Huazheng®

# HZ1731
# Full Automatic Surface Tension Tester

# User Manual

Huazheng Electric Manufacturing (Baoding) Co., Ltd

Dear user:

Thank you for choosing HZ1731 Full Automatic Surface Tension Tester.

We hope that this instrument can make your work easier and more enjoyable, so that you can get the feeling of office automation in the test and analysis work.

Before using the instrument, please read this manual, and operate and maintain the instrument according to the manual to prolong its service life. "Just a light press, the test will be completed automatically" is the operating characteristics of this instrument.

If you are satisfied with this instrument, please tell your colleagues; if you are not satisfied with this instrument, please call (0312) 6775656 to tell you to serve you at all times-Baoding Huazheng Electric Manufacturing Co., Ltd., our company will definitely make you satisfied!

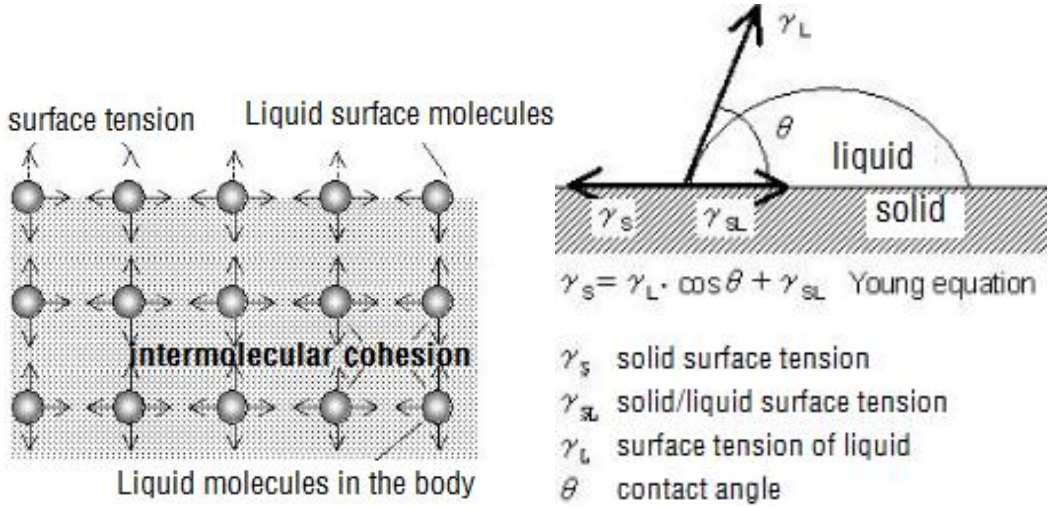
# Contents

# I.Summary

This is HZ1731 full automatic surface tension tester including platinum plate method and platinum ring method produced by . The surface tension is a basic property of liquid, especially surfactant aqueous solution. Can measure the surface tension value of various liquid quickly and accurately with physical method instead of chemical method. It has a wide range of application. It can measure surface tension in hydropower sector to strengthen supervision on the quality of insulating oil; it can measure and analyze the surface tension value of various liquid in petroleum and chemical industry, scientific research and education department.

## 1.1 What is the surface tension

Surface tension is the tension of liquid surface on any boundary line along the surface due to the unbalanced molecular attraction. The resultant force on a molecule by surrounding molecules inside the liquid is 0. However, that on the surface is not zero because attraction on the molecule on the surface by gas phase molecular in the upper space is smaller than that by the internal liquid phase molecule. The resultant force is perpendicular to the liquid inside, resulting in automatic contracting trend in the surface of the liquid and this contraction force is called surface tension.




Molecules inside the liquid are close to each other, maintaining a balanced distance between molecules with attraction on a little farther distance and repulsion on a little closer distance. It makes liquid molecules can only vibrate and rotate near the equilibrium position unlike gas molecules that can diffuse infinitely. Liquid molecules near the surface are only affected significantly by liquid inside. With uneven stress, the molecular in higher velocity can easily escape from liquid and become steam thus resulting in molecule

distribution in the surface layer (a thin liquid layer contacting gas ) is sparser than internal. Intermolecular repulsion in surface layer decreases as the distance between each other increases. Intermolecular attraction prevails in surface layer. Mutual traction of any two parts in surface layer prompts a shrinking trend in surface layer. The liquid surface tends to reduce as much as possible due to the effect of surface tension, so the small droplet in the air is in spherical shape.

## 1.2 Platinum plate method)

When the platinum plate is immersed in the liquid to be measured, the surface tension will occurs around the platinum plate. The surface tension of the liquid will try to pull plate down. When surface tension of the liquid and other related stress are equal to the equilibrium force, the platinum plate will stop. At this time, the balance sensor will measure the immersion depth, and convert it to the liquid surface tension values.

Steps:

(1) Raise the platform;

(2) When the bottom of the platinum plate contacts with the liquid surface, the equilibrium value is measured by the sensor and converted to the surface tension value to display.

## 1.3 Platinum ring method

A circular membrane between testing part and the liquid sample will be formed with this method.

Steps:

(1) Immerse the platinum ring gently into liquid inside.

(2)The platform descends and then a bubble film forms below the platinum ring and eventually leaves it.

(3)The equilibrium value is measured by the sensor and converted to the surface tension value to display.

## 1.4 Comparison

① The platinum plate method measures the change of liquid surface (or interface) tension over time. Platinum plate is always contacting with the liquid to be tested and as long as the liquid surface tension changes, the test value will change. The curve of surface tension over time can be observed with data processing software.

② The platinum plate method can easily measure the surface tension of medium and high viscosity liquid; The platinum ring method requires the ring to ascend and the ring is acted upon surface tension and viscous force in that process.

③ The platinum plate method has high precision. Platinum plate is harder to be deformed than ring. Irregular and uneven round ring may affect test precision.

# II.Instrument Introduction

## 2.1 Technical index

| | |
|---|---|
| Model | HZ1731 |
| Resolution (mN/m) | 0.1 |
| Measure range(mN/m) | 0-1000 |
| Repeatability (mN/m) | 0.1 |
| Accuracy(mN/m) | 0.1 |
| Balance precision(Domestic) | 1/1,000 |
| Weighing system | electromagnetic force balance |
| Test mode | both platinum plate and platinum ring method are provided; |
| Display mode | 5-inch color touch screen |
| Measure mode | touch operation;<br>automatic sample stage lifting; automatic conversion |
| Measure time | 10 secs for Plate Method, 50 secs for Ring |
| Accuracy correction | automatic one provided |
| Option | data processing software |

## 2.2 Function

- Platinum plate method and platinum ring method for wide appliance
- Automatic and intelligent operation and data acquisition minimizing artificial operation error
- Imported key parts(including sensors) making test data in good accuracy and repeatability
- Data automatic generation, storage and printing
- Stable operation with low noise

## 2.3 Preparation

Please make sure the following items have been completed before assembly.

① The lab should be clean at constant room temperature.

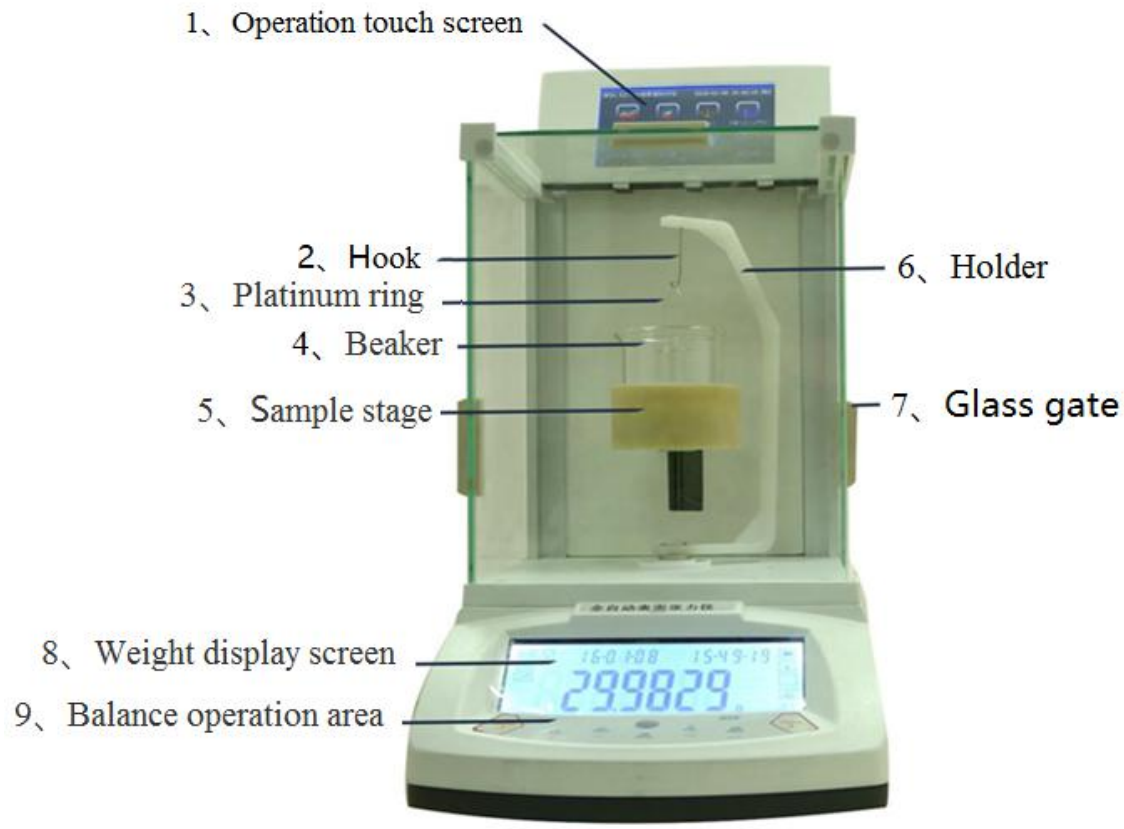
② Make sure water available for apparatus cleaning.

③ Make sure open flames available to burn platinum ring and platinum plate.

④ Install ground socket and plug in 220V power;

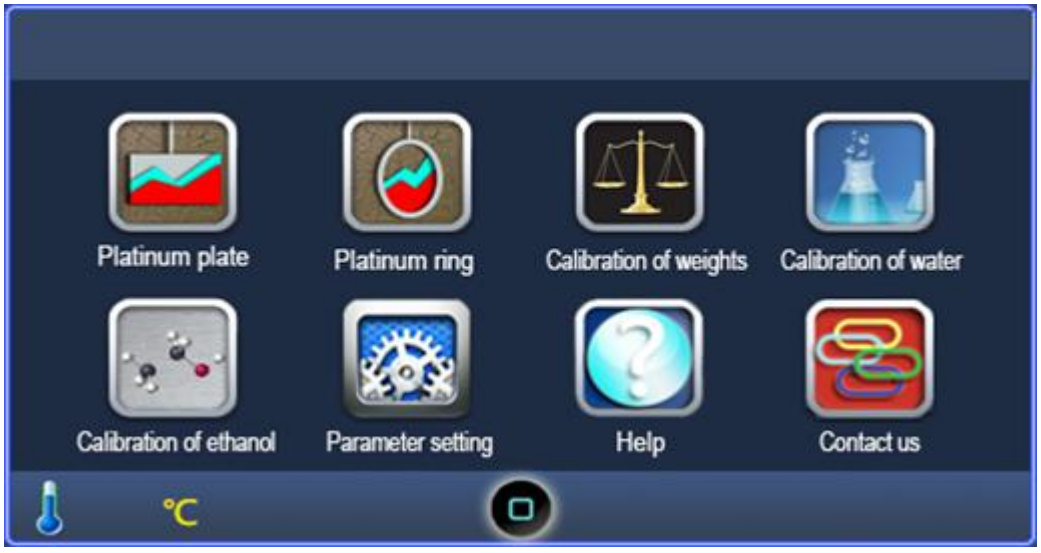
⑤ Check the instrument appearance and let it stand still for 1-2 hours

## 2.4 Instrument panorama

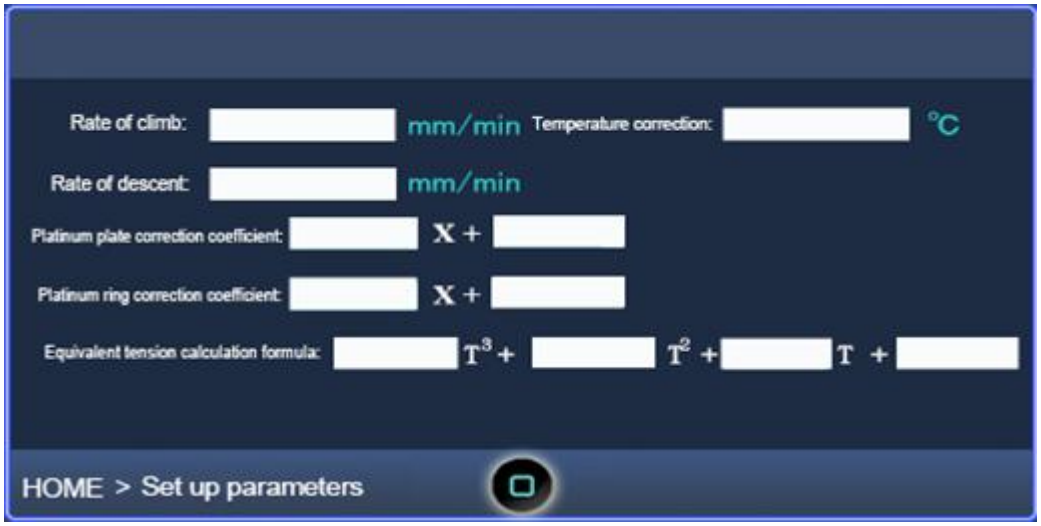



## 2.5 Touch screen

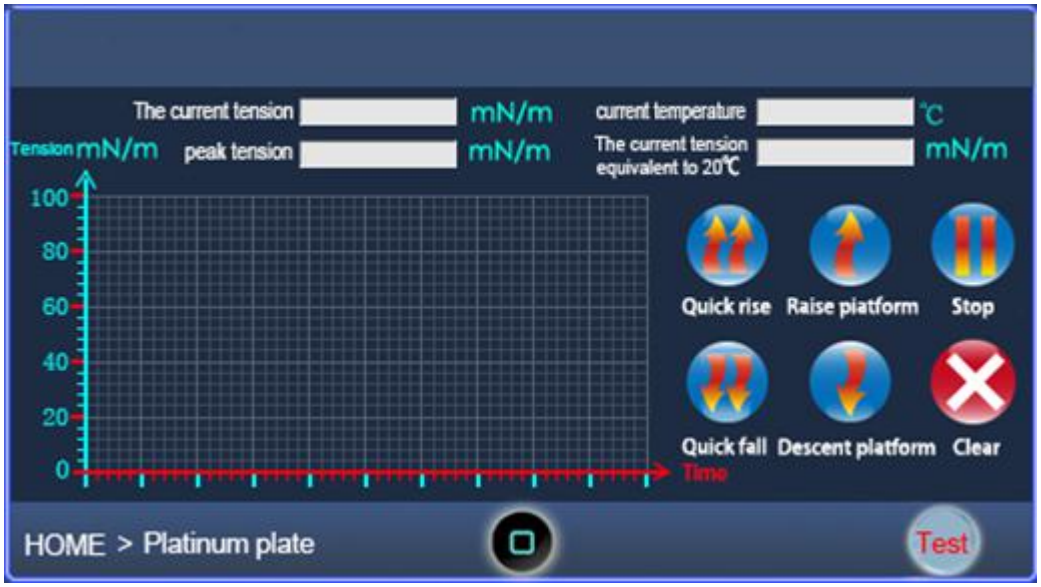
Home




Parameter setting




Testing interface(platinum plate）




## 2.6 Software installation

(Both touch screen and software operation are available in usage of  If do not use software, please ignore this part. But the touch screen can only display the data at a time and can't bring up the history data.)

Preparation: connect the software CD and software dog; connect the power cord with a computer and start up.

① Software installation: Open the installation CD, which contains the  PZ series of surface tension control system, USB serial port driver and CH340 driver (USB serial driver)

SFZL Series Surface Tension Control System Setup.exe

② Driver installation: Select the "USB serial driver", select the suitable driver according to the computer system:


"PL-2303 Driver (Windows 7 32)" for the win 7, 32 bit operating system;

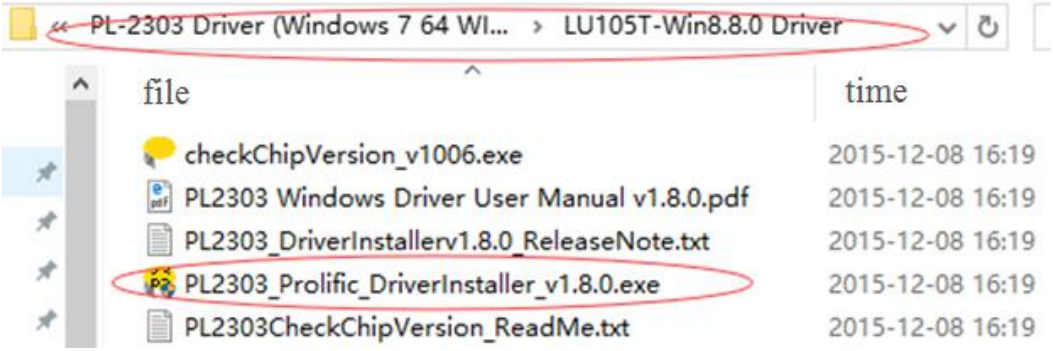
"PL-2303 Driver (Windows 7 64 WIN8)" for the win 7 64 bit /win 8/win 10operating system;

"PL-2303 Driver (Windows 98 2K XP") for the win XP operating system;

“PL-2303 Driver (Windows Vista32)” for the win Vista operating system

When using win 764 /win 8/win 10 operating system, open the “PL-2303 Driver (Windows 764 WIN8)” folder, select the “LU105T-Win8.8.0 Driver” file to install “PL2303_Prolific_DriverInstaller_v1.8.0 ”, and click the next step.

There is a single driver “PL-2303 Driver Installer” in the corresponding folder in other systems.



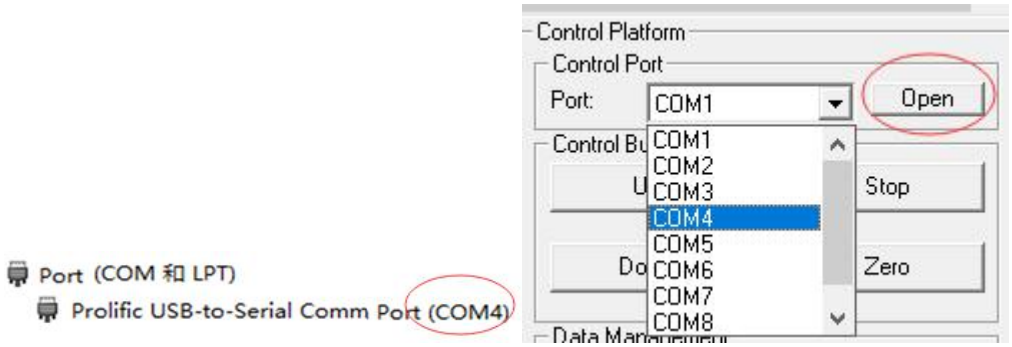

③ CH340 driver (USB serial driver) installation: Double click "CH340 driver (USB serial driver)", select the installation


④ Right click “my computer”, open the device manager, and check the port- if there is a yellow exclamation mark, right click "Prolific USB-to-Serial Comm Port", select "update driver software" and "browse the driver files on the computer" to find the driver in the CD-drive".

If it displays update state as the fig. above, no update is required.

⑤ Select the corresponding port number in the software interface and open it(if it has been opened, ignore this step).

Chose the port com (the port com number in the "device manager": Right click on the "computer", click "device manager" in the "management", chose the "Port"), then click “Open”.




# III.Instrument Operation

If the platinum plate / ring or beaker is not clean, the measured value will have error with poor repeatability, being unstable or having continuous increase or decrease. Please keep clean.

For example, when testing water, if you touch the water with finger the tension value will be smaller, because the finger oil can change surface properties of water. Please keep the platinum plate/ring and beaker clean (ultrasonic cleaning then drying before use).

## 3.1 Instrument calibration

1) Level calibration

Let the device stand still for 1-2 hours, observe whether the calibration bubble on the back is in the middle. If not, there is no level.

Calibration method: turn adjustment knob until the bubble is in the middle of level.

2) Scale calibration

Put on the supporter. When screen is stable, press "TARE" to reset, then it shows “0.0000 g”. Long press "CAL", then "CAL" and *didi* sound shows, flashing 100.0000 g. If it shows 100g when 100-g weight is put, the correction is success (please don’t

touch the weights by hand directly)

**Note**: In correction, long press "MENU" and "CAL", then "CAL" and *didi* sound shows, flashing 20.0000g.put into the 20-g weight and make correction.

3) Temperature calibration

Click "Parameter setting" on the touch screen.

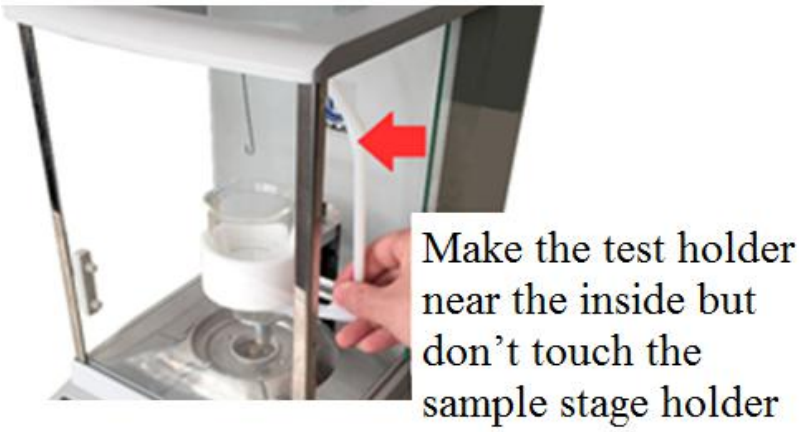


Temp correction = actual room temp- display temp

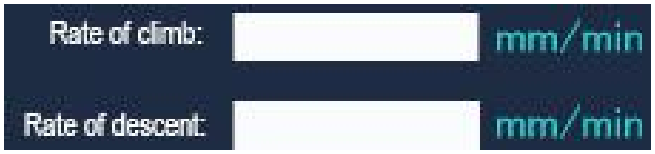
## 3.2 Parameter calculation: platinum ring operation

Calculate parameters with distilled water and high purity ethanol before the test(For example, if distilled water parameters need correction and the sample is ethanol, just replace the test liquid with distilled water in operation steps.)

① Install the holder and make it near the inside, avoiding directly leaning on the connecting rod between sample stage and host.




② Set parameter: Click "Parameter setting", set "Rise speed" "Fall speed". Because liquid membrane tension occurs when sample table falls, fall speed should be slow as far as possible.




③ Clean beaker, then make infiltration: Wash a beaker with distilled water, and make infiltration with test liquid-a little ethanol beaker, and pour it out.

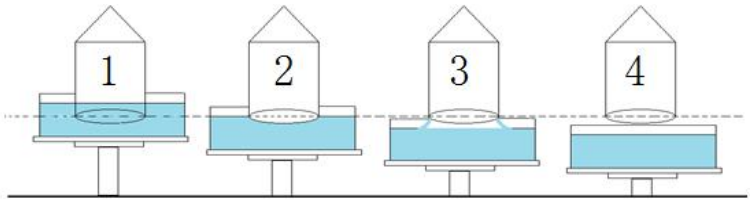
④ Let sample stage go down and put into liquid to be tested: Click "Ring method", "Platform fall" to make platform down to the lowest and stop automatically. Add ethanol into the beaker after infiltration and put the beaker on the platform.

⑤ Burn platinum ring and reset: Gently remove the ring with tweezers (the ring is round; deformation should be avoided), burn it for 20-30 secs to red with alcohol lamp and hung it on the hook. Press "TARE" button on the scales and "Reset" on the touch screen.

⑥ Let sample stage go up. Press "Platform rise". When the ring is emerged in the depth of 3-5 mm into ethanol, press "Platform stop".

⑦ Start measuring: Click the "Test" 

in the "Ring method" interface. Then sample stage began to decline and collect data. When collection is finished, the device stop automatically and the peak tension is the current surface tension value.




⑧ Continue tests. Raise platform directly, repeat steps⑥⑦ until the data is generally stable(Usually, we take the average value of the third, fourth and fifth experimental data in the current test; several times tests are needed for sample of high viscosity.)

⑨ Repeat tests. Please clean the ring with slowly running clear water before burning (If possible, please use the ultrasonic water.) to prevent the ring from being destroyed by material difficult to burn in the liquid to be tested. Repeat steps⑤⑥⑦⑧.

⑩ Change the ethanol to distilled water. Repeat steps③④⑤⑥⑦⑧⑨.

## 3.3 Parameter calculation: platinum plate operation

Calculate parameters with distilled water and high purity ethanol before the test (For example, if distilled water parameters need correction and the sample is ethanol, just replace the test liquid with distilled water in operation steps)

① Install the holder and make it near the inside, avoiding directly leaning on the connecting rod between sample stage and host.

Make the test holder near the inside but don't touch the sample stage holder


② Set parameter. Click "Parameter setting", set "Rise speed" "Fall speed". Because liquid membrane tension occurs when sample table falls, fall speed should be slow as far as possible.

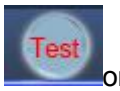
③ Clean beaker and make infiltration. Wash a beaker with distilled water, and make infiltration with test liquid-a little ethanol beaker, and pour it out.

④ Let sample stage go down and put into liquid to be tested. Click "Ring method", "Platform down" to make platform down to the lowest and stop automatically. Add ethanol into the beaker after infiltration and put the beaker on the platform.

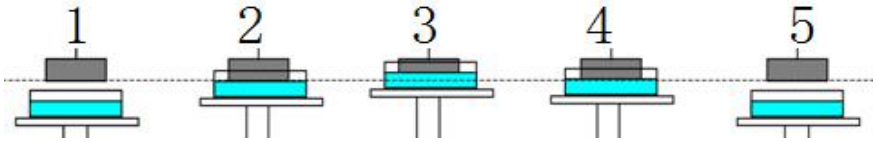
⑤ Burn platinum plate and reset. Light the alcohol lamp. Gently remove the plate (there is a right angle between the plate and the holder; make sure the platinum bottom is on the level) and hold it with tweezers, burn it to red (don't burn the holder; the fire is generally 45 degrees angle to the horizontal) and hang it on the hook gently. Press "TARE" button on

the scales and "Reset" on the touch screen.

⑥ Let sample stage go up. Press "Platform rise" on the touch screen. When the bottom of the platinum plate is 3~5 mm apart from the ethanol liquid level, press the "Platform stop" on the touch screen.

⑦ Start measuring. Click the "Test" 

on the "Platinum plate method" interface. The sample stage began to rise, and collect data, when after the data collection, instrument and automatic stop, the tension is the surface tension value at this time




⑧ Continue tests and repeat step⑥ until the data is basically stable (Usually, we take the average value of the third, fourth and fifth experimental data in the current test; more tests are needed for sample of high viscosity).

⑨ Repeat tests. Please clean the plate with slowly running clear water before burning (If possible, please use the ultrasonic water.) to prevent the plate from being destroyed by material difficult to burn in the liquid to be tested. Repeat steps ⑤⑥⑦.

⑩ Change the ethanol into distilled water and repeat steps ③④⑤⑥⑦⑧.

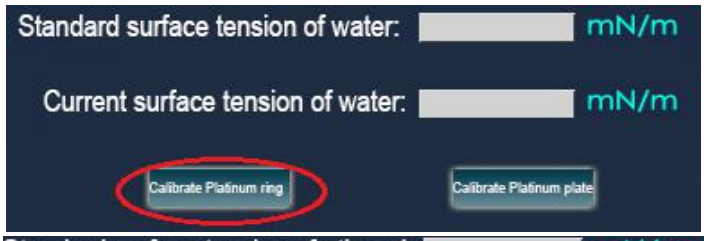
## 3.4 Parameter calculation

Check the *Index Table* 5.2 or 5.3 according to the current temp, enter the ideal and measured tension value of distilled water and ethanol and calculate correction coefficient respectively.

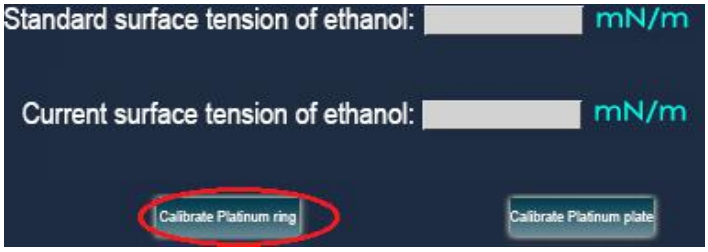
1) Using touch screen

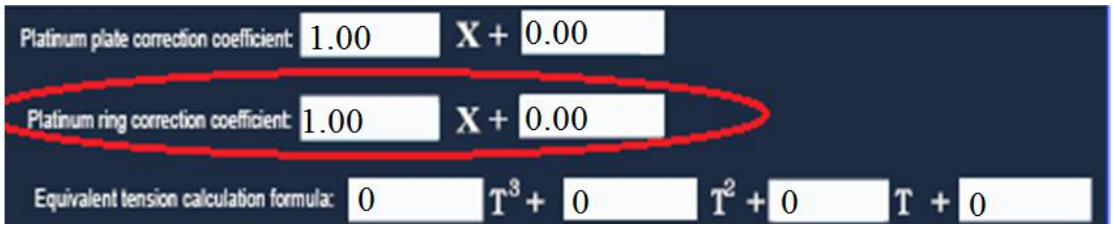
① Click "Calibration of water", input standard and measured values, then click" Ring calibration".

② Click "Calibration of ethanol" , input standard and measured values, then click" Ring calibration".





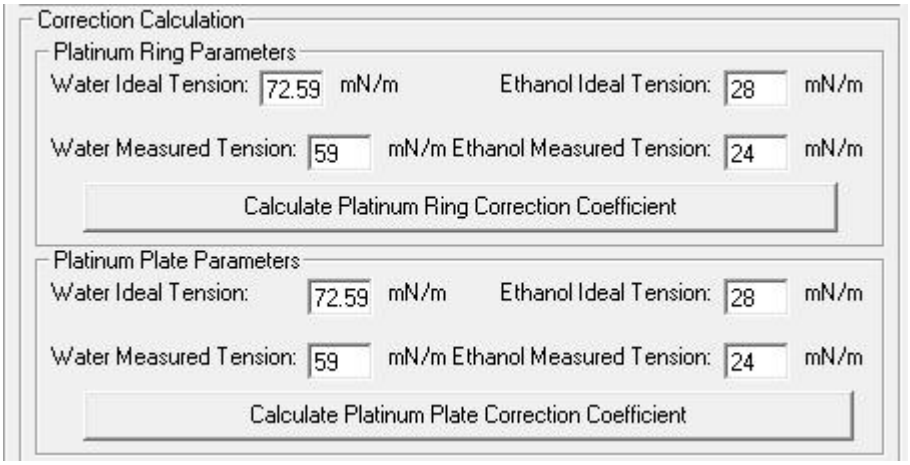




Press "ring correction coefficient" in "set parameter" to calculate the correction data.

Note: with Plate Method, please select "plate correction "to calculate" plate correction coefficient".

2) Using software:

Input the ideal and measured tension value of distilled water and ethanol on the interface and then calculate correction coefficient respectively.




## 3.5 Actual operation

Replace the ethanol or distilled water with the liquid to be tested and repeat the above operation (3.2 for ring or 3.3 for plate)

# IV.Attention

## 4.1 Low / high value

- Platinum plate or ring is not burnt clean (most likely); the beaker is not clean.

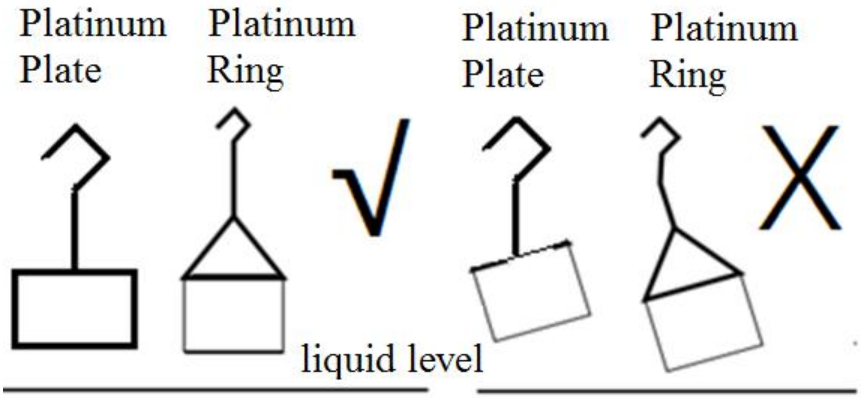
- No return to zero of correction before the experiment; inaccurate reset or no reset after a platinum plate or ring being hanged.
- Sample contamination in wrong operation process
- The characteristic of liquid to be tested is changing with time. The liquid should be stirred evenly with the same ratio and in full rest.
- The wetability of the liquid is not very high, it has viscosity or volatility.

## 4.2 Poor repeatability

- Platinum plate or ring is not clean.
- The characteristic of liquid to be tested is changing with time. The liquid should be stirred evenly with the same ratio and in full rest.

## 4.3 Platinum ring / plate maintenance

To keep the experiment accuracy, please make sure platinum ring is standard round. Please put deformed one back to the container and gently smooth it with tweezers. If the ring is deformed badly or damaged, please buy a new one.




Check whether the platinum ring on the holder is parallel to the liquid level.

# V.Appendix

## 5.1 Surface tension values of some liquid at 20 ℃

Some of the liquid γ (20℃)

| liquid | γ（mN/m） | |
|---|---|---|
| | liquid-steam | water-liquid |
| water | 72.75 | |
| octane | 21.69 | 51.68 |
| dodecane | 25.44 | 52.90 |
| hexane | 27.46 | 53.77 |
| benzene | 28.88 | 35.0 |
| tetrachloromethane | 26.77 | 45.0 |
| octanol | 27.53 | 8.5 |

| | | |
|---|---|---|
| butanol | 24.6 | 1.6 |
| aniline | 42.9 | 5.9 |
| aether | 17.0 | 10.7 |
| ethyl acetate | 23.9 | 3 |
| mercury | 284 | 426 |

## 5.2 Density, viscosity and surface tension in the air interface of water at different temp

| t/℃ | d/(g/cm3) | η/(10-3 Pa.s) | γ/(mN/m) |
|---|---|---|---|
| 0 | 0.99987 | 1.787 | 75.64 |
| 5 | 0.99999 | 1.519 | 74.92 |
| 10 | 0.99973 | 1.307 | 74.22 |
| 11 | 0.99963 | 1.271 | 74.07 |
| 12 | 0.99952 | 1.235 | 73.93 |
| 13 | 0.99940 | 1.202 | 73.78 |
| 14 | 0.99927 | 1.169 | 73.64 |
| 15 | 0.99913 | 1.139 | 73.49 |
| 16 | 0.99897 | 1.109 | 73.34 |
| 17 | 0.99880 | 1.081 | 73.19 |
| 18 | 0.99862 | 1.053 | 73.05 |
| 19 | 0.99843 | 1.027 | 72.90 |
| 20 | 0.99823 | 1.002 | 72.75 |
| 21 | 0.99802 | 0.9779 | 72.59 |
| 22 | 0.99780 | 0.9548 | 72.44 |
| 23 | 0.99756 | 0.9325 | 72.28 |
| 24 | 0.99732 | 0.9111 | 72.13 |
| 25 | 0.99707 | 0.8904 | 71.97 |
| 26 | 0.99681 | 0.8705 | 71.82 |
| 27 | 0.99654 | 0.8513 | 71.66 |
| 28 | 0.99626 | 0.8327 | 71.50 |
| 29 | 0.99597 | 0.8148 | 71.35 |
| 30 | 0.99567 | 0.7975 | 71.18 |
| 40 | 0.99224 | 0.6529 | 69.56 |
| 50 | 0.98807 | 0.5468 | 67.91 |
| 60 | 0.96534 | 0.3147 | 60.75 |

## 5.3 Density, viscosity and surface tension in the air interface of ethanol at different temp

| t/℃ | d/(g/cm3) | η/(10-3Pa.s) | γ/(mN/m) |
|---|---|---|---|
| 20 | 0.795 | 1.18 | 22.3 |
| 30 | 0.785 | 0.97 | 21.2 |
| 40 | 0.777 | 0.82 | 20.4 |
| 50 | 0.765 | 0.69 | 19.8 |
| 60 | 0.755 | 0.58 | 18.8 |
| 70 | 0.746 | 0.505 | 18 |
| 80 | 0.735 | 0.44 | 17.15 |
| 90 | 0.73 | 0.38 | 16.2 |
| 100 | 0.716 | 0.34 | 15.2 |