Laser Scattering Particle Size Distribution Analyzer LA-950V2

Instruction Manual

CODE:GZ0000079069C

Preface

This manual describes the operation of the Laser Scattering Particle Size Distribution Analyzer, LA-950V2.
Be sure to read this manual before using the product to ensure proper and safe operation of the instrument. Also safely store the manual so it is readily available whenever necessary.

Product specifications and appearance, as well as the contents of this manual are subject to change without notice.

■ Warranty and Responsibility

HORIBA warrants that the Product shall be free from defects in material and workmanship and agrees to repair or replace free of charge, at HORIBA's option, any malfunctioned or damaged Product attributable to HORIBA's responsibility for a period of one (1) year from the delivery unless otherwise agreed with a written agreement. In any one of the following cases, none of the warranties set forth herein shall be extended;

- Any malfunction or damage attributable to improper operation
- Any malfunction attributable to repair or modification by any person not authorized by HORIBA
- Any malfunction or damage attributable to the use in an environment not specified in this manual
- Any malfunction or damage attributable to violation of the instructions in this manual or operations in the manner not specified in this manual
- Any malfunction or damage attributable to any cause or causes beyond the reasonable control of HORIBA such as natural disasters
- Any deterioration in appearance attributable to corrosion, rust, and so on
- Replacement of consumables

HORIBA SHALL NOT BE LIABLE FOR ANY DAMAGES RESULTING FROM ANY MALFUNCTIONS OF THE PRODUCT, ANY ERASURE OF DATA, OR ANY OTHER USES OF THE PRODUCT.

■ Trademarks

Generally, company names and brand names are either registered trademarks or trademarks of the respective companies.

FDA Rules

■ WARNING

- This instrument is a Class 1 laser product complying with CFR 21, Chapter 1, Paragraph J.
- The laser specifications are as follows.
  Laser: Laser Diode
  Company: SANYO Electric Co.,Ltd.
  Model: DL-3147-165
  Output: 5 mW
  Wavelength: 650 nm
- Although this equipment is encased in a protective housing to prevent leakage of the laser beam, there is a danger of exposure to laser radiation if the protective housing is removed. There is no need to open the protective housing during either ordinary operation or maintenance.
- This warning plate has been attached to the instrument:

DANGER ——— Laser radiation when open.
AVOID DIRECT EYE EXPOSURE

● Label

Certification/Identification Label
This product complies with 21 CFR Chapter1 Subchapter J.
Manufacture of record: Horiba Instruments, Inc.
Address:17671 Armstrong Avenue, Irvine, California 92614
Phone:949-250 4811
*1 Date manufactured:
*2 Model:
*3 Serial Number

*1: MM.DD.YY
*2: LA-950V2
*3: 10-digit numerals

FCC Rules

■ WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC label

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS : (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

Conformable Directive

This equipment conforms to the following directives and standards:

CE

Directives: the EMC Directive 2004/108/EC
the Low Voltage Directive 2006/95/EC

Standards: [the EMC Directive]
EN61326-1:2006
EMISSION: Class B, IMMUNITY Category: Industry
[the Low Voltage Directive] EN61010-1:2001

● Installation Environment

This product is designed for the following environment:

- Installation Categories II
- Pollution degree 2

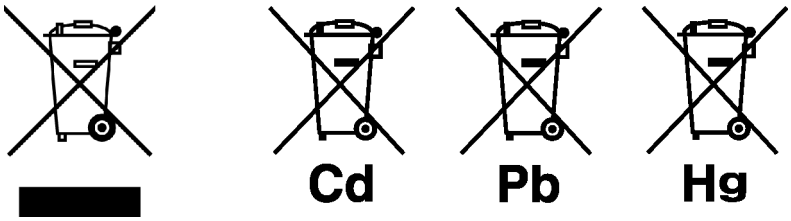
● nformation on Disposal of Electrical and Electronic Equipment and Disposal of Batteries and Accumulators

The crossed out wheeled bin symbol with underbar shown on the product or accompanying documents indicates the product requires appropriate treatment, collection and recycle for waste electrical and electronic equipment (WEEE) under the Directive 2002/96/EC, and/or waste batteries and accumulators under the Directive 2006/66/EC in the European Union.

The symbol might be put with one of the chemical symbols below. In this case, it satisfies the requirements of the Directive 2006/66/EC for the object chemical.

This product should not be disposed of as unsorted household waste.
Your correct disposal of WEEE, waste batteries and accumulators will contribute to reducing wasteful consumption of natural resources, and protecting human health and the environment from potential negative effects caused by hazardous substance in products.

Contact your supplier for information on applicable disposal methods.



For your safety

Warning messages are described in the following manner. Read the messages and follow the instructions carefully.

● Meaning of warning messages

⚠DANGER	This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
⚠WARNING	This indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	This indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. Without safety alert indication of hazardous situation which, if not avoided, could result in property damage.

● Symbols

Description of what should be done, or what should be followed

Description of what should never be done, or what is prohibited

■ Safety Precautions

This section provides precautions to enable you to use the product safely and correctly and to prevent injury and damage. The terms of DANGER, WARNING, and CAUTION indicate the degree of imminency and hazardous situation. Read the precautions carefully as it contains important safety messages.

⚠ DANGER
HIGH VOLTAGE Do not touch inside with power on.

⚠ WARNING
Incorrect wiring can lead to an electrical shock. Be sure to ground all wiring.
LA-950V2 weighs approx. 56 kg. Use at least 3 workers to lift.

⚠ CAUTION
LASER RADIATION The laser light source is used in this product. Do not open the part where the label “LASER RADIATION” is attached. If you open it, the laser radiation may leak.
Caution on organic solvents • Exposure to sample liquid may occur during operation. • During operation, take adequate precautions for the organic solvents in use, such as wearing chemical-resistant gloves.

Safety and Usage Cautions

In order to operate the LA-950V2 safely and correctly, be sure to read and follow the instructions given below.

- When moving the LA-950V2, be sure to contact HORIBA.
- Do not subject the unit to shaking or vibration.
- Be sure to use only a 3-pin power cable and connect it securely to the LA-950V2.
- Since this unit uses precision optical parts, a laser light source and a motor, be sure to handle it carefully.
- After supplying power to the LA-950V2, approximately one (1) hour is required for the laser light to stabilize.
- Do not remove or modify any of this devices internal parts.
- When using volatile dispersion medium, a spark from the motor or other part can cause the dispersion medium to ignite. This device's specifications are not explosion proof.
- When using a dangerous dispersion medium or sample, be careful for leaks and drainage.
- Do not operate this unit in a manner different from the instructions given in this installation manual, since it can lead to unit degradation or damage.
- Do not damage the surface of the cell, or handle the cell in the following ways:
  - Leave the cell soaking in cleaning solution.
  - Use ultrasonic to clean the cell.
  - Dip the cell in acid or alkaline solutions.
  - Rub the surface of the cell with a hard object.
- Be sure to follow the PC's installation instructions when making backup copies of previously installed PC software. HORIBA does not make backup copies.
- In order to always use the LA-950V2 in the best condition possible, it is recommended that HORIBA perform an inspection and maintenance once a year (fee required).
- Be sure any power cable used is equivalent to the cord set included (power cable) with the LA-950V2.

Confirm the power supply voltage

The internal setting of this unit differs by the power supply voltage of 100 V to 120 V AC and 230 V AC.

Confirm the applied voltage written in the label at the back panel of this unit.

If the power supply voltage and the power cable are not appropriate, be sure to contact HORIBA as these parts will need to be changed.

Disposal of the product

None of the LA-950V2 parts requires any special treatment for disposal. Dispose of this unit as you would standard industrial waste.

Description in this manual

Note

This interprets the necessary points for correct operation and notifies the important points for handling the unit.

Reference

This indicates the part of where to refer the information.

Tip

This indicates reference information.

Documents related to this product

The LA-950V2 documentation consists of the instruction manual (this document) and online help (included with the product).

● Instruction manual (this manual)

Covers procedures through power ON and starting measurement. The information (the refractive index information for the dispersion medium, etc.) is for use as a reference only when needed.

● Online help

Provides detailed descriptions of actual measurement procedures.

● LA-950V2 Dry Measurement Unit Instruction Manual (option)

Describes basic operations and brief measurement procedures when the LA-950V2 dry measurement unit is mounted in LA-950V2. Covers procedures through power ON and starting measurement. The information is for use as a reference only when needed.

Contents

1 Overview

1.1 Product Overview

- The LA-950V2 is a "Measurement Unit" designed to measure particle size distributions.
- The LA-950V2 uses a signal cable to communicate with a personal computer (PC), and PC control is used to perform measurements and send data.
- Particle size distribution measurement is used for quality control in basic research and production processing of fine ceramics, cement, drugs and other products.
- Particle size distributions from 0.01 μm to 3000 μm can be measured, without changing ranges. Processing is extremely reliable and normally requires only 1 minute, from insertion of dispersion medium to display of result.
- LA-950V2 is a generic name, and the specification is determined as follow, confirm your model.
  The details of each specification are described at “ 12.1 Unit Specifications ” (page 52).

● Specification for water/ethanol dispersant "6 types"

Model	Specification
LA-950A2	Standard
LA-950L2	Large volume
LA-950W2	Direct water supply from water service tube
LA-950E2	Single laser system
LA-950N2	Optical bench only
LA-950P2	Perista pump

● Specification for organic dispersant "2 types"

Model	Specification
LA-950S2	Standard
LA-950PS2	Perista pump

1.2 LA-950V2 System Design

The LA-950V2 system design is as follows.
The "Fraction cell Unit" shown below is an optional item.

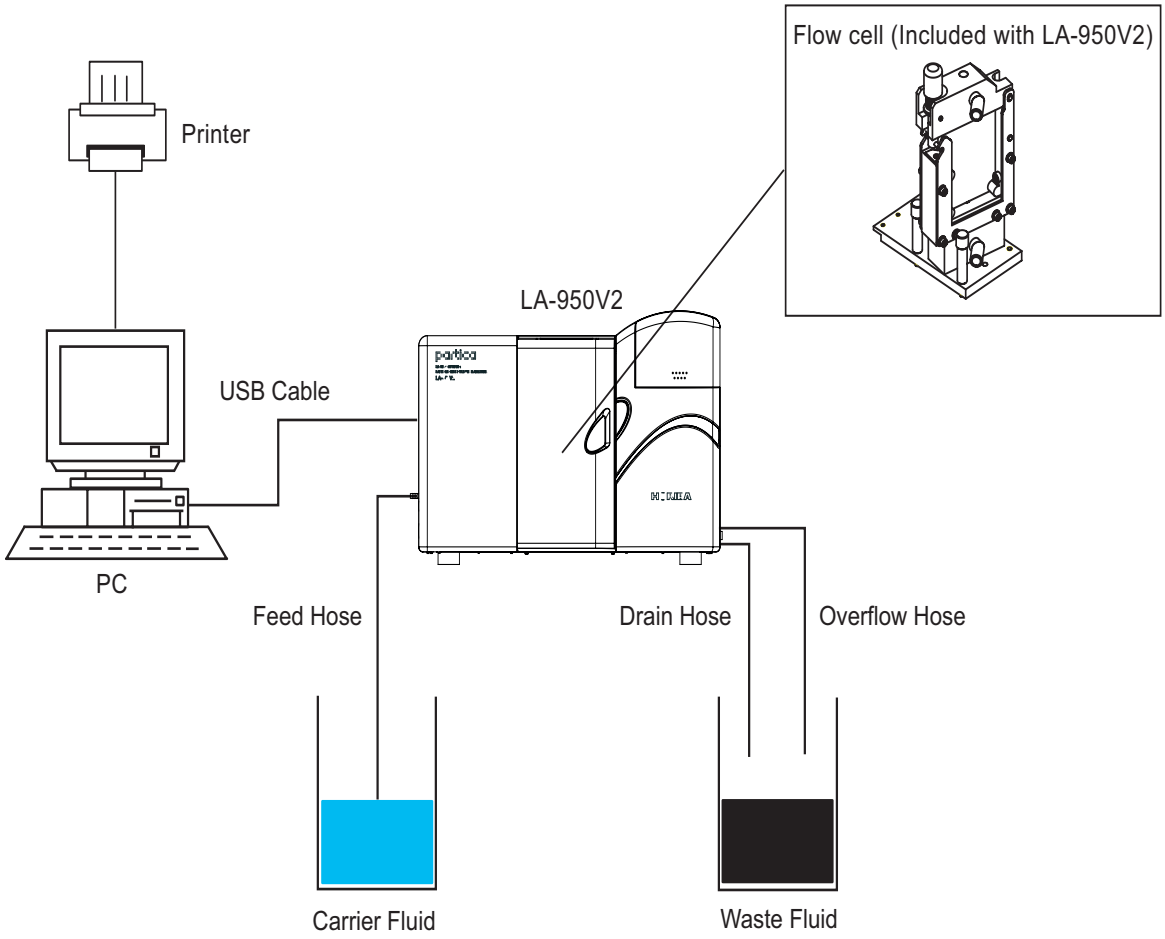


Fig. 1 System Design diagram

1.3 LA-950V2 Description and Functions

1.3.1 External view

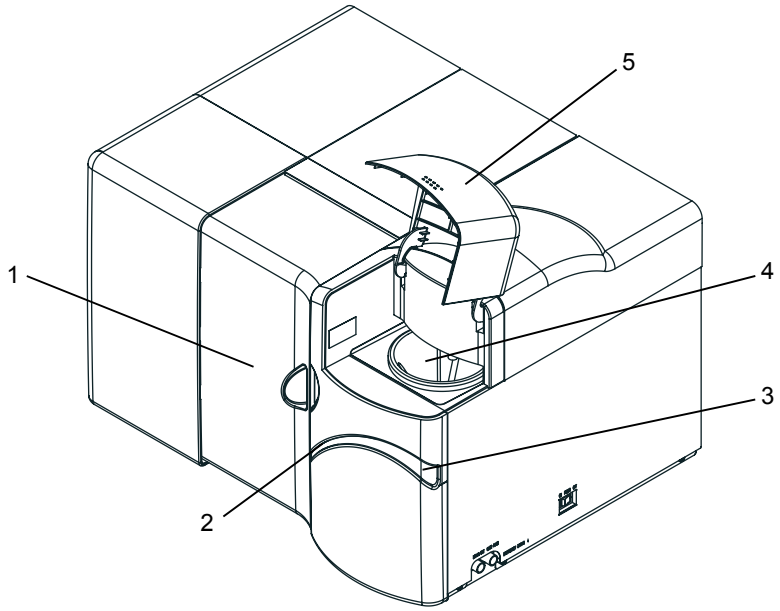
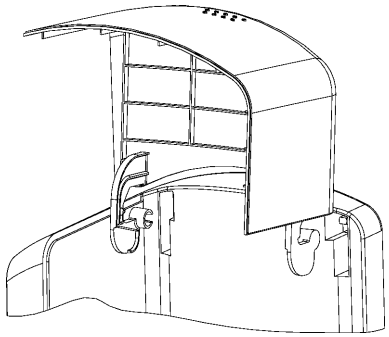


Fig. 2 Front

No.	Name	Function
1	Cell Chamber Door	Door for sample chamber
2	Power Lamp	The lamp lights when the power switch turned ON.
3	Indicator	Indicates the status of LA-950-V2 by emitting pattern.
4	Sampling Bath	Bath for inserting a sample
5	Sampling Bath Cover	Cover for sampling bath

Note

- **Do not put any experimental tools, for example spatula, around the sample bath.**
- **Be careful not to foreign body fall into the sample bath.**
- **The sample bath cover can be removed.**



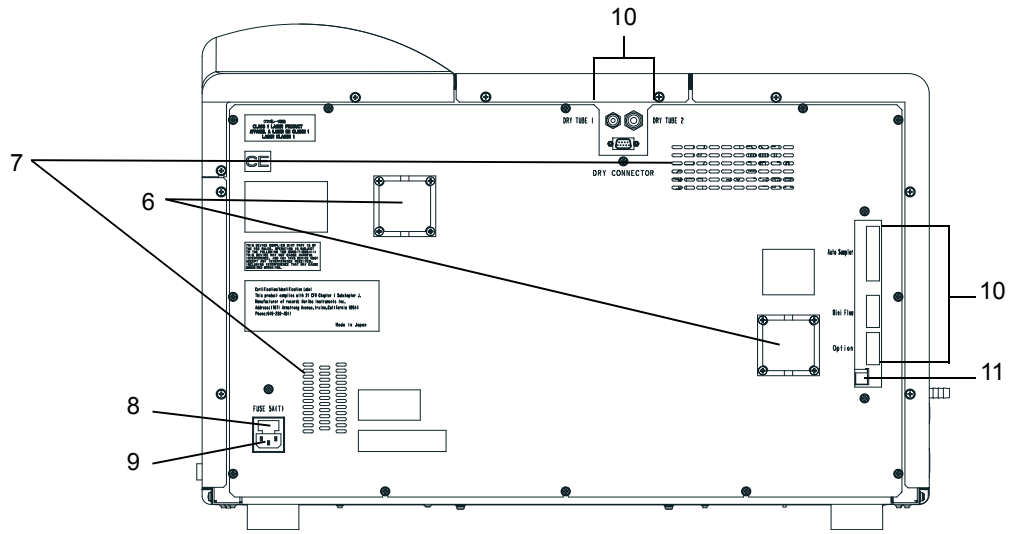


Fig. 3 Rear

No.	Name	Function
6	Suction Duct	Duct to take cooling air in Do not obstruct the air duct.
7	Exhaust Ducts	Ducts for exhausted air Do not obstruct the air duct.
8	Fuse	5 A (rated), time-lag fuse. 2 fuses are used.
9	AC power socket	Power input socket for LA-950V2
10	Accessory connection ports	RS-232 sockets to communicate LA-950V2 with option(s)
11	USB socket	USB socket to communicate LA-950V2 with PC

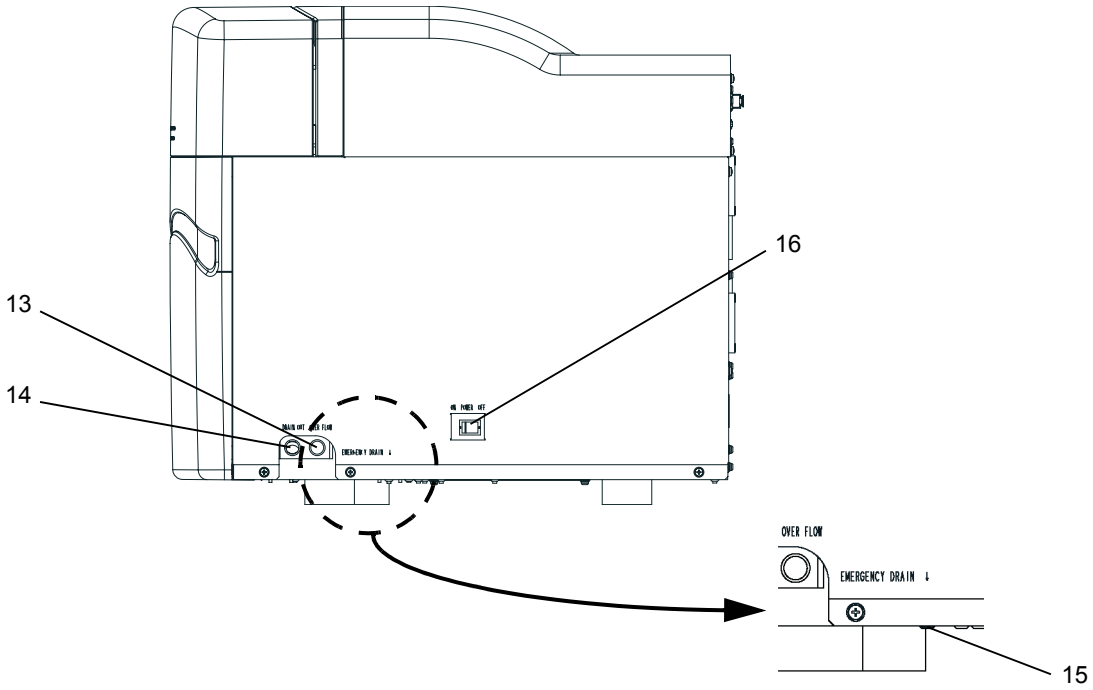


Fig. 4 Right side

No.	Name	Function
13	Overflow pipe	Pipe to connect with an overflow hose
14	Drain pipe	Pipe to connect with a drain hose
15	Leakage Solvent Drain	Leaked solvent is drained from here. Do not block leakage solvent drain. Keep enough space.
16	Power switch	Power ON/OFF switch for LA-950V2

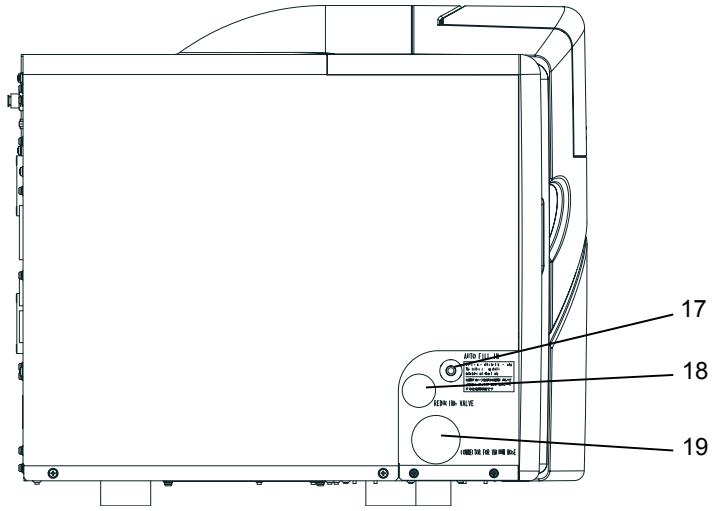
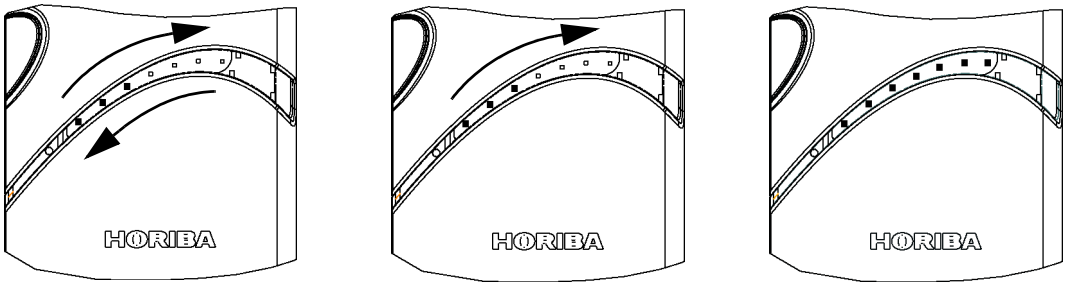


Fig. 5 Left side

No.	Name	Function
17	Feed Pipe	Pipe to connect a feed hose
18	Connector with Pressure Control for Direct Water Pipe Supply (LA-950W2)	Injection to connect with pressure control valve
19	Outlet for Dry Feeder Unit (for LY-9505)	Injection to connect with outlet connector

Status of instrument is displayed by LED emitting patterns at the indicator.



A B C

	LED emitting pattern	Message
A	Upper and lower round trip	Starting up LA-950V2. It is displayed until communicate with PC.
B	Sequential light from down to up	Solvent is in circulation, or instrument is working for measurement.
C	All the LED Blinking	Warning message: Operator is starting measurement with opening the sample door. Abnormal condition in the instrument.

Indicator ON/OFF can be selected in the software. Refer to “ 8 Indicator Setting ” (page 40).

1.3.2 Sample container

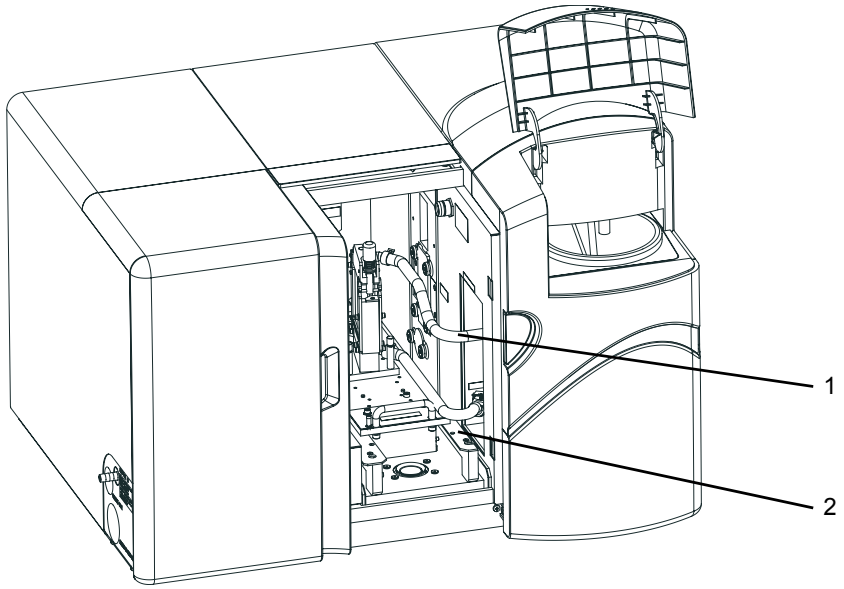


Fig. 6 Sample Container (Using Flow Cell)

No.	Name	Function
1	Circulation Tube	Supplies dispersion medium to the cell.
2	Cell Changer	The Cell Holder slides forwards and backwards to change the cell type.

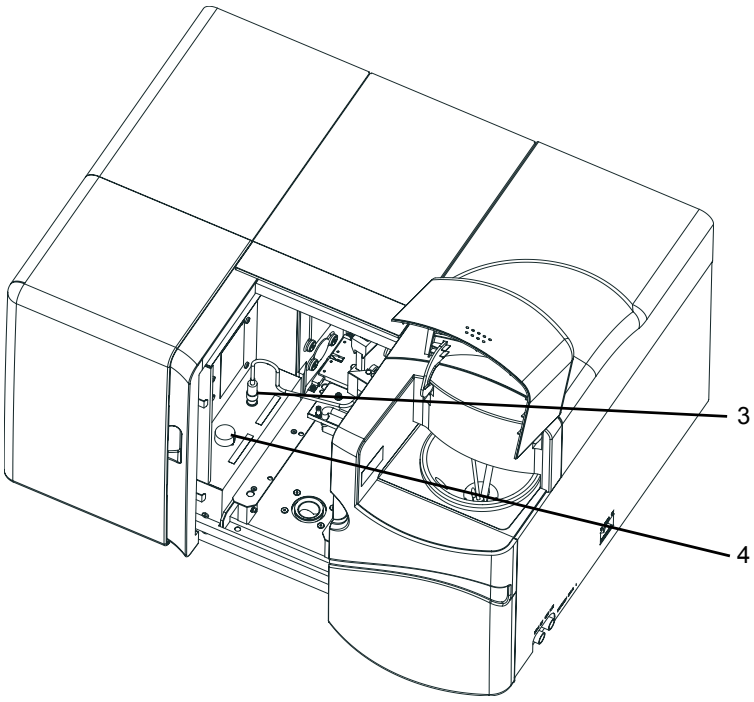


Fig. 7 Sample Container (Using Fraction Cell)

No.	Name	Function
3	Fraction Cell Connector	Used to connect the stirrer motor for fraction cells.
4	Speed Adjustment Knob	Used to adjust the rotation speed of the stirrer motor.

2 Starting Operation

2.1 Confirm Operation Conditions

Check that the LA-950V2 operation environment fulfills the following conditions.

Note

Operating the LA-950V2 in an environment that does not fulfill the following conditions may lead to abnormal operation. It may also degrade the unit performance, or lead to an accident or breakdown.

- Voltage range is 120 V AC ±10% or 230 V ±10%. Also, be sure to use a power supply that does not fluctuate. Power supply capacity should be 300 VA or more.
- Power supply frequency should be 50/60 Hz, with a fluctuation range of 1% or less.
- Be sure to ground the unit's ground terminal or ground adapter's ground wire.
- Operating temperature should be 15ºC to 35ºC (59ºF to 95ºF). Temperature fluctuations during measurement should be ±1ºC (±2ºF).
- Do not operate this unit in areas receiving direct sunlight, direct air conditioning, or where large temperature changes can occur.
- Areas with high levels of humidity can lead to condensation, which can, in turn, cause measurement errors and electrical part failures.
  Be sure to operate the unit in areas with a relative humidity of 85% or less, and no condensation.
- Be sure to operate the unit where dust levels are low, and no corrosive gases are present.
- Be sure the unit is horizontal, and there is no vibration.
- Be sure the table which the unit is placed on is stable.
- The rear face of this unit has cooling fan air vents. Be sure they are not blocked.
- Do not operate this unit near strong magnetic or electrical fields, or high-frequency devices.
- This device is designed to be operated in a Category (overvoltage category) II Pollution Degree 2 environment (Applicable standard IEC1010-1). Be sure to not use this device in an environment where an impulse voltage in excess of this amount can be applied.

Measurement with pressurizing water supplied from valve directly (LA-950W2).

- Use exclusive hose band in accessory kit.
- Water pressure should be 0.05 MPa to 1 MPa.
  Do not supply over than 1 MPa pressure.
  (In the case of water supply from water service tube, watch out for water pressure condition changing in summer and winter. Be sure to water pressure control.)
- Flowing quantity should be more than 1 L/min. Low quantity causes "time out error" and disable automation water supply.
- Contamination should not be in the system. Existence of contamination obstructs correct measurement, and causes fatal problem in valve. Use filter for direct water supply from water service valve.
- Only water is available as dispersant.
- Water temperature should be 10ºC to 40ºC (50ºF to 104ºF). Control water temperature close to the room temperature. If temperature between water and room is so miss matched, measurement result will be unstable which caused by instability. Do not flow water under 2ºC (35.6ºF) or fatal error at the magnetic valve will be caused.

2.2 Checking Cable and Piping Connections

Prior to turning the LA-950V2 ON, be sure to check that all cables and pipings are connected as follows.
Check all related explanation manuals for PC and peripheral device connections.

Checking cable connections

⚠ WARNING

Incorrect wiring can lead to an electrical shock. Be sure to ground all wiring.

- Check that the communication cable included is securely connected to the LA-950V2 rear face communication connector and to the PC's USB port.
- Check that both the LA-950V2 and the PC's power cables are securely connected.
- Be sure to use only a 3-pin power cable.

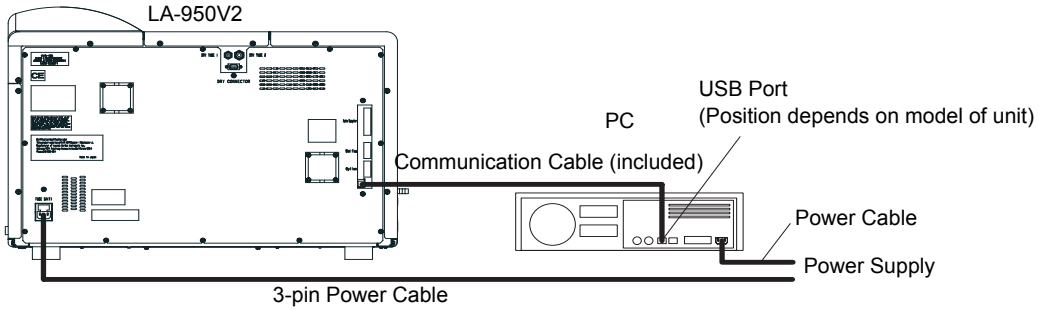


Fig. 8 Check all wiring between the LA-950V2 and the PC

Checking piping connections

- Check that the dispersion medium Supply Pipe, Drain Water Pipe and Overflow Pipe hoses are connected and secured in place by their hose bands.
- Check that the Dispersion Medium Supply Pipe and supply hose are securely connected.
- Check that all hose ends are securely connected with the Drainage, Drain Tank and Dispersion Medium Container.
- Check that hoses are not pinched or twisted.
- Check that the Drain Water and Overflow hose ends are not used for other fluids.

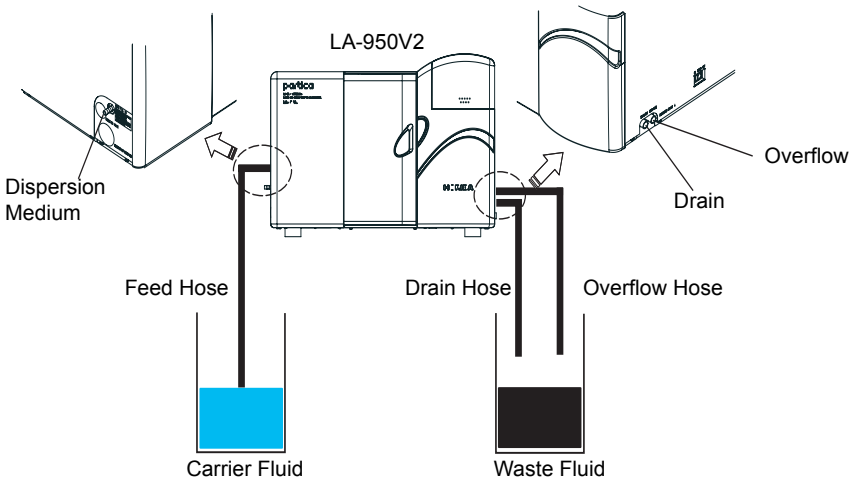
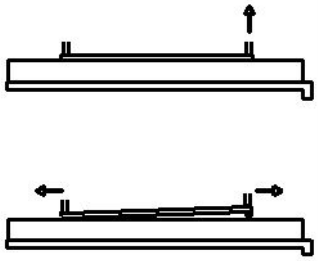


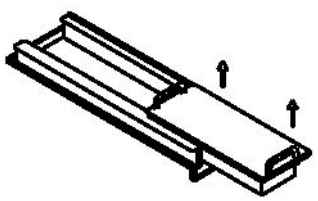
Fig. 9 Piping Connections

2.3 How to Handle the Cell Slide Stage

1. **Pull up the front handle, and slide the cell stage to the right position.**



2. **When you take the cell slide stage out to the analyzer, lift up the both side handles.**



2.4 Flow Cell Holder

- Check that the O-rings (2) are inserted in the O-ring grooves on the flow cell holder without protrusion.
- Check that the flow cell is in the flow cell holder correctly, and the lock clip of the holder cover is fastened securely.

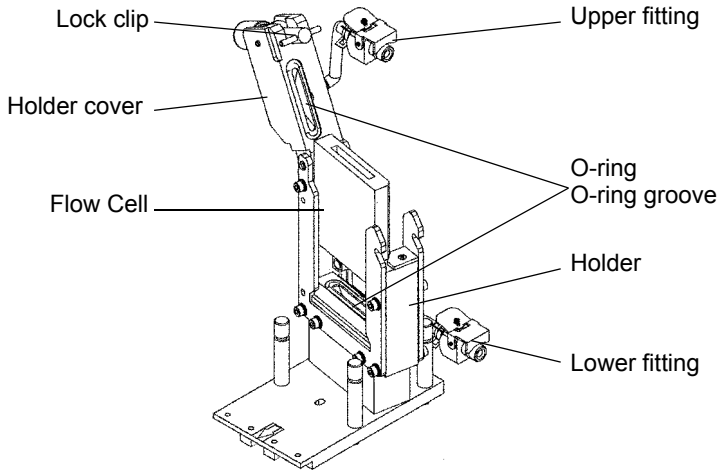


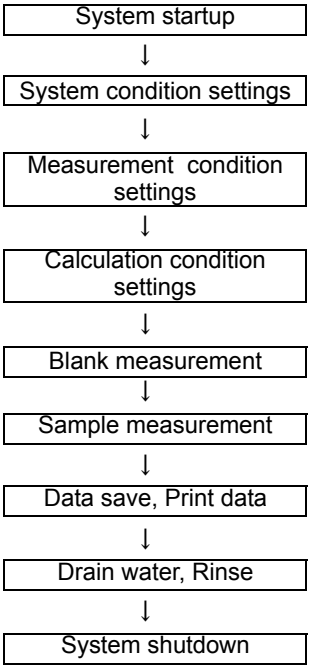
Fig. 10 Flow Cell Holder

3 Basic Operation

3.1 Operation Flow

Measurement in standard LA-950V2 requires flow type cell unit. Particle size analysis is carried out in solvent.

In flow cell measurement, the sample and the dispersant circulate in the circulation system powered by circulation pump. An internal ultrasonic probe urges sample dispersion in the measurement.



3.2 System Startup and Shutdown

3.2.1 System startup

The following explanation describes the LA-950V2 startup procedures.

1. **Turn the LA-950V2's power ON.**
   The LA-950V2 power switch is located on the right side.
   Check that the unit's front face power lamp is lit.
2. **Turn the PC ON.**
   Windows automatically starts.
3. **Double-click the desktop's [LA-950 Wet]  icon.**
   The program starts and the startup screen appears.
4. **Enter the desired settings and begin measurement.**
   Refer to “ 4 Condition Settings ” (page 14).

Tip

- **Although measurement can be performed soon after program startup, wait at least one hour after turning the LA-950V2 power ON before performing measurements, to ensure that all unit conditions are stable.**
- **For detailed software operation information, refer to the software's online help function.**

3.2.2 System shutdown

The following explanation describes the LA-950V2 shutdown procedures.

1. **After the sample is discharged, clean the circulation system using cleaning fluid.**
2. **Exit the LA-950V2 software.**
   The following methods can be used to exit the software.
   - Click the [File] menu and select [Exit].
   - Simultaneously press the [Alt] and [F4] keys.
   - Click the Title Bar's far right-side [close] button.
3. **Shut down Windows.**
4. **Turn the LA-950V2 and the PC's power OFF.**
   The LA-950V2 power switch is located on the right side.

Note

- **Laser is continuously lighted during LA-950V2 power on. If you do not use LA-950V2 for a long period, be sure to power OFF to save the laser life time.**
- **After the sample solution is discharged, be sure to clean the circulation system. If sample solution remains in the unit's circulation system for a long period of time, it may become impossible to clean the circulation system and the cell.**

4 Condition Settings

Prior to beginning measurement, system conditions, measurement conditions, calculation conditions and sample conditions should be checked and, if necessary, modified.

4.1 Regular Settings

Regular Settings are opened from the [Setting] menu - [Set Conditions].

- **Sample information**

  Check and modify the sample information. Choose the items to modify and change their settings. The items that can be modified are as follows.

Sample Information	Sample name, Material, Source, Lot Number, Test or Assay Number

- **Setting a refractive index file**

  Use the Refractive Index Panel to designate the refractive index file used when calculating the particle size distribution.

  Click the [selection] button above the Refractive Index Panel to view a list of the currently registered refractive index files. Select the desired refractive index file and click the [OK] button.

● Creating a refractive index file

If the desired refractive index file is not registered, a new refractive index file can be created.

To create a refractive index file, click the [Create] button, located above the Refractive Index Panel. The [Refractive Index File Creation] panel will appear. Click either the [List] button or the [Edit] button and enter the sample and dispersion medium's absolute refractive index information.

When the value used for the blue wavelength's refractive index differs from the red wavelength's value, click the [Set Blue Refractive Index] checkbox. If this checkbox is not checked, the same refractive index is used for the blue wavelength and the red wavelength.

Click the [List] button to display a list of representative sample and dispersion medium absolute refractive indexes.

If the desired refractive index is not in the list, click the [Edit] button and enter the refractive index information by hand. The data to be entered is as follows.

Item	Description
Name	Enter the name of the sample.
Comment	If desired, enter a comment.
Real number (LD)	Absolute refractive index's Real Number for a red laser beam. (Ex.) For the figure "1.6-0.3i", enter "1.6".
Imaginaly number (LD)	Absolute refractive index's Imaginaly number for a red laser beam. (Ex.) For the figure "1.6-0.3i", enter "-0.3i".
Real number (LED)	Absolute refractive index's Real Number for a red LED beam. (When entering the red color's refractive index).
Imaginaly number (LED)	Absolute refractive index's Imaginaly number for a blue LED beam. (When entering the blue color's refractive index).

After all data entry is completed, click the [Create] button at the bottom of the [Refractive Index File Creation] panel. The new refractive index file is created/registered.

Reference

“ 12.10.1 Inorganic substances ” (page 80), “ 12.10.2 Dispersion medium ” (page 83)

● Fixed value

Enter each type of computing condition for the particle size distribution calculation. The particle size distribution calculation is based on the relational operator of the measured scattering pattern and the response function (theoretical dispersion pattern). Sets the relational operator's iteration number.

Form of Distribution	Select the form of distribution from, [Auto] and [Manual]. Auto: The software determines and sets the appropriate number of iterations: either 15 or 150 iterations. Manual: Lets you enter a user-specified number of iterations. Clicking the [Iteration Number] button displays an input box.

● Graph

Distribution Base	Enter the standard for the particle size distribution. The standard is [Volume]. Other types of standard distributions are derived from a mathematical conversion of the volume standard distribution. Assuming the total particle volume is 100, the volume standard distribution becomes the ratio of the volume of all particle diameters.

4.2 System Condition Settings

The [System Condition] dialog box is used to enter each type of system condition.

1. **Click the [Condition] - [Measurement Condition] - [System] button.**

   The [System Condition Settings] dialog box opens.

● **Settings for pre and post-measurement automatic operations (Auto function panel)**

These settings designate the operations performed automatically before and after measurement.

Designated operations are performed after each measurement.

Set Condition before measurement	Prior to performing measurement, be sure to open the [Sample Information] window and register the sample information.
Automatic Printing	After particle size distribution measurement is completed, the measurement results are automatically printed.
Automatic Save	After particle size distribution measurement is completed, the measurement results are automatically saved using the following filename. Automatic Save Filename: YYYY MM DD HH mm XXX ↑ ↑ ↑ ↑ ↑ ↑ Year Month Day Hour Min Auto ID # Click to display the folder selection panel. Specify the folder to save the file in.
Autoscale after Meas.	After measurement an autoscale of the Measurement graph is performed.
Recalculation after graph range expansion	Recalculation is automatically performed when the graph range is expanded. Selecting [Do] designates that recalculation is automatically performed when the graph range is expanded.
Automatic Save to Database	Used to automatically save measured data to the database.

Tip

The ID# is incremented after each measurement.

● Modifying the sample information definition (User definition panel)

When default settings are used, the following items are included in the sample information.
Sample name, Material, Source, Lot Number, Test or Assay Number, Remarks 1 to 10.

The following method can be used to change sample definitions.

1. **Select the User Definition tab.**
   The User Definition Change panel will appear.
2. **Change the User Definition.**

● Settings for the Circulate/Agitate/Ultra Sonic operating conditions (Sample preparation panel)

Settings for the circulation speed, ultrasonic operation time and ultrasonic strength default values used to adjust the sample.

Circulation Speed	Sets the circulation pump's speed. (1 to 15)
Ultra Sonic Power	Sets the ultrasonic strength. (1 to 7)
Ultra Sonic Time	Sets the ultrasonic operation time. (1 minute to 30 minutes or 1 second to 1800 seconds)
U-Sonic during Meas.	Checking this item allows ultrasonic operation while measurement data is being captured.
Agitation Speed	Sets the agitation speed. (1 to 15)
Agitation Setting	Select either [Continuous] or [Intermittent].

Note

When a surfactant is being used as a dispersant, agitation should not be performed. When agitation is performed the sample will foam, which will have a negative effect on measurement. Also, if surfactant is already included in the feed solution, during feed or during de-bubble foaming can easily occur. Therefore, after feeding the dispersant, be sure to feed surfactant to the sampling bath.

4.3 Measurement Condition Settings

1. **Click the [Condition] menu - [Measurement Condition] - [Measurement] button.**
   The [Measurement Condition] dialog box opens.

● Settings for the optimal transmittance range

Settings for the appropriate transmittance range to be used as a criterion when adjusting the sample concentration.
The values set here are displayed as a horizontal, light green band in the measurement screen's transmittance display graph bar.
Test sample concentration is calculated based on the transmittance.
When diluting the sample with dispersion medium, adjust the concentration while checking the transmittance displayed on the screen.

Transmittance (R) Upper/Lower	Sets the upper and lower limits for the laser diode's appropriate transmittance value.
Transmittance (B) Upper/Lower	Sets the upper and lower limits for the LED's appropriate transmittance value.

Tip

This setting value does not effect other values, such as the particle size distribution calculation value. When the sample concentration becomes too high, multiple scattering occurs which degrades measurement accuracy. A transmittance setting of 70% or higher is recommended.

● Settings for the injection and resource

Settings for the dispersion medium injection amount and the number of rinses performed.
When measuring test samples that are highly adhesive, increase the number of rinses performed.

Feed Liquid level	Dispersion medium injection amounts are set using one of four levels (Low, Medium, High, Full).
Number of times to Rinses	Sets the number of rinses performed (1 to 5).

● Selecting the standard value for auto concentration adjustment

During auto concentration adjustment, the sample concentration is monitored by transmittance. Select whether to use Red Light (R) or Blue Light (B) as the standard.

Settings for the number of data acquisitions

Settings for the number of scattering data acquisitions. The average of acquired scattering data is used when calculating particle size distributions. Increasing the number of data acquisitions also increases the reliability of the Measurement.

When measuring test samples with large transmittance fluctuations, set a large number of acquisitions.

Settings for sample measurement and blank measurement items.

Number of Data Acquisitions	Sets the number of scattering data calculations performed when measuring the sample and the blank sample. Increasing the setting value also increases the amount of scattering data calculated. Data can be calculated from 1 to 500000 times. The default value is 5000 times.

Selecting whether to perform an optical axis alignment

The [Alignment before measurement] setting lets you select whether to execute optical axis adjustment before executing sample measurement. Normally, select [No] for this item.

If you select [Yes], optical axis adjustment is executed before sample measurement.

If you select [No], optical axis adjustment is not executed before sample measurement.

Tip

For blank measurement, optical axis adjustment is executed before measurement regardless of this setting.

4.4 Calculation Condition Settings

1. **Click the [Condition] menu - [Measurement Condition] - [Calculation]**  **button.**
The [Calcuration condition] dialog box opens.

● **Settings for the cumulation counter % diameter, cumulation counter % value (Fixed value panel)**

Settings for the cumulation counter % diameter, cumulation counter % value display conditions.

Cumulative % on Particle Size	Sets the standard cumulation counter % diameter. The checked cumulation counter % value shows the particle distribution diameter.
Particle size on Cumulative %	Sets the standard cumulation counter % diameter. The checked particle distribution diameter shows the cumulation counter % value .

● **Settings for the graph's display conditions (Graph panel)**

Designate the distribution graph's display conditions.

Density Distribution Graph	Sets the particle size axis separation method when the particle size distribution will be displayed. The settings entered will be effective from the next measurement and afterwards, or when a recalculation is performed. ● Standard The separation method (logarithm, etc. interval) set as the default is used to separate and display the distribution for the particle diameter axis. ● Custom Setting The user-designated arbitrary particle diameter interval is used to separate and display the distribution for the particle diameter axis. ● Custom Setting % The user-designated arbitrary undersize cumulative distribution interval is used to separate and display the distribution for the particle diameter axis.

● Settings for the span/verification (Verification panel)

The Verification panel is used to set the [Span] and the [Verification].
When the calculation result's display item settings are used to [Span] to [ON], the result of the span value calculation is shown in the calculation result window. The span value becomes the criterion that expands the distribution. To calculate the span value, the required cumulation counter % diameter must be set. The span value is the value obtained by dividing the difference between two cumulation counter % diameters by the median diameter.
Checking [Verification Result] displays a calculation result window showing whether the measured value meets the set standard after measurement. The standard value used for determination must be entered.

Span operation	Selects whether the span value is calculated or not.
Cumulative	Enters the values used to calculate the span value. Example: When 10% and 90% are entered: Span value =| D 90% diameter - D 10% diameter | / Median diameter **Note** **In this formula, the character "| |" means an absolute value.**
Verification	Click the [Setting] button and enter the values using the [Verification Setting] dialog box. Enter the Standard and Allowable range.

4.5 Sample Information

1. **Click the [Condition] menu - [Measurement Condition] - [Sample Information] button.**
The [Sample Information] dialog box opens.

● Entering the sample information

Use the [Sample Information] dialog box to check and/or modify the sample conditions.
After the memory to be modified is selected, choose the items to modify and change their settings. The items that can be modified are as follows.

Other Information	Remarks1, Remarks2, Remarks3, Remarks4, Remarks5, Remarks6, Remarks7, Remarks8, Remarks9, Remarks10

5 Measurement

Particle size distribution measurement in LA-950V2 is carried out with using a flow type cell. After recording a scattering light of blank, sample measurement is measured.
Options (Miniflow, Spray type, Fraction cell, and Paste cell/cell holder) are carried out by installing them to LA-950V2 in advance.
Available option is determined by the specification of LA-950V2. Refer to “ 12.7 Options ” (page 73).

- **Performing blank**

  Even if fine particles are not included in the dispersion medium, weak scattering will be detected by each detection unit. Because of this, during sample measurement scattering from particles also includes background data (unneeded scattering).
  Blank measurement is used to measure only this background data, and the result is recorded as the blank value.
  When sample measurement is performed, this blank value is subtracted and therefore provides a scattering value that does not include background data.
  The blank value will vary, depending cell differences, cell internal or external scratches, stains or other causes. It is recommended that blank measurement be performed for each sample measurement.
  The blank measurement's scattering acquisition frequency is based on the settings in the [Measurement Condition Settings] dialog box.

5.1 Using a Flow Cell

5.1.1 Measurement

The measurement procedure is as follows.

1. **Enter each required measurement condition and system condition item.**

- **Blank measurement**

2. **Click the [Feed] button to supply dispersion medium to the sampling bath.**

Note

Use a dispersion medium with a viscosity of 10 mPa·s or less.
If the dispersion medium is not drawn up when you click the [Feed] button, lift up the feed hose, insert a small amount of dispersion medium in the end of the hose, then click the [Feed] button again.

3. **Click the measurement screen's [Circulation] button to perform circulation until the circulation system is filled with dispersion medium.**

4. **Click the [De-bubble] button and release the circulation system's trapped air.**
If a single purge is not enough to release all trapped air, repeat the De-bubble until all air is released.

Note

- **If a large air bubble remains in the system, the distribution will appear 100 μm or higher in the simple distribution graph.**
- **If a small air bubble remains in the system, the distribution will appear 10 μm or near in the simple distribution graph.**
- **When using surfactants or other products that easily produce bubbles, stop the circulation in advance and measure a blank. Then, restart circulation and confirm that the distribution is not displayed in the simple distribution graph.**

5. **Click the [Blank] button.**
When performing blank measurement, scattering data is recorded as the blank value.

● **Sample measurement**

6. **If necessary, adjust the circulation speed.**

Note

The optimal circulation speed will vary, depending on the type of sample, as well as the type and amount of dispersion medium.
If the circulation speed becomes slow and a heavy sample is used, sedimentation can easily occur in the unit's piping.
If the circulation speed becomes fast, air dissolved in the sample solution can become foam, and bubbles can easily become attached to the inside of the cell.

7. **Feed the sample into the sampling bath.**

The optimal amount of sample to feed will vary, depending on the sample's material, properties, particle size distribution and other items.
Make the following amount the criterion.

		Particle diameter	<	1 μm	→	Microspatula (1 scoop)
1 μm	<	Particle diameter	<	10 μm	→	Microspatula (3 scoops)
		:				:
200 μm	<	Particle diameter	≦	3000 μm	→	Spatula (small) 2 scoops

If the sample concentration is not optimal, feed additional sample or dispersion medium and adjust the transmittance so it is within the appropriate range.

Note

Do not put the sample which diameter is larger than 3000 μm to avoid to block drain tube.

Reference

Sample Concentration Check Method: " ● Settings for the optimal transmittance range" (page 18)

8. **If necessary, perform agitation.**

Adjust the speed so the sample does not stagnate, or water ripples and swirls do not occur.

9. **If necessary, set the ultrasonic operation time and begin to apply ultrasonic.**

Note

- **If measurement is performed without sufficient dispersion, measurement reproducibility will decline.**
- **The optimal dispersion time will vary, depending on the type of sample, as well as the type and amount of dispersion medium/dispersant.**
  Find the appropriate dispersion time by repeating the measurement while increasing the dispersion time, or similar actions.
- **If measurement is performed during dispersion, minute differences in items such as dispersion medium amount, temperature and others can change the dispersion conditions and damage the reproducibility of the measurement. Be sure an adequate amount of dispersion is performed prior to measurement.**
- **If the unit's internal ultrasonic wave bath does not provide sufficient dispersion, the use of a separate, stronger ultrasonic wave cleaning unit or ultrasonic wave homogenizer is recommended.**

10. **Re-check the sample's concentration (to confirm that the transmittance is within the appropriate range) via the transmittance graph, and if it is appropriate, click the [Measure] button.**

The particle size distribution measurement will begin, and the Measurement will be displayed in the measurement screen.

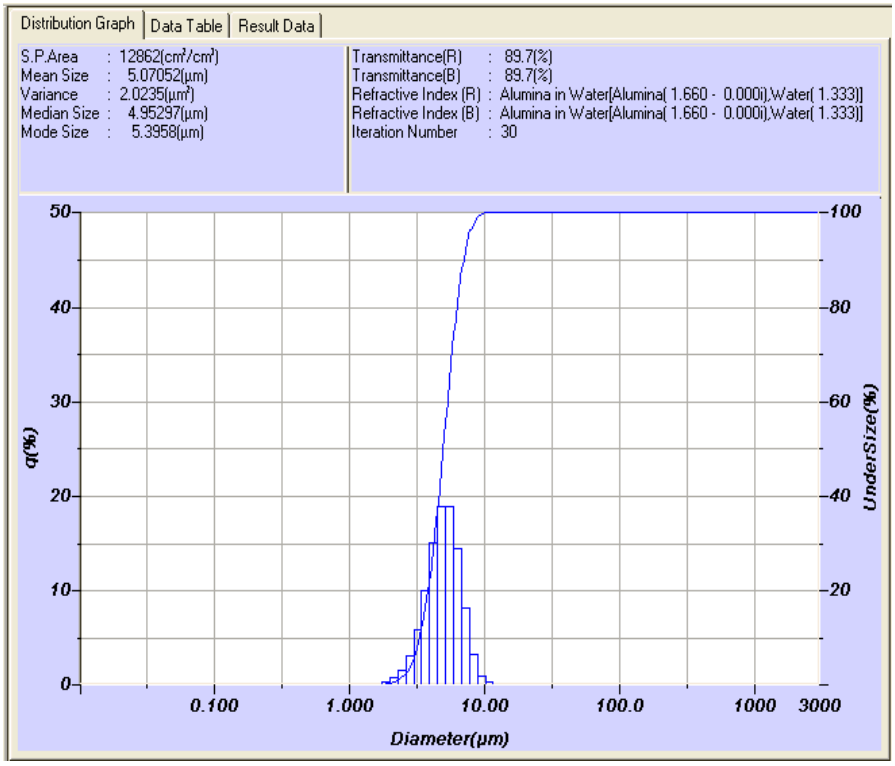


Fig. 11 Measurement + Results Display

Note

- **When using test samples whose particle diameters will change depending on the circulation speed, find a circulation speed that does not change particle diameters and perform measurement using those conditions.**
- **When using test samples that can change over time, find conditions that prevent this change and perform measurement using those conditions.**
- **Depending on the amount of water used, ultrasonic can greatly change a sample. Perform measurement only after finding the optimal amount of water for each unit and using ultrasonic to adequately disperse the sample.**
- **Ultrasonic and circulation speed change the sample over time. Periodic use of a pre-determined sample to check the unit's performance is recommended.**

5.1.2 Sample preparation

Test sample preparation is performed using the measurement screen's buttons.

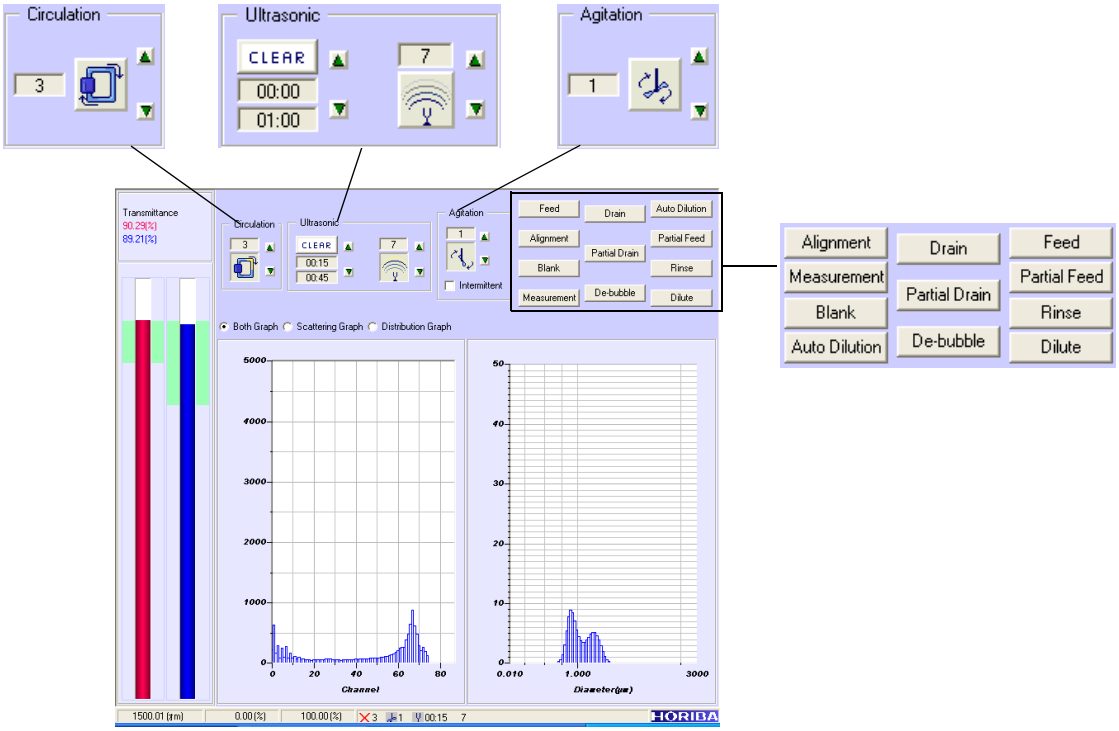


Fig. 12 Adjustment Buttons

- **Circulation speed**

  Sets the circulation pump's speed. (1 to 15)

- **Ultra sonic**

  Sets the ultrasonic operation time. (1 minute to 30 minutes)

  Sets the ultrasonic strength. (1 to 7)

- **Agitation speed**

  Sets the agitation speed. (1 to 15)

- **Auto dilution**

  Automatically uses dilution to adjust concentration and reduce the transmittance until it reaches the transmittance range's lower limit value. Transmittance (Transmittance (R)/ Transmittance (B)) is selected based on measurement conditions. If the sample's transmittance falls below the transmittance range's lower limit, this feature activates.

Note

When a surfactant is being used as a dispersant, agitation should not be performed. When agitation is performed the sample will foam, which will have a negative effect on measurement. Also, if surfactant is already included in the feed solution, during injection or during de-bubble foaming can easily occur. Therefore, after feeding the dispersant, be sure to feed surfactant to the sampling bath.

● **Drain**

Drains all of the dispersion medium from the circulation system.

Used after measurement is completed to drain all dispersion medium, or after circulation system cleaning to drain all cleaning solution.

Clicking the [Drain] button opens the drain valve for a specified period of time while the circulation system operates speed to drain all solution. Circulation stops after drain is completed.

● **Partial drain**

Drains a portion of the dispersion medium from the circulation system.

Partial drain can be used to remove excess dispersion medium, or to create the required amount of empty space needed in order to feed additional dispersion medium and dilute the sample's concentration.

Clicking the [Partial Drain] button drains a portion of the dispersion medium and reduces the sampling bath one level.

If the level is already at the minimum, drain will not be performed.

● **Feed**

Used for sample measurement or blank measurement to feed dispersion medium.

Clicking the [Feed] button adds dispersion medium until the designated solution amount is reached.

If the level is already at the maximum, solution will not be added.

● **Partial feed**

Feeds dispersion medium until the sampling bath increases one level.

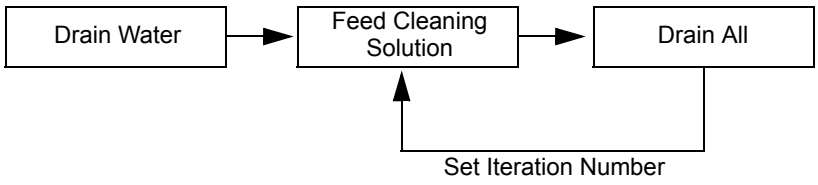
If the level is already at the maximum, dispersion medium will not be added.

● **Rinse**

Cleans the unit's circulation system, according to the conditions set.

Cleaning solution is added by the automatic pump unit to clean the circulation system.

Clicking the [Rinse] button performs the following cleaning operations for the set Iteration Number.



● **Dilute**

Dilutes the sample using a partial drain, followed by adding a small amount of dispersion medium.

6 Measurement Results

When the particle size distribution measurement is completed, the Measurement screen displays graphs and numeric data to show the Distribution Graph, Data Table, Measurement Data and the Calculation Result Data.
The following explanation explains the data displayed in the distribution graph and chart.
Depending on the data display settings, certain data or items may not be displayed.

The data shown in the Particle Size Distribution (Fig. 13) graph's upper area and in the Result Data Summary can include any item(s) from the Measurement data and the calculation result data.

Three types of displays are available - [Distribution Graph], [Data Table], and [Result Data], each of which can be displayed by clicking on the screen's upper-left tabs.

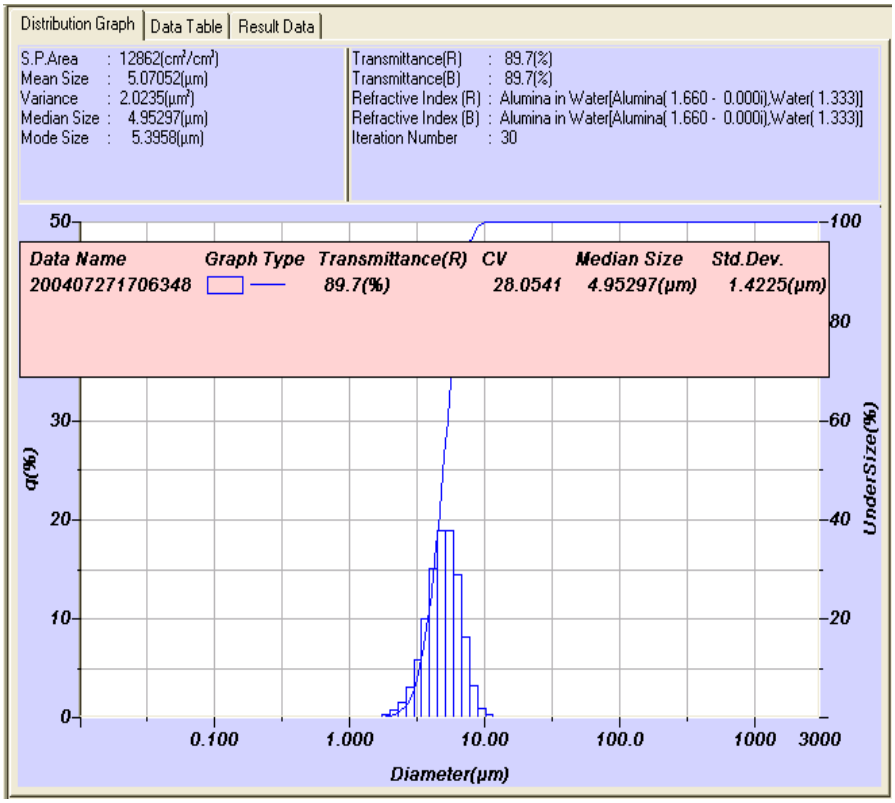


Fig. 13 Measurement display (Distribution Graph)

6.1 Measurement Data

The measurement result panel displays the following items.

File Name
Displays the file name on top of this panel.
Nothing is displayed if you haven't named the file yet.

ID#
Displays the Serial Number. This number is automatically attached to data after each measurement, and can not be changed after the measurement.

Circulation Speed
Displays the pump speed during measurement.

Agitation Speed
Displays the agitation speed during measurement.

Ultra Sonic
Displays the ultrasonic output used during measurement, and the operated calculation time.

Transmittance (R)
The sample concentration is displayed using the red laser beam's transmittance.

Transmittance (B)
The sample concentration is displayed using the blue LED beam's transmittance.

Form of Distribution
Displays the particle size distribution calculation's form of distribution.

Iteration Number
Displays the particle diameter calculation's iteration number.

Distribution Base
Displays the particle size criteria of the displayed measured data.

Refractive Index (R)
Displays the refractive index of the red laser beam used for calculation.
This data is displayed using the following format.
"Refractive Index filename [Sample Refractive Index (R), Dispersion Medium Refractive Index (R)]"

Refractive Index (B)
Displays the refractive index of the blue LED beam used for calculation.
This data is displayed using the following format.
"Refractive Index filename [Sample Refractive Index (B), Dispersion Medium Refractive Index (B)]"

Sample Information
Data entered as sample information. The following items are included.
Sample name, Material, Source, Lot Number, Test or Assay number, Remarks 1 to 10

Project Name
Displays the name of the project displayed in the Project View.

Data Name
Displays the name of the data displayed in the Project View.

Wavelength (LD)
Displays the set laser wavelength.

Wavelength (LED)
Displays the set LED wavelength.

Sample/Data acquisition times (LD)
Displays the sampling count for laser scattered light data.

Sample/Data acquisition times (LED)
Displays the sampling count for LED scattered light data.

Concentration
"OK" indicates the sample concentration is high enough for measurement. "Thin" indicates the sample concentration is too low for measurement.

Measurement Time
Displays the measurement date/time.

HGS No.
Displays the equipment's manufacturing number.

Model Type
Displays the equipment model.

Algorism Option
Displays the software version which is used to measure the data on the screen, or the software version which is used to re-calculate the data after measurement.

6.2 Calculation Result Data

S. P. Area

Unit Volume For each (1 cm^3) a particle's total surface area (cm^2)

In general, the value calculated using particle size distribution data is different from the surface area calculated using other measurement principles.

Mean Size

The frequency distribution is found using the arithmetical mean diameter, as shown in the formula below.

$$\text{Arithmetic Mean Diameter} = d\Sigma\{q(J) \times X(J)\} \div \Sigma\{q(J)\}$$

J: Particle Diameter Division Number

q(J): Frequency Distribution Value (%)

X(J): Jth Particle Diameter Range's Sample Diameter (μm).

Variance

The value for the expanded distribution condition is found using the formula below.

$$\text{Variance} = \sum\left[(X(J) - \text{Mean})^2 \cdot \frac{q(J)}{100}\right]$$

J: Particle Diameter Division Number

q(J): Distribution Graph Value(%)

X(J): Jth Particle Diameter Range's Sample Diameter (μm)

Mean: Arithmetic Mean Diameter (μm)

Median Size

Cumulative Particle Diameters Equivalent to 50%

Mode Size

Frequency distribution value's largest values that become particle diameters of the frequency distribution graph's peak.

Std. Dev.

Value taken from arithmetic distribution value's square root.

Coefficient of Variation (CV)

This result of dividing the arithmetic standard deviation by the mean diameter.

Span

Value that becomes the criteria for widening the distribution, as shown below.

Not displayed if both of the diameter on cumulative % are not set.

$$\text{Span Value} = \frac{|\ \text{Diameter on cumulative \% A} - \text{Diameter on cumulative \% B}\ |}{\text{Median diameter}}$$

* Inside the formula the "| |" symbol indicates an absolute value.

Diameter on cumulative % A: the first value set in the display conditions.

Diameter on cumulative % B: the second value set in the display conditions.

Geometric Mean Size

The frequency distribution is found using the geometric mean value, as shown in the formula below.

$$\text{Geometric Mean Diameter} = 10^{\frac{\sum(\log X(J) \times q(J))}{\sum q(J)}}$$

J: Particle Diameter Division Number
q(J): Frequency Distribution Value (%)
X(J): Jth Particle Diameter Range's Sample Diameter (μm)

Geometric Variance

The value for the expanded distribution condition is found using the formula below.

$$\text{Geometric Variance} = 10^{\sum(\log X(J) - \log(\text{Mean}))^2 \cdot \frac{q(J)}{100}}$$

J: Particle Diameter Division Number
q(J): Frequency Distribution Value (%)
X(J): Jth Particle Diameter Range's Sample Diameter (μm)
Mean: Geometric Mean Diameter (μm)

Geometric Standard Deviation

$$\text{Geometric Distribution Deviation} = 10^{\sqrt{\sum(\log X(J) - \log(\text{Mean}))^2 \cdot \frac{q(J)}{100}}}$$

J: Particle Diameter Division Number
q(J): Frequency Distribution Value (%)
X(J): Jth Particle Diameter Range's Sample Diameter (μm)
Mean: Geometric Mean Diameter (μm)

Chi Square

Indicates the degree of similarity between the refractive index used to produce the particle size distribution calculation result and the actual scattering data. The closer to "0", the greater the similarity. Becomes the selection's criterion when the refractive index is not known for the sample being measured. Chi Square(χ^2) is found using the following formula.

$$\chi^2 = \sum\left\{\frac{1}{\sigma_i^2}[y_i - y(x_i)]^2\right\}$$

y_i: Actual scattering measurement data
$y(x_i)$: Scattering data found using refractive index file data and displayed particle size distributions
σ_i: Scattering data standard deviation

R Parameter

Indicates the degree of similarity between the refractive index used to produce the particle size distribution calculation result and the actual scattering data. The closer to "0", the greater the similarity.

Becomes the selection's criterion when the refractive index is not known for the sample being measured.

The Residual R Parameter is found using the following formula.

$$R = \frac{1}{N} \sum_{i=1}^{N} \left\{ \frac{1}{y_{(x_i)}} \left| y_i - y(x_i) \right| \right\}$$

y_i: ith detection device's actual scattering measurement data

y(xi): Scattering data calculated by calculating backwards from the refractive index data and the displayed particle size distribution.

N: Number of light detection devices

Diameter on cumulative %

According to the display settings, a maximum of 10 particle diameter points are displayed that correspond to the accumulated distribution values.

Cumulative % on Diameter

According to the display settings, a maximum of 10 accumulated distribution values that correspond to particle diameter points are displayed.

7 Save Data

7.1 Data Manager

The Research and Development Mode and Quality Control Mode have different ways of managing data.

In the Research and Development Mode, Data Manager is generally used to save the measured data in memory, select the data that users need, and save it to the hard disk.

It is convenient for testing various measurement and operation conditions in the research and development department.

In the Quality Control Mode, Data Manager is generally used to add all the measured data to the database and save it to the hard disk at the same time.

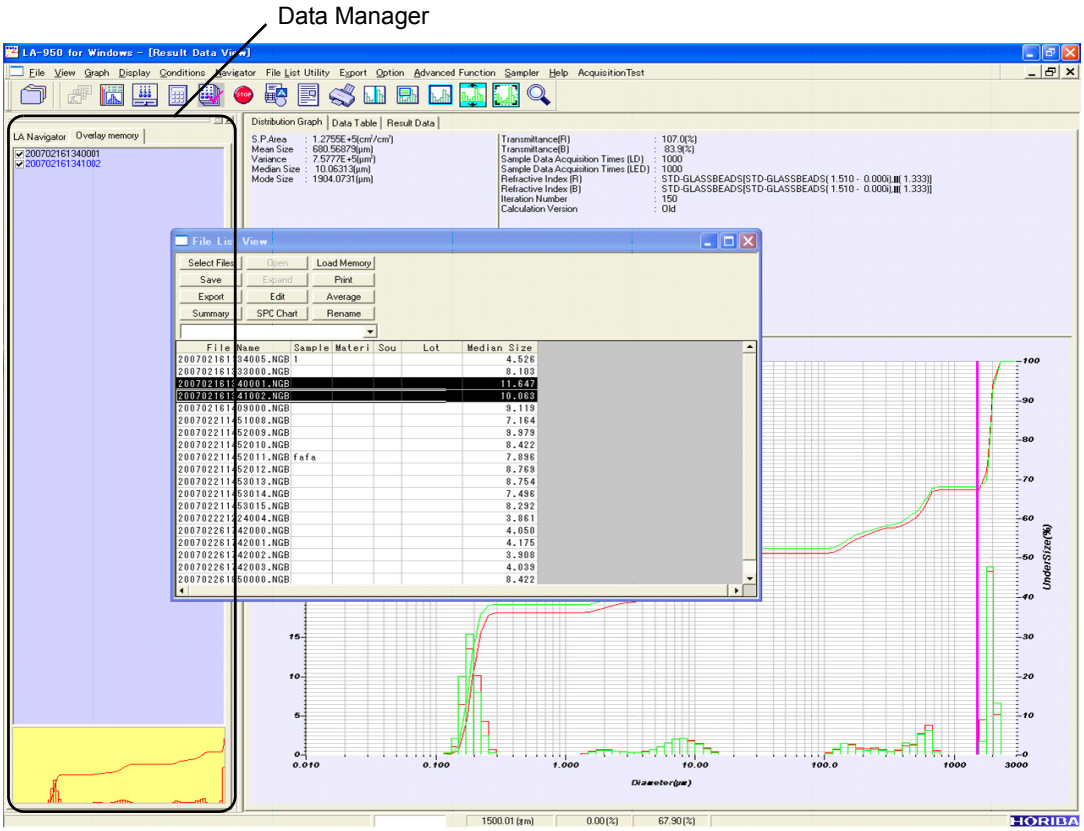
It is convenient for measuring a large amount of samples repeatedly when the measurement conditions are already determined by the quality control department.

Switch between the Research and Development Mode and Quality Control Mode using the administration software.

7.2 General Use in the Research and Development Mode

Click the [Conditions] - [Measurement Condition] - [System Condition] button, click the [Auto Functions] tab and set the [Automatic Save] item to [No Save].
This will save the measurement data only in memory without saving it to the hard disk.

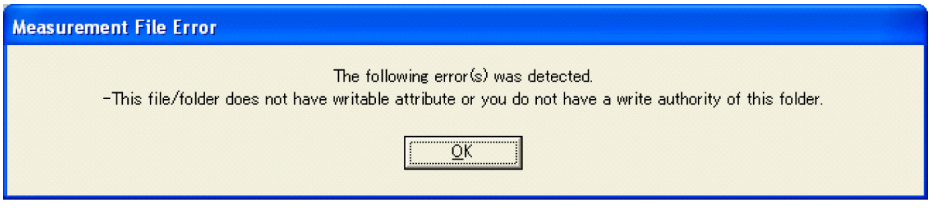
After the sample measurement, the data items are added to Data Manager's [Overlay memory] tab.



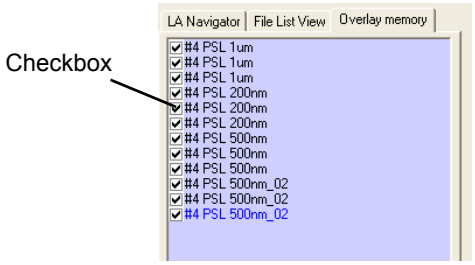
Selecting [Save As] from the [File] menu saves the data to the hard disk or other media as a file.

Note

For Windows Vista, files cannot be saved in the folder protected by the operating system.
When the following error message appears in saving a file of selecting a folder, select another folder.



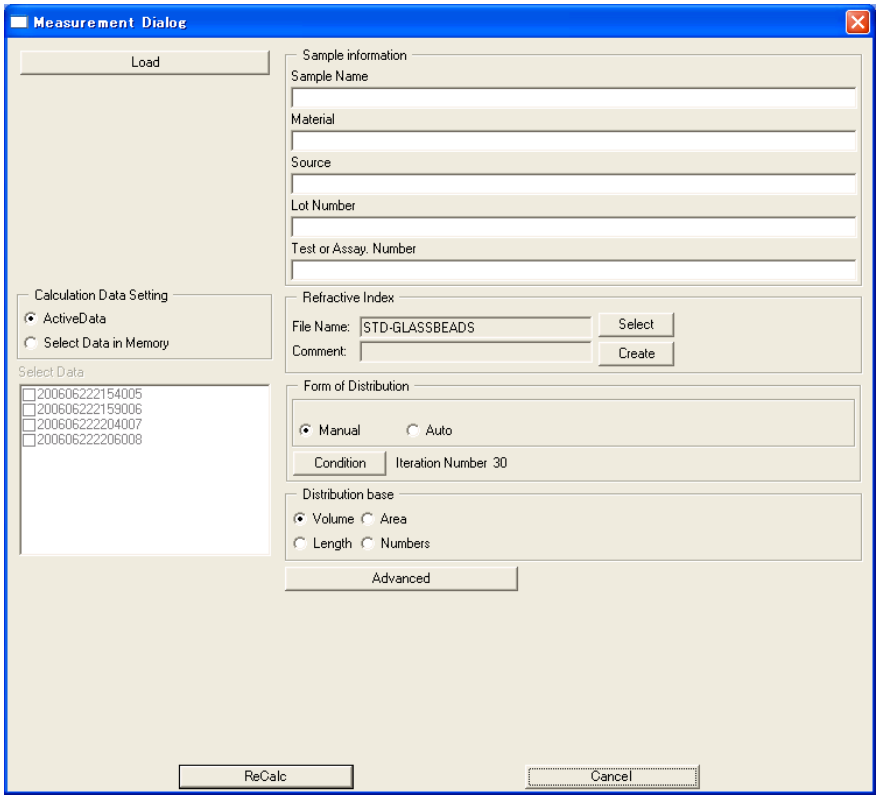
In the Research and Development Mode, out of the data items listed on the overlay memory tab, only the data items that are checked in the left checkbox are overlaid as graphs on the right Measurement Result screen. If you click a checkbox to clear a checkmark, the graph displayed on the Measurement Result screen disappears. If you put a checkmark in the check box, the graph appears again.
When [Single Display Mode] is selected in the [View] menu, only the graph for one data item is displayed on the Measurement Result screen. To overlay graphs, select [Overlay Display Mode] from the [View] menu.



There are 25 memory entries in all. When the memory is full, the data is overlaid and deleted starting from the oldest entry.
To delete data from a specific memory entry, right-double-click the data name or left-double-click the data to activate the data, and then select the [View] menu - [Delete Active Data].
To delete all the memory data, select the [View] menu - [Delete All Data].
To save memory data, select the data name to save with a double click and then select the [File] menu - [Save As].

To view a simplified graph for each data item, single-click the data name. The selected data's simplified graph is displayed in the [Child Window] in the lower part of the [Overlay memory] tab.
The Child Windows for checked data (displayed on the Measurement Result screen) are displayed in yellow. The Child Windows for unchecked data (not displayed on the Measurement Result screen) are displayed in blue.

To change the operation condition to recalculate the refractive index of memory data or to change the data's sample information, select the data to change with a double click and click the [Recalculation] icon or select the [Conditions] menu - [Recalculation] to open the [Condition Setting] dialog box. Then change the refractive index or the sample information and click the [Recalculation] button.



To change multiple memory data items at a time, choose [Select from Memory] from [Select Operation Data] on the left of this dialog box, put a checkmark in the checkbox to the left of the data name of the memory data you want to change, and click the [Recalculation] button.

In this case, changing the memory data does not change the data saved on the hard disk. To save the changed data, select the data and then click the [File] menu - [Save As] to save the data.

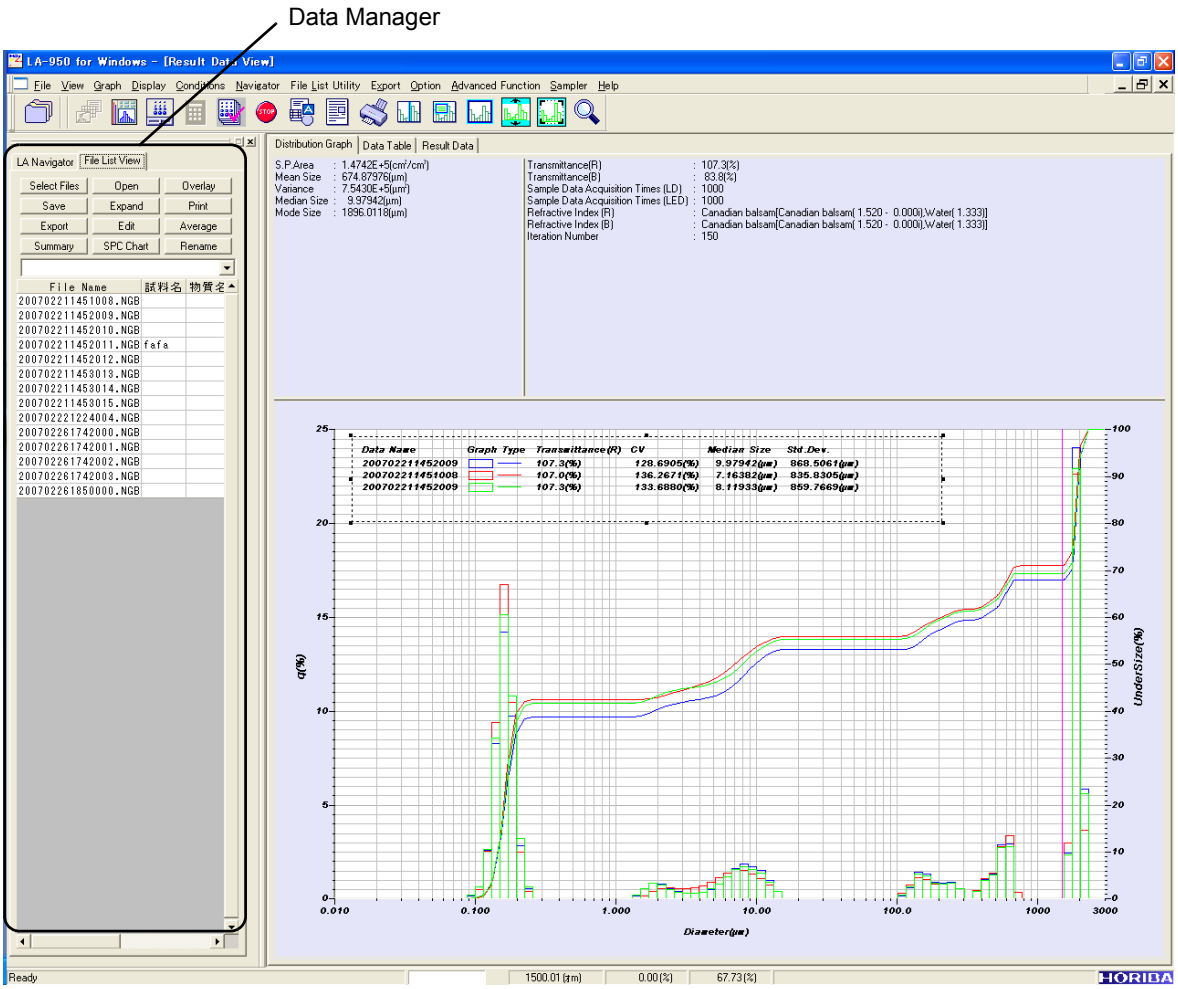
To open the saved data in memory, click the [File] menu - [Open].

In the Measurement Result screen, all the numerical data except the graph legend is displayed for active memory data.

7.3 General Use in the Quality Control Mode

Click the [Conditions] - [Measurement Condition] - [System Condition] button, click the [Auto Functions] tab, and set the [Automatic Save] item to [Automatic Save].

This will automatically save the measurement data to the hard disk.

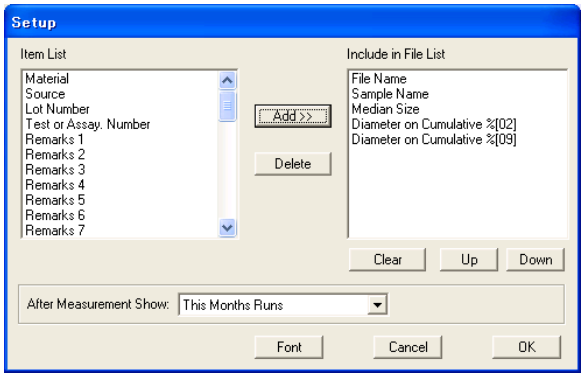


After the sample measurement, the data items are added to Data Manager's [File List View] tab.

On the [File List View] tab, you can display not only data names but also measurement conditions, operation data, and other desired items as a list.

To change the items, click the [File List Utility] menu - [Setting] command to open the dialog box, select items to display from the left [Item Name], and click the [Add] button.

To delete unnecessary items, select unnecessary items from the right [Add to file list], and click the [Delete] button.



To display the file list data, select data to display with a double click or single click and then click the [Open] button on the [File List View] tab.
The selected data will become the "Main Data." The graph will be displayed on the Measurement Result screen and all the numerical data (except the data legend) on the Measurement Result screen will belong to the main data.

To overlay other data graphs, select data to overlay with a single click and then click the [Overlay] button on the [File List View] tab.
The selected data graph will be overlaid on the Measurement Result screen and the numerical data of the main data will remain displayed.

To change the operation condition to recalculate the refractive index of data in the file list, or to change the data's sample information, select data to change (multiple data items can be selected) with a single click and then click the [Edit] button on the [File List View] tab. When the dialog box appears, change the refractive index or sample information and click the [Recalculation] button.
The changed operation condition and sample information will overwrite the data saved in the hard disk.

From the pull-down menu on the File List View, you can limit the creation dates and types of the data to display in the file list.
To display all data, select [All Data] from the pull-down menu.

8 Indicator Setting

Click the [Option] - [Setting of indicator], and set the indicator ON/OFF.

9 Print Data

With the LA-950V2, the print layout can be easily set or modified. Also, your print layout settings can be saved.
The following procedure explains how to open a previously saved print layout file and print.

1. **Click [File] - [Print Template].**
   The print layout screen appears.
2. **Click [LOAD] button to choose a print layout file.**
   The print setting file is read in.
3. **Click [File] - [Print Layout].**
   The print preview screen appears.
4. **Click [File] - [Print].**
   The [print] dialog box appears.
5. **Select the Printer, and enter the Number of copies, and Print range data.**
6. **Click the [OK] button.**
   Printing will begin.

Tip

Details of editing the print layout, refer to the Online Manual "2.1.6 Editing the print layout."

10 Useful Measurement Techniques

10.1 Measurement Sampling Procedure

When measuring particle size distributions, either particles in a powder or particles in a solution, an overall measurement model should be used as a guide. In other words, individual measurements of particle size distributions should match the overall distribution rate.

When performing sampling of measurements using a large collection of response data, it is natural to expect that particle size distributions of measurements collected near the surface of the sample container will differ from measurements taken near the bottom.

This is because large and heavy particles will collect near the bottom of the sample container. The term for this is "Size Segregation." If the degree of size segregation becomes the measurement criteria, the above mentioned method is good, however, when looking at all measurements of particle size distributions, if the sampling method is not correctly performed, the data becomes non-reproducible.

10.1.1 Using powder or liquid

- Collect an equal amount from every section of the overall measurement data.
- “A chute riffler” or “a spinning riffler” are used.
- “Stream cutting” and “cone and quartering” are used to collect data. Refer to Fig. 14 and Fig. 15.

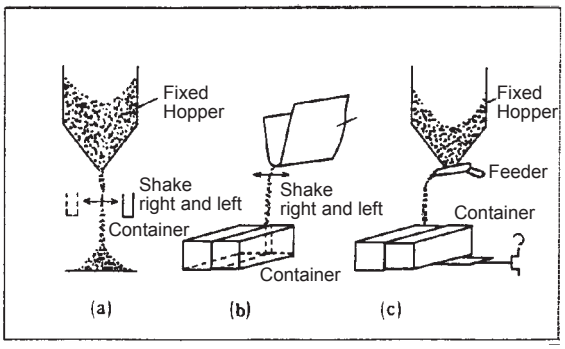


Fig. 14 Stream Cutting

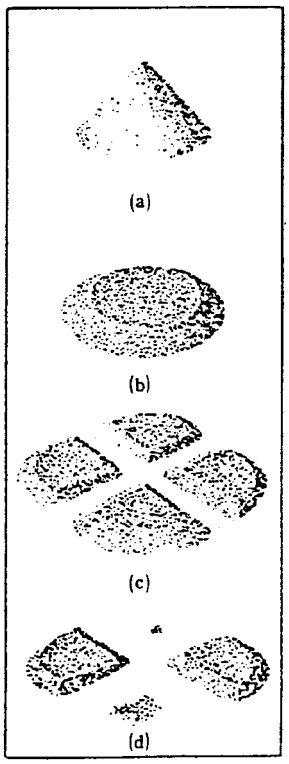


Fig. 15 Cone and Quartering

● **When using flow measurement**

- Add sample powder or dispersion medium while 180 mL to 250 mL of dispersion medium is circulated in the sampling bath.
- Use ultrasonic to completely distribute the sample.
- Adjust the concentration.
- Optimized dispersant volume in each specifications is determined as follows.

LA-950S2, LA-950A2, LA-950W2, LA-950E2, LA-950P2	LA-950PS2	LA-950L2
Approx.180 mL	160 mL	1000 mL

- Use instrument at appropriate laser penetration ratio, by controlling sample concentration.

10.1.2 When using particles in a solid

When particles are contained a solid object, use the appropriate solvent to create a solution.

- Use the solution as it is for the measurement liquid.
  However, if organic solvents have been used, be sure to use a fraction cell. Even with a fraction cell, certain organic solvents can not be used.

Note

The fraction cell is made of Tempax glass.
The chemical composition is equivalent to borosilicate glass.
When using an organic solvent, confirm that the cell is chemically resistant to it.
If the chemical resistance is unknown for the solvent you wish to use, contact our sales department or customer support center for assistance.

- Remove only the particles and perform measurement.
  To remove all solid object solution, wash the unit and take out all particles. Afterwards, do the same as “ 10.1.1 Using powder or liquid ” (page 42).

10.2 Sample Dispersion Methods

In this unit, in order to measure a sample while it is dispersed in the dispersion medium, the particle dispersion status is an important point for measurement accuracy.

Even if the powder's sampling is performed correctly, if the dispersion is insufficient and particles have condensed, unexpectedly large particles are measured, creating an unnatural distribution.

On the other hand, if a particle solution-like dispersion medium is used, the particles are measured as small, creating measurement errors and reproducibility problems. To perform measurements that do not have these types of problems, be careful when selecting your dispersion method and dispersion medium.

10.2.1 Dispersion methods

- **Evenly Dispersed Particle Samples**

The LA-950V2 internal ultrasonic probe produces ultrasonic to break up large, agglomerated particles.

The ultrasonic wave exposure time used will differ, depend on the type of sample used, however, it is normally 3 minutes to 5 minutes, and even long exposures are usually less than 10 minutes. If exposure times are too long, particle condensation or destruction can occur. Therefore, it is important that the exposure time selected for a sample is appropriate.

A single exposure can be up to 30 minutes.

Prior to being used as a sample, hard-to-disperse materials such as micronized ceramics should be processed using a separate high-output ultrasonic dispersion unit.

- **Unevenly Dispersed Particle Samples**

Dispersion by the agitating motor equipped with LA-950V2 is applied.

Selecting a dispersion medium

The dispersion medium must be one that will moisten the sample powder. Also, the dispersion medium must not chemically react with particles or cause them to condense, fuse, or swell.

Normally, water is after used as dispersion mediums, however, depending on the sample material, organic solvents such as ethanol, ethylene glycol and others can be used and measured.

When using the LA-950V2 for flow measurement, contact HORIBA for a list of usable (measurable) organic solvents.

10.2.2 Dispersant benefits and types

Particle measurement traditionally uses an electrical charge, and the charge's interaction with the solution causes condensation and leads to insufficient dispersion. Thus, the purpose of a dispersion medium is to neutralize this effect and disperse the sample into individual, separated particles. Normally used dispersion agents include sodium hexametaphosphate, and sodium pyrophosphate. Also, surfactants are often used to disperse particles that are hydrophilic or lipophylic. However, since using too much dispersion medium can lead to particle condensation, for the solution concentration be sure to pay attention to the type of dispersant used. While the dispersant concentration will normally vary, a concentration of approximately 0.1% to 0.2% will provide a reliable result.

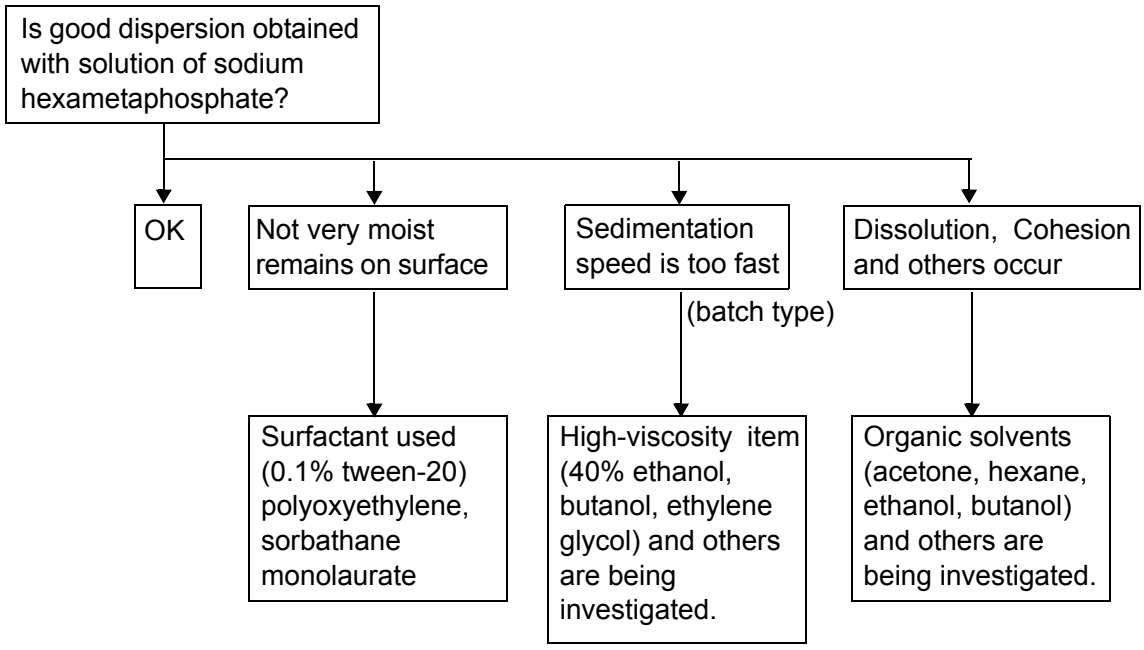


Fig. 16 Effect of Dispersant

Table 1 Sample and Dispersant

Sample	Dispersion Medium
$BaCO_3$	Ethanol
$CaCO_3$	0.2%NaHMP, Ethanol, Isopropyl Alcohol
$MgCO_3$	Ethanol
Al_2O_3	0.2% NaHMP
CeO_2	0.2% NaHMP
MgO	Ethanol
SiO_2	0.2% NaHMP
TiO_2	0.2% NaHMP
Fe_2O_3	Ethylene Glycol, 0.2% NaHMP
$Al(OH)_3$	0.2% NaHMP, Ethanol
$Ca(OH)_2$	Ethanol
$Mg(OH)_2$	Ethanol
SiC	0.2% NaHMP
Si_3N_4	0.2% NaHMP
Cu	Ethylene Glycol
Ceramic Materials	Ethylene Glycol, 0.2% NaHMP
Clay	Ion Exchange Water, 0.2% NaHMP, 0.1% Surfactant
Cement	0.2% NaHMP, Ethanol
Coal Ash	0.1% Surfactant
Fly Ash	0.2% NaHMP, 0.1% Surfactant
Toner	Ethylene Glycol, 0.2% NaHMP
Paint Material	O-xylene
Carbon Black	0.1% Surfactant
Plaster	Ethanol
Wax	Ion Exchange Water, 0.1% Surfactant
Latex	Ion Exchange Water, 0.1% Surfactant
Coffee, Cocoa	Ion Exchange Water
Chocolate	Cooking Oil
Powdered Milk	Octanol
Pepper	0.1% Surfactant
Drugs	Xylene

NaHMP: sodium hexametaphosphate

11 Maintenance

11.1 Daily Maintenance

- When the unit becomes dirty, use a dry cloth to wipe the unit, or use gauze dipped in a neutral detergent to gently remove dirt and stains.
- Remove the measurement cell from the sample container, wash it thoroughly and replace it.

● Flow cell check Items

1. **Check that no sample solution remains in the flow cell, and unfasten the holder's lock clip and remove the holder cover.**

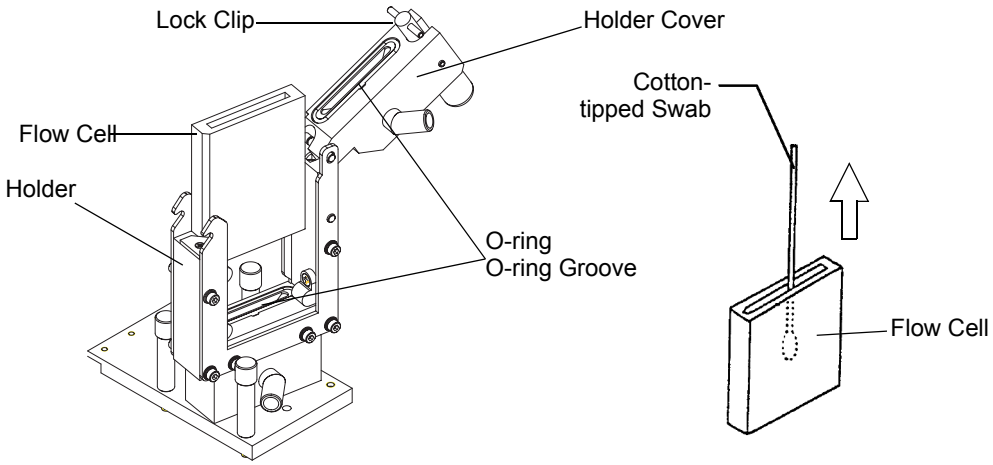


Fig. 17 Flow cell removal

2. **Insert the cotton-tipped swab and withdraw it slowly.**

3. **Use cleaning dispersion medium, clean water, alcohol or other fluid to wash the inside of the flow cell and the o-ring.**
Clean the flow cell using a cotton-tipped swab or soft cloth.

4. **Wipe the holder's o-ring groove with a cotton-tipped swab.**

5. **Insert the o-ring and flow cell into the holder, and close the lock clip to secure them in place.**

Note

- **Since the outside face of the flow cell is covered with a glare-resistant coating, be sure that any detergent or chemical used to clean the flow cell does not contact the cell's outside face.**
- **Gently clean the outside surface of the with a cotton-tipped swab or a soft cloth, and do not use excessive force or allow a hard material to contact the surface.**
- **When a highly adhesive sample is measured, check all flow cell-related items coming in contact with sample solution (holder, o-ring, etc.) for sample material residue. If a large amount of sample material residue is found, solution may be leaking or the flow cell or holder may be damaged. Also, if sample residue is found in the unit, use a sponge or small plastic spatula to remove residue from each area.**
- **After closing the holder cover, circulate water or dispersion medium through the system and check for leaks.**

● Exchange peristaltic pump tubes (LA-950P2)

Check the condition of the pump tube once a week.
When there is any deterioration, replace the tube with a new one. If deteriorated tube is used, a dispersion medium or sample may leak.

11.2 Troubleshooting

11.2.1 Prior todeciding the unit has broken down

If you suspect equipment malfunction, first check the items below.

Table 2 Problems and Solutions

Symptom	Cause	Solution
Even though the power switch is turned ON, the unit's front face indicator does not light.	Power cable is not connected.	Turn the power switch OFF and connect the unit's power cable.
	Fuse is blown.	Contact to HORIBA.
Scattering graph fluctuations are severe.	Laser light source is burned out.	Laser light must be replaced. Contact to HORIBA.
Measurement results reproducibility is poor.	Affect by room temperature instability.	Stabilize room temperature.
	Affect by dispersant temperature instability.	Stabilize dispersant temperature.
	Unit is receiving excessive vibration.	Remove the vibration source.
Draining is slow or terminated.	Check that hoses are not pinched or twisted.	Straighten all hoses.
	The hose end is submerged in water.	Position the hose end so it is not submerged in water.
	Check that peristaltic pump tubes are not pinched or twisted.	Straighten all hoses.
Drain is not started.	Dispersant tank is empty.	Replenish dispersant.
	Drain tube is stick at the bottom of tank.	Cut the tube tip diagonally.
	Peristaltic pump tube is bending.	Straighten the peristaltic tube.
	Magnetic valve is not opened.	Contact to HORIBA.
Displays "alignment error"	There is not a dispersant in the cell.	Inject dispersant.
	There are contamination on the cell glass.	Wash the cell.
	Dispersant bubbles, and the incident laser does not penetrate.	Select non-bubble dispersant.
	Cell is not connected correctly.	Check the cell attachment.
	There is a foreign body on the incident laser path.	Remove the foreign body.
	Laser in not coming.	Check the sample door closed.
	Optical axis is moved by outer shock.	Contact to HORIBA.
	Laser or laser shutter is broken.	Contact to HORIBA.
Liquid leakage from the cell.	O-ring is not equipped correctly.	Wash O-ring and the holding ditch., and equip O-ring to the holding ditch with confirming that there is no dispersing agent.

The above table is for hardware-related problems. If an error occurs, refer to the online help.

If the problem persists after trying the solution above, contact HORIBA.

11.2.2 Unit status check

Use the following steps to check the version of the software. The HORIBA may ask you to provide the following information.
In that case, follow HORIBA instructions and use the following steps to provide them with each type of information.

- **Version information check**
  1. **Click the [Help] menu's [About] selection.**
     The [Version Information] dialog box will open, and the software version will appear.
- **System information check**
  1. **Click the [Help] menu's [System Information] selection.**
     The System Information panel will appear and the model numbers, operating times, etc. for parts being used, as well as unit status information will be displayed.

11.3 Other Notes

11.3.1 Transporting the equipment

Contact HORIBA to transport the equipment.
Transport that could damage the equipment should be done by HORIBA service personnel.
Before transporting the equipment, check that the new location satisfies the conditions referring “ 2.1 Confirm Operation Conditions ” (page 8).

11.3.2 When moving the equipment yourself

Before moving the equipment, first fasten internal equipment parts in place and make the other preparations below.

⚠ WARNING

LA-950V2 weighs approx. 56 kg.
Use at least 3 workers to lift.

- **Preparations for moving the equipment**

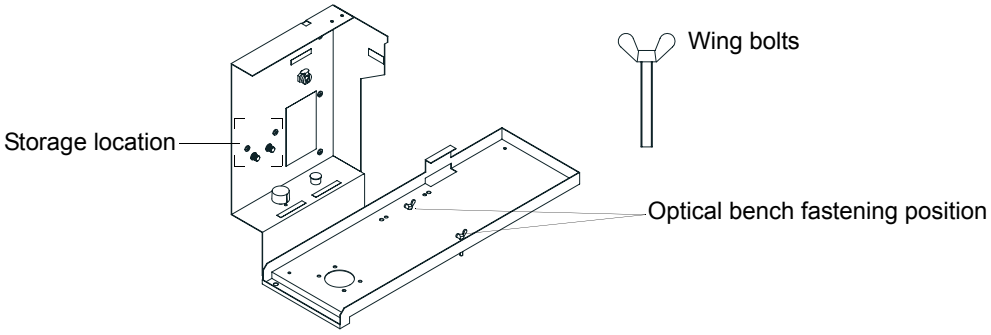
Fastening internal equipment parts in place

Follow the procedure below to fasten internal equipment parts in place.
Turn the LA-950V2 power OFF, and unplug the power cable before performing the procedure.

Note

Prior to moving the unit, it is necessary to lock the optical bench and other internal parts of the instrument. Failing to lock these items in place prior to moving the unit can lead to unit damage.

1. **Remove the cell changer with its attached cell holder from LA-950V2.**
2. **Remove the cell window from the cell holder, and wrap it in a soft clean cloth.**
   Package the cell changer and cell window separately from LA-950V2.
3. **Fasten the optical bench in place with wing bolts.**
   Remove the seal screws at the optical bench fastening position, and tighten the wing bolts to fasten the optical bench in place.
   The wing bolts are attached at the storage location.



4. **Attach the seal screws to the storage location.**
   The preparations to move LA-950V2 are now finished.

Wiring/piping

Remove the cables and piping, referring to “ 2.2 Checking Cable and Piping Connections ” (page 9).

11.3.3 Long-term storage

- **With flow cell measurement**
  1. **Disconnect the Feed hose.**
  2. **Perform [Feed] and drain all solution from the feed pump.**
  3. **Operate [Drain] 2 or more times, and remove all circulation system liquid.**
- **With fraction cell measurement**
  1. **Remove the fraction cell from the sample container.**
- **Work common to both methods**
  1. **Remove the sample container's flow cell.**
  2. **Close the sample container's cover.**
  3. **Wash the cell and the o-ring.**
     After cleaning, dry the cell completely.
  4. **Gently wash the cell's transparent face with gauze to prevent scratches.**
  5. **Wrap the cell and the o-ring in gauze and store them in the cell case.**
  6. **Turn the PC and the LA-950V2 power switches OFF.**
  7. **If PC peripherals or LA-950V2 optional items are being used, turn their power switches OFF.**
  8. **Disconnect all power cables and related wirings.**
  9. **Store all PC-related items (cables, system disks, etc.) in the same location as the PC.**
     Also, store all disks, CRTs, etc. in a location that is not near strong magnetic fields.

11.3.4 Unit disposal method

None of the LA-950V2 parts requires any special treatment for disposal. Dispose of this unit as you would standard industrial waste.

12 Material

12.1 Unit Specifications

● LA-950V2 series for organic dispersant

● Standard (LA-950S2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Organic dispersion
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 180 mL
Optical system		
	Light source	650 nm Laser Diode approx. 5 mW 405 mm Light Emitting Diode (LED) approx. 3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, 7 levels - variable
	Circulation pump	Centrifugal pump
	Agitator	15 levels - variable
	Injection	Vane pump 4 levels - variable
	Drain	Plunger and electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz, 300 VA
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 500 (H) mm
Mass		Approx. 56 kg

● Perista pump (LA-950PS2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Organic dispersion
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 160 mL
Optical system		
	Light source	650 nm Laser Diode approx. 5 mW 405 mm Light Emitting Diode (LED) approx. 3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, ON/OFF
	Circulation pump	Roller pump
	Agitator	15 levels - variable
	Injection	Vane pump 4 levels - variable
	Drain	Plunger and electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 451 (H) mm
Mass		Approx. 56 kg

● LA-950V2 Series for Water and Ethanol

● Standard (LA-950A2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Water, Ethanol
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 180 mL
Optical system		
	Light source	650 nm Laser Diode approx. 5 mW 405 mm Light Emitting Diode (LED) approx. 3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, ON/OFF
	Circulation pump	Centrifugal pump
	Agitator	15 levels - variable
	Injection	Diaphragm pump 4 levels - variable
	Drain	Plunger and electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 500 (H) mm
Mass		Approx. 56 kg

● Large volume (LA-950L2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Water, Ethanol
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 1 L
Optical system		
	Light source	650 nm Laser Diode approx. 5 mW 405 mm Light Emitting Diode (LED) approx. 3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, 7 levels - variable
	Circulation pump	Centrifugal pump
	Agitator	15 levels - variable
	Injection	Diaphragm pump 4 levels - variable
	Drain	Plunger and electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 500 (H) mm
Mass		Approx. 56 kg

● Standard (LA-950W2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Water, Ethanol
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 180 mL
Optical system		
	Light source	650 nm Laser Diode approx. 1.6 mW 405 mm Light Emitting Diode (LED) approx. 0.3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, 7 levels - variable
	Circulation pump	Centrifugal pump
	Agitator	15 levels - variable
	Injection	Electromagnetic valve (no pump)
	Drain	Electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 500 (H) mm
Mass		Approx. 56 kg

● Narrow Measurement Range (LA-950E2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Water, Ethanol
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 180 mL
Optical system		
	Light source	650 nm Laser Diode approx. 1.6 mW 405 mm Light Emitting Diode (LED) approx. 0.3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, 7 levels - variable
	Circulation pump	Centrifugal pump
	Agitator	15 levels - variable
	Injection	Diaphragm pump 4 levels - variable
	Drain	Plunger and electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 500 (H) mm
Mass		Approx. 56 kg
Capable option		LY-9501

● Standard (LA-950N2)

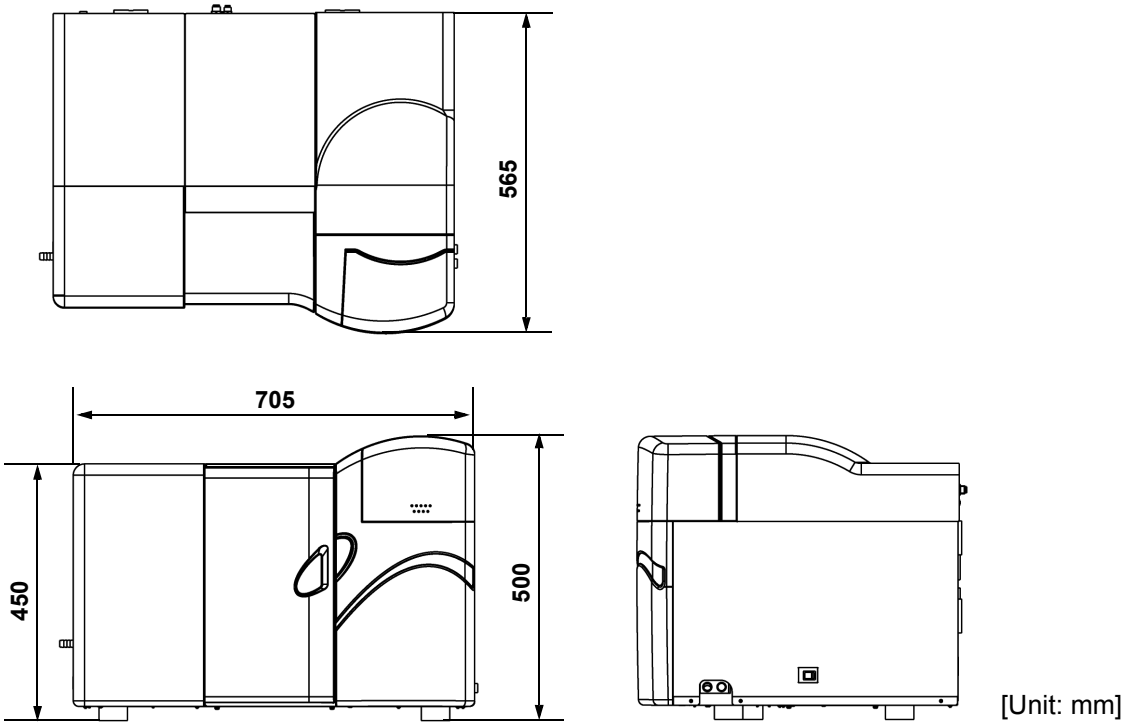
Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Water, Ethanol
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 180 mL
Optical system		
	Light source	650 nm Laser Diode approx. 1.6 mW 405 mm Light Emitting Diode (LED) approx. 0.3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 500 (H) mm
Mass		Approx. 48 kg

● Perista pump (LA-950P2)

Measurement method		Mie Scattering Theory
Measurement range		0.01 μm to 3000 μm
Measurement time		Approx. 1 minute after dispersion medium feed
Measurement type		Flow cell
Sample		
	Available dispersant	Organic dispersion
	Required amount	10 mg to 5 g
	Dispersion medium	Approx. 160 mL
Optical system		
	Light source	650 nm Laser Diode approx. 5 mW 405 mm Light Emitting Diode (LED) approx. 3 mW
	Detection devices	Ring-type 64 segment Silicon Diode (1) 4ch Silicon Photo Diode Array (5) Silicon Photo Diode (3)
Circulation system		
	Dispersion	Ultrasonic probe: frequency 20 kHz, ON/OFF
	Circulation pump	Roller pump 15 levels - variable
	Agitator	15 levels - variable
	Injection	Vane pump (no pump)
	Drain	Plunger and electromagnetic valve
	Fraction cell	Tempax glass
Power supply		100 V/120 V/230 V AC, 50/60 Hz (excluding LA-950V2)
Operating temperature		15ºC to 35ºC (59ºF to 95ºF)
Operating humidity		Relative humidity: 85% or less (no condensation)
External dimensions		705 (W) mm × 565 (D) mm × 451 (H) mm
Mass		Approx. 63 kg

12.2 External View

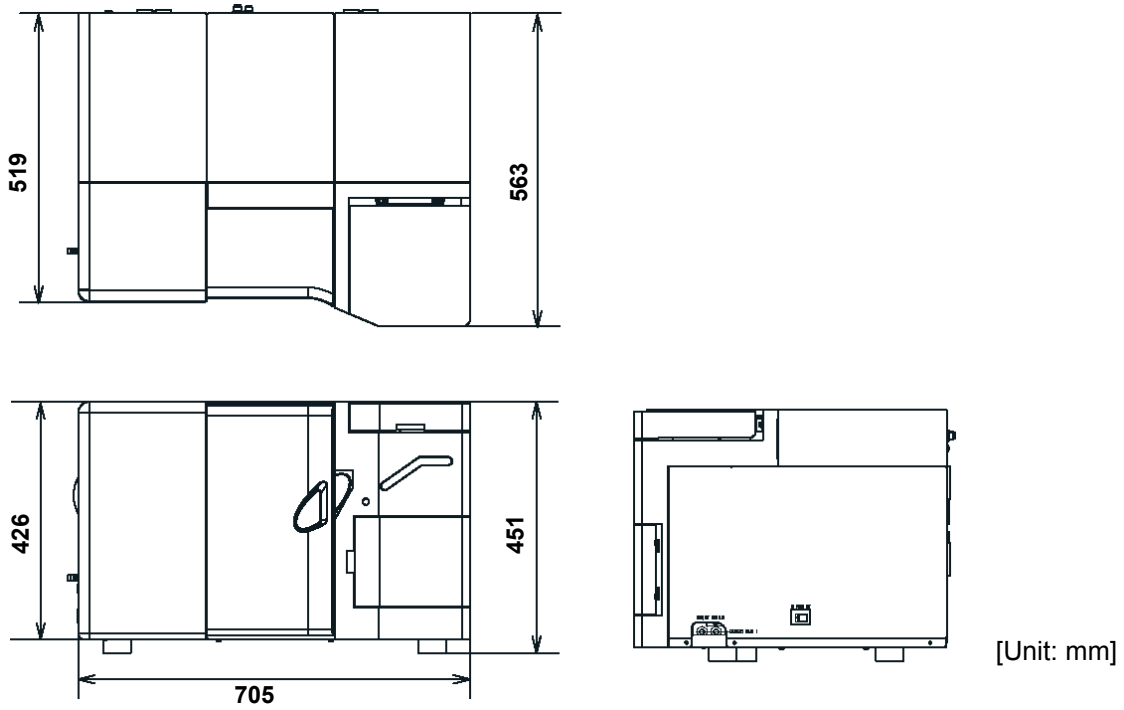
● **LA-950 (A2, L2, W2, E2, N2, S2)**



[Unit: mm]

Fig. 18 LA-950 (A2, L2, W2, E2, N2, S2) external view

● **LA-950 (P2, PS2)**



[Unit: mm]

Fig. 19 LA-950 (P2, PS2) external view

12.3 Chemical Resistance of Surfaces in Contact with Liquids

This section describes the chemical resistance of the materials used in surfaces in contact with liquids. Refer to the table below when measuring with organic solvents or special solvents.

- **Materials used in both standard equipment and organic solvent-resistant equipment**

Stainless steel

Usually susceptible to strong acids, alkalis and halogen compounds.

Titanium alloy

Susceptible to hydrofluoric acid, sulfuric acid, phosphoric acid and hydrochloric acid.

Hard glass

Susceptible to strong alkalis and hydrofluoric acid.

Note

Prevent the cell's hard glass surface from coming into contact with acids or alkalis. Contact with acids or alkalis can erode the anti-reflective coating.

- **Materials used only in standard equipment/organic solvent-resistant equipment**

Note

Depending on actual usage conditions, certain items may differ from Table 3.
When using special chemicals, be sure to contact HORIBA.

Table 3 Chemical Resistance of Surfaces in Contact with Liquids

Meaning of Estimated Mark
○ : Usable △ : Necessity of Test × : Nonapproved ― : Untried
RT : Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt% ・ Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
1	Acetaldehyde	○	―	○	△	―
2	Acetamide	△	―	○	―	―
3	Acetic acid [10 ・ RT]	△	―	○	○	―
4	Acetic acid [50 ・ RT]	△	―	○	○	―
5	Acetic acid [50 ・ 70]	△	―	△	○	―
6	Acetic acid [100 ・ RT]	△	○	△	○	―
7	Acetic anhydride	×	―	△	○	○
8	Acetone	×	―	×	○	○
9	Acetophenone	―	―	―	―	○
10	Acetylene	×	―	○	○	―
11	Acrylkic acid	―	―	×	―	○
12	Acrylonitrile	×	―	△	○	○
13	Alums NH_3, Cr, K	○	―	―	○	―

Meaning of Estimated Mark

○：Usable △：Necessity of Test ×：Nonapproved －：Untried

RT：Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt% ・Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
14	Aluminum acetate	×	－	－	○	－
15	Aluminum bromide	△	－	－	○	－
16	Aluminum chloride	△	－	－	○	－
17	Aluminum fluoride	△	－	－	○	－
18	Aluminum nitrate	△	－	－	○	－
19	Aluminum sulfate	○	－	－	○	－
20	Ammonia	×	－	○	○	－
21	Ammonia gas	○	－	○	○	－
22	Ammonia gas	○	－	△	○	－
23	Ammonia liquid	○	－	○	○	○
24	Ammonium carbonate	△	－	－	○	－
25	Ammonium chloride	△	－	－	○	－
26	Ammonium hydroxid	○	×	－	○	－
27	Ammonium nitrate	△	－	－	○	－
28	Ammonium nitrite	△	－	－	○	－
29	Ammonium persulfate	－	－	－	○	－
30	Ammonium phosphate	○	－	－	○	－
31	Ammonium sulfate	○	－	－	○	－
32	Amyl acetate	×	－	×	○	－
33	Amyl alcohol	×	－	○	○	－
34	Amyl borate	－	－	－	○	－
35	Amyl naphthalene	×	－	－	○	－
36	Aniline cold	△	○	×	○	○
37	Aniline hot	－	－	×	－	－
38	Aniline dyes	－	－	×	○	－
39	Animal oil	○	－	－	○	－
40	Anon	－	－	－	－	－
41	Aqua regia	×	－	△	○	－
42	Arsenic acid	○	－	○	○	－
43	Asphalt	×	－	－	○	－
44	ASTM oil No.1	×	－	－	○	－
45	ASTM oil No.2	×	－	－	○	－
46	ASTM oil No.3	×	○	－	○	○
47	ASTM reference fuel A	×	－	－	○	－
48	ASTM reference fuel B	×	－	－	○	－
49	ASTM reference fuel C	×	－	－	○	－
50	Barium chloride	○	－	－	○	－

Meaning of Estimated Mark

○：Usable　△：Necessity of Test　×：Nonapproved　－：Untried

RT：Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt%・Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
51	Barium hydroxide	○	－	○	○	－
52	Barium sulfate	△	－	－	○	－
53	Barium sulfide	△	－	－	○	－
54	Benzaldehyde	○	－	△	○	－
55	Benzal chloride	－	○	－	－	－
56	Benzene(Benzol)	×	－	×	○	○
57	Benzine	×	－	－	○	－
58	Benzyl alcohol	－	－	○	○	－
59	Benzyl benzonate	－	－	○	○	－
60	Benzyl chloride	－	○	△	○	－
61	Boric acid	△	－	○	○	－
62	Bromine	×	－	－	○	－
63	Butane	×	－	－	○	－
64	Butadiene	－	×	－	－	－
65	Butyl acetate	×	○	×	○	－
66	Butyl acrylate	○	－	×	○	－
67	Butyl alcohol	△	－	○	○	－
68	Butyl aldehyde	－	△	－	－	－
69	t-Butyl methyl ether	－	○	－	－	－
70	Butyl stearate	－	－	○	○	－
71	Calcium acetate	－	－	－	○	－
72	Calcium disulfite	△	－	－	○	－
73	Calcium chloride	○	－	－	○	－
74	Calcium hydroxide	△	－	○	○	－
75	Calcium hypochlorite	△	－	－	○	－
76	Calcium nitrate	△	－	－	○	－
77	Calcium sulfide	△	－	－	○	－
78	Carbitol	○	－	－	－	－
79	Carbon dioxide	○	－	－	○	－
80	Carbon disulfide	×	－	－	○	－
81	Carbonic acid	×	－	－	○	－
82	Carbontetrachloride	×	－	×	△	△
83	Castor oil	○	－	－	○	－
84	Cellosolve	－	－	×	○	－
85	Cellosolve, Acetate	△	－	×	－	－
86	Cellosolve, Butyl	－	○	×	－	－
87	China wood oil	×	－	－	○	－

Meaning of Estimated Mark

○ : Usable △ : Necessity of Test × : Nonapproved ― : Untried

RT : Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt% ・ Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
88	Chlorine gas (dry)	―	―	―	△	―
89	Chlorine gas (wet)	―	―	―	△	―
90	Chloride liquide	―	―	―	△	―
91	Chlorine salvents	×	―	―	△	―
92	Chloroacetic acid	―	―	○	○	―
93	Chloroacetone	×	―	×	―	―
94	Chloroform	×	―	×	△	○
95	Chloronaphthalene	×	―	×	―	―
96	Chlorosulfonic acid	×	―	―	○	―
97	Chlorotoluene	×	―	×	○	―
98	Chormic acid [2 ・ 70]	×	―	○	○	―
99	Chormic acid [5 ・ 70]	×	―	○	○	―
100	Chormic acid [10 ・ 70]	×	―	○	○	―
101	Chormic acid [25 ・ 70]	×	―	○	○	―
102	Citric acid	○	―	○	○	―
103	Cocoanut oil	○	―	―	○	―
104	Copper chonde	○	―	―	○	―
105	Copper cyanide	○	―	―	○	―
106	Copper sulfate	○	―	―	○	―
107	Corn oil	×	―	―	○	―
108	Cottonseed oil	×	―	―	○	―
109	Creosote oil	×	―	―	○	―
110	Cresol	×	―	○	○	―
111	Cyclohexane	×	―	×	○	△
112	Cyclohexanol	―	―	×	○	○
113	Cyclohexanone	×	―	×	○	―
114	Daiflon solvent S3 (R-113)	―	―	―	―	×
115	Daifloil (Liquid Fluorocarbon)	―	―	―	―	×
116	Developing solutions(Hypos)	○	―	―	○	―
117	Dekalin	―	―	―	―	○
118	1,8-diazabicyclo[5.4.0]undec	―	―	―	―	○
119	Dibenzi ether	―	―	△	△	―
120	Dibutyl ether	×	―	△	△	―
121	Dibutyl phthalate	△	―	×	○	―
122	Dichlorobenzene	×	―	△	○	―
123	o-Dichlorobenzene	―	○	―	―	―
124	Diethanol amine	―	○	―	―	―

Meaning of Estimated Mark

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RT : Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt% ・ Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
125	Diethylene glycol	△	―	○	○	―
126	Diethyl ether	×	―	△	△	△
127	Diethyl sebacate	△	―	△	○	―
128	Diisopropyl ketone	―	―	×	○	―
129	Dimethyl aniline	―	―	×	―	―
130	N,N'-Dimethylacetamide	―	―	―	―	○
131	Dimethyl formamide	○	○	×	△	―
132	N,N'-Dimethyl formamide	―	―	―	―	○
133	Dimethyl maleic	―	―	―	―	○
134	Dioctyl phtalate(DOP)	○	○	×	○	―
135	Dioctyl sebacate(DOS)	○	―	×	○	―
136	Dioxane	×	―	×	―	―
137	1,4-Dioxane	―	―	―	―	○
138	Diphenyl	×	―	―	○	―
139	Diphenyl oxide	△	―	―	○	―
140	Cutting oil	―	―	―	―	○
141	Dowtherm G	―	○	―	―	―
142	Epichlorohydrine	―	×	×	○	―
143	Engine oil	―	―	―	―	○
144	Ethanolamine	△	―	―	○	―
145	Ether	―	―	×	―	―
146	Ethyl acetate	×	○	×	○	―
147	Ethyl acetoacetate	―	―	×	○	―
148	Ethyl acrylate	△	―	×	○	―
149	Ethyl alcohol	△	―	○	○	○
150	Ethyl benzene	×	―	×	○	○
151	Ethyl carbitol	―	―	―	―	○
152	Ethyl cellulose	△	―	○	○	―
153	Ethyl chloride	×	―	×	○	―
154	Ethylene chlorohydrin	×	―	×	○	―
155	Ethylene diamine	○	×	×	○	○
156	Ethylene dichloride	×	―	×	○	―
157	Ethylene glycol	○	○	△	○	○
158	Ethylene oxide	×	×	×	○	―
159	Ethyl ether	―	―	―	―	―
160	Ethyl mercaptan	―	―	―	○	―
161	Ethyl oxalate	―	―	△	○	―

Meaning of Estimated Mark
○ : Usable △ : Necessity of Test × : Nonapproved ― : Untried
RT : Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt% ・ Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
162	Ethyl silicate	―	―	△	○	―
163	Fatty acid	×	―	―	○	―
164	Ferric chloride	―	―	―	―	○
165	Ferric chloride	△	―	―	○	―
166	Ferric nitrate	×	―	―	○	―
167	Ferric sulfate	△	―	―	○	―
168	Fluorororide acid	―	―	○	○	―
169	Fluorobenzene	×	―	×	○	―
170	Fluosilicic acid	―	―	○	○	―
171	Formaldehyde [40 ・ RT]	―	―	○	○	―
172	Formalin	―	―	○	―	○
173	Formamide	―	―	―	―	○
174	Formic acid [25 ・ RT]	△	―	○	○	―
175	Formic acid [50 ・ RT]	△	―	○	○	―
176	Formic acid [90 ・ RT]	△	―	○	○	○
177	Freon 11	×	―	―	○	―
178	Freon 12	×	―	―	○	―
179	Freon 21	×	―	―	○	―
180	Freon 22	×	―	―	○	―
181	Freon 113	×	―	―	○	―
182	Freon 114	×	―	―	○	―
183	Fuel oil	×	―	―	○	―
184	Furan Furfuran	―	―	×	△	―
185	Furfural	○	―	×	○	○
186	Gasoline	×	○	―	○	―
187	Gelatin	○	―	―	○	―
188	Glauber's salt	○	―	―	○	―
189	Glycerin	○	―	○	○	―
190	Grease	―	―	―	○	―
191	Hexamethlyene diamine	―	×	―	―	―
192	(n-)Hexaldehyde	○	―	×	○	―
193	Hexane	×	―	―	○	―
194	n-Hexane	―	―	○	―	○
195	Hexyl alcohol	△	―	○	○	―
196	Hydrazine	×	―	―	△	―
197	Hydrobromic acid [20 ・ RT]	―	―	○	○	―
198	Hydrobromic acid [20 ・ 70]	―	―	△	○	―

Meaning of Estimated Mark

○：Usable △：Necessity of Test ×：Nonapproved －：Untried

RT：Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt%・Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
199	Hydrobromic acid [37・RT]	×	－	○	○	－
200	Hydrochloric acid [10・RT]	△	－	○	○	－
201	Hydrochloric acid [20・RT]	△	○	○	○	－
202	Hydrochloric acid [20・80]	×	－	△	○	－
203	Hydrochloric acid [38・RT]	×	－	○	○	○
204	Hydrocyanic acid	－	－	○	○	－
205	Hydrofluoric acid [10・RT]	－	－	○	○	－
206	Hydrofluoric acid [20・RT]	－	－	○	○	－
207	Hydrofluoric acid [40・RT]	×	－	○	○	－
208	Hydrofluoric acid Mixture(4.8%)	－	×	－	－	－
209	Hydrofluoric acid anhydrous	×	－	○	○	－
210	Hydrogen	△	－	－	○	－
211	Hydrogen peroxide [5・RT]	○	－	－	○	－
212	Hydrogen peroxide [5・50]	○	－	－	○	－
213	Hydrogen peroxide [30・RT]	○	－	－	○	－
214	Hydrogen sulfide	×	－	－	○	－
215	Hydroquinone	－	－	○	○	－
216	Hypochlorous acid	×	－	○	○	－
217	Isobutyl alcohol	○	○	○	○	－
218	Isooctane	×	－	×	○	△
219	Isopropyl acetate	－	－	×	○	－
220	Isopropyl alcohol	○	－	○	○	－
221	Isopropyl ether	－	－	△	○	－
222	JIS No.1oil	－	－	－	－	○
223	Kerosene	×	－	－	○	－
224	lacquer	×	－	－	○	－
225	Lactic acid	○	－	○	○	－
226	Lard	△	－	－	○	－
227	Lead acetate	×	－	－	○	－
228	Lead nitrate	△	－	－	○	－
229	Lead sulfamate	△	－	－	○	－
230	Linoleic acid	○	－	○	○	－
231	Linseed oil	○	－	－	○	－
232	Liquifide petroleum gas(LPG)	×	－	－	○	－
233	LLG 50%aq	－	－	－	－	○
234	Lubricatig oil	×	－	－	○	－
235	Magnesium chloride	○	－	－	○	－

Meaning of Estimated Mark

○ : Usable △ : Necessity of Test × : Nonapproved ― : Untried

RT : Ambient Temperature

	Name	Standard			Organic solvent	
	[Density: wt% ・ Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
236	Magnesium hydroxide	―	―	○	○	―
237	Magnesium sulfate	○	―	―	○	―
238	Maleic acid	―	―	○	○	―
239	Malic acid	△	―	○	○	―
240	Marcuric chloride	―	―	―	○	―
241	Marcury	―	―	―	○	―
242	Methyl acetate	×	―	×	○	―
243	Methyl acrylate	―	―	―	―	○
244	Methyl alcohol	△	―	○	○	○
245	Methyl carbitol	―	―	―	―	○
246	Methyl chloride	×	○	×	○	―
247	Methyl ethyl ketone(MEK)	×	○	×	○	○
248	Methyl methacrylate	×	―	×	○	―
249	Methyl isobutyl ketone	△	○	×	○	○
250	Methyl tertiary butyl ether	―	○	―	―	×
251	Methylene chloride	―	○	―	―	○
252	Methylene dichloride	×	―	×	○	―
253	Mineral oil	×	―	―	○	―
254	Mobil 254 lube oil	―	○	―	―	―
255	Mobil jet Ⅱ lube oil	―	○	―	―	―
256	Monochlorobenzen	×	―	×	○	―
257	Monochltoluene	―	―	―	―	○
258	Monoethanolamine	△	×	○	○	―
259	Naphtha	×	―	―	○	―
260	Naphthalene	×	―	○	○	―
261	Naphthenic acid	―	―	○	○	―
262	Natural gas	△	―	―	○	―
263	Nickel acetate	―	―	―	○	―
264	Nickel chloride	○	―	―	○	―
265	Nickel sulfate	○	―	―	○	―
266	Nitric acid [10 ・ RT]	△	―	○	○	○
267	Nitric acid [10 ・ 70]	―	―	△	○	―
268	Nitric acid [30 ・ RT]	―	―	○	○	○
269	Nitric acid [30 ・ 70]	―	―	×	○	―
270	Nitric acid [61.3 ・ RT]	×	○	△	○	―
271	Nitric acid [smoking ・ RT]	×	―	△	○	―
272	Nitrobenzene	×	―	×	○	○

Meaning of Estimated Mark

○：Usable △：Necessity of Test ×：Nonapproved －：Untried

RT：Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt%・Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
273	Nitroethane	×	－	×	○	－
274	Nitromethane	×	－	×	○	－
275	Nitropropane	×	－	×	○	－
276	Nitrogen	○	－	－	○	－
277	N-methyl-2-pyrrolidone	－	×	－	－	○
278	Octyl alcohol	△	－	○	○	－
279	Oleic acid	×	－	○	○	－
280	Olive oil	×	－	－	○	－
281	Oxalicacid	△	－	○	○	－
282	Oxygen	○	－	－	○	－
283	Ozone	○	－	－	○	－
284	Palmitic acid	×	－	－	○	－
285	Perchloric acid	×	－	○	○	－
286	Perchloroethylene	△	－	×	○	－
287	Petroleum	△	－	－	○	－
288	Phenyl hydrazine	－	－	×	○	－
289	Phenol	○	○	○	○	－
290	Phosphoric acid [50・RT]	○	－	○	○	－
291	Phosphoric acid [50・70]	－	－	○	○	－
292	Phosphoric acid [75・RT]	－	－	○	○	－
293	Pickling solution	－	－	○	○	－
294	Pickling solution	－	－	○	○	－
295	Picric acid	×	－	△	○	－
296	Pinene	×	－	×	○	－
297	Pine oil	－	－	－	○	－
298	Piperidine	－	－	－	○	－
299	Potassium chloride	○	－	－	○	－
300	Potassium cyanide	○	－	－	○	－
301	Potassium dichromate	○	－	－	○	－
302	Potassiumhydroxide	×	－	○	○	－
303	Potassium permanganate	－	－	－	○	－
304	Potassium sulfate	○	－	－	○	－
305	Propane	×	－	－	○	－
306	Propyl acetate	×	－	×	○	－
307	Propyl alcohol	△	－	△	○	－
308	Propylene	－	－	－	○	－
309	Propylene glycol	－	－	－	－	－

Meaning of Estimated Mark
○ : Usable △ : Necessity of Test × : Nonapproved ― : Untried
RT : Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt% ・ Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
310	Propylene oxide	―	×	―	―	―
311	Pyridine	―	―	―	○	○
312	Salicylic acid	―	―	○	○	―
313	Salt water	○	―	―	○	―
314	Silicate esters	△	―	―	○	―
315	Silicone greses	×	―	―	○	―
316	Silicone oil	×	―	―	○	―
317	Silver nitrate	○	―	―	○	―
318	Soap solutions	○	―	―	○	―
319	Soda ash	○	―	―	○	―
320	Sodium bicarbonate	○	―	―	○	―
321	Sodium bisulfate	○	―	―	○	―
322	Sodium bisulfite	○	―	―	○	―
323	Sodium borate	○	―	―	○	―
324	Sodium chloride	○	―	―	○	―
325	Sodium cyanide	○	―	―	○	―
326	Sodium hydroxide [10 ・ RT]	×	―	○	○	―
327	Sodium hydroxide [30 ・ RT]	×	○	○	○	○
328	Sodium hydroxide [30 ・ 70]	×	―	△	×	―
329	Sodium hypochlorite [5 ・ RT]	○	―	―	○	○
330	Sodium hypochlorite [5 ・ 70]	○	―	―	○	―
331	Sodium metaphosphate	―	―	―	○	―
332	Sodium nitrate	×	―	―	○	―
333	Sodium perborate	△	―	―	○	―
334	Sodium peroxide	×	―	―	○	―
335	Sodium phosphate	×	―	―	○	―
336	Sodium thiosulfate	○	―	―	○	―
337	Sodium sulfite	○	―	―	○	―
338	Soybeen oil	×	―	―	○	―
339	Stannic chloride	△	―	―	○	―
340	Stearic acid	×	―	○	○	―
341	Stauffer 7700 oil	―	○	―	―	―
342	Styrene	×	―	×	○	―
343	Sulfur	○	―	―	○	―
344	Sulfur chloride	―	―	―	○	―
345	Sulfur dioxide	△	―	―	○	―
346	Sulfuric acid [10 ・ RT]	―	―	○	○	―

Meaning of Estimated Mark

○：Usable　△：Necessity of Test　×：Nonapproved　－：Untried

RT：Ambient Temperature

Name		Standard			Organic solvent	
	[Density: wt%・Temperature:°C]	Silicon	Karlez	Vinyl chloride	Teflon	Perfluoroelastomer
347	Sulfuric acid [10・70]	－	－	△	○	－
348	Sulfuric acid [30・RT]	－	－	○	○	○
349	Sulfuric acid [30・70]	○	－	△	○	－
350	Sulfuric acid [98・RT]	×	－	△	○	－
351	Sulfuric acid [smoke・RT]	×	－	×	○	－
352	Sulfurous acid [10・RT]	△	－	○	○	－
353	Syydlo 500-B4	－	△	－	－	－
354	Tannic acid	△	－	○	○	－
355	Tar	△	－	－	○	－
356	Tartaric acid	○	－	○	○	－
357	Tetrachloroethane	－	－	×	○	－
358	Tetrachloroethylene	－	－	－	－	△
359	Tetraethyl lead	－	－	△	○	－
360	Tetra hydrofuran	×	○	×	○	△
361	Tetralin	×	－	△	○	－
362	Turbine oil MIL-L-7808	－	○	－	－	－
363	Thionyl chloride	－	－	－	○	－
364	Toluene	×	－	×	△	○
365	Toluene sulfonyl chloride	－	×	－	－	－
366	Triacetin	－	－	－	○	－
367	Tributyl phosphate	－	－	×	○	－
368	Trichlori acetic acid	－	×	－	－	－
369	Trichloroethylene	×	－	×	○	○
370	Trichloro trifluoroethane	－	×	－	－	－
371	Tricresyl phosphate	×	－	×	○	○
372	Triethylphosphate	－	－	－	－	○
373	Triethanol amine	×	○	○	○	－
374	Triethyltentramin	－	－	－	－	○
375	Turpentile oil	×	－	－	○	－
376	Valclene 1	－	－	－	－	－
377	Vegetable oil	×	－	－	○	－
378	Vinegar	○	－	－	○	－
379	Xylene	×	○	×	○	○
380	Zinc acetate	×	－	－	○	－
381	Zinc chloride	－	－	－	○	－
382	Zinc sulfate	○	－	－	○	－
383	Calcium nitrate	△	－	－	○	－

12.4 Accessories

The following accessories are included with LA-950V2.

Table 4 Included Accessory List

Item Name	Amount	Description
Power Cable	1	–
Communication Cable	1	–
Feed Hose	1	Internal diameter: 8 mm
Drain Hose	1	Internal diameter: 15 mm
Feed Hose Bands	3	For feeding liquid
Drain Hose Bands	2	For draining liquid
Cotton-tipped Swabs (100/package)	1 package	For cleaning cells
LA-950V2 Installation Manual	1	This manual
LA-950V2 Software CD-ROM	1	To back up the main unit
Test Report	1	–
Sample	1	Size standard 1 μm (Polystyrene latex)
O-ring	2	For the flow cell holder
Filter	1	For feeding liquid

Note

The included sample (Size standard 1 μm) is used for test measurement when setting up the LA-950V2.

12.5 Supplemental Items

Item Name	Part Number	Application	Specification
Cotton-tipped Swab	9059001100	For cell interior cleaning	100 swabs
Flow Cell	H1019316001	For the flow cell holder	Tempax Glass, 1
O-ring	9016001500	For the flow cell holder	Viton Rubber, S34, 1
Fraction Cell	H1020473001	For fraction cell holder	Tempax glass, 1

12.6 Lifetimes of Spare Parts

The standard lifetimes of the LA-950V2 spare parts are as follows.
However, these values are for reference purposes only and are not guaranteed.

Table 5 Consumable Part List

Part Name	Lifetime (continuous operation)	Description
Agitator Motor	1000 hours	No load, at maximum speed
Agitator Bearing	5 years	–
Circulation Pump Motor	5 years	No load, at maximum speed
Circulation Pump Bearing	5 years	–
Ultrasonic Probe Tip	100 hours	At maximum output
Drain Valve Plug	30000 times	–
Drain Valve Shaft Seal	30000 times	–
Drain Valve Drive Solenoid	3 years	–
Cooling Fan	30000 hours	–
Laser Shutter	500000 times	–
Laser Diode	10000 hours	Normally lit when LA-950V2 power is ON
LED	5 years	Normally lit when LA-950V2 power is ON
Feed Pump	2000 hours	–
Optical Axis Adjustment Drive Screw	5 years	–
LED for lighting	5 years	–

When part replacement is required, contact our sales department or the customer support center.

12.7 Options

Options for LA-950V2 are as follows.
Available option is determined by the model of LA-950V2.

Item Name	Type	LA-950A2, N2, L2, W2, S2	LA-950P2, PS2	LA-950E2
Fraction cell holder	LY-9501	○	○	○
Miniflow (with ultra sonic)	LY-9502	○	○	×
Miniflow (without ultra sonic)	LY-9503	○	○	×
Paste cell holder	LY-9504	○	○	×
Dry feeder unit	LY-9505	○	○	×
Slurry sampler	LY-9506	○	×	×
Auto sampler	LY-9507	○	×	×
Spray unit	LY-9508	○	×	×

○ : available, × : disable

12.8 Organic solvent-resistant equipment

CAUTION

Caution on organic solvents

- Exposure to sample liquid may occur during operation.
- During operation, take adequate precautions for the organic solvents in use, such as wearing chemical-resistant gloves.

● Overview

In the organic solvent-resistant equipment, the parts that come into contact with liquid have been partly modified to support the use of organic solvents. The differences with the standard equipment are described below.

● Differences with standard equipment

Piping

The organic solvent-resistant equipment has a different feed hose, drain hose and overflow hose from the standard equipment.

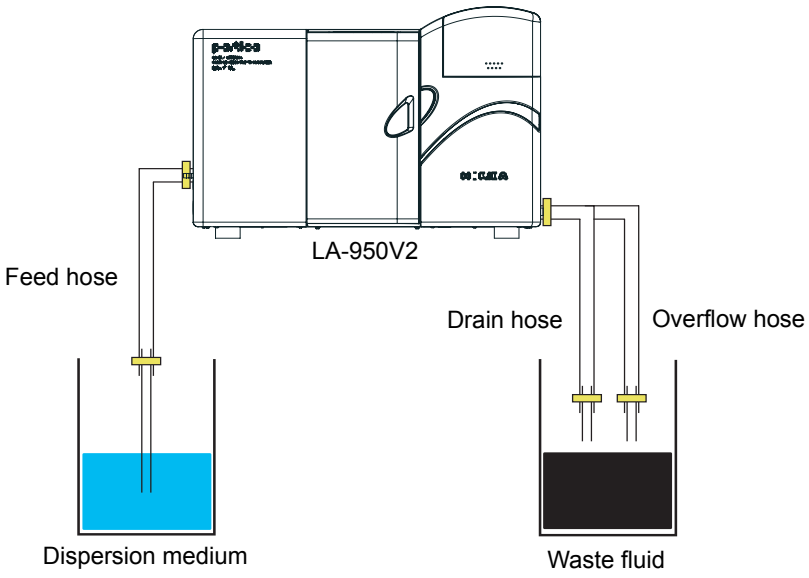


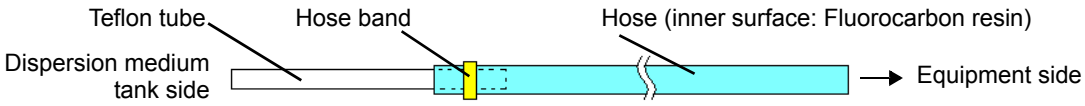
Fig. 20 Special Piping Used in Organic Solvent-Resistant Equipment

Reference

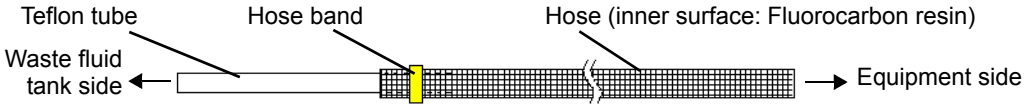
“ 2.2 Checking Cable and Piping Connections ” (page 9)

Organic solvent-resistant hoses

- The feed hose consists of a transparent hose and Teflon tube.



- The drain hose consists of a Teflon tube and a bend-preventing fiber mesh hose.



- Connect the hose side to the equipment joint, and secure it with the hose band provided.

● **Cell holder drawer**

Undo the circulation tube joints (2) in the sample container walls, then slide the cell holder. In organic solvent-resistant equipment, the circulation tube has a transparent tube with a fluorocarbon resin inner surface.

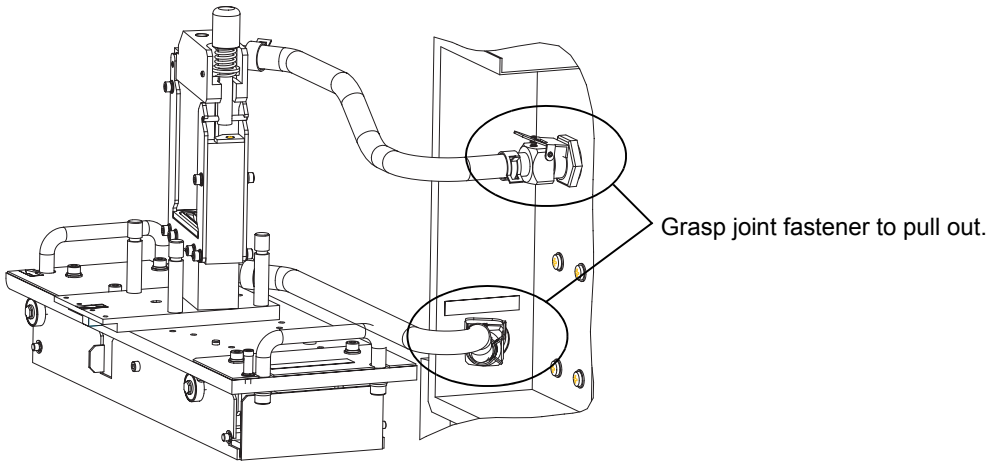


Fig. 21 Circulation Tube Joints

Reference

“ Fig. 6 Sample Container (Using Flow Cell) ” (page 7)

● Chemical resistance

Organic solvent-resistant equipment uses the materials below in parts contacting liquids.

Table 6 Chemical Resistance of Parts Contacting Liquid

Name	Chemical resistance	Description
Teflon	See “ Table 3 Chemical Resistance of Surfaces in Contact with Liquids ” (page 61).	
PEEK resin	Outstanding chemical resistance against almost all solvents except concentrated sulfuric acid.	
Daieru Perflow	See “ Table 3 Chemical Resistance of Surfaces in Contact with Liquids ” (page 61).	
Stainless steel	Outstanding chemical resistance against almost all solvents except strong acids, strong alkalis and halogen compounds.	Same as standard equipment
Titanium alloy	Outstanding chemical resistance against almost all solvents except hydrofluoric acid, sulfuric acid, phosphoric acid and hydrochloric acid.	
Hard glass	Outstanding chemical resistance against almost all solvents except strong alkalis and hydrofluoric acid.	

● Accessories

The accessories of the organic solvent-resistant LA-950V2 are listed below. Parts marked by asterisks (*) are different from the standard equipment.

	Part name	Quantity	Remarks
	Power cable	1	
	Communication cable	1	
*	Feed hose	1	8 mm inner diameter, transparent hose + Teflon tube
*	Drain hoses	2	15 mm inner diameter, hose with mesh + Teflon tube
	Feed hose band	1	
	Drain hose bands	2	
	Cotton swabs (100 per bag)	1 bag	For cell cleaning
	LA-950V2 instruction manual	1	This document
	LA-950V2 software CD-ROM	1	For equipment software backup
	Inspection result sheet	1	
	Samples	1	Size standard 1 μm (Polystyrene latex)
	O-rings	2	For flow cell holder

Note

The filter provided with the standard equipment (for fluid feeding) is not provided with the organic solvent-resistant equipment.

Reference

“ Table 4 Included Accessory List ” (page 72)

12.9 Measurement Principles

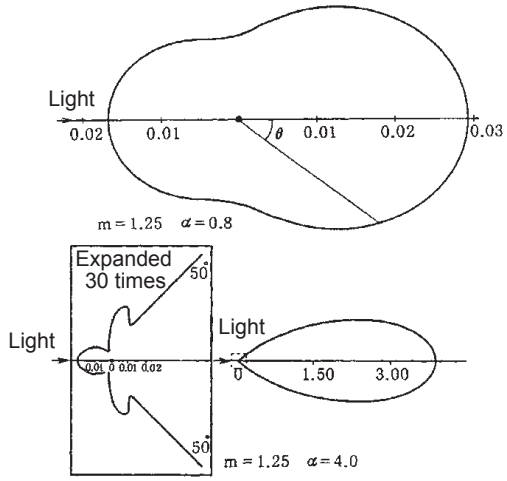
When light strikes a particle, scattered (diffracted) light is produced from the particle.
According to light scattering theory, when a single particle of diameter D is struck by incoming or incidental light, the scattered light strength that can be observed from the particle, if the particle's circumference length and the incoming light's wavelength are compared, is decided by the designated particle diameter parameter α ($\alpha=\pi D/\lambda$) and the particle's diffractive index m.
When the particle diameter is large, the scattered light is concentrated forward. On the contrary, when the particle diameter becomes smaller than the incoming (incidental) light wave length, light is scattered in all directions. In this case, the strength of scattered light depends on the scattering angle θ (incoming light direction and scattering direction angle) and changes.
When the scattering angle is as follows.

$0 < \theta < 90°$: Forward scattering
$\theta \cong 90°$: Sideways scattering
$90° < \theta \leq 180°$: Rear scattering

is said to be.

In light of this, when measuring large particle diameters it becomes necessary to obtain information about the scattered light strength (forward scattering) of small scattering angles, and when measuring small particle diameters it becomes necessary to obtain information about the scattered light strength (side and back scattering) of large scattering angles.

With the LA-950V2, for each sample particle's scattered light, small angle (forward) scattered light intensity distributions are detected by a ring detector. Large angle scattered light is detected using side and rear-mounted detectors. Thus, particle size distributions are calculated based on the collected scattered light strength's angle distribution values.



Scattering light pattern

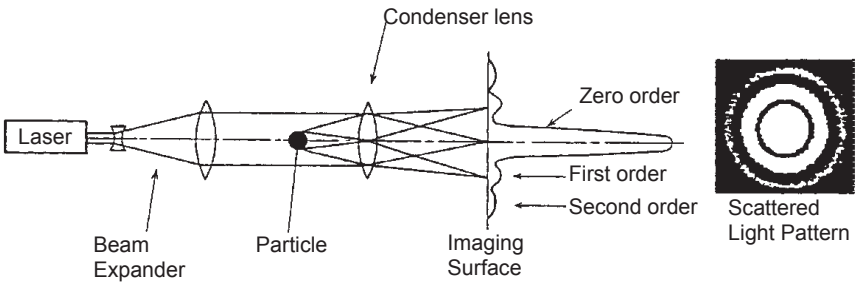


Fig. 22 Measurement Principles

12.10 List of the Refractive Index Values

12.10.1 Inorganic substances

Substance	Composition	Specific Gravity	Refractive index, n_1
Lead white	$Pb_3(CO_3)_2(OH)_2$	6.8	2.02
Zink flower	ZnO	5.6	2.00
Titanium oxide(rutile)	TiO_2	4.2	2.75
Titanium oxide(anatase)	TiO_2	3.9	2.50
Zinc sulfide	ZnS	4.0	2.37
Lead titanate	$PbTiO_2$	7.3	2.70
Ziconium oxide	ZrO	5.7	2.40
Barium sulfate	$BaSO_4$	4.4	1.62
Barium carbonate	$BaCO_3$	4.3	1.60
Calcium carbonate	$CaCO_3$	2.8	1.58
Gypsum	$CaSO_4 \cdot 2H_2O$	2.4	1.55
Alumina	Al_2O_3	-	1.66
Iron oxide	Fe_2O_3	4.8	2.90
Red lead	Pb_3O_4	8.9	2.42
Mercuric sulfide	HgS	8.0	2.95
Lead chromate	$PbCrO_4$	6.0	2.40
Cadmium sulfide	CdS	4.4	2.42
Zinc yellow	$ZnCrO_4$	3.5	1.87
Strontium yellow	$SrCrO_4$	-	1.96
Barium yellow	$BaCrO_4$	4.4	1.63
Chrome green	Red lead + Prussian blue	4.1	2.40
Emerald green	-	3.2	1.97
Chromium oxide	Cr_2O_3	5.1	2.50
Cobalt green	$CoO \cdot xZnO$	-	1.97
Ultra marine		2.4	1.57
Prussian blue	$Fe_4[Fe(CH)_6]_3$	1.8	1.56
Cobalt blue	$CoO \cdot xAl_2O_3$	3.8	1.74
Celuriene	$CoO \cdot xSnO_2$	-	1.84
Cobalt violet	$Co_3(PO_4)_2$	-	1.72
Manganese violet	$(NH_4)_2Mn_2 (P_2O_7)_2$	-	1.70
Silver chloride	AgCl	-	2.08
Fluorite	CaF_2	-	1.43
Germanium	Ge	-	4.10
Potassium bromide	KBr	-	1.58
Potassium chloride	KCl	-	1.80
Lithium fluoride	LiF	-	1.39
Magnesium oxide	MgO	-	1.76
Silicon	Si	-	3.50
Quartz	SiO_2	-	1.45

Substance	Composition	Specific Gravity	Refractive index, n_1
Rock crystal	SiO_2	-	1.54
Optical glass	BK-7	-	1.51
Optical glass	SF-2	-	1.64
Diamond	-	-	2.41
Sapphire	Al_2O_3	-	1.76
Magnesium fluoride	MgF_2	-	1.37
Mica	-	-	1.59
	$BaCa_2 (C_3H_5O_2)_6$	-	1.45
	$BaC_{12} \cdot BaF_2$	-	1.64
	BaF_2	-	1.47
	$BaHPO_4$	-	1.62
	BaS	-	2.16
	$Ca_3Al_2 O_6$	-	1.71
	$CaO \cdot B_2O_3$	-	1.60
	Cr_2O_3	-	2.50
	Cu_2O	-	2.71
	$CuSO_4$	-	1.73
	$3MgO \cdot B_2O_3$	-	1.65
	K_2CO_3	-	1.50
	$KHCO_3$	-	1.48
	KCN	-	1.41
	$KClO_4$	-	1.62
	NaBr	-	1.64
	NaCN	-	1.45
	Na_2SiO_3	-	1.52
	Na_2SO_3	-	1.55
	$SrCr_2O_7 \cdot 3H_2O$	-	1.71
	SrF_2	-	1.44
	SrS	-	2.11
	$ZnSiO_3$	-	1.62
Iron	Fe	-	3.5-3.8i
Zinc	Zn	-	2.4-5.5i
Gold	Au	-	0.34-3.3i
Silver	Ag	-	0.20-3.9i
Copper	Cu	-	0.64-3.5i
Platinum	Pt		2.9-4.5i
Aluminum	Al	-	1.6-5.5i
Antimony	Sb	-	3.2-5.0i
Magnesium	Mg	-	1.4-4.6i
Manganese	Mn	-	2.5-4.0i
Nickel	Ni	-	1.9-3.7i
Molybdenum	Mo	-	3.6-3.0i
Cobalt	Co	-	2.2-4.0i
Tungsten	W	-	3.4-2.6i

Substance	Composition	Specific Gravity	Refractive index, n_1
Asphalt	-	-	1.63
Ebonite	-	-	1.66
Opal	-	-	1.44
Canadian balsam	-	-	1.52
Amber	-	-	1.54
Ivory	-	-	1.54
Vinyl chloride resin	-	-	1.54
Vinylidene chloride resin	-	-	1.61
Vinyl acetate resin	-	-	1.46
Silicon oil	-	-	1.40
Tetrafluoroethylene resin	-	-	1.35
Nylon	-	-	1.53
Polyethylene	-	-	1.53
Polystyrene	-	-	1.60
Methylmethacrylic acid resin	-	-	1.49
Melamine resin	-	-	1.60

12.10.2 Dispersion medium

Dispersion Medium	Absolute Refractive Index	Source
Water	1.333	I.C.T
Ethanol	1.36	I.C.T
Isopropanol	1.378	I.C.T
Methanol	1.329	I.C.T
Hexane	1.376	I.C.T
Cyclohexane	1.4273	I.C.T
Cyclohexanol	1.4606	I.C.T
Acetone	1.3591	I.C.T
Tetrahydrofuran	1.404	CRC
o-Xylene	1.5058	I.C.T
m-Xylene	1.4973	I.C.T
p-Xylene	1.4956	I.C.T
Methyl Ethyl Ketone	1.3791	I.C.T
Dichloromethane	1.4237	I.C.T
Glycerin	1.4729	I.C.T
n-butanol	1.3993	I.C.T
sec-butanol	1.397	I.C.T
tert-butanol	1.387	I.C.T
isobutanol	1.396	I.C.T
Cyclohexanone	1.4526	I.C.T
Decane	1.4209	I.C.T
Ethyl Acetate	1.3707	I.C.T
Ethylene Glycol	1.429	CRC
Methyl Isobutyl Ketone	1.3959	I.C.T
Toluene	1.4962	I.C.T

* I.C.T: INTERNATIONAL CRITICAL TABLES
* CRC: HANDBOOK OF CHEMISTRY AND PHYSICS

Bibliography

- Shinpan Butsuri Teisuhyo ("New Physical Constants Tables"), Asakura Shoten
- Kagaku Binran Kisohen, Kaitei 2 Ban ("Chemical Handbook: Basic, Revised 2nd Edition"), Maruzen
- Handbook of Chemistry and Physics, CRC Press
- American Institute of Physics Handbook, McGraw-Hill
- The Merck Index, Merck & Co.

Note

Depending on the material qualities, the values shown in this table may differ from a portion of the internal refractive index file values. Depending on the literature quoted, these values may differ. These values are intended for reference use only.

Reference materials

JIS R 1629-1997: Determination of particle size distributions for fine ceramic raw powders by laser diffraction method

JIS R 1622-1995: General rules for the sample preparation of particle size analysis of fine ceramic raw powder

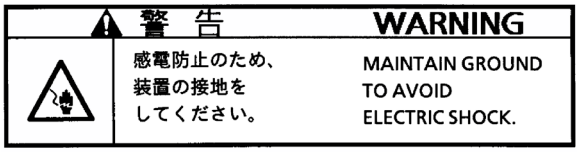
12.11 Labels

The LA-950V2 has warning labels placed on its rear and side as shown in the figure below.

● **Labels**

High voltage label

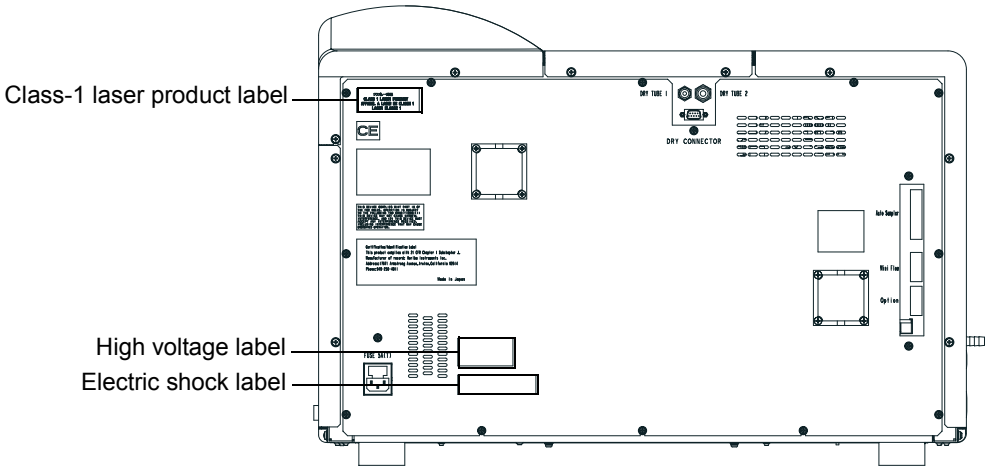
Electric shock label



Laser label

Class-1 laser product label

● Label location



Rear of LA-950V2

Laser label is inside of the device.

HORIBA, Ltd.
2 Miyanohigashi, Kisshoin Minami-ku, Kyoto 601-8510 Japan
http://www.horiba.com