Benchtop Particle Counter

LWT-3

Product Operation manual

Shanghai LUWATECH Industrial Co,.LTD

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1 Description

The Oil Particle Counter(LWT-3) 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

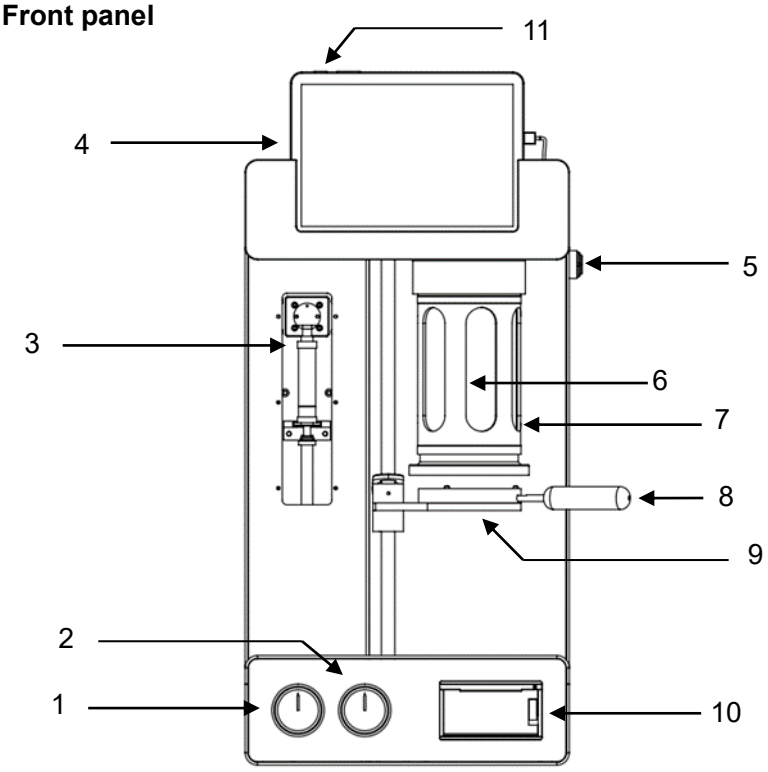
Size range	0.8μm～600μm
Number of channel	64 channels(the number of channels can be edited simultaneously), size can be set free（in the range of selected curve）
Sampling volume	0.2ml-6000ml
Sampling speed	5ml/min～80ml/min
Resolution	≤10%
Coincidence deviation limit	12000～40000 粒/ml
Maximum pressure	0.8Mpa
Maximum vacuum	-0.08Mpa
Data output	printer
Power supply	AC220V±10%; 50Hz; ≤200W
Ambient Temperature	0～60℃

3 Instrument Structure

3.1 System composition

The LWT-3 is composed by the instrument and a pump.

3.2 Front panel



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

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

3. High pressure precision syringe: Sampling device.

4. Tablet: Built-in instrument control software to realize the operation of the instrument.

5. Emergency pressure relief button: Release the pressure in the dome when emergency. (Note：Beside the instrument)

6. Sampling needle: Used by sampling.

7. Dome：Place the liquid under Test. Sealed with the pressure or vacuum.

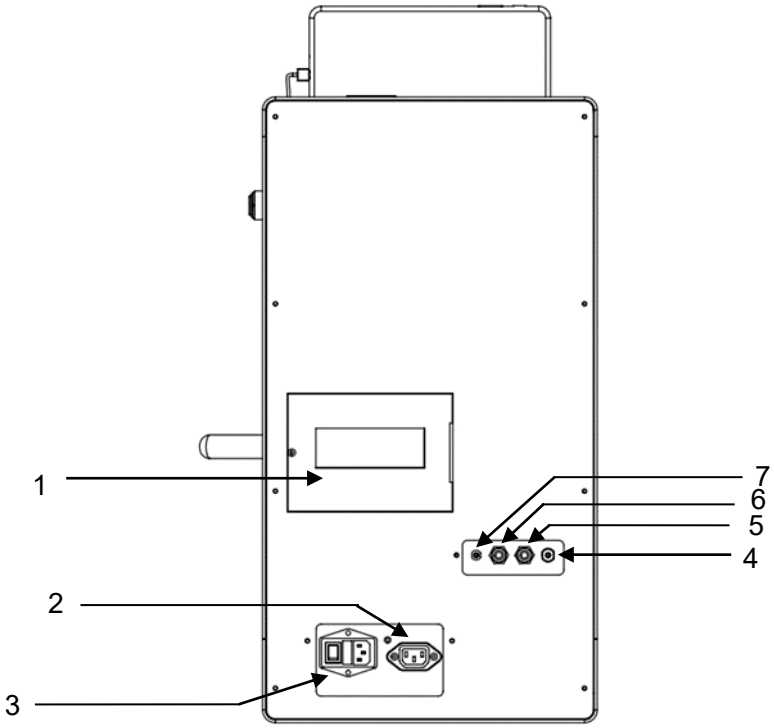
8. Handle: Operation dome open and close.

9. Inspection desk: To place the sample during the test.

10. Printer：Built-in micro printer, print the test data.

11. Tablet switch: Long press this button to open the tablet.

3.3 Back panel



1. Observation window：Built-in filter combination, you can observe whether the filter combination needs to carry out drainage operation
2. Pump input voltage：Connect pump for power supply.
3. Input voltage & switch: Connect with the power and turn on the power switch.
4. Outlet of liquid drain tubing: connect with the drain tubing.
5. Outlet of pressure tubing: Connect with the pressure outlet of pump.
6. Outlet of vacuum tubing: Connect with the vacuum outlet of pump.
7. Outlet sewage: Connected with sewage discharge device.

4 Installation

4.1 Installation environment

a. The instrument should be placed in a relatively stable air flow, air dust less environment, and away from the source of electromagnetic interference.

b. The instrument operates at a suitable temperature: 10～35℃, relative humidity: ≤80%.

c. The power supply of the instrument should be in line with AC100-240V. The

grounding terminal of the instrument power socket should have a reliable grounding wire to ensure personal safety and reliable operation of the instrument.

4.2 Connect with pump

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

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

4.3 Install the high pressure 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. Tightening the lock screw at the bottom of the syringe firmly (see figure 3).

Fig1

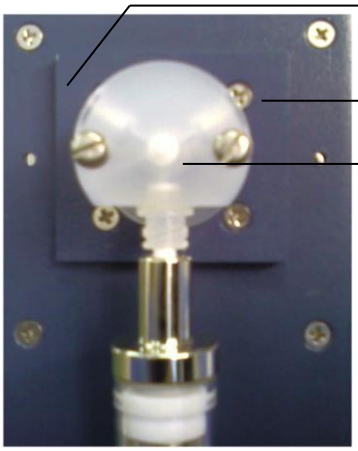


Fig2

Fig3

5 The theory of the instrument

5.1 The theory of sensor

When the sensor works, the liquid sample passes through the sample glass slit from bottom to top due to the principle of negative pressure siphon. After the optical lens parallel the laser beam vertically into the middle of the sample glass slit, and then passes through the horizontal detection slit to the photo diode. If no particles pass through the sample, the photo diode output the maximum constant photo current; At the moment when a particle in the sample passes through the beam, the optical power of the beam incident to the photo diode is reduced due to the blocking of the particle. Therefore, the photo diode outputs a negative pulse current, whose amplitude is proportional to the projection area of the particle in the direction of the beam. This principle is used to inspect the insoluble particles in liquid samples by photo resist method. The principle can be quantitatively calculated by the following formula:

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

I_p —Blocked current(μA)

I_O —Normal current(μA)

A —the area of glass slit(μm^2)

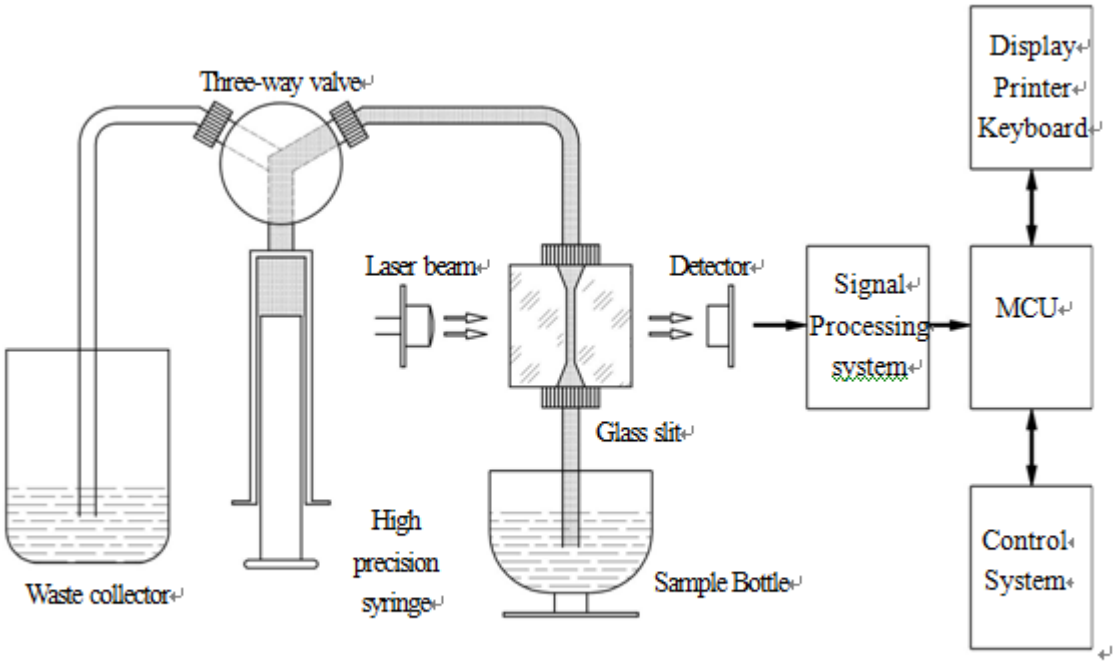
a —the projected area of particle(μm^2)

5.2 The working diagram of instrument

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.

The working diagram of instrument is as followed:



The working diagram of instrument

6 Test operation

1. Power on the instrument and turn on the power switch. The instrument will conduct self-test. After self-test, open the OPC application software in the tablet, display the login interface, and select the corresponding identity account to log in (see **7.1 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 **7.9 Test**).

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 volume, Test speed, pressure value, print format, serial port, 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.

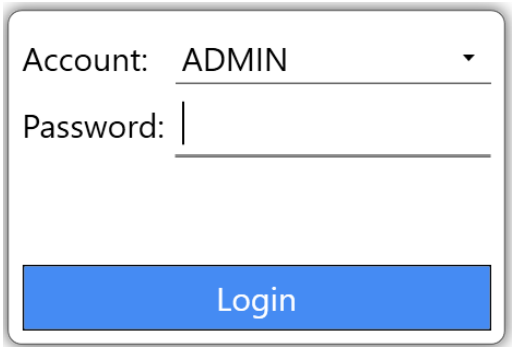
6. Enter the test interface to select the standard test type displayed, and click the Test button to conduct the test. If the test sample is viscous and cannot be tested properly, pressure can be applied to assist the test during the test (see **7.9 Test**).

7. At the end of the test, the previous test data of the current group data can be viewed (see **7.9 Test**); 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 **7.9 Test**). After flushing, test the next sample or shut it down.

7. Instrument Usage

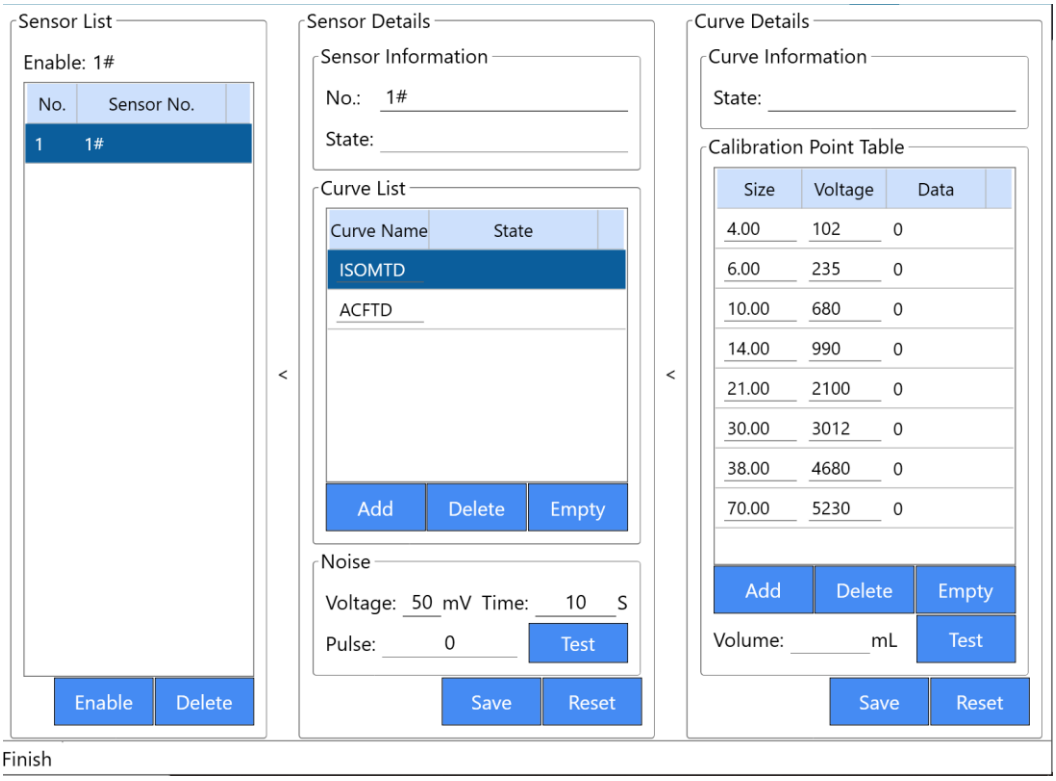
7.1 Log in



After the self-test of the instrument, double-click on the tablet to open the application software "OPC". After the software starts, the login interface will be displayed and the corresponding identity will be selected to log in.

Functions such as adding or subtracting accounts and authority management can be realized through the "Account" function of the software. See details in detail 7.8 Account.

7.2 Sensor Setup



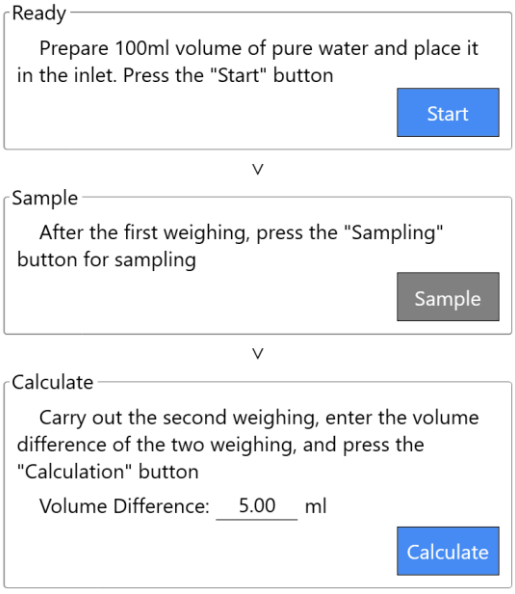
Click the **Sensor Setup** button on the main interface to enter the sensor selection interface. The user can select the appropriate sensor to enable in the “Sensors List”. After enabling the sensor, the user can view the basic information of the sensor in "Sensor Details"; View the calibration curve of the sensor in "Curve List", and click the corresponding curve name to view the detailed calibration point parameters of

the curve in "Curve Details"; In the "Noise" Test bar, you can view and test the noise level of the sensor.

Curve calibration: when the instrument is new or has reached the calibration period, the sensor needs to be calibrated to ensure the accuracy of the test results. Take the calibration 1# sensor ISOMTD curve as an example: In the "Calibration Point Form", each channel diameter after input threshold level, and then place the calibration substance on the sampling platform, click the **Test** button to calibrate sampling (if the Test, not full of calibration material in the pipeline, abandon reshuffle test data, to test), after the test, after each channel diameter data compared with the same volume calibration data in material. When the test data is higher (lower) than the nominal value of the calibrated substance, increase (decrease) the threshold level value of the channel to make the Test data consistent with the nominal value of the calibrated substance. Click **Save** to complete the calibration of the curve. Users can "Add", "Delete", "Empty" and "Reset" the calibration points of the calibration curve.

Note: users are not allowed to calibrate the sensor calibration curve at will!

7.3 Volume calibration



Click the **Volume Calibration** button on the main interface to enter the volume calibration operation interface. Volumetric calibration is carried out in three steps: Ready, Sample and Calculate.

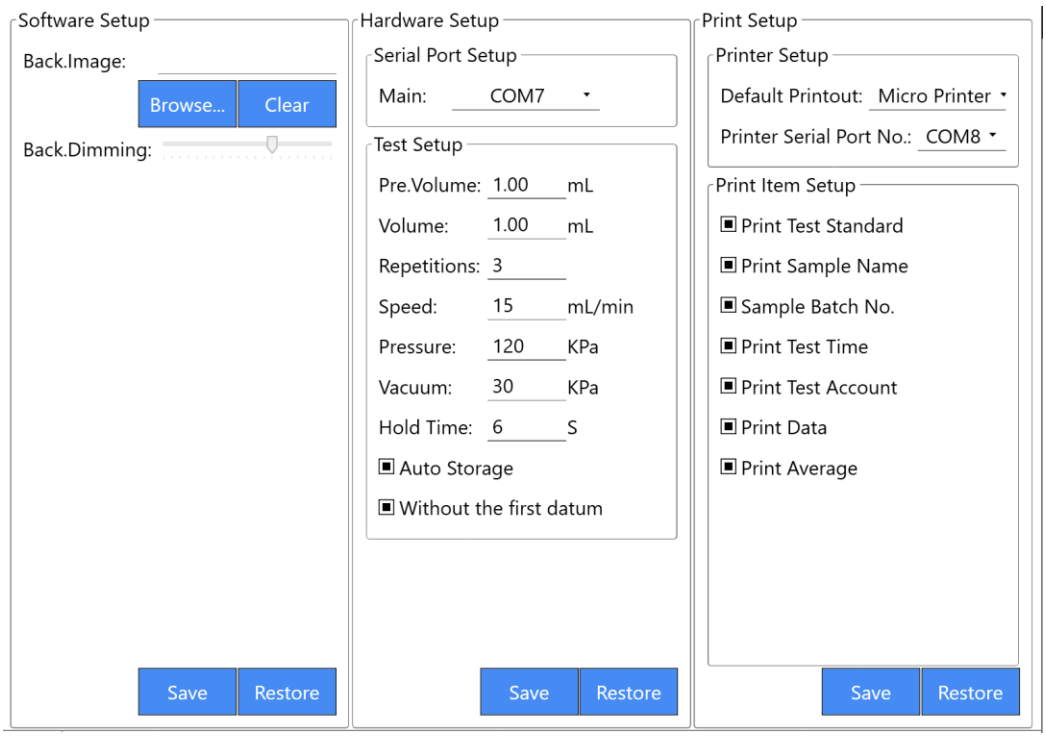
Ready: Take a clean, dry beaker containing about 100ml of purified water (or other calibrated volume solution), making sure that the outer wall of the beaker is free of water droplets. Place the beaker of pure water on the examining table and move the examining table upward so that the needle sinks into the water. Click the **Start** button to sample. After sampling is completed, take off the

beaker and weigh it with a balance, and record the value.

Sample: place the weighed beaker on the inspection table again and click the **Sample** button. After the injection was completed, the beaker was removed again and weighed with a balance, and the value was recorded.

Calculate: Input the difference between the first two weighing values into the input box of "Volume Difference", click the **Calculate** button, and the instrument will automatically complete the volume calibration.

7.4 Setup



Click the **Setup** button on the main interface to enter the setup main interface. You can set software, hardware, Test parameters, print and print items respectively.

In the "Software Setup" function bar, you can customize the software background image and display brightness.

The serial port number used inside the instrument can be changed in the "Serial Port Settings" function bar, and the user does not need to set it. When the user's tablet uses the USB interface to expand, the serial port number should be set accordingly when it changes.

In the "Test Setup" function bar, parameters related to the test can be set accordingly:

Predicted Volume: 0～10.0mL during automatic test, one prediction and set number of test will be carried out;

Test Volume: 0.2～6000.0mL sampling volume will be set;

Test Times: 1～10 times, the test will be conducted according to the set number of Tests;

Test Speed: instrument test sampling speed, 5ml/min ~ 80ml/min;

Pressure: 0～800kPa, automatic test will be pressurize according to the set value;

Vacuum: 0～80kPa, automatic test will be degassing according to the set value;

Vacuum Hold Time: 0～99s, automatic test will be in accordance with the set time to hold vacuum;

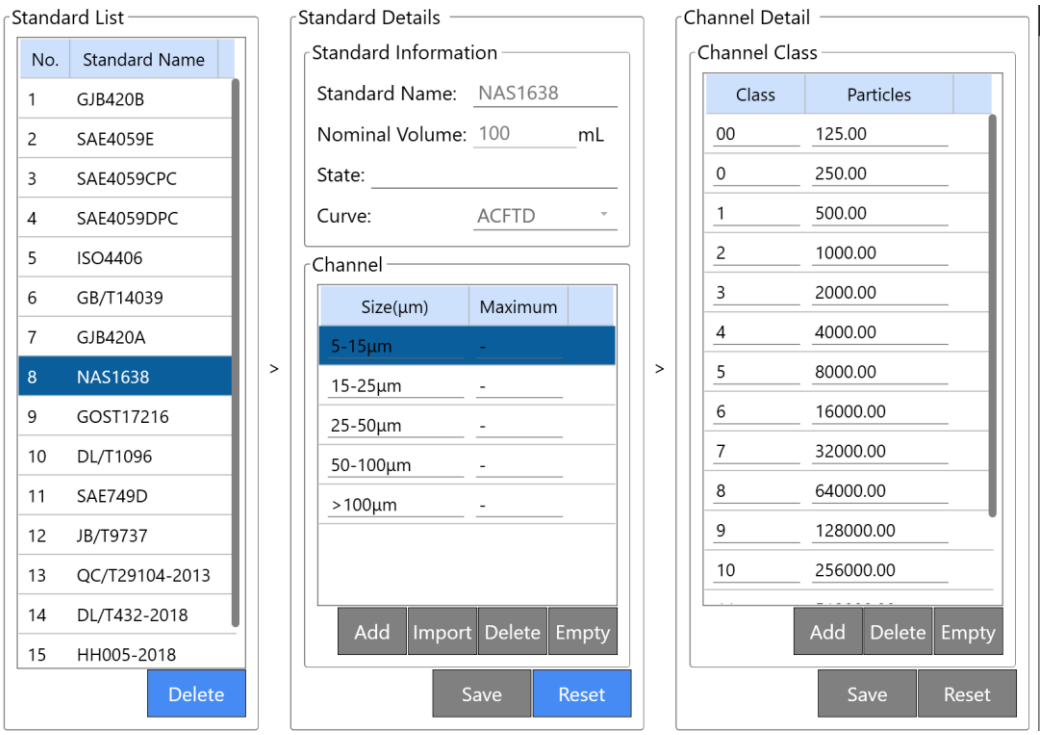
Cancel the first time in average calculation: After the test result is selected, the first-time test data will be automatically discarded when the test result (the number of Tests is greater than 1) is calculated by mean calculation.

In the function bar of "Printer Setup", the user can select the desired printer as the output device to complete the data printing function.

"Print Item Setup", users can select the corresponding item to print output setting according to actual requirements.

"Stir", the user can adjust the stir speed at any time on the main interface.

7.5 Standard

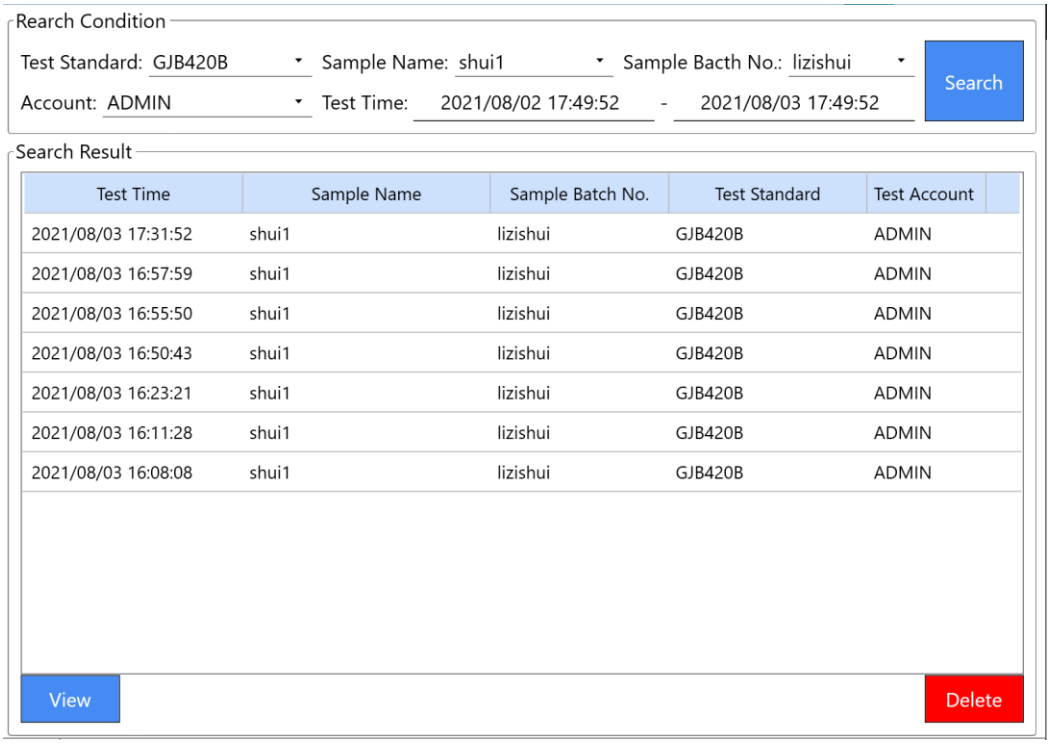


Click the **Standard** button in the main interface to enter the standard selection and view interface. The software has a variety of built-in international and domestic standards to choose from, respectively: GJB420B, SAE4059E, SAE4059F-CPC, SAE4059F-DPC,ISO4406,GB/T14039, GJB420A,NAS1638,GOST17216, DL/T1096, SAE749D, JBT9737, QC/T29104-2013, DL-T432-2018, HH005-2018 and custom tests.

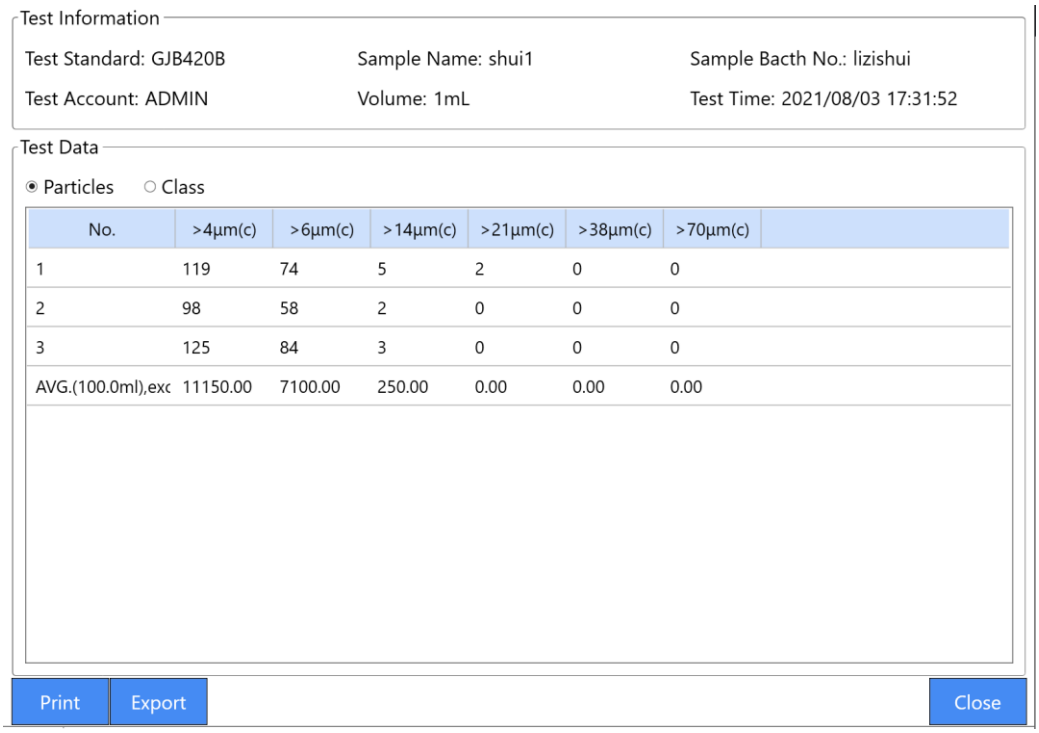
Users can directly click the required standard name, and view the detailed information of the standard in the "Standard Details" and "Channel" on the right side. They can also "Delete", add and delete channels, import new channels and other corresponding operations. Click the corresponding channel in the "Channel" column, and you can view the grading rules of this channel in the standard in the "Channel Details" column on the right.

For the "Custom" standard, the user can Add, Delete, Empty and other operations, fixed standard cannot.

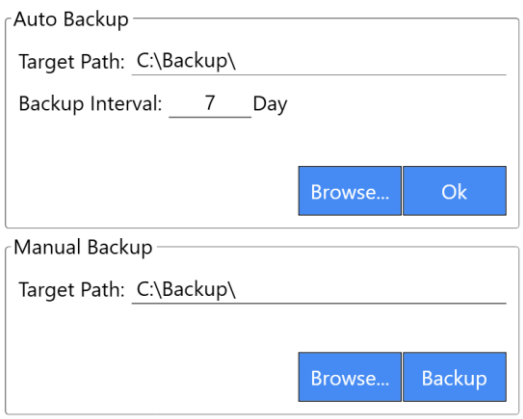
7.6 Search



Click the **Search** button on the main interface to enter the historical data retrieval interface. In this interface, you can retrieve the required historical data by setting retrieval conditions. Click the **View** button on the history data entry to see the set of data details.

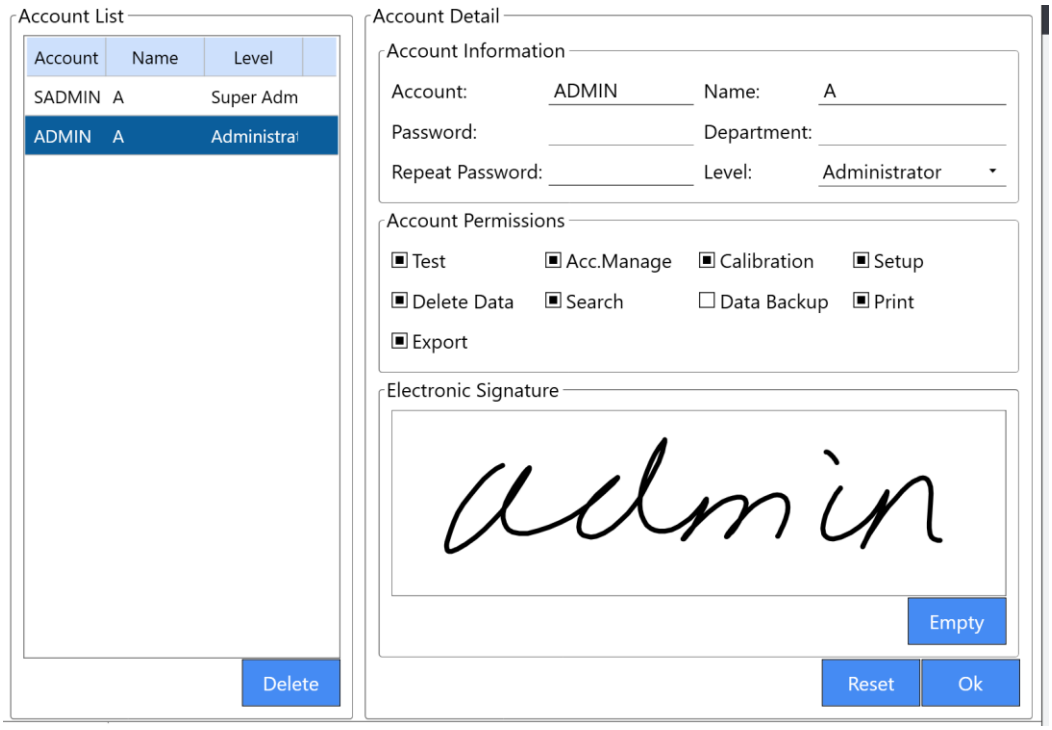


7.7 Backup



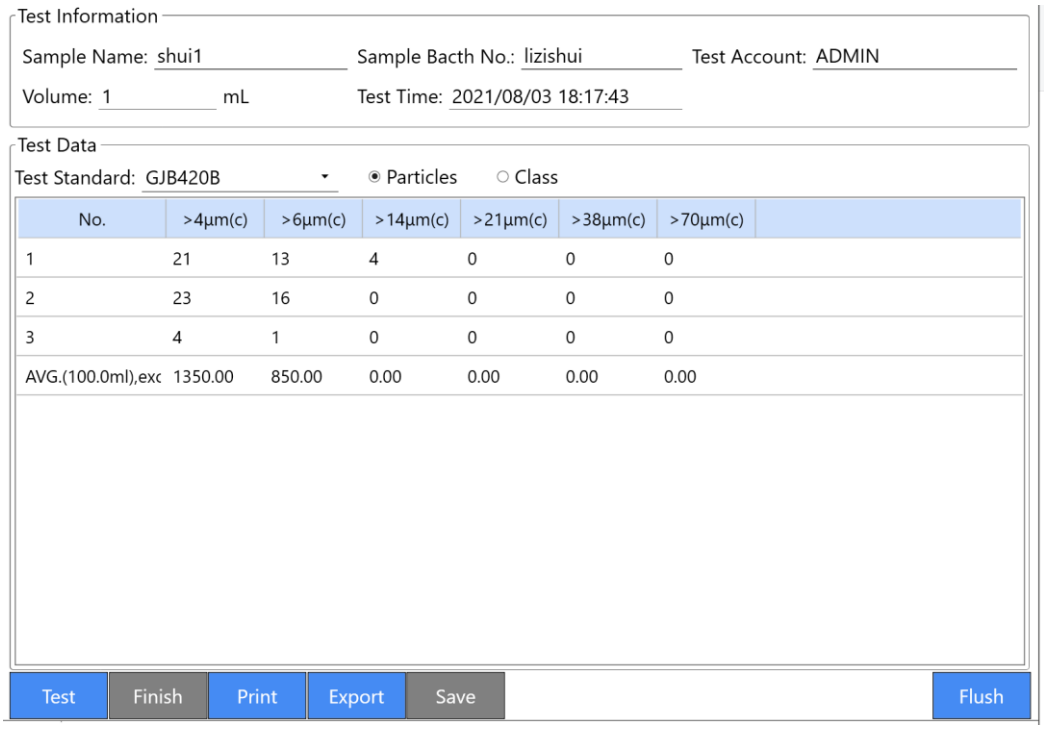
Click the **Backup** button in the main interface to enter the local database backup setting interface. Automatic backup, the software according to the path and time interval, automatic database backup. When manual backup is needed, the database can be backed up directly after the target path is selected.

7.8 Account

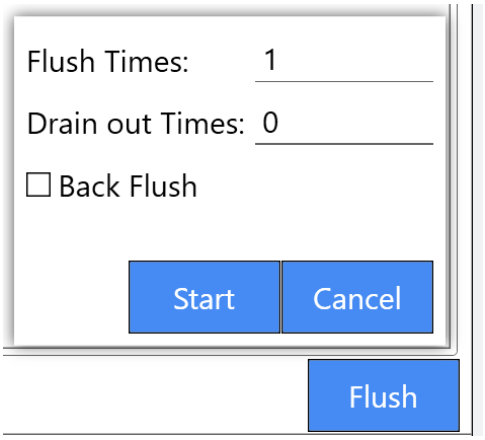


Click the **Account** button in the main interface to enter the account setting management interface. The “Account List” shows all the account names and permission levels in the current software. When you log in as a "Super Administrator", you can "Delete" the account, and you can change the setup of "Account Information", "Account Permissions" and "Electronic Signature" for other accounts. When the account name is new, a new account is automatically created after confirmation. **Other accounts do not have this permission.**

7.9 Test



After logging in the software, click the **Test** button in the main interface to enter the Test interface. The " Test Information" can display the sample name, sample batch number, Test account, Test volume and Test time. In " Test Data", Test Standards can be switched according to requirements. In the test table on the left, the pollution level of each test and the value of each setting parameter can be observed; in the test table on the right, the particle number of each channel can be observed. Test: the instrument will automatically test according to the parameters set. Print: the test data can be printed after the test is completed. Export: the test data can be exported to other locations if required.



Click the **Flush** button to enter the interface of Flushing setup. In this interface, you can set the Flushing Times and whether the Back Flush is needed. After setting, automatic flushing can be carried out.

8 Maintenance

1. The laser sensor assembly shall not be disassembled by itself under any circumstances.

2. Sampling window and casing should be kept clean and dry to prevent corrosion of instrument components and casing.

3. When the instrument is not in use, the power of the instrument should be turned off to extend the service life of the laser components.

4. The high pressure precision syringe should be cleaned regularly to avoid the inaccurate Test volume caused by the pollution of the high pressure precision syringe.

5. The instrument often detects samples with large viscosity or large particle size, which is easy to cause blockage of the injection glass slit, which is shown as: prolonged injection time; In the process of sampling, the speed of sampling is slower than that of the high pressure precision syringe, and a large amount of gas is pumped into the high pressure precision syringe. The data is too large and unstable. The processing methods are as follows:

Back-flush method

Before the reverse flushing, the emptying operation should be carried out first, and the device containing waste liquid should be put into the sampling table, and the drain pipe should be put into the cleaning liquid. In reverse flushing, the cleaning liquid will enter the instrument pipeline through the drain pipe, and the waste liquid will be discharged from the inlet pipe. Reverse flushing shall be performed several times to ensure that piping and slits are clean.

Alternate flush method

Enter the flush interface and enter the number of flush times. At the beginning of flush, remove the sample liquid level from the injection needle and make the air and sample enter the injection glass slit alternately. Repeat several times to eliminate the material blocking the injection glass slit and make it smooth.

Cleaner flush method

Use neutral cleaning agent or other suitable solvent for cleaning. Enter the cleaning interface and enter the number of cleaning times. Clean the glass slit and pipeline for cleaning the remaining samples, oil stains and impurities in the pipeline. Flush the pipeline clean again.

Appendix Ⅰ Sensor Removal

When the instrument count is not normal or the injection is abnormal, consider whether the sensor is blocked. If it is determined to be caused by the blockage of the sensor, it can be flushed with petroleum ether several times. If not excluded, the sensor can be removed and the foreign body in the sensor slit can be blown out with the suction ball. The specific sensor disassembly steps are as follows:

a. Ensure the injection path is clean. When the instrument is turned on, the residual sample is emptied, and then the petroleum ether solution is used for one cleaning operation. Finally, the instrument is emptied and shut down after emptying.

b. Open the cover of the instrument. Remove the screws on both sides of the instrument head with a cross screwdriver, lift the upper cover of the instrument up and rotate it open.

c. Remove data transmission lines. Remove the data line at the end of the sensor with a small screwdriver (cross or word).

d. Remove the upper end connector of the sensor. Hold the sensor in one hand and remove it with the other hand by turning the wrench counterclockwise.

e. Remove the sensor. Hold the sensor with one hand and fasten the lock nut (the nut near the sensor) on the lower end of the sensor with a wrench in the other hand. Rotate counterclockwise to remove the sensor.

Appendix Ⅱ Air Clean Combination Handling

1. Air filtration combination of drainage

When the instrument works for a certain period of time, especially in the environment with high air humidity, there may be some residual moisture in the air filtration combination. Please check whether drainage is needed through the observation window on the rear panel of the instrument. When drainage operation is required, power off the instrument and empty the air in the pressure chamber. Then remove the small cover with the observation window on the rear panel with a cross screwdriver. Put the water collecting vessel at the lower end of the air filtration combination, and then rotate the black knob at the lower end of the air filtration combination counterclockwise to carry out drainage operation. (**Note: a.** Do not leak water into the instrument during drainage; **b.** After drainage, turn the black knob tightly clockwise to prevent air leakage)

2. The replacement of desiccant

When the water content of the compressed air of the instrument is too high, you can consider replacing the molecular sieve desiccant. The specific method: first remove the instrument back panel, and then the fixed ring of the fixed drying cylinder with a cross screwdriver removed, pull out the air pressure tube at one end of the drying cylinder, and then the drying cylinder this end of the sealing cover unscrewed, the internal desiccant poured out for replacement. Finally, the instrument is installed in reverse.

3. The replacement of the filter block

When the instrument is working, if the pressure speed is felt to be significantly slower, it can be considered whether the filter block is blocked and needs to be replaced. The specific method of replacing the filter block: first remove the back panel of the instrument, the pneumatic tube at the outlet end of the hexagonal prism filter is pulled out, and then the filter at the outlet end of the hexagonal prism filter is screwed down with a wrench, and the filter is removed and replaced. Finally, the instrument is installed in reverse. (**Note:** When installing the filter, make sure there are O-rings at both ends of the filter, and make sure the O-rings are centered and flat.)

Appendix Ⅲ Cleanliness Class

GJB420B-2006 (Particles/100ml)

Size code	A	B	C	D	E	F
Size	>1μm	>5μm	>15μm	>25μm	>55μm	>100μm
	>4μm(c)	>6μm(c)	>14μm(c)	>21μm(c)	>38μm(c)	>70μm(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）

Class	>1μm	>5μm	>15μm	>25μm	>50μm	>100μm
	>4μm(c)	>6μm(c)	>14μm(c)	>21μm(c)	>38μm(c)	>70μm(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

Particles /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

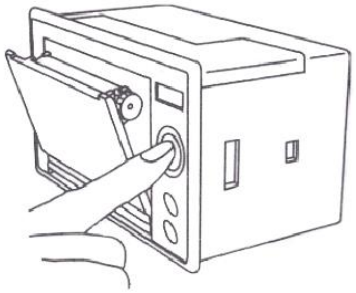
Г ОСТ17216-71

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	630	0.064

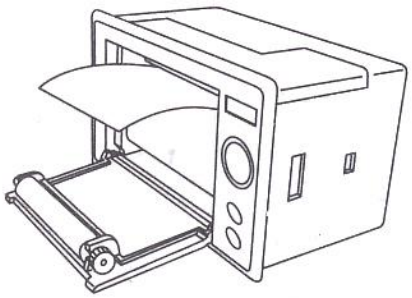
Appendix Ⅳ Changing Printer Thermo Paper Roll

The procedure is as followed:

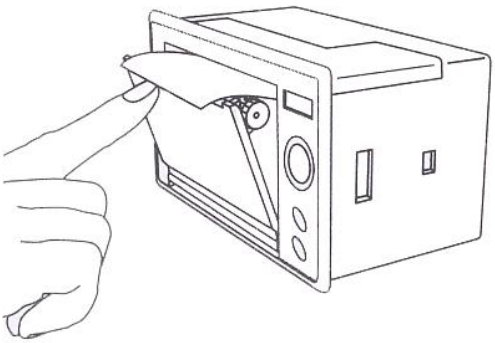
1.Press the open-door button to open the printer's door. Take out the rest paper roll.



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.



ShangHai LUWATECH Industrial Co.,Ltd.
Address：2F, South Gate, Building 5, No. 333 Kangqiao East Road, Pudong New Area, Shanghai
TEL：139173371469 (VX) 021-58073569
E-mail：maorong.long@luowansy.com
http://www.luwatech.com.cn

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