

How to Measure Surface Tension

with ramé-hart DROPimage Advanced

This knol walks through the steps necessary to create an experiment using the Experiment Wizard that will measure surface tension of a pendant drop using DROPimage Advanced Software and any ramé-hart goniometer or tensiometer.

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[Surface Tension with DROPimage Advanced](#)

Surface tension is measured using a pendant drop of liquid while the external phase consists of a gas – typically air. (When the external phase is an immiscible liquid, the measurement is called interfacial tension.) Since the drop phase is denser than the external phase, we use a hanging pendant.

The following products are used with this experiment:

- ramé-hart Model 250 Standard Goniometer with DROPimage Advanced (p/n 250-F1)
- Microsyringe (p/n 100-10-20, included with Model 250)
- 22g Stainless Steel Straight Needle (p/n 100-10-12-22, included with Model 250)

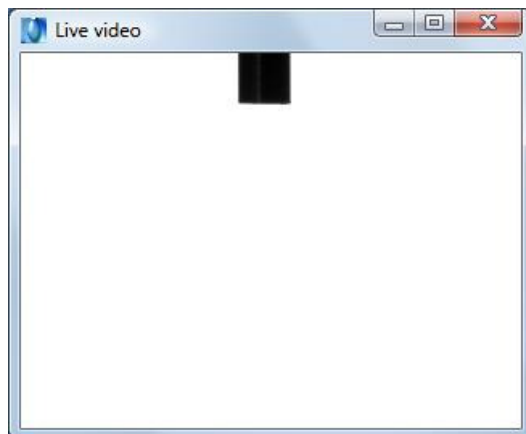
Goal

The goal of this experiment is to take ten surface tension measurements over 10 seconds while the drop is at ambient temperature, humidity and pressure.

Procedure

1. Verify that the instrument is setup according the instructions provided and has been calibrated.
2. Fill the microsyringe assembly with the test liquid.
3. Attach the straight needle to the syringe firmly.

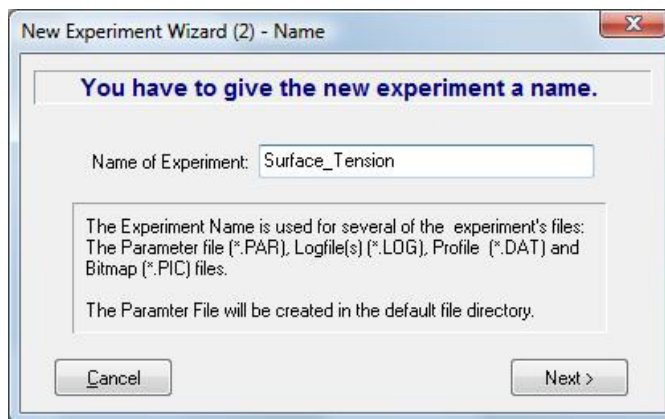
4. Turn the dispensing knob on the microsyringe to remove air from the needle.
5. Start the DROPimage Advanced software.
6. Install the microsyringe in the fixture and adjust it so that the tip of the needle is visible in the center top of the DROPimage live image window as shown below.



7. Next, let's begin a new experiment using the Experiment Wizard. Click on File > New Experiment Wizard. Or simply hit Ctrl-T on the keyboard.

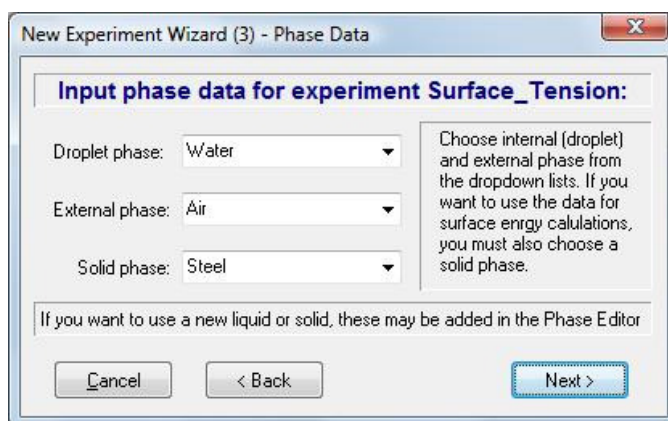


8. We will use the first choice "Surface Tension – Pendant".
9. Click Next.
10. On the next screen, enter an experiment name. We will use "Surface_Tension".



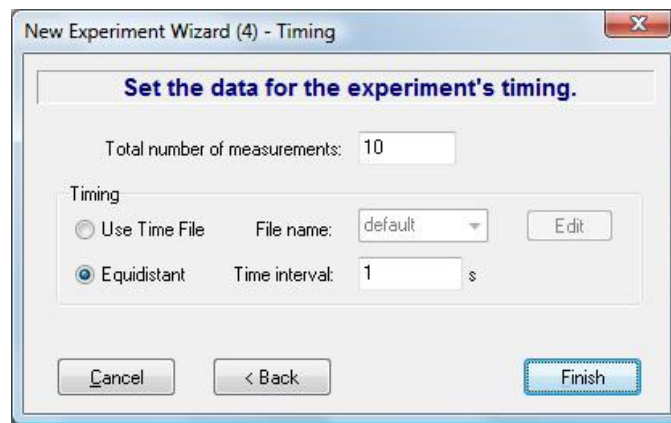
11. Click Next.

12. On the next screen we will enter the phase data. For the droplet phase, select the liquid you are using from the list. Note that if the liquid is not in the list, you will first need to add it using the Phase Editor. Select the External phase – in this case, water. And then the solid phase which is steel (the needle).



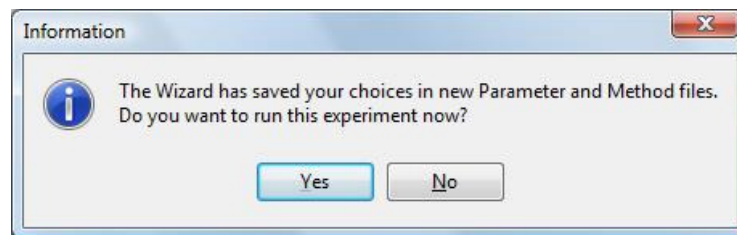
13. Click Next.

14. Now enter "10" for the number of measurements. For the timing, you can use an existing time file – or create a new one – we will use the Equidistant option and set the "Time Interval" to "1" which means that the measurements will be taken one second apart.

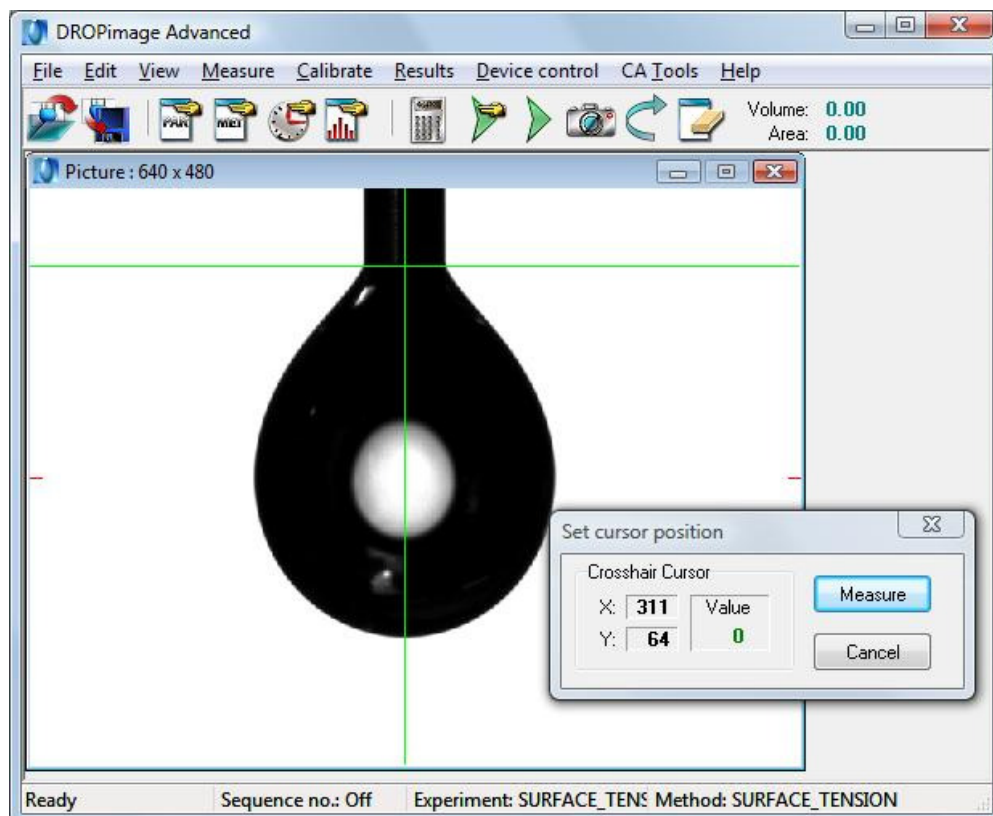


15. Click Finish.

16. At this point, DROPImage has created a Parameter and Method file for your experiment. Click Yes to run it.



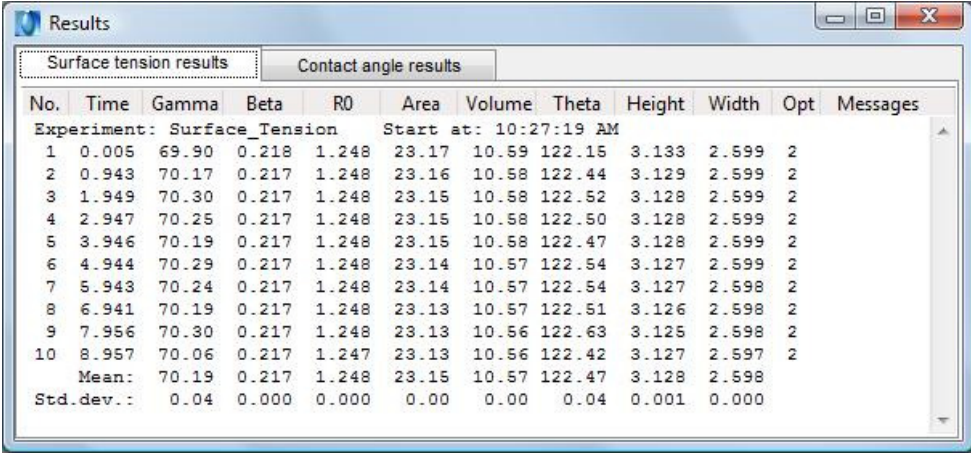
17. Now you will need to dispense your test liquid in order to produce a pendant drop similar to the one shown below. As a rule of thumb you want to use enough volume to produce a drop that is stable and not so large that it releases itself from the needle.



18. With the drop created, now is a good time to make sure that your lighting is set properly. The background should be white while the needle and perimeter of the drop should be black. The interface between the drop and the external phase should be crisp. If not, focus and take a new picture.

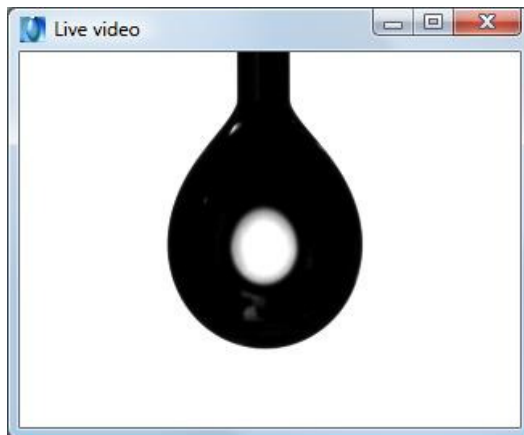
19. Place the crosshairs so that the horizontal line passes through the interface between the needle and the drop and the vertical line passes through the center of the drop and needle as shown above.

20. When you ready, click Measure on the "Set cursor position" dialog box. The experiment will now begin.



Results											
Surface tension results						Contact angle results					
No.	Time	Gamma	Beta	RO	Area	Volume	Theta	Height	Width	Opt	Messages
Experiment: Surface_Tension Start at: 10:27:19 AM											
1	0.005	69.90	0.218	1.248	23.17	10.59	122.15	3.133	2.599	2	
2	0.943	70.17	0.217	1.248	23.16	10.58	122.44	3.129	2.599	2	
3	1.949	70.30	0.217	1.248	23.15	10.58	122.52	3.128	2.599	2	
4	2.947	70.25	0.217	1.248	23.15	10.58	122.50	3.128	2.599	2	
5	3.946	70.19	0.217	1.248	23.15	10.58	122.47	3.128	2.599	2	
6	4.944	70.29	0.217	1.248	23.14	10.57	122.54	3.127	2.599	2	
7	5.943	70.24	0.217	1.248	23.14	10.57	122.54	3.127	2.598	2	
8	6.941	70.19	0.217	1.248	23.13	10.57	122.51	3.126	2.598	2	
9	7.956	70.30	0.217	1.248	23.13	10.56	122.63	3.125	2.598	2	
10	8.957	70.06	0.217	1.247	23.13	10.56	122.42	3.127	2.597	2	
	Mean:	70.19	0.217	1.248	23.15	10.57	122.47	3.128	2.598		
	Std.dev.:	0.04	0.000	0.000	0.00	0.00	0.04	0.001	0.000		

21. The results window will now appear if it's not already on your desktop and look similar to the one shown below.



22. The results window provides the following information:

1. No. – run number, e.g., 1,2,3...
2. Time – precise time in seconds of measurement relative to the start of the current run.
3. Gamma – surface tension in mN/m.
4. Beta – shape factor; as a rule a number between 0.2 and 0.4 is good.
5. RO – The radius of curvature at the drop's apex in mm.
6. Area – The drop surface area in mm².
7. Volume – The drop volume in mm³.
8. Theta – The contact angle at the drop limit (horizontal) baseline.
9. Height – The total measured distance from baseline to the drop apex in mm.
10. Width – The dimension in mm at the maximum width.
11. Opt – The number of optimizations performed.
12. Messages – Errors or other messages.

Congratulations. You've now successfully measured surface tension. If you want to make changes to your experiment use the Method Editor and Phase Editor to change the settings.

Should you have any problems not covered in this tutorial, please email your screen shot to carl@ramehart.com for an opinion.
