

Version

6.0

Surface & Electro-Optics Corporation

Released 2014. 05

DST 30 Series
Surface Tension Meter

Administrative
Guide

Surface & Electro-Optics Corporation

Administrative Guide

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Registration of SEO Series

Model	DST 30 Series
Input Serial Number	
Date of P/O	
Manufacture	S.E.O. Co. Ltd
Warranty	1 year

Registration of Software

Measurement Method	Du Noüy Ring, Wilhelmy Plate
Measuring Range	0 to 500 dynes / cm
Balance Capacity	210 grams
Balance Accuracy	1 mg
Sample Stage Operation	Precise manual stage
Power Supply	110 to 220 VAC
Dimension	200 mm x 250 mm x 310 mm

For safe and effective use

It is recommended that you read this manual carefully to guarantee correct installation of the system and to speed up introduction to the system. It also helps to avoid misuse, which could lead to damaging the system.

In this operation manual, warning points are indicated with the following symbols to prevent operators from injuries and the instrument from damage.

SEO uses its accumulated design and production experience to deliver advanced surface analysis products that offer superior performance and enhanced durability. Complete customer satisfaction through product quality is our goal.



Symbol	Meaning
	Indicates a situation of potential injury to humans and damage to the instrument if operations against the contents are done. Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates potential electric shock.
MEMO	Indicates techniques and know-how to get more accurate measurements.

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1. Hardware Set-up (DST 30 Manual Type)

Diagram & Installation

1.1 Basic items included with the DST 30

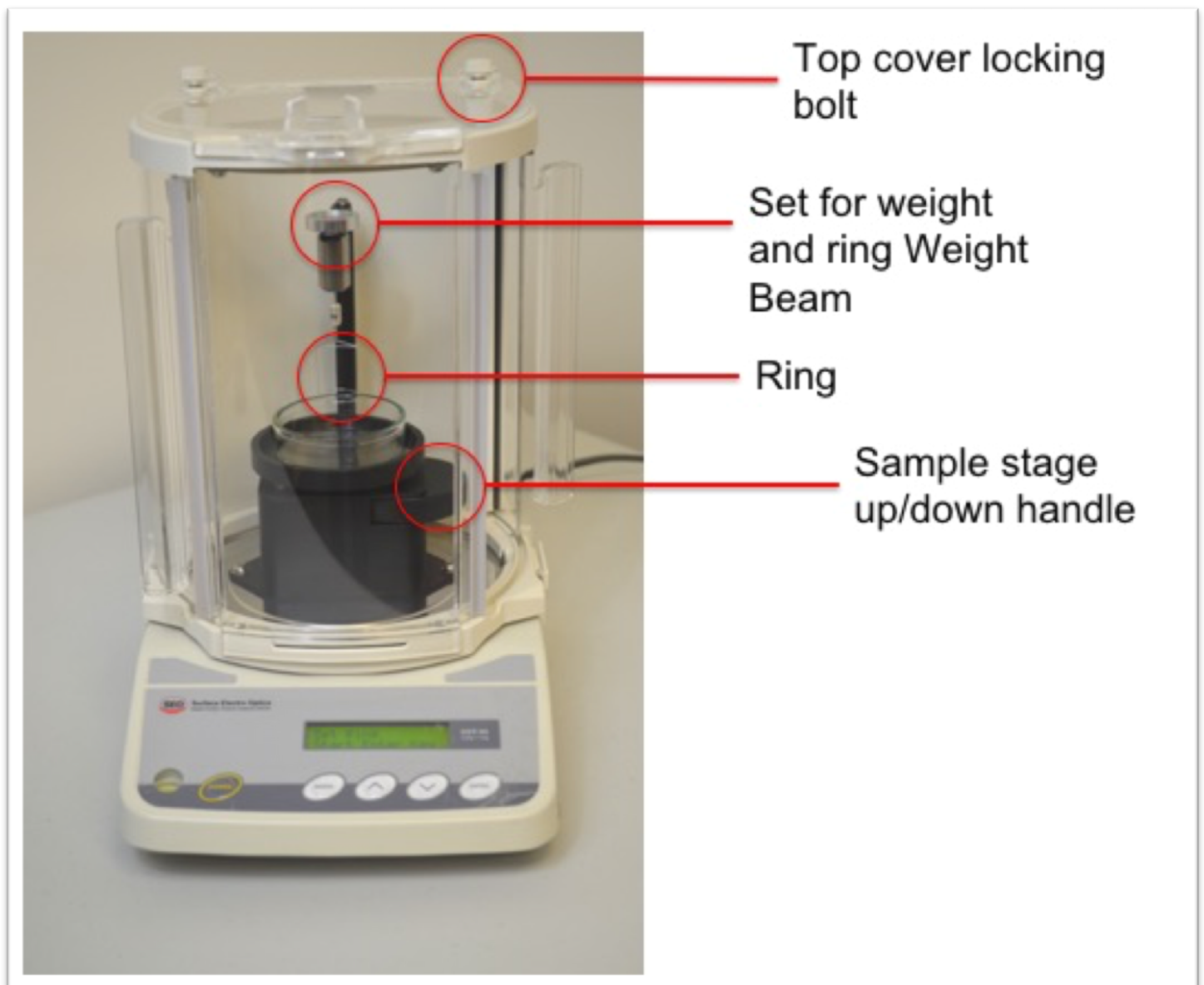
No.	Description	Quantity
1	Main Unit [200 mm x 250 mm x 310 mm]	1
2	Weight Carrier Beam Rod	1
3	Calibration Weight (50 g)	1
4	Hanger for the ring & Extender	1
5	Du Noüy Ring	1
6	Glass Beaker	1
7	Tweezers & power cable	1
8	Instruction manual	1

Optional:

No.	Description	Quantity
1	Circulator, Heat/Cool -10 °C to 100 °C	1
2	Glass chamber for temperature control	1

1.2 Components and Control Elements

The DST 30 consists of several parts. This chapter provides an overview over the instrument and its components.




1.3 Conditions of Installation

A. Environmental conditions

- ✓ Indoor use
- ✓ Temperature $\leq 40\text{ }^{\circ}\text{C}$
- ✓ Maximum relative humidity 80% for temperatures up to $31\text{ }^{\circ}\text{C}$ decreasing linearly to 50% relative humidity at $40\text{ }^{\circ}\text{C}$
- ✓ Main power supply voltage fluctuations not to exceed $\pm 5\%$ of the nominal voltage

B. Attention

When setting up the instrument, choose a location that is not in front of a bright light source. Vibration can affect the result of the measurement. Please choose a location as vibration as free as possible.

	<p>CAUTION</p> <p>Install the base unit on a flat surface. Connect to a ground outlet for protection. Install in a well-ventilated location.</p>
-------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------

1.4 Initial DST 30 Set up

A. Set up the DST 30 system on a stable, anti-vibration table.

- The DST 30 footprint is 200 mm x 250 mm x 310 mm.
- When installing the instrument, avoid placing the instrument in sunlight, near a noisy place, or near an area with vibration.

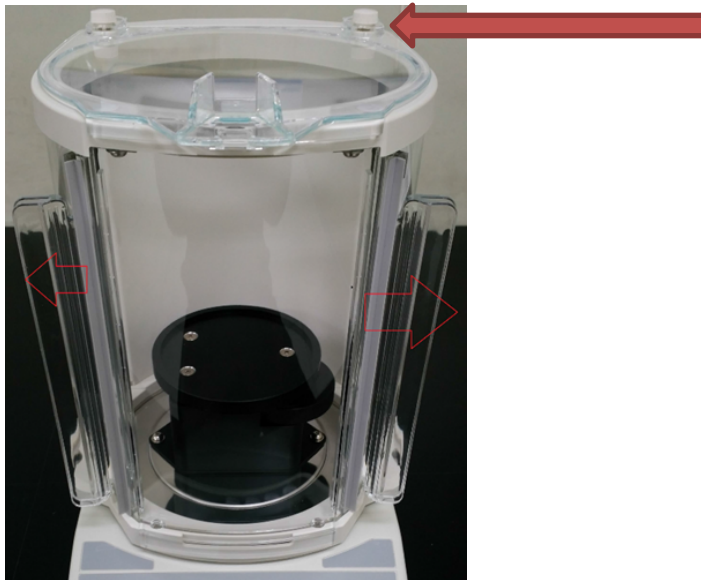
B. Unlock the “Shipping Lock Bolt”.



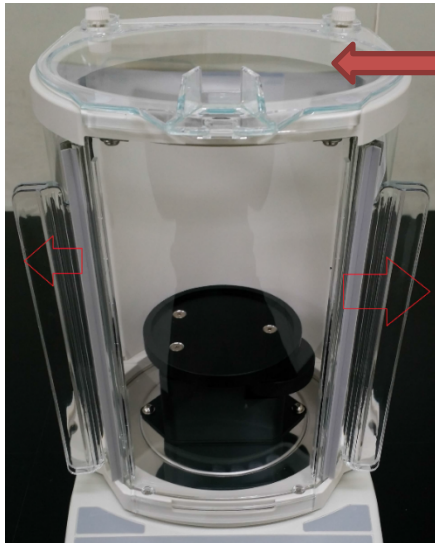
Shipping bolt unlock: This enables use of the instrument

- When installing the instrument, you must loosen the shipping lock bolt prior to use.
- When moving the instrument, lock the shipping bolt prior to moving.

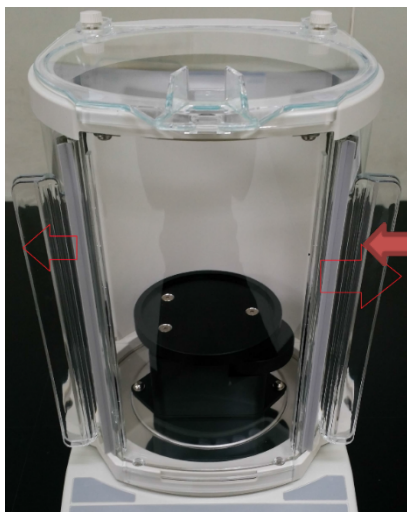
C. Undo the Thumbscrew.



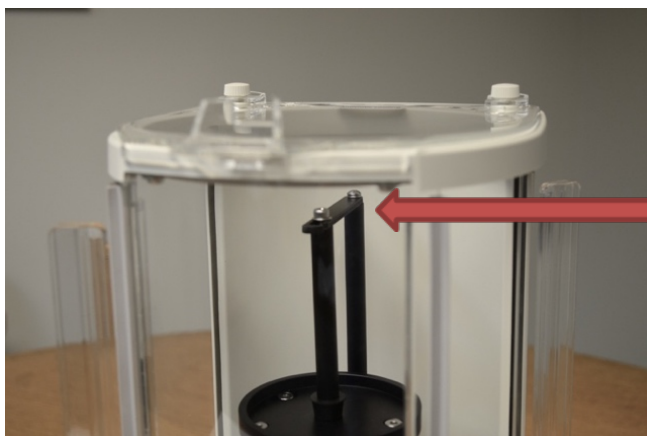
D. Open the top door.



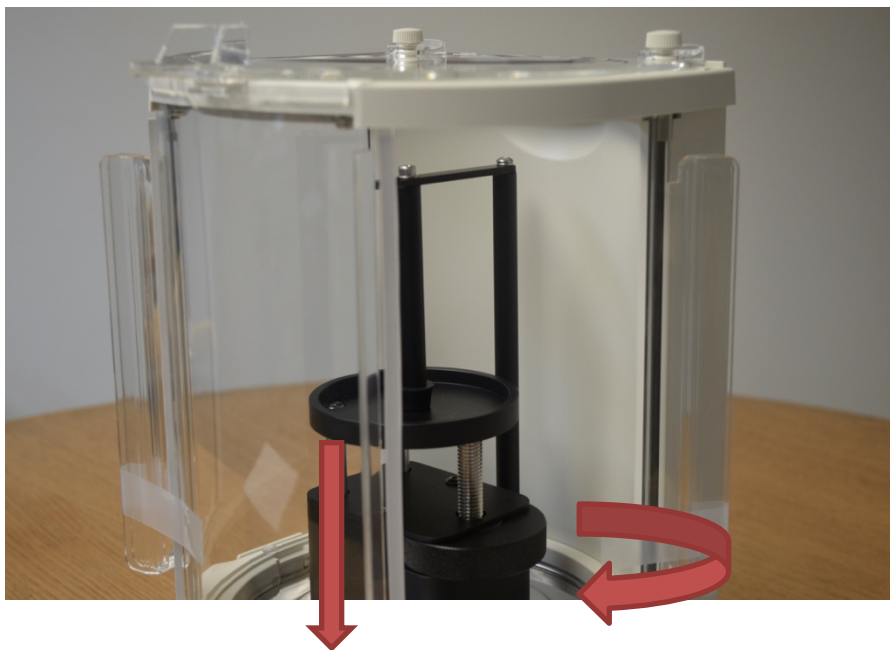
E. Open the wall window of the DST 30.



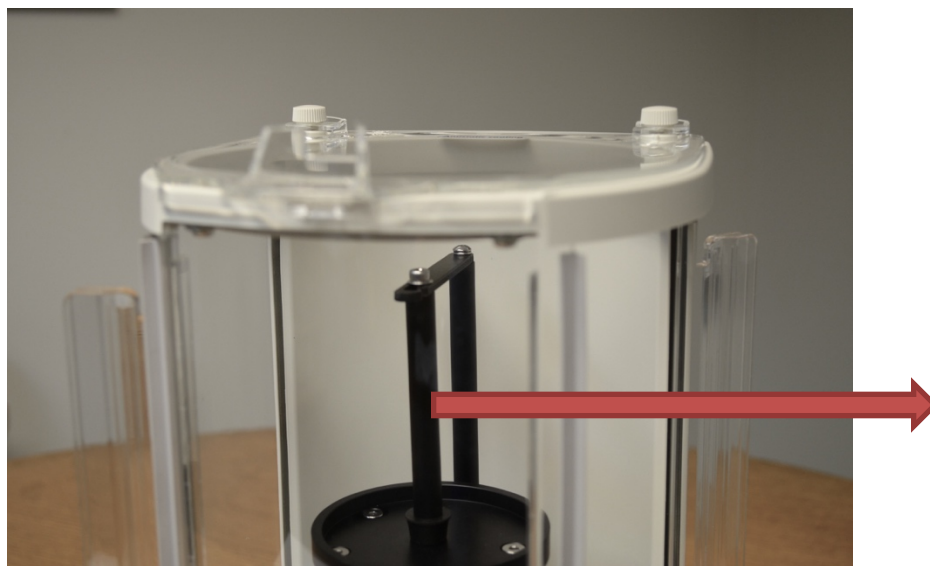
F. Remove the wrench bolt.



G. Turn the handle to lower the sample stage.



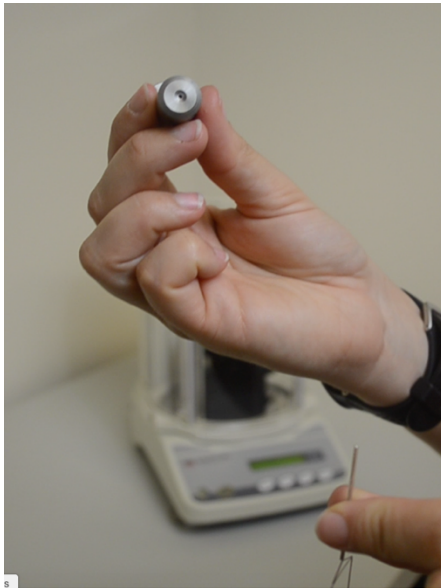
H. Remove the aluminum shipping support stick.



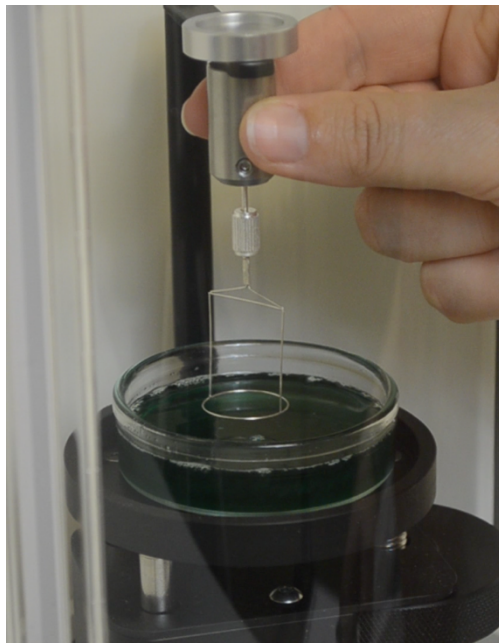
I. Level the instrument with the leveling legs at the base of the instrument.



J. Insert the ring into the in-line Hanger.



K. Place the in-line Hanger onto the weight beam.



2 Operation

2.1 Cleaning the Du Noüy Ring

- A. Remove the Du Noüy (Pt-Ir) ring from the in-line Hanger.
- B. Clean the Du Noüy ring carefully using an appropriate solvent.
- C. Lightly flame the Du Noüy ring over a blue flame from an alcohol burner.
- D. To properly flame the Du Noüy ring, hold over the flame for only a few seconds on the round edge.
- E. This should be done carefully! Do not allow the flame to crack or melt the edges as this will ruin the ring resulting in unreliable measurements.
- F. After a few passes through the flame on the round edge of the ring, allow the ring to cool to room temperature for two or three minutes prior to measurement.
- G. Replace the ring into the in-line hanger.



CAUTION

Use utmost care in handling the ring. Extreme care is important when opening, removing and cleaning the ring as it is fragile and easily damaged.

2.2 Loading the Sample

- A. Power on the DST 30.
- B. Select the preferred “method” parameter on the digital display.
- C. Insert the Du Noüy ring or Wilhelmy plate into the in-line hanger.
- D. Lower the sample stage to the bottom with the dial, using a clockwise motion.
- E. Fill the beaker (approximately half full) with the sample.
- F. Place the beaker on the sample stage.
- G. Adjust the beaker so that ring is positioned at the center of the beaker.
- H. Raise the sample stage for the test. Immerse the ring or plate in the sample.
 - The distance between the immersed ring and the liquid surface should not be less than 5 mm. This ensures a clean break of the meniscus on immersed ring.
- I. You are now ready to start the experiment.



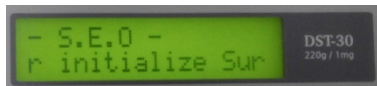
CAUTION

Handle liquids carefully. Do not to spill liquid on the instrument.

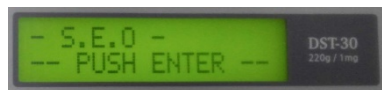
2.3 Measuring Surface Tension by the Du Noüy Ring Method

The following procedure shows proper operation the DST 30 system for surface tension analysis with a Du Noüy Ring.

After powering on the instrument, it will automatically initialize.



When the initialization process is complete, press the “Enter” key.



Surface tension can be measured with or without a balance tare.

Method 1: Measuring surface tension with a balance tare.

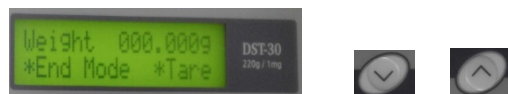
1. Press the “Enter Key” with “Balance Mode” selected.



2. Wait for the balance to tare.



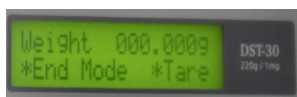
3. Selecting “Tare” using the “arrow” keys to move the cursor.



4. Wait for the weight to stabilize.



5. Select “End Mode” to return to the “Balance Mode” / “Tension Mode” selection menu.



6. Proceed to Method 2 to measure surface tension.

Method 2: Measuring surface tension without a balance tare.

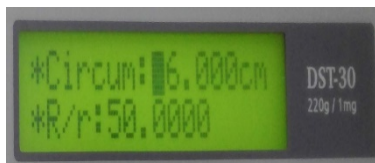
1. Use the “arrow” key to select “Tension Mode”.



2. Select “Ring Method” and press the “Enter” button.



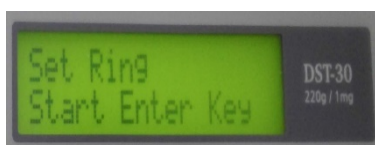
3. Input the ring circumference and R/r value. This information is found on the front of the wooden ring holder.



4. Press the “Enter” key to move to each numerical selection component. Use the “arrow” keys to increase or decrease the number.
5. Enter the density between the sample and air. Then enter the temperature of the sample.
 - a. Example: 0.998 (water) – 0.001 (air) = 0.997
 - b. Temperature may be room temperature, the temperature of the heater/chiller, or the temperature of the sample if it is not at room temperature.



6. Ensure the ring is properly submerged in the sample. This “sets” the ring. Then press the “Enter” button.



7. Move the sample stage down until the meniscus on the ring breaks. When “Max g” appears, press the “Enter” button.

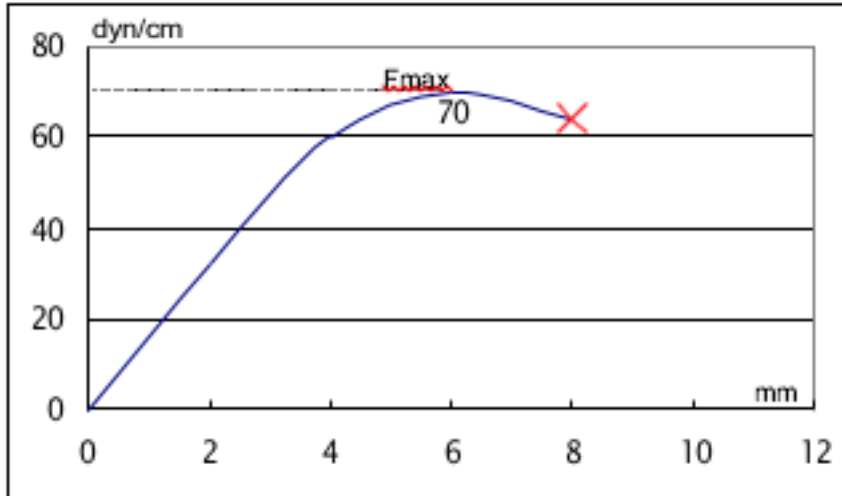


8. The surface tension value will be displayed. Selecting “Restart” allows you to run another sample by returning to the “Set Ring” step. Selecting “End” returns to the first menu to select “Tension Mode” or “Balance Mode”.



2.3.1 Surface Tension Result by Ring Method

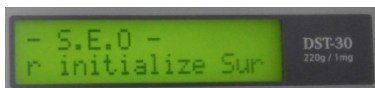
This is a typical graph of surface tension using a Du Noüy ring.



(*Note: the DST 30 model does not produce this graph, it will only display the digital value.)

2.4 Measuring Surface Tension by the Wilhelmy Plate Method

After powering on the instrument, it will automatically initialize.



When the initialization process is complete, press the “Enter” key.



Surface tension can be measured with or without a balance tare.

Method 1: Measuring surface tension with a balance tare. (*Note: this is the same for both ring and plate methods.)

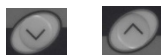
1. Press the “Enter Key” with “Balance Mode” selected.



2. Wait for the balance to tare.



3. Selecting “Tare” using the “arrow” keys to move the cursor.



4. Wait for the weight to stabilize.



5. Select “End Mode” to return to the “Balance Mode” / “Tension Mode” selection menu.



6. Proceed to Method 2 to measure surface tension.

Method 2: Measuring surface tension without a balance tare.

1. Use the “arrow” key to select “Tension Mode”.



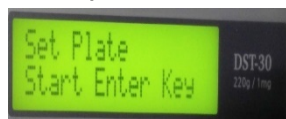
2. Use the “arrow” key to select “Plate Method” and press the “Enter” button.



3. Input the width and thickness of the plate. This information is found on the front of the plate holder.



4. Press the “Enter” key to move to each numerical selection component. Use the “arrow” keys to increase or decrease the number.
5. Ensure the plate is properly submerged in the sample. This “sets” the plate. Then press the “Enter” button.



6. Then wait for the plate to “zero”.



7. After the “zero adjust” is completed, move the sample stage down until the “Max g” appears, then press the “Enter” button.

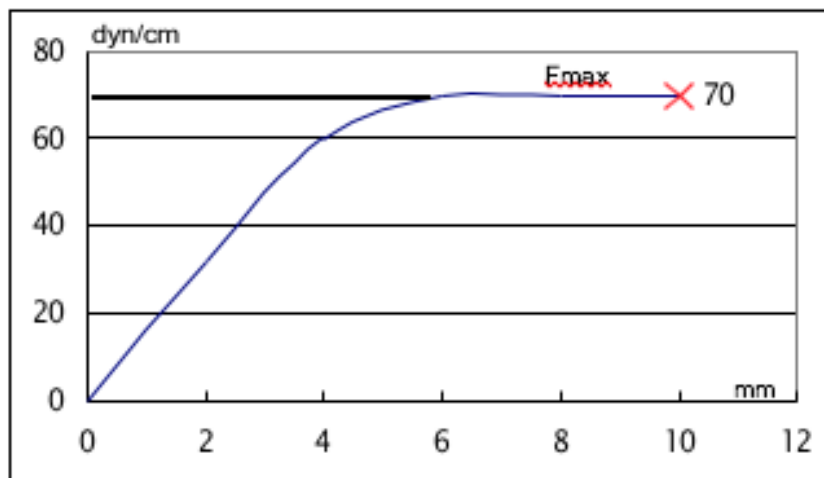


-
8. The surface tension value will be displayed. Selecting “Restart” allows you to run another sample by returning to the “Set Plate” step. Selecting “End” returns to the first menu to select “Tension Mode” or “Balance Mode”.



2.4.1 Surface Tension Result by Plate Method

This is a typical graph of surface tension using a Wilhelmy plate.

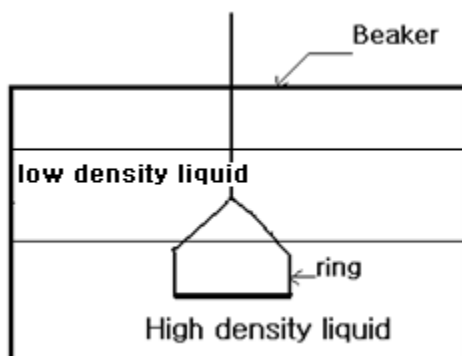


(*Note: the DST 30 model does not produce this graph, it will only display the digital value.)

2.5 Measuring Interfacial Tension

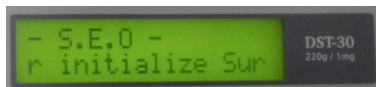
The following procedure shows proper operation the DST 30 system for interfacial tension analysis with a Du Noüy Ring. This procedure is very similar to the surface tension analysis procedure as interfacial tension is another aspect of thermodynamic interaction between the components of a system.

First, prepare the two liquid samples in the beaker, as shown in the image below.



Interfacial Tension Measurement Method:

1. After powering on the instrument, it will automatically initialize.



2. When the initialization process is complete, press the “Enter” key.



3. Press the “Enter Key” with “Balance Mode” selected.



4. Wait for the balance to tare.



5. Selecting “Tare” using the “arrow” keys to move the cursor.



6. Wait for the weight to stabilize.



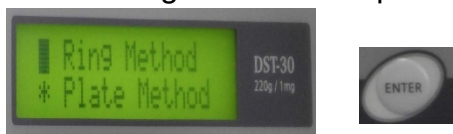
7. Select "End Mode" to return to the mode selection menu.



8. Use the "arrow" key to select "Tension Mode".



9. Select "Ring Method" and press the "Enter" button.



10. Input the ring circumference and R/r value. This information is found on the front of the wooden ring holder.



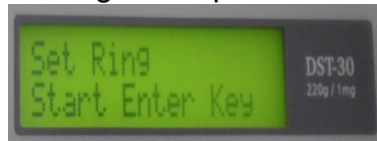
11. Press the "Enter" key to move to each numerical selection component. Use the "arrow" keys to increase or decrease the number.

12. Enter the high-density sample (D) – low-density sample (d). Then enter the temperature of the sample.

- Example: 0.998 (water) – 0.7134 (diethyl ether) = 0.28640
- Temperature may be room temperature, the temperature of the heater/chiller, or the temperature of the sample if it is not at room temperature.



13. Ensure the ring is properly submerged in the high-density sample. This “sets” the ring. Then press the “Enter” button.



14. Move the sample stage down until the ring completely enters the low-density liquid. When “Max g” appears, press the “Enter” button.

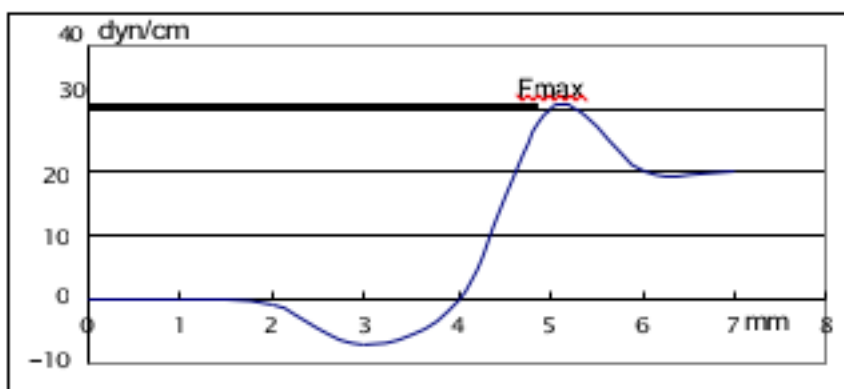


15. The interfacial tension value will be displayed. Selecting “Restart” allows you to run another sample by returning to the “Set Ring” step. Selecting “End” returns to the first menu to select “Tension Mode” or “Balance Mode”.



2.5.1. Interfacial Tension Result

This is a typical graph of interfacial tension using a Du Noüy ring.



(*Note: the DST 30 model does not produce this graph, it will only display the digital value.)

2.6 CMC (Critical Micelle Concentration) Measurement

When surfactants at very low concentrations are dispersed in water, they tend to become absorbed as a closely packed monolayer at the Gas-Liquid interface.

CMC measurements are used to measure the surface tension in surfactant industries.

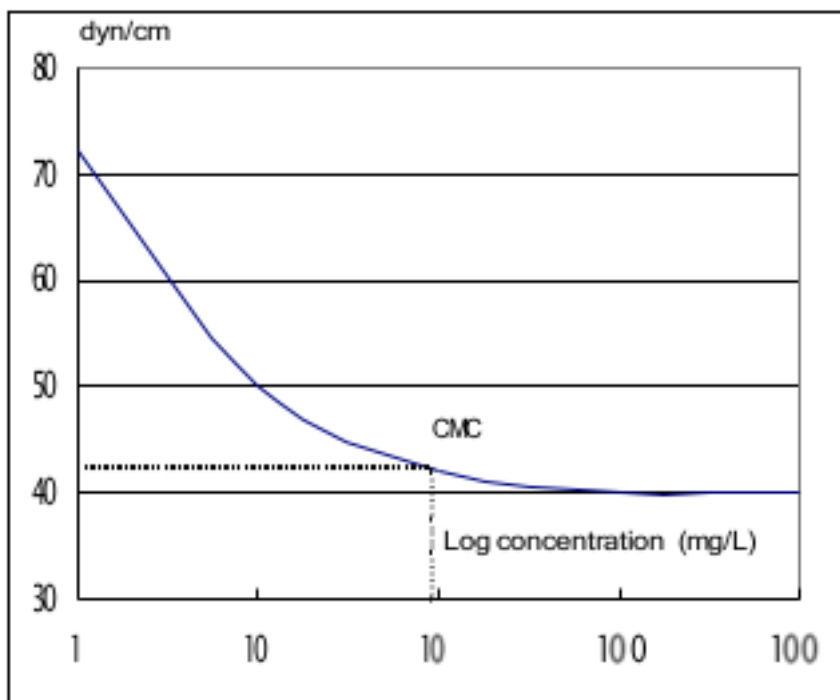
CMC can be identified from the fact that the equilibrium and transport properties of the solution are affected by the aggregation of the surfactant.

Micelles can increase the solubility of compounds with poor solubility.

To measure the critical micelle concentration:

1. Prepare several liquid samples including the surfactant at different concentrations.
2. Measure the surface tension using the Du Noüy ring Method.

This is a typical graph of CMC using a Du Noüy ring.



(*Note: the DST 30 model does not produce this graph, it will only display the digital value.)

3 Calibration

3.1 Calibration Procedure

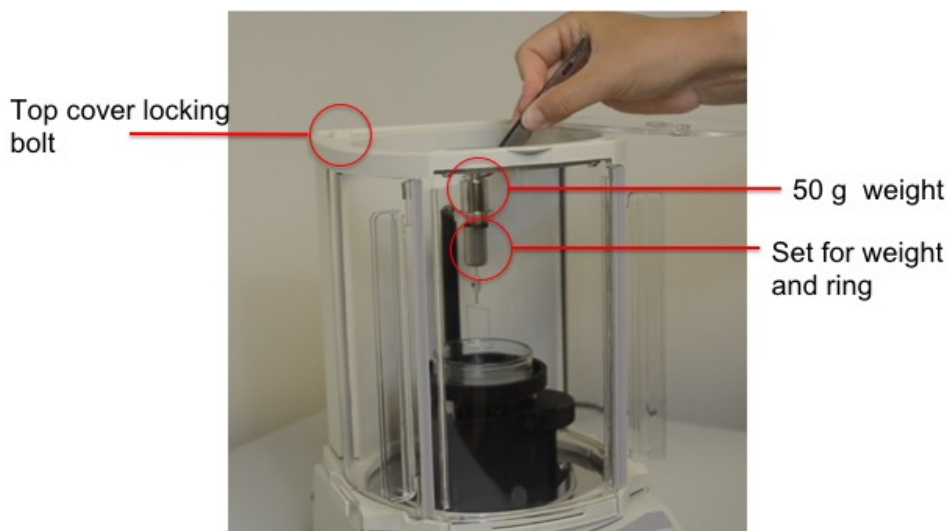
1. Press the “down arrow” twice to view the “Calibration Mode”. Press the “down arrow” a third time to select “Calib”, then press “Enter”.



2. Wait for the “Calibration Mode Processing” to complete.



3. Load the 50 g weight as show in the picture below, then press “Enter”.
To load the weight:
 - a. Open the top cover.
 - b. Place the 50 g weight as shown, using a tweezers (provided with the weight).



4. Wait for the calibration to process.



-
5. Unload the 50 g weight, using tweezers, when instructed.



6. Select "End" to return to the main menu.



4 Theory of Surface Tension

The property of a liquid surface that causes it to act like a stretched elastic membrane. The strength of this membrane depends on the forces of attraction between the particles of the liquid itself and with the particles of the gas, solid, or liquid with which it comes in contact. Surface tension is a physical property that allows certain insects to stand on the surface of water and can support a razor blade placed horizontally on the liquid's surface, even though the blade may be denser than the liquid and unable to float. Surface tension results in spherical drops of liquid, as the liquid tends to minimize its surface area.

Liquid surface tension is the tangential force that keeps a fluid together at the air/liquid interface. It is the intermolecular force of attraction between adjacent molecules. Surface tension is expressed in force per unit width, as mN/m (millinewton/meter) or dyn/cm (dyne/centimeter).

4.1 Du Noüy Ring Method

The existence of surface tension can be expected from the difference in energies between molecules in the bulk phase of liquids.

Below is the equation of Ring method basic of Harkins & Jordan and developed the equation by Zuidema/Waters.

$$f = 0.7250 + \sqrt{\frac{1.452P}{4\pi^2 R^2(D-d)} + 0.04534} - \frac{1.679}{R/r}$$

P = scale reading

R = radius of ring

r = radius of wire of ring

D = density of water

d = density of sample

5 Conditions Influencing Surface Tension

5.1 Temperature

Surface tension is influenced by temperature. In most cases, when the temperature increases the surface tension decreases.

5.2 Time

Measurements that are conducted too fast may provide in an incorrect result. Therefore, please keep in mind to maintain calm and slow handling of the instrument.

5.3 Density

When the difference in density between two samples is small, the interfacial tension value will also be small, and it may be difficult to obtain a correct measurement. When the interface tension measurement is below 5 dyn/cm, the spinning drop method is recommended.

5.4 Surface Cleaning

When a dirty or contaminated ring or plate is used, the surface tension measurement will not be valid.

5.5 Purity of Liquid

Impurities in the liquid sample can affect the molecule exchange between liquid and air phase, resulting in an inaccurate measurement. Correct surface tension measurements are dependent upon the purity of the sample.

5.6 Surface roughness and pore size

If samples have microscopic dust on the surface, it will change the surface tension measurement.

5.7 Influence of Adsorption

When moisture is prematurely absorbed in samples, it is difficult to obtain a correct measurement.

5.8 Vibration

The DST 30 has an anti-vibration algorithm. However, excessive vibration will fault the balance.

6 Company Information

6.1 Address & Phone Numbers

CSC Scientific Company, Inc.
2799-C Merrilee Dr.
Fairfax, VA 22031
T 800-621-4778
F 703-280-5142
csc@cscscientific.com
www.cscscientific.com

SEO (Surface and Electro-Optics) Corporation Head Office
#946 Kosek, Suwon city, Kyunggi-Do, 441-813. Korea
T 82-31-298 9561
F 82-31-298 9565
www.s-eo.com

6.2 Service Information

Warranty

The warranty for the DST 30 is valid for one year from the date of shipment.

Parts or components troubled which fail during normal operation described on this manual will be replaced free of charge during the warranty period. However, during the warranty period, there will be a fee for replacement of parts or components if the following conditions occur:

1. Misuse of the instrument, natural disasters such as fire, public nuisance, or abnormal electric power.
2. Unsuitable or unauthorized repair, adjustment, disassembling, or modification.
3. A drop or fall of the instrument during transportation.

