use the SUCTION FILTER with tube and fittings for pump inlet (Part No. 228-45708-91) or SUCTION FILTER with tube and fittings for the low pressure gradient kit or the degassing unit (Part No. 228-61905-49) as necessary.

NOTE Contamination of suction filters can lead to contamination of mobile phase solvents and bottles, causing background rise and ghost peaks. Even if you are wearing gloves, do not touch the metal parts of the suction filter as much as possible. Hold the non-metal part of the filter element.

CAUTION

Prohibition

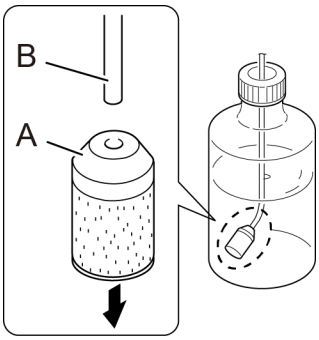
After using the buffer solution as the mobile phase, do NOT replace with an organic solvent such as 2-propanol without first replacing with water.

When using a buffer solution, replace it with distilled water or purified water, and after pumping at least 20 mL into the instrument, replace it with new 2-propanol. If the buffer solution is directly replaced with 2-propanol, crystals will be precipitated, which can cause damage to the plunger seal or cause problems with the check valve.

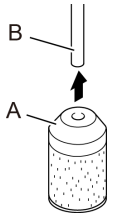
Reference System Guide "Precautions When Replacing the Mobile Phase"

1 **Pull the suction filter (A) from the suction tubing (B).**

2 **Place the suction filter into a clean container with 2-propanol, and clean it for 5 minutes using an ultrasonic bath.**



3 **Insert the suction tubing (B) into the suction filter (A).**



4 **Replace the solvent in reservoir bottle with water, and place the suction tubing back into the bottle.**

5 **Press [CE] to display the initial screen.**

6 **Deliver water at 1 mL/min for 10 minutes.**

7 **Check for air bubbles inside the suction tubing.**

Replace the suction filter if air bubbles are present.

NOTE If Ghost peaking occurs, rinse the suction filter. Refer to System Guide "5.3.2 Symptoms Presumably Due to an Error, Based on a Chromatogram".

4.12 Replacing the Drain Valve

Necessary tools

Part Name	Quantity	Part No.
Phillips screwdriver	1	-

Necessary parts

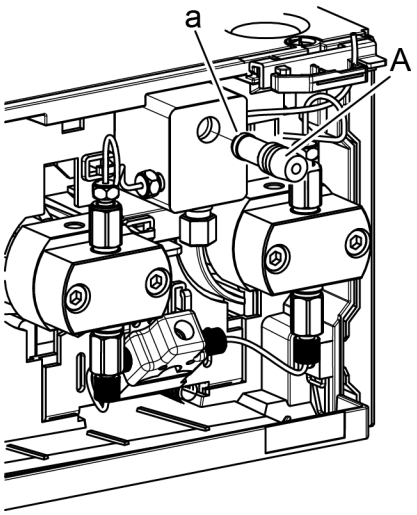
Part Name	Part Type	Part No.
DRAIN VALVE ASSY,TP	Replacement part	228-51229-93

1 **Rotate the drain valve ASSY counter-clockwise at least 3 complete rotations and pull it off straight.**

NOTE Check the hole for foreign objects.

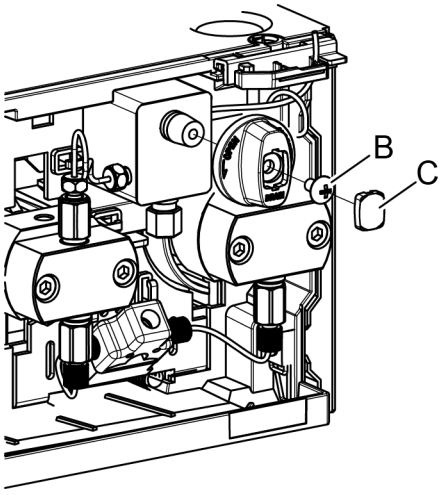
2 **Wet the seal portion (a) of the new drain valve ASSY (A) with 2-propanol, etc., and insert it into the hole.**

NOTE If the drain valve ASSY is forcefully inserted or is not inserted straight, the seal portion may become deformed, resulting in leakage.



3 **Tighten the drain valve ASSY clockwise.**

4 **After tightening the drain valve ASSY, attach the knob with the screw (B) using a phillips screwdriver so that it is vertical, and then attach the cap (C).**



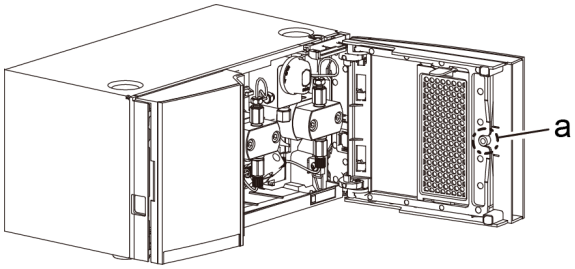
4.13 Replacing the Air Filter (Right Panel)

This section explains about replacement on the air filter of the right panel.

Necessary parts

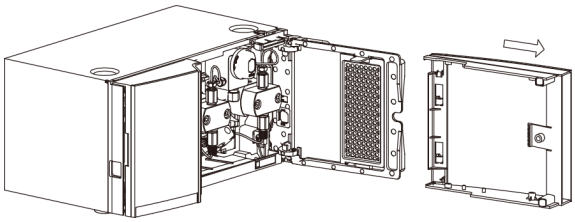
Part Name	Part Type	Part No.
Air Filter Element, Non Woven, for Right Panel	Consumable part	228-53924-06

1 **Open the right panel.**

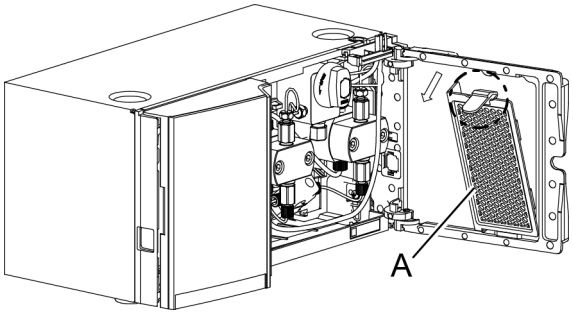


2 **Remove the right panel cover.**

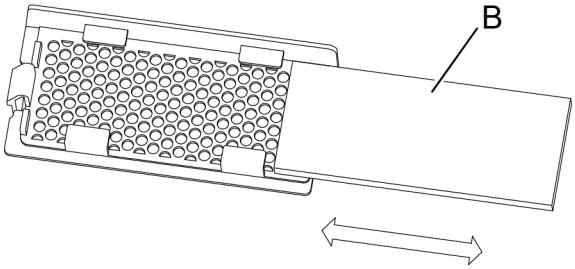
While lightly pressing the cylinder-shaped projection (a) inside the right panel cover, slide the cover to the front.



3 While pressing the knob at the top of the filter holder (A), remove it toward the front.



4 Slide the air filter (B) to attach/remove it.



5 Attach the filter holder and the right panel.

4.14 Cleaning of the Leak Tray

NOTE If a leak occurred, wipe off the leak in the leak tray completely as below. Leak of mobile phase solution used as buffer solution may dry and crystallize, clogging the leak tray. If the leak tray is contaminated by such crystallized buffer solution, wipe off the leak tray with paper wiper soaked in water in the same manner as below.

1 **Wipe off leak around the leak sensor or on the leak tray completely with wiper paper.**

NOTE
- Do not bend or pull the leak sensor.
- If there is contamination such as crystallized buffer solution, wipe it off with wiper paper soaked in water.

4.15 Cleaning the Exterior

4.15.1 Usual cleaning

If the exterior of the instrument is dirty, clean it with a dry soft cloth or tissue paper. If it is very dirty, clean it as below.

1 **Clean with a cloth soaked in diluted neutral detergent and wrung tightly.**

2 **Wipe off detergent with a cloth soaked in water and wrung tightly and then wipe off water with a dry cloth.**

⚠ CAUTION

Do NOT leave any part wet nor use thinner for cleaning.
Doing so may cause rust or discoloration.

4.15.2 Decontamination cleaning

After handling the hazardous substances, using the following procedure.

1 **Turn off the power of the column oven.**

NOTE The gas sensor may defect volatile gas generated from organic solvent.

2 **Clean with a cloth soaked in Aqueous ethanol solution (80%) or aqueous sodium hypochlorite solution (0.05%) and wrung tightly.**

⚠ CAUTION

Prohibition

Do not leave metal surfaces wet.
This can cause rusting and discoloration.

4.16 Cleaning of the Automatic Rinsing Kit

Necessary parts

Part Name	Part Type	Part No.	Quantity
WASHING PUMP SEAL KIT	Replacement part	228-56201-41	1

NOTE If the 10% 2-propanol water in the rinse solution bottle is dirty, replace with new solution. If getting significantly dirty, replace with new solution once a day. Even if it does not appear dirty, replace with new solution once a week.

1 **Remove the rinse cap of the automatic rinsing kit from the rinse solution bottle.**

2 **Pour distilled water into the rinse solution botte and clean the inside of the rinse solution bottle using a brush, etc.**

3 **Pour distilled water into the rinse solution bottle and rinse the inside of the rinse solution bottle for about 5 minutes using an ultrasonic bath.**

4 **Pour new 10% 2-propanol water into the rinse solution bottle, and return the cap and rinse solution bottle back to their original positions.**

5 **Replace the rinse tube if the inside is dirty.**

5 Technical Information

5.1 Specifications

5.1.1 LC-40D X3 CL Specifications

Item		Specification
Pump Type		Micro-volume double plunger pump (approx. 10 µL/stroke)
Pumping Methods		Constant flow pumping and constant pressure pumping
Allowable Maximum Pressure		130 MPa
Constant Flow Pumping	Flow Rate Setting Range	0.0001 to 10.0000 mL/min
	Maximum Delivery Pressure	130 MPa (0.0001 to 3.0000 mL/min) 80 MPa (5.0000 mL/min) 22 MPa (10.0000 mL/min)
	Flow Rate Accuracy	±1 % (1 mL/min when water is pumped at 80 MPa, with water and room temperature constant between 20 to 30 °C)
	Flow Rate Precision	Larger value of either 0.06 % RSD or 0.02 min SD
Pressure Display Accuracy		Larger value of either ±2 % or ±2.4 MPa
Suction Filter		10 µm
Line Filter		5 µm
Time Program		Commands for flow rate, pressure, [LOOP] (for program repetition), 320 steps (total of 10 program files)

*1 When water is pumped at 10 to 40 MPa, with water and room temperature constant between 20 to 30 °C.

*2 When water is pumped at 40 to 60 MPa, with water and room temperature constant between 20 to 30 °C.

5.1.2 LC-40D XR CL Specifications

Item		Specification
Pump Type		Micro-volume double plunger pump (approx. 10 µL/stroke)
Pumping Methods		Constant flow pumping and constant pressure pumping
Allowable Maximum Pressure		70 MPa
Constant Flow Pumping	Flow Rate Setting Range	0.0001 to 10.0000 mL/min
	Maximum Delivery Pressure	70 MPa (0.0001 to 3.0000 mL/min) 44 MPa (3.0001 to 5.0000 mL/min) 22MPa (5.0001 to 10.0000 mL/min)
	Flow Rate Accuracy	Larger value of either ±1 % or ±2 µL/min (0.01 mL/min to 3 mL/min) Larger value of either ±2 % or ±2 µL/min (0.01 mL/min to 3 mL/min)
	Flow Rate Precision	No more than the large value calculated with either 0.06 % RSD or 0.02 min SD
Constant Pressure Pumping	Pressure Setting Range	1.0 to 60 MPa (in steps of 0.1 MPa)
	Pressure Accuracy	Larger value of either ±10 % or 1.5 MPa
Pressure Display Accuracy		Larger value of either ±2 % or ±1.0 MPa
Suction Filter		10 µm
Line Filter		5 µm
Time Program		Commands for flow rate, pressure, [EVENT], [LOOP] (for program repetition), 320 steps (total of 10 program files)

5.1.3 High-Pressure Gradient System

Item	Specification	
	LC-40D X3 CL	LC-40D XR CL
Number of Solvents Mixed	2 or 3	
Gradient Profile	Step, linear and exponential functions (Only when controlled by LC workstation) possible at multiple levels	
Maximum Program Steps	400 steps (total of 20 program files)	
Program Duration	0.01 to 9999.90 minutes (in steps of 0.01 minutes)	
Range of Set Concentrations	0 % to 100 % (in steps of 0.1 %)	
Concentration Accuracy*1	±0.5 % (1 mL/min, 80 MPa)	±0.5 % (0.05 to 3 mL/min, 1 to 40 MPa)
Flow Rate Possible	0.0001 mL/min to 10 mL/min	

*1 For binary gradient with water/caffeine solution

5.1.4 Low-Pressure Gradient System

Item	Specification
Number of Solvents Mixed	Max. 4
Gradient Profile	Step, linear and exponential functions (Only when controlled by LC workstation) possible at multiple levels
Maximum Program Steps	400 steps (total of 20 program files)
Program Duration	0.01 to 9999.90 minutes (in steps of 0.01 minutes)
Range of Set Concentrations	0 % to 100 % (in steps of 0.1 %)
Concentration Accuracy	±0.5 %(1 mL/min, 10 MPa) (for binary gradient with water/caffeine solution)
Flow Rate Possible	0.0001 mL/min to 10 mL/min

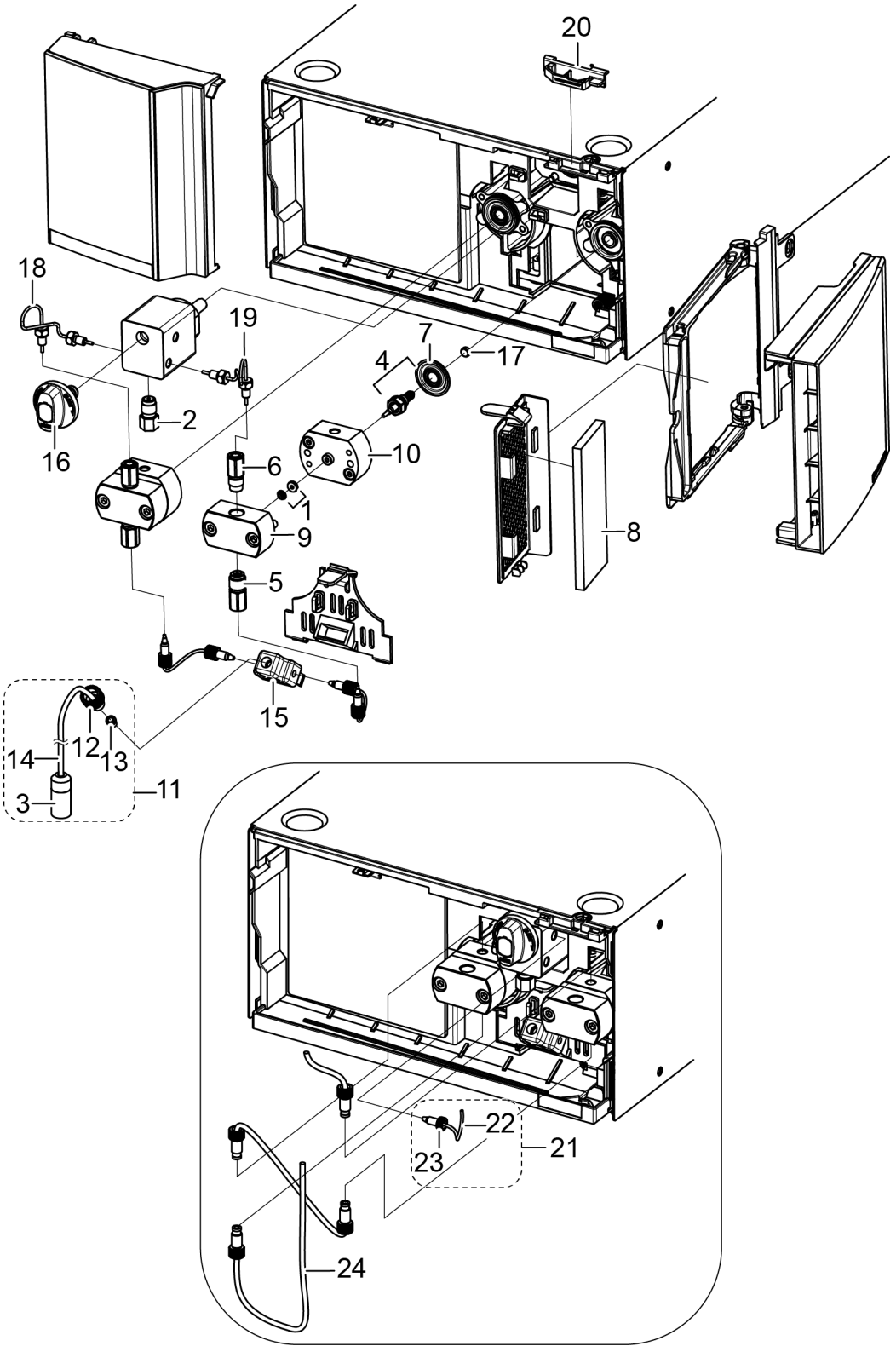
5.1.5 Other Specifications

Item		Specification
Liquid-Contacting Part Materials		SUS316L, PEEK, ruby, sapphire, HastelloyC, polyethylene
Operating Temperature Range		4 °C to 35 °C
Humidity Range		20 % to 85 %
Available pH Range		1 to 14
Dimensions		W260 mm × H140 mm × D500 mm (Excluding protruding parts)
Mass		10 kg
Power Supply	Power Supply Voltage (indicated on the instrument)	100 V AC to 240 V AC * Mains supply voltage fluctuations are not to exceed 10 % of the nominal supply voltage.
	Power Consumption	150 VA
	Frequency	50/60 Hz
	Rated Breaking Capacity	50 A * Connect the instrument to a power outlet that is equipped with a circuit breaker that shuts off the current at the described value or less.
Installation Environment (IEC)		Installation Category Ⅱ, Pollution Degree 2, Altitude 2000 m max. Install indoors.
Plunger Rinsing Line		Automatic rinsing kit as standard equipment
Pressure Limiter Operations		Upper/lower limits can be set
Error Display		Exist (Error display and stop at the time of malfunction)

■ Low Pressure Gradient Kit

Item	Specification
Flow Line Switching Method	Flow Line Switching with the five-way solenoid valve
Number of Flow Lines	1 (with four built-in two way solenoid valve)
Solenoid Valve Operating Pressure	0 kPa to 50 kPa
Materials for Parts Exposed to Liquid	PTFE, PEEK, fluororubber
Operating Temperature	4 °C to 35 °C
Available Flow Rate	0.0001 mL/min to 10 mL/min
Available pH	1 to 14

5.2 Maintenance Parts



5.2.1 Consumable Parts

No.	Part Name	Part No.	Remarks
1	PLUNGER SEAL	228-52711-93	Seal for pump head, with backup ring
	Plunger Seal GFP	228-52711-94	Optional parts
2	Line Filter ASSY, SUS	228-57501-92	LC-40D X3 CL
		228-35871-96	LC-40D XR CL
3	Suction filter	228-45707-91	Filter body only (cleaned)
4	Plunger Holder ASSY	228-52069-44	with diaphragm
5	Inlet Check Valve ASSY	228-52964-42	LC-40D X3 CL
		228-48249-96	LC-40D XR CL
	Inlet Check Valve ASSY, 2 pieces	228-48249-97	LC-40D XR CL
6	Outlet Check Valve ASSY	228-53334-96	LC-40D X3 CL
		228-45705-43	LC-40D XR CL
7	DIAPHRAGM 2PCS	228-55272-41	
8	AIR FILTER FOR RIGHT PANEL	228-53924-06	Filter only

5.2.2 Replacement Parts

No.	Part Name	Part No.	Remarks
9	PUMP HEAD	228-55230-45	
10	HEAD HOLDER,2030	228-38022-01	
11	Suction Filter ASSY	228-45708-91	
12	PEEK Bush Fitting 3	228-39084	For suction filter
13	FERRULE,3.0F-T	228-12493	For suction filter
14	FEP TUBE 3.0 (O.D.)×1.5(I.D.)	670-10321-05	For suction filter
15	INLET BLOCK PEEK	228-47518	Pump inlet
16	DRAIN VALVE ASSY,TP	228-51229-93	
17	THRUST	228-34469	
18	SUS PIPE L	228-70472-01	For the left pump head of LC-40D X3 CL
		228-70026-01	For the left pump head of LC-40D XR CL
19	SUS PIPE R	228-70472-02	For the right pump head of LC-40D X3 CL
		228-70026-02	For the right pump head of LC-40D XR CL
20	TUBE HOLDER	228-70044	
21	DRAIN TUBE ASSY	228-25495-93	
22	ETFE TUBE 1.6(O.D.)X0.8(I.D.)	228-18495-01	For use between the inlet block and the check valve
23	MALE NUT 1.6 PEEK	228-35403	For plumbing between the inlet block and the check valve

5.2.3 Maintenance Kit

A set of consumable parts is provided as Maintenance Kit

■ Maintenance Kit for LC-40D X3 CL (Parts No. 228-53265-45)

Part Name	Part No.	Quantity	Remarks
PLUNGER SEAL,BACKUP RING UHP	228-52711-93	2	With backup ring
Line Filter ASSY, SUS	228-57501-92	1	
Suction Filter ASSY	228-45708-91	1	
Plunger Holder ASSY	228-52069-44	2	With diaphragm
Inlet Check Valve ASSY	228-52964-42	2	
Outlet Check Valve ASSY	228-53334-96	2	
Air Filter for Right Panel	228-53924-06	1	

■ Maintenance Kit for LC-40D XR CL (Parts No. 228-45593-49)

Part Name	Part No.	Quantity	Remarks
PLUNGER SEAL,BACKUP RING UHP	228-52711-93	2	With backup ring
Line Filter ASSY, SUS	228-35871-96	1	
Suction Filter ASSY	228-45708-91	1	
Plunger ASSY	228-52069-44	2	With diaphragm
FERRULE 1.6F 316L	228-16000-10	2	
MALE NUT 1.6MN	228-16001	2	
SUS316LTP 0.3	228-50579-91	1	0.3 mm (I.D.) × 2 m
Inlet Check Valve ASSY	228-48249-96	2	
Outlet Check Valve ASSY	228-45705-43	2	

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