

LWT-2A

Particle Counter

P r o d u c t O p e r a t i o n m a n u a l

ShangHai LUWATECH Industrial Co,.LTD.

Table of Contents

1 Description	4
2 Technical Indicator	4
3 Instrument Structure	4
3.1 System composition.....	4
3.2 Front panel.....	5
3.3 Back panel	6
4 Installation.....	6
4.1 Installation environment.....	6
4.2 Connect with pump	7
4.3 Install the high precision syringe	7
5 The theory of the instrument.....	8
5.1 The theory of sensor	8
5.2 The working diagram of instrument	8
6 Test operation	9
7. Instrument Usage	10
7.1 Menu structure	10
7.2 Menu Button Description	12
7.2.2 Keys Instructions	12
7.3 Log in	12
7.4 Setup.....	13
7.4.1 Time Setup.....	13
7.4.2 Measurement Setup	13
7.4.3 System Setup.....	14
7.4.4 Print Setup	14
7.4.5 Size Setup.....	14
7.4.6 Stir Setup	14
7.5 Measurement.....	15
7.5.1 Auto Measurement.....	15

7.5.2 Manual Measurement	15
7.5.3 Data View	16
7.6 Data.....	16
7.6.1 Saved Data Message View.....	17
7.7 Flush Menu	17
7.8 Calibration	18
8 Making a measurement	20
8.1 Preparing the oil sample	20
8.2 making a measurement	20
9 Maintenance	20
9.1 Sensor removal.....	20
9.2 Replace the filter	21
8 Troubleshooting	22
Appendix A Cleanliness Class	23
Appendix B Changing Printer Thermo Paper Roll.....	28

1 Description

The instrument is designed on the principle of light resistance (shading method) and is used to detect the size and number of particles in the liquid. Can be widely used in aerospace, aviation, electric power, petroleum, chemical industry, traffic, port, metallurgy, machinery, automobile manufacturing and other fields in the hydraulic oil, lubricating oil, transformer oil, insulating oil, turbine oil, turbine oil, gear oil, engine oil, aviation kerosene, water-based hydraulic fluid solid particle pollution tests such as oil, And the detection of insoluble particles in organic liquid and polymer solution.

2 Technical Indicator

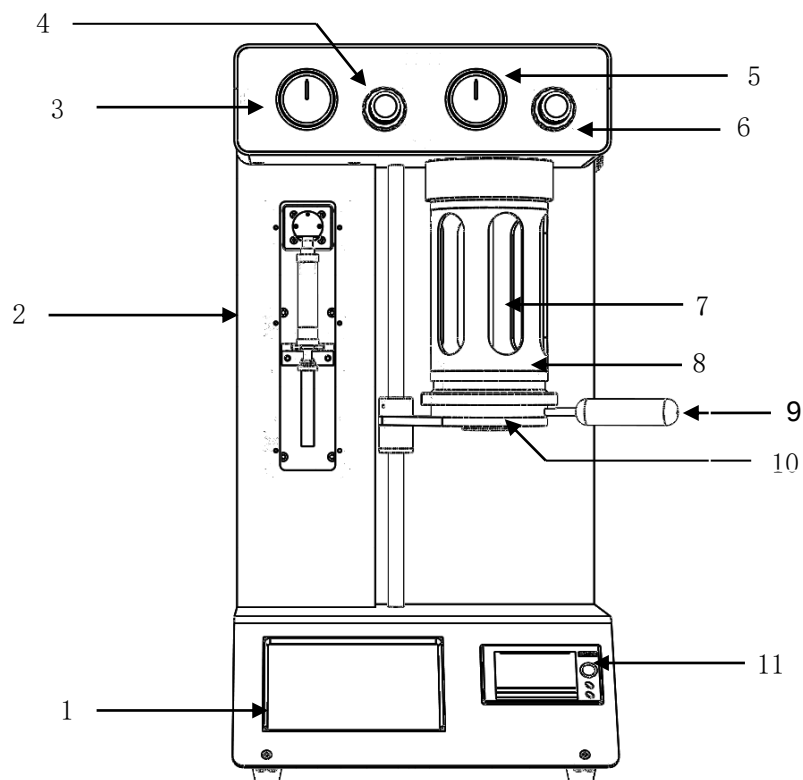
Size range	0.8 μ m~600 μ m
Number of channel	16channel, size can be set free (in the range of selected curve)
Sampling volume	0.2ml-1000.0ml
Sampling speed	5ml/min~80ml/min
Resolution	$\leq 10\%$
Coincidence deviation limit	24000 Particles/ml
Maximum pressure	0.8Mpa
Maximum vacuum	-0.08Mpa
Data output	printer and R232 interface
Power Supply	AC220V $\pm 10\%$; 50Hz; $\leq 200W$
Ambient Temperature	0 $^{\circ}$ C-60 $^{\circ}$ C

3 Instrument Structure

3.1 System composition

The instrument is composed by the instrument and a pump.

3.2 Front panel



1 LCD : Display menu touch interface, realize the operation of the instrument.

2 High pressure precision syringe: Used by sampling.

3 Pressure gauge: Indicate the pressure value in the dome.

4 Pressure valve: Adjust the maximum pressure value.

5 Vacuum gauge: Indicate the vacuum value in the dome.

6 Vacuum valve: Adjust the maximum vacuum value.

7 Sampling needle: Used for sampling.

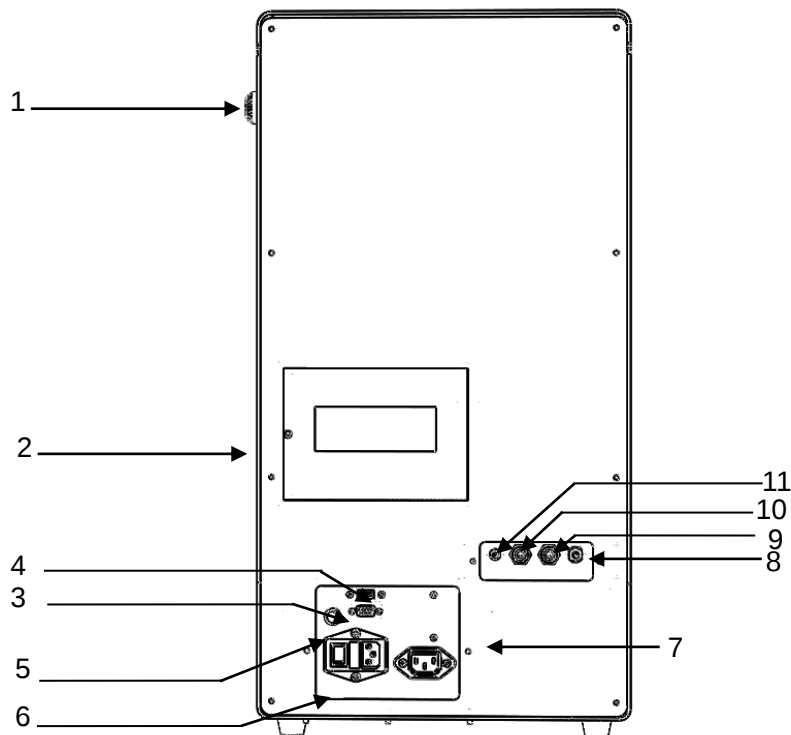
8 Dome: Sealed with the pressure or vacuum.

9 Handle: Operates the opening and closing of the dome.

10 Inspection desk: To place the sample during the measurement.

11 Printer: Print the measurement data.

3.3 Back panel



- 1 Emergency pressure relief button: Release the Pressure in the dome when emergency (Note: Beside the instrument)
- 2 Observation window: Observe the filter combinations.
- 3 Serial port: Be connected with the computer to transmit data.
- 4 USB port: USB disk storage port.
- 5 Reset button: Reset the instrument.
- 6 Input voltage & switch: Connect with the power.
- 7 Pump input voltage: Supply power for pump.
- 8 Outlet of liquid drain tubing: connect with the drain tubing.
- 9 Outlet of pressure tubing: Connect with the pressure outlet of pump.
- 10 Outlet of vacuum tubing: Connect with the vacuum outlet of pump.
- 11 Outlet sewage: Connected with sewage discharge device.

4 Installation

4.1 Installation environment

- a. The instrument should be placed in an environment with relatively stable air flow

and less dust, and far away from electromagnetic interference sources.

b. Suitable working temperature: 10~35°C, relative humidity: ≤80%.

c. The power supply of the instrument should comply with AC100-240V. The grounding end of the instrument power socket should be equipped with reliable grounding wire to ensure personal safety and reliable instrument operation.

4.2 Connect with pump

a. Connect the outlet of pressure which is back of the instrument with the pump use tube.

b. Connect the outlet of vacuum which is back of the instrument with the pump use tube.

4.3 Install the high precision syringe

a. Before the operation, the lifting arm should in a lower position. If it is not, power the instrument then run the lifting arm down.

b. Take the syringe from the packing case. First make connecting hole under the syringe set on the lifting arm and screw. The retaining screw (Note: do not lock the screw, see figure 1).

c. Pull up the syringe vertical, aligning the upper end of syringe with the three-way valve, screw the syringe carefully (see figure 2).

d. Lock the screw (see figure 3).



Fig1



Fig3

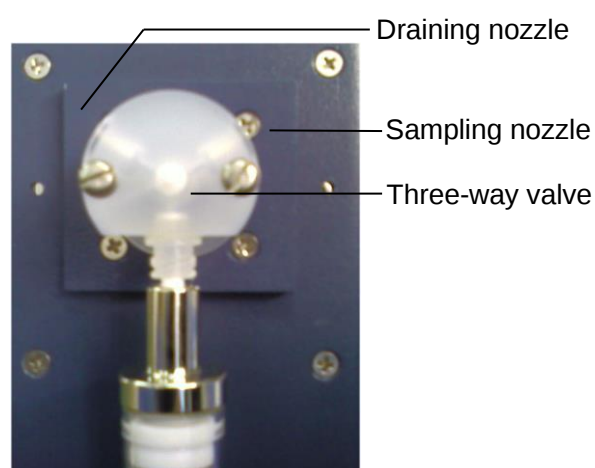


Fig2

5 The theory of the instrument

5.1 The theory of sensor

The theory described as follow:

The sensor is composed by the glass slit and the laser beam. The Laser beam is profiled for optimal illumination and responsiveness. The detector gather the laser beam to produce a current. When sample with particles through the glass slit from the bottom up due to negative pressure, the particle block part of the laser beam. This block lead to the detector's output current changed, the value of the changed current is proportional to the particle's projected area. The formula is as follow:

$$I_p = -I_o \frac{a}{A}$$

I_p —Blocked current(μA)

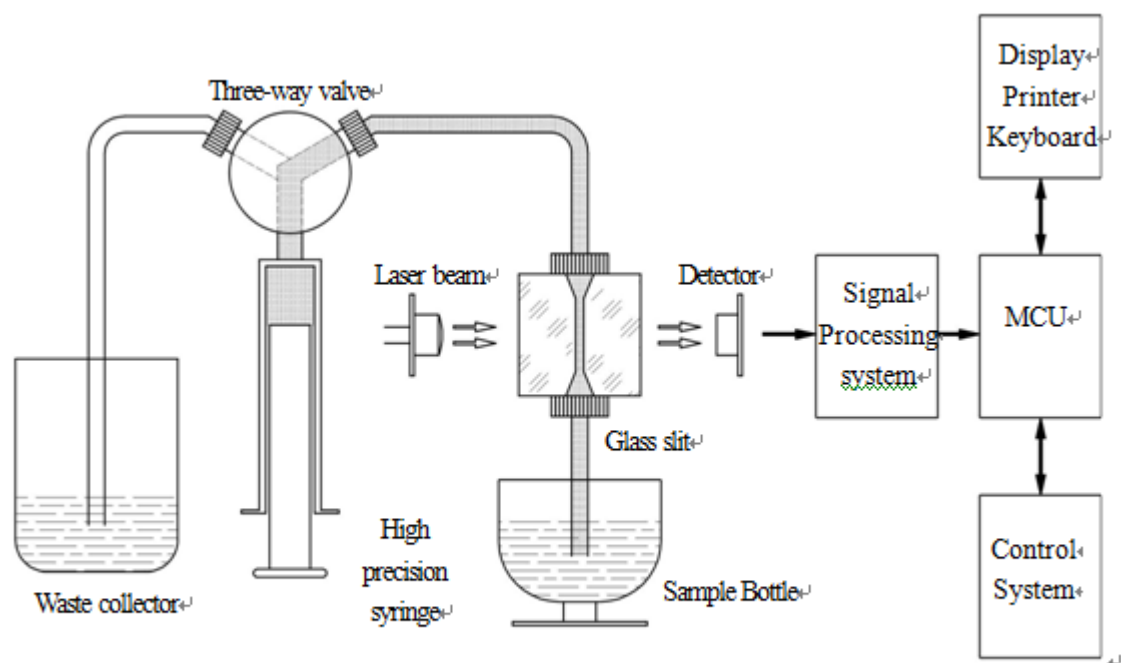
I_o —Normal current(μA)

A —the area of glass slit(μm^2)

a —the projected area of particle(μm^2)

5.2 The working diagram of instrument

The working diagram of instrument is as followed:



The working diagram of instrument

When the instrument is sampling, the tee turns to the valve to turn to the sampling position, the high pressure injection pump moves, the sample passes through the sampling needle through the sampling slit, the particles in the sample block the laser light source, causing the photoelectric receiving end to produce electrical signals, the electrical signals through the amplification collection system to determine the size of the particles and count, and then transmitted to the single chip microcomputer. MCU control system and display, printing, keyboard control. After sampling is completed, the three-way steering valve turns to the drain position, the high-pressure injection pump moves, and the sample is discharged into the waste liquid (recoil) cup. During the recoil, the three-way steering valve turns to the drain position, the high-pressure injection pump moves, and the recoil liquid is flushed from the waste liquid (recoil) cup to the injection slit to achieve the effect of cleaning the injection slit.

6 Test operation

1. Power on the instrument and turn on the power switch. The instrument will conduct self-test. After the self-check is complete, the login page is displayed. Select an administrator or operator to log in (see 7.3 **Log in**), and then should be preheated for 10 minutes before measuring.
2. Place a sampling bottle containing petroleum ether solution (grade 6 or below, or other suitable cleaning solution) on a sampling table and close the air pressure chamber (see 3. **Dome operate**), enter the flushing interface, set the flushing times and carry out flushing (see 7.7 **Flush Menu**).
3. Dome operate:
 - 1) The operation of seal the dome
 - a. A hand hold the handle and rotate the handle to align the two signs.
 - b. The other hand move up the test sets to the stop position.
 - c. Rotate the handle to the stop position to seal the dome.
 - 2) The operation of open the dome
 - a. A hand hold the handle and the other hand hold the test sets.

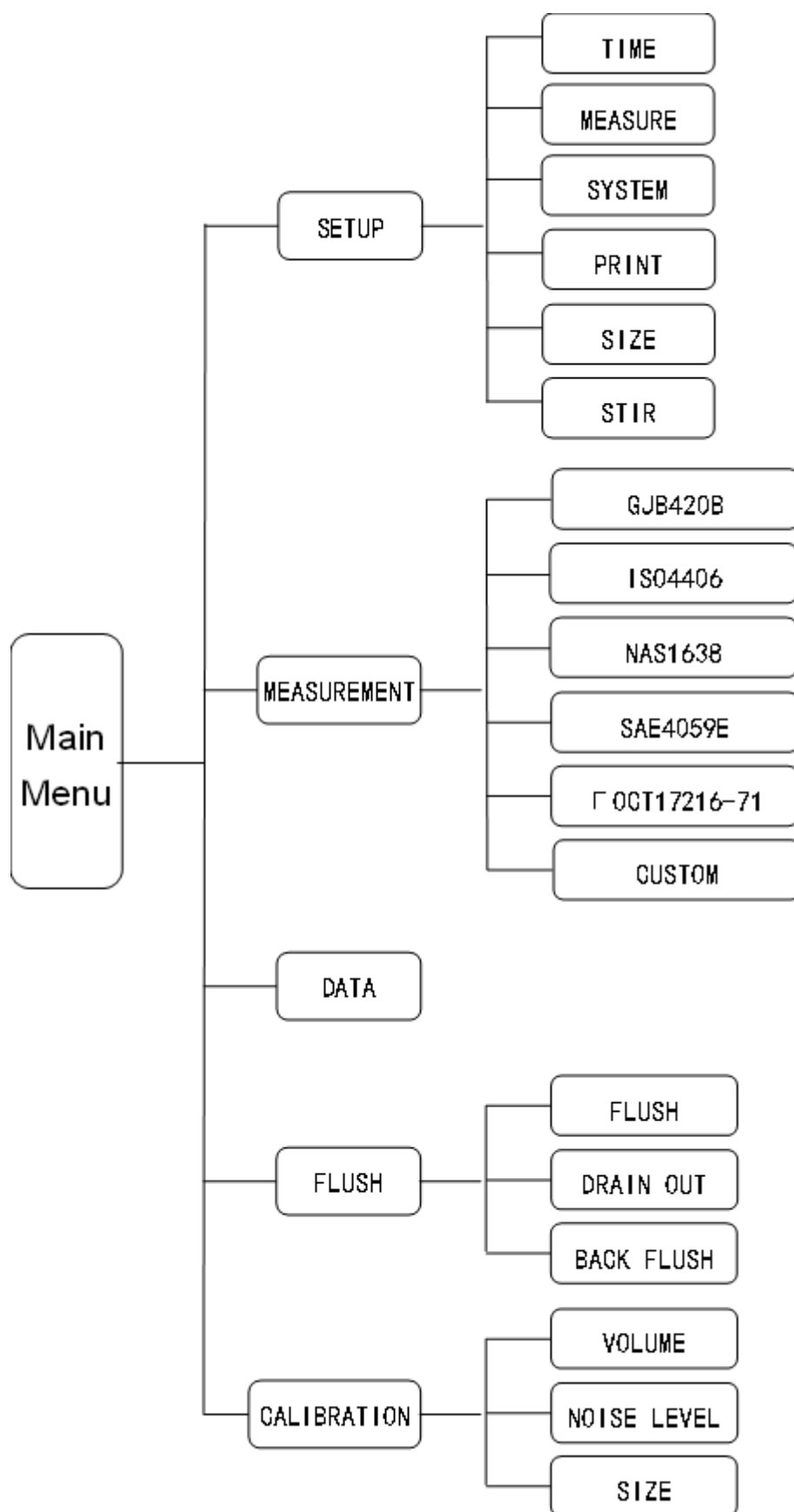
- b. Rotate the handle counterclockwise until the two signs align.
- c. Move the test sets down slowly to open the dome.

Warning: Before opening the dome, make sure there is no pressure in the dome. If there is pressure in the dome, press the manual pressure relief valve to relieve the pressure manually!

- 4. Setup the instrument (see **7.4 Setup**), setup the Test times, Test mode(Manual、Auto) (see **7.4.2 Measurement Setup**), print format (see **7.4.4 Print Setup**), channel particle size and channel number (see **7.4.5 Size Setup**), system time (see **7.4.3 System Setup**), etc.
- 5. Re-disperse the sample to be tested: tighten the cap and put it into the ultrasonic cleaning tank (with power of at least 4000W/m²) to vibrate for at least 1 minute. The liquid in the ultrasonic cleaning tank should be the same as the liquid level of the sample bottle to be tested. After the ultrasonic vibration, shake the sample bottle vigorously by hand for 5 minutes. Then again ultrasonic wave mu vibration or the use of negative pressure degassing, time should be as short as possible. Let stand for 2-3 seconds.
- 6. Enter the measure interface to select the standard test type displayed, and click the Sample button to conduct the test. If the test sample is viscous and cannot be tested properly, pressure can be applied to assist the test during the test (see **7.5 Measurement**).
- 7. At the end of the test, the previous test data of the current group data can be viewed (see **7.5.3 Data View**); Can store and print test data.
- 8. After completion of the test, perform at least 10 cleaning operations with petroleum ether flushing solution or other suitable solution (see **7.7 Flush**). After flushing, test the next sample or shut it down.

7. Instrument Usage

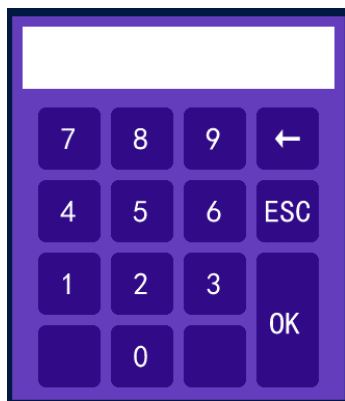
7.1 Menu structure



7.2 Menu Button Description

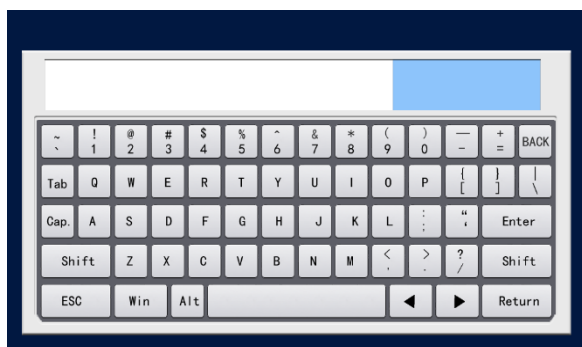
In the menu, there will be a keyboard and some fixed functions of the keys, now it is explained.

7.2.1 Keyboard Instructions



OK: Change the data and exit the keyboard;

ESC: Do not change the data and exit keyboard.



Select: Determine the input;

Return: Save input and exit the keyboard;

ESC: exit keyboard.

7.2.2 Keys Instructions

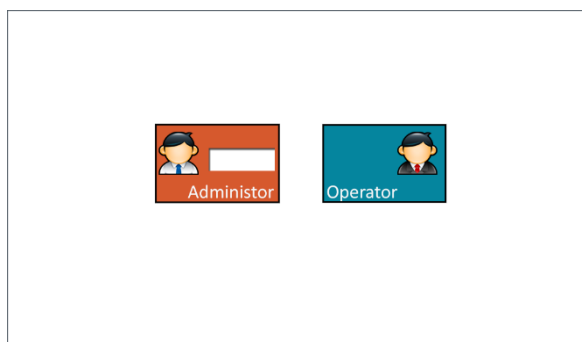
OK: Save the Settings and return to the previous menu;

ESC: Do not save the settings and return to the previous menu;

Stirring speed adjustment button: Adjust stirring speed;

SWITCH: You can switch between GJB420B, NAS1638, ISO4406, SAE4059E, TOCT17216-7 and custom to test and data display for different test standards.

7.3 Log in



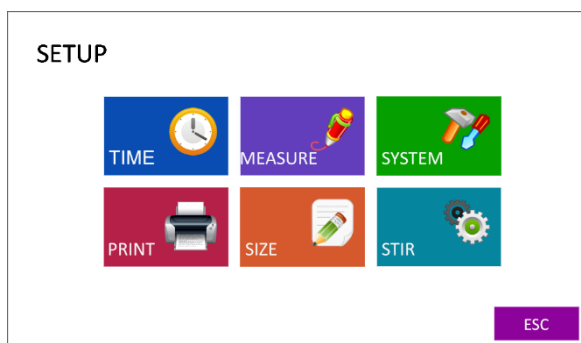
After the instrument is powered on, the login interface is displayed. Choose to log in as an Administrator or Operator.

Click the **Administrator** button on this interface, and the password input

keyboard. After entering the password, click **OK**. If the password is correct, the main interface will be entered. Click **Operator** to enter the main interface directly as operator without entering the password.

After logging in to the system, the administrator can set operator permissions on the system Settings page. The operator can set the following permissions: Calibration, Time Setup, Delete Saved Data and Measurement setup.

7.4 Setup



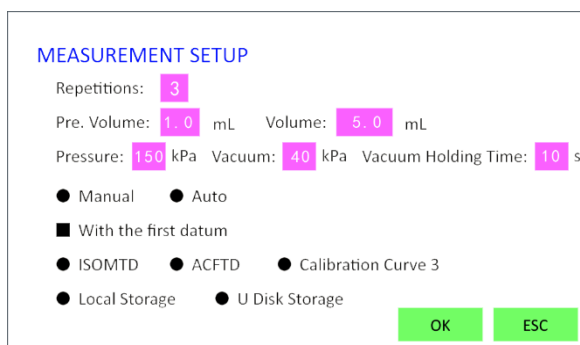
In main menu press **SETUP** button to display the Setup main menu. TIME, MEASUREMENT, SYSTEM, PRINT, SIZE and STIR can be carried out.

7.4.1 Time Setup

In Setup main menu, press **TIME** button to display the Time setup menu.

Click the corresponding text boxes of year, month, day, hour and minute to pop up the numeric keyboard, and input the set value through the numeric keyboard.

7.4.2 Measurement Setup

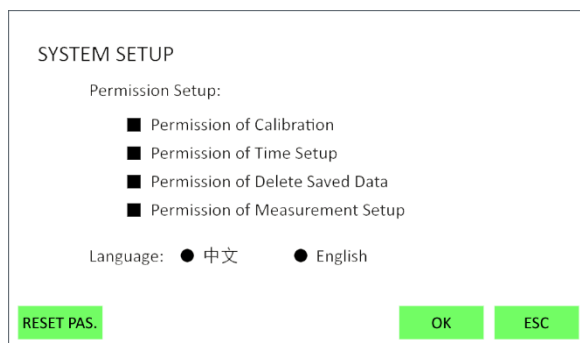


In Setup main menu, press **MEASUREMENT** button to display the Measurement setup menu.

The following parameters can be set in this menu: the measurement repetitions(1-10)、the volume(0.2-

1000.0mL)、the predict volume(0-10.0mL)、the pressure(0-800kPa)、the vacuum(0-80kPa)、the vacuum holding time(0-99s)、the measurement mode selected、the calibration curve selected、the data storage mode (local storage, USB storage) and the first data take into account or not.

7.4.3 System Setup



SYSTEM SETUP

Permission Setup:

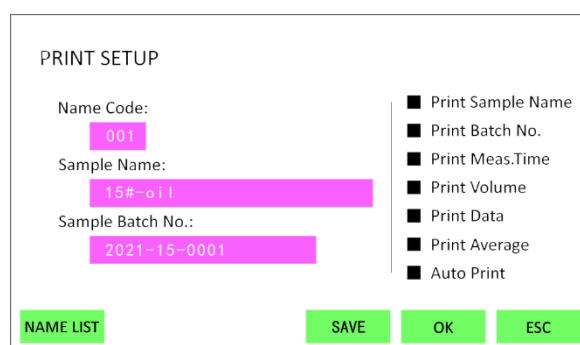
- ☐ Permission of Calibration
- ☐ Permission of Time Setup
- ☐ Permission of Delete Saved Data
- ☐ Permission of Measurement Setup

Language: ☒ 中文 ☐ English

RESET PAS. OK ESC

In Setup main menu, press **SYSTEM** button to display the System setup menu. **Only the administrator has the system setting permission.** In this menu the password can be change.

7.4.4 Print Setup



PRINT SETUP

Name Code: 001

Sample Name: 15#-oil

Sample Batch No.: 2021-15-0001

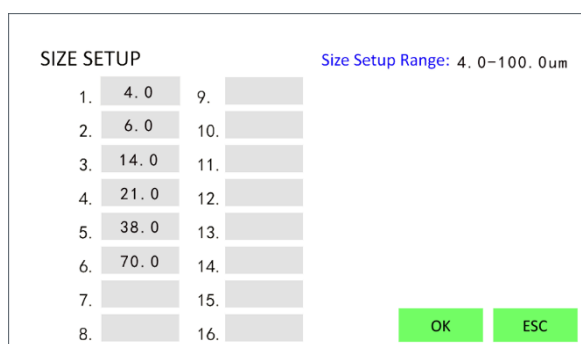
- ☐ Print Sample Name
- ☐ Print Batch No.
- ☐ Print Meas.Time
- ☐ Print Volume
- ☐ Print Data
- ☐ Print Average
- ☐ Auto Print

NAME LIST SAVE OK ESC

In Setup main menu, press **PRINT** button to display the Print setup menu. In this menu the print contents and the sample messages can be set, such as Name Code(0-99) 、 Sample

Name(20 words Max)、Batch Number(15 words Max). Click the corresponding text box to setup.

7.4.5 Size Setup



SIZE SETUP

Size Setup Range: 4.0-100.0um

1.	4.0	9.	
2.	6.0	10.	
3.	14.0	11.	
4.	21.0	12.	
5.	38.0	13.	
6.	70.0	14.	
7.		15.	
8.		16.	

OK ESC

In Setup main menu, press **SIZE** button to display the Size setup menu. In this menu the sizes of two custom measurement can be set.

The input particle size should be within the set range of particle size, otherwise, when saving, a prompt "Setting out of range! Please reset".

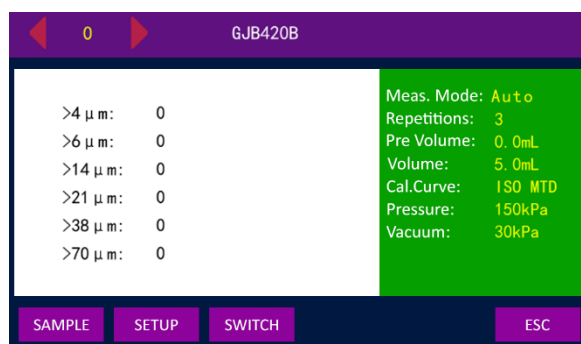
7.4.6 Stir Setup

In Setup main menu, press **STIR** button to display the Stir setup menu. You can set the stir speed on this interface. The stirring speed adjustment range is 12 gears.

7.5 Measurement

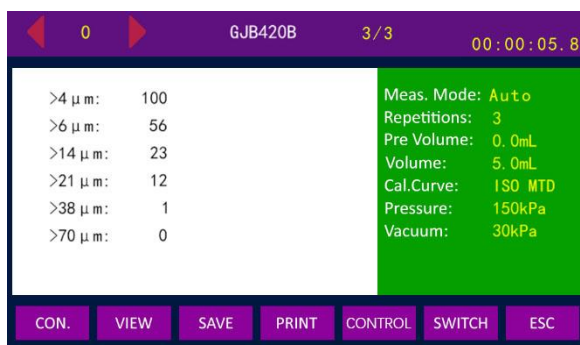
In main menu press **MEASUREMENT** button to display the Measurement Menu. All the measurement parameters can be set in the Measurement setup menu(see 7.4.2 Measurement Setup). There are two modes of measurement: Auto and manual.

7.5.1 Auto Measurement



In the auto measurement menu, press **SETUP** button to set measurement parameters and size setup(note: the pressure setting value is valid only under automatic Measurement); press

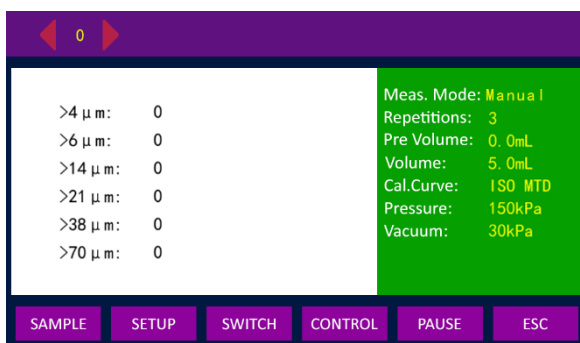
SAMPLE button to start sampling; Press **ESC** button to return to the main menu; press **SWITCH** button to switch standards. During the sampling, press **END** button to end the measurement.



After the measurement, the LCD will display measurement completed menu. In this menu, the measurement data can be view、save and print. Press **CON.** button to start a new

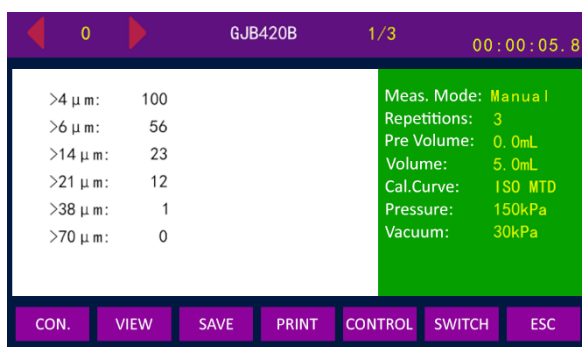
measurement; press **VIEW** button to view the data; press the **SAVE** button to save the data; press the **PRINT** button to display the Print menu; press **CONTROL** button for pressure、vacuum and other operations; press the **ESC** button to return to the main menu.

7.5.2 Manual Measurement



In the manual measurement menu, press **SETUP** button to set measurement parameters and size setup(note: the pressure

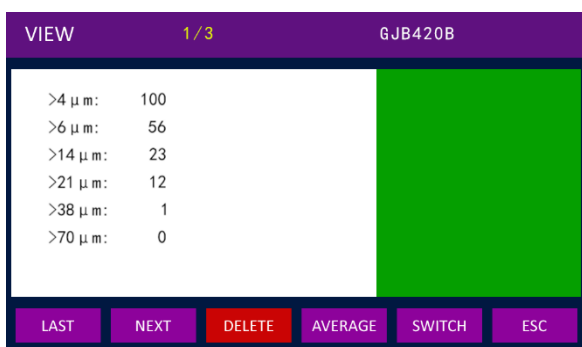
setting value is valid only under automatic Measurement); press **SAMPLE** button to start sampling; press **SWITCH** button to switch standards; press **CONTROL** button to display the pneumatic button, press **PRESSURE** button to put the pressure pump on; press **VACUUM** button to put the vacuum pump on; press **EXHAUST** to exhaust the pressure or vacuum in the dome; press **PAUSE** button to stop the pump and remain the pressure or vacuum; press **ESC** button to return to the main menu.



After the measurement, the LCD will display measurement completed menu. In this menu, the measurement data can be view、save and print. Press **CON.** button to start a new

measurement; press **VIEW** button to view the data; press the **SAVE** button to save the data; press the **PRINT** button to display the Print menu; press **CONTROL** button for pressure、vacuum and other operations; press the **ESC** button to return to the main menu

7.5.3 Data View



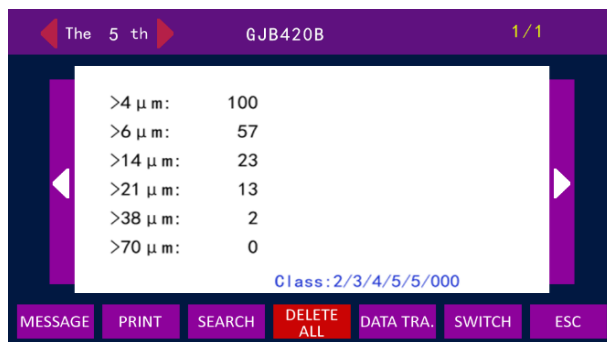
In the measurement completed menu, press **VIEW** button to display the Data View menu. In this menu the measurement data can be viewed. In the manual measurement mode, the data can

be deleted. Press **LAST** button to view the last datum; Press **NEXT** to view the next datum; Press **DELETE** button to delete datum(Note: in the auto measurement ,data cannot be deleted); Press **ESC** button to return the last menu.

7.6 Data

In main menu press **DATA** button to display the saved data Menu. The data which be saved in measurement can be view and print in this menu.

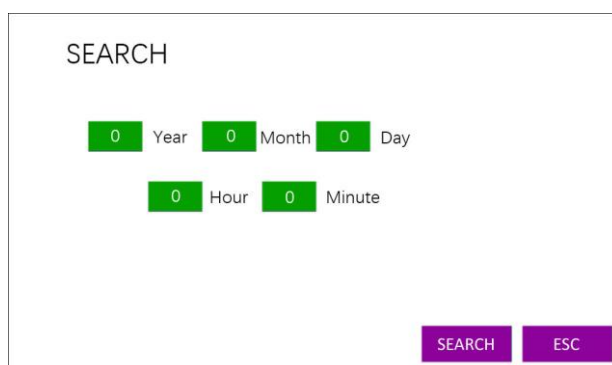
7.6.1 Saved Data Message View



In saved data menu, press **LAST SET** button to view the last set of data; press **NEXT SET** button to view the next set of data; press **LAST** button to view the last datum in this set data;

Press the **NEXT** button to view the next datum in this set data; Press **MESSAGE** button to view the print contents with this set data; Press **SEARCH** to filter the data with measurement time; Press **PRINT** button to print the viewed data; Press **ESC** button to return to the main menu.

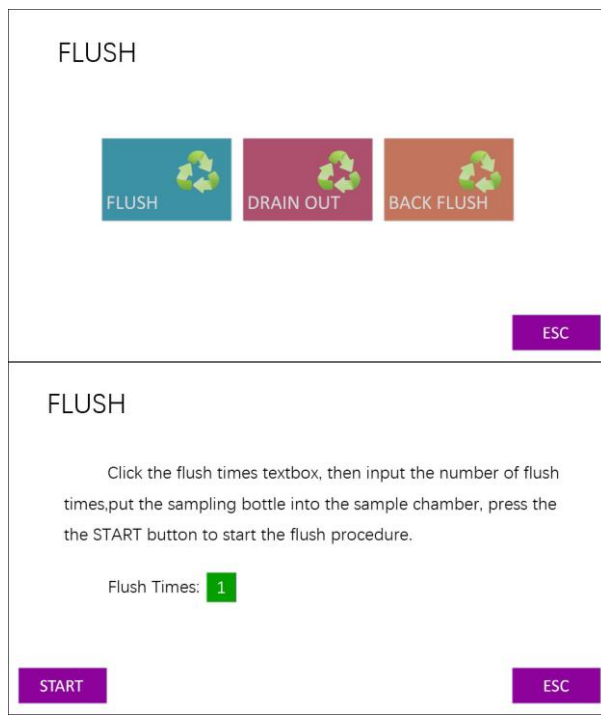
7.6.2 Saved Data Search



In saved data menu, press **SEARCH** button to display the saved data search menu. In this menu, press the textbox to edit the measurement time want to search. Press **SEARCH** button to filter the saved data, the

filtered data will be displayed, can be viewed and print.

7.7 Flush Menu



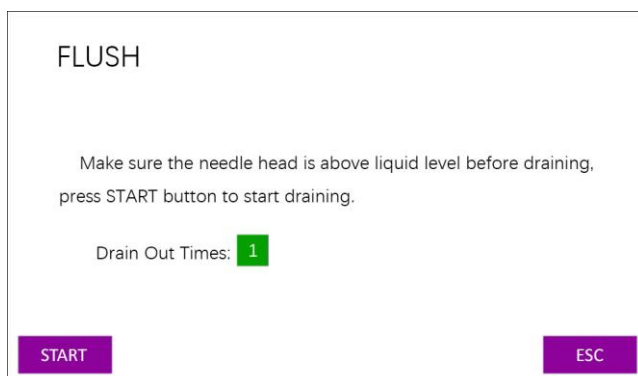
In the main menu press **FLUSH** button to display the flush menu. In this menu the Flush, Drain Out and Back Flush can be operated. This is very important to the maintenance of the instrument.

7.7.1 Flush

In this menu the Flush, press

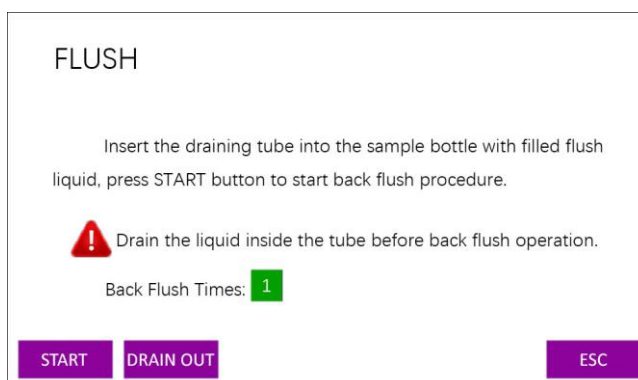
FLUSH button to display the Flush menu. In this menu, press **START** button, the instrument will be flushed according to the set flushing times; press **ESC** button to return the main menu. During the procedure of the auto flush, press **END** button to stop this flush operation.

7.7.3 Drain Out



In the drain out menu, press **START** button to start the draining operation; press **ESC** button to return to the main menu. During the procedure of draining, press **END** button to end the drain out.

7.7.4 Back Flush



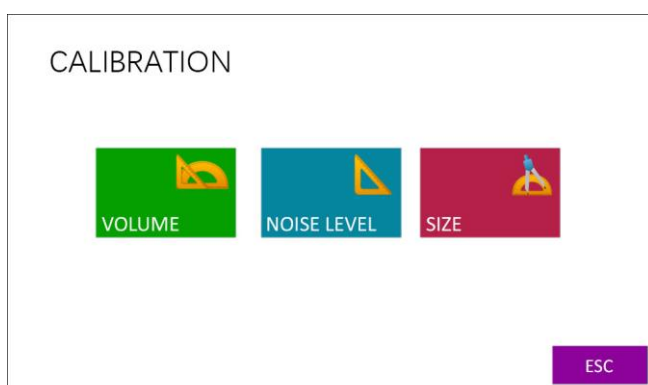
Caution! Before the back flush, the drain out operation must be done to ensure the sample tubes are empty.

In the back flush menu, press **START** button to start the

back flush procedure; press **ESC** button to return to the main menu.

During the back flush procedure, press **END** button to complete the operation.

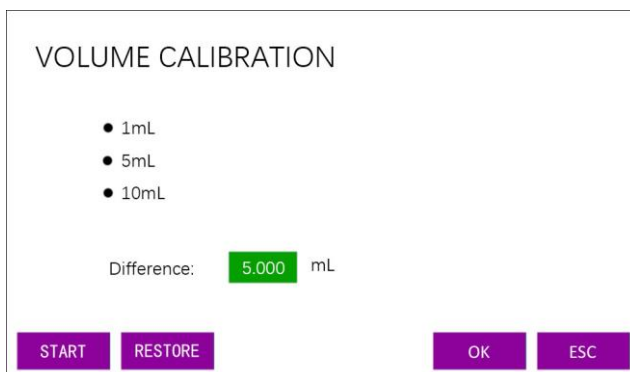
7.8 Calibration



In main menu press **CALIBRATION** button to display the Calibration Menu. Volume calibration, noise level calibration and size calibration can be carried out. Click the corresponding

button to enter the corresponding interface.

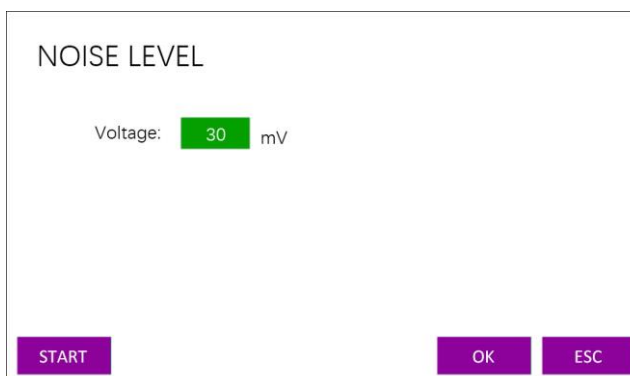
7.8.1 Volume Calibration



In Calibration main menu, press **VOLUME** button to display the Volume Calibration menu. In this menu, press **RESTORE** button restore the sampled data to a preset value; you can also directly

input the volume difference and click **OK** button for volume calibration.

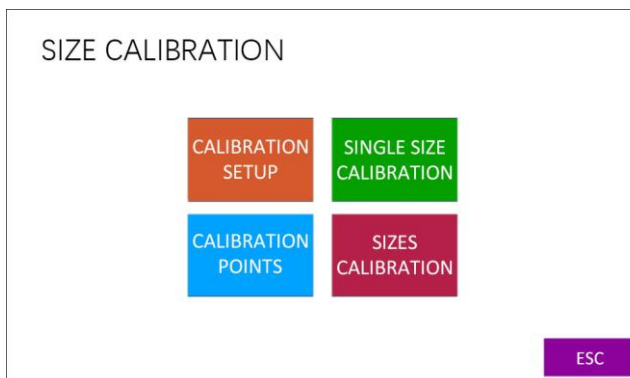
7.8.2 Noise Level



In Calibration main menu, press **NOISE LEVEL** button to display the Noise Level menu. Press **START** button to start Noise Level. Fill the sensor with clean and non-flowing liquid, start the

instrument to count 60s, adjust the threshold level until the measured value meets the range, then the threshold level is the noise level of the instrument.

7.8.3 Size Calibration



In Calibration main menu, press **SIZE** button to display the SIZE CALIBRATION menu. There are three calibration curves inside the instrument, which can be calibrated separately. Each

curve can be calibrated single-size calibration, multi-size, calibration and view

calibration data.

8 Making a measurement

8.1 Preparing the oil sample

Use suitable methods like shaking of the sample, ultrasonic treatment, etc., to reach a homogeneous sample liquid, make sure that there are no air bubbles left in sample, since they were counted as particles, which will cause false results.

8.2 making a measurement

- a. Power the instrument.
- b. Use the suitable rinsing agent for the instrument, flush the instrument according to 5.4 Flush Menu.
- c. Operate the dome to put the sample in it.
- c. Set up the measurement parameters such as volume, repetition, measurement mode (auto or manual), pressure pump on time, vacuum pump on time, with the first datum and so on.
- d. In main menu, press **MEASUREMENT** button to display measurement menu. Press **SAMPLE** button to making a measurement. When the measurement is done, the data can be viewed, printed, saved and transmitted by RS232 port.
- e. When the measurement complete, flush the instrument immediately with petroleum ether.
- f. Power off the instrument or make further measurements.

9 Maintenance

9.1 Sensor removal

When the instrument give out the false results, the sensor blocking can be take into consider.

When the block is exist, flush the instrument with flush liquids times. If the problem cannot be saved, the operation of remove the sensor can be done. Then Use suitable tools to clean the blocked sensor. The procedure of sensor removal is as followed:

- a. Flush the instrument times and drain out.
- b. Open the up lid of the instrument. Use a screwdriver screw the two retaining screws, then lift up the lid.
- c. Disconnect the data line. Use a screwdriver screw the retaining screw to off the data line
- d. Remove the top joint of the sensor. A hand hold on the sensor, the other hand use a spanner to unlock the joint anticlockwise.
- e. Remove the sensor. A hand hold the sensor, the other hand use the spanner to unlock the lower end joint.

9.2 Replace the filter

9.2.1 Air filter combined drain out

When the instrument in a certain period of time, especially in the air humidity of the environment, air filter combination will may be the remnants of a certain amount of water,. Through the observation window back of the instrument to see whether it need to drain out.

When the drain out operation is needed, firstly, exhaust the pressure or vacuum in the dome ,then power off the instrument .

Secondly, Use the screwdriver unlock the retaining screw of view window, put a vessel in the lower end of the air filter .

Thirdly, screw the black lid to draining (Note: 1,make sure there are no water leakage into the inside of instrument ;2, After the drain out operation ,screw the black lid tightly to avoid leakage.)

9.2.2 Replace the dryer

Firstly, remove the back panel of the instrument.

Secondly, screw the retaining screw of the drying cylinder, pull off the pressure tube on the drying cylinder, then screw off the seal lid in the other side. Replace the dryer, then screw the seal lid and the pressure tube. Screw the drying cylinder tightly use the screwdriver. Finally, fix up the back panel of the instrument.

9.2.3 Replace the filtration module

When the pressure pump inefficiency, replace the filtration module should be considered. The procedure is as followed:

Firstly, remove the back panel of the instrument use the screwdriver.

Secondly, pull off the pressure tube of filtration module, then screw the retaining screw of filter, replace the filter.

Thirdly, install the filtration module with the reverse procedure.(note: when replacing the filter, make sure the both two O ring be placed in the middle)

8 Troubleshooting

	Cause	Remedy
Occurring of high counts especially in bigger size channels	Air bubbles at the sample point or in the beaker.	Do the right procedure of preparing the sample
There is no flow through the system, high counts in channels	The sensor is dirty/block can be considered	Do the Back flush operation to clean the sensor
Occurring of high counts especially in smaller size channels	There is humidity in the sample, the sample looks cloudy	Please contact Tianhe to check if a measurement of this sample is possible
The flow rate is reduced, air bubbles are entrained	The viscosity of the sample is too high	Dilute the sample with an appropriate liquid
No counts	The oil is too dark/too dirty. The laser light can't pass the sample cell	Dilute the oil with an appropriate liquid

Appendix A Cleanliness Class

GJB420B-2006 (Particles/100ml)

Size code	A	B	C	D	E	F
Size	>1 μ m	>5 μ m	>15 μ m	>25 μ m	>55 μ m	>100 μ m
	>4 μ m _(c)	>6 μ m _(c)	>14 μ m _(c)	>21 μ m _(c)	>38 μ m _(c)	>70 μ m _(c)
000	195	76	14	3	1	0
00	390	152	27	5	1	0
0	780	304	54	10	2	0
1	1560	609	109	20	4	1
2	3120	1220	217	39	7	1
3	6250	2430	432	76	13	2
4	12500	4860	864	152	26	4
5	25000	9730	1730	306	53	8
6	50000	19500	3460	612	106	16
7	100000	38900	6920	1220	212	32
8	200000	77900	13900	2450	424	64
9	400000	156000	27700	4900	848	128
10	800000	311000	55400	9800	1700	256
11	1600000	623000	111000	19600	3390	512
12	3200000	1250000	222000	39200	6780	1020

SAE4059E (Particles/100ml)

等级	>1 μ m	>5 μ m	>15 μ m	>25 μ m	>50 μ m	>100 μ m
	>4 μ m _(c)	>6 μ m _(c)	>14 μ m _(c)	>21 μ m _(c)	>38 μ m _(c)	>70 μ m _(c)
000	195	76	14	3	1	0
00	390	152	27	5	1	0
0	780	304	54	10	2	0
1	1560	609	109	20	4	1
2	3120	1217	217	39	7	1
3	6250	2432	432	76	13	2
4	12500	4864	864	152	26	4
5	25000	9731	1731	306	53	8
6	50000	19462	3462	612	106	16
7	100000	38924	6924	1224	212	32
8	200000	77849	13849	2449	424	64
9	400000	155698	27698	4898	848	128
10	800000	311396	55396	9796	1696	256
11	1600000	622792	110792	19592	3392	512
12	3200000	1245584	221584	39184	6784	1024

ISO4406

/ml		Code
Greater than	Less than or equal to	
2500000		>28
1300000	2500000	28
640000	1300000	27
320000	640000	26
160000	320000	25
80000	160000	24
40000	80000	23
20000	40000	22
10000	20000	21
5000	10000	20
2500	5000	19
1300	2500	18
640	1300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8
0.64	1.3	7
0.32	0.64	6
0.16	0.32	5
0.08	0.16	4
0.04	0.08	3
0.02	0.04	2
0.01	0.02	1
0.00	0.01	0

NAS1638 (Particles/100ml)

Cleanliness Class	Size/ μm				
	5-15	15-25	25-50	50-100	>100
00	125	22	4	1	0
0	250	44	8	2	0
1	500	89	16	3	1
2	1000	178	32	6	1
3	2000	350	63	11	2
4	4000	712	126	22	4
5	8000	1425	253	45	8
6	16000	2850	506	90	16
7	32000	5700	1012	180	32
8	64000	11400	2025	360	64
9	128000	22800	4050	720	128
10	256000	45600	8100	1440	256
11	512000	91200	16200	2880	512
12	1024000	182400	32400	5760	1024

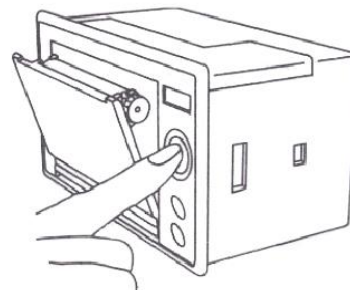
Γ OCT17216-71

Cleanliness Class	Less than or equal to （Particles/100ml）									Less than %																														
	>0.5-1	>1-2	>2-5	>5-10	>10-25	>25-50	>50-100	>100-200																																
00	800	400	32	8	4	1		A.O	A.O																															
0	1600	800	63	16	8	2																																		
1		1600	125	32	16	3																																		
2				250	63	32	4	1																																
3						125	63	6		2																														
4								250		125	12	3																												
5										500	250	25	4	1																										
6												1000	500	50	6	2	1	0.0002																						
7														2000	1000	100	12	4	2	0.0002																				
8																4000	2000	200	25	6	3	0.0004																		
9																		8000	4000	400	50	12	4	0.0006																
10																				16000	8000	800	100	25	5	0.0008														
11																						31500	16000	1600	200	50	10	0.0016												
12																								63000	31500	3150	400	100	20	0.0032										
13																											63000	6300	800	200	40	0.005								
14																														125000	12500	1600	400	80	0.008					
15																																	25000	31500	800	160	0.016			
16																																				50000	63000	1600	315	0.032
17																																							125000	3150

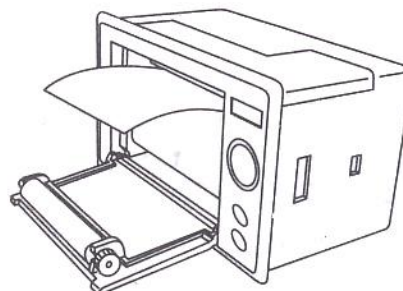
Appendix B Changing Printer Thermo Paper Roll

The procedure is as followed:

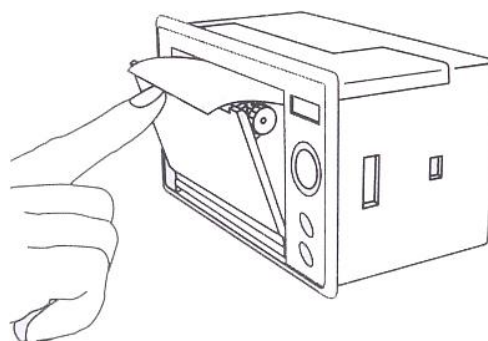
1. Press the open-door button to open the printer's door. Take out the rest paper roll.



2. Changing the new paper roll followed the right picture. Be caution! Take note of the right direction, otherwise the paper will not be printed.



3. Close the printer's door as the picture showed. Note: before close the door, make sure the paper out of the door a little, then the printer will print correctly.



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