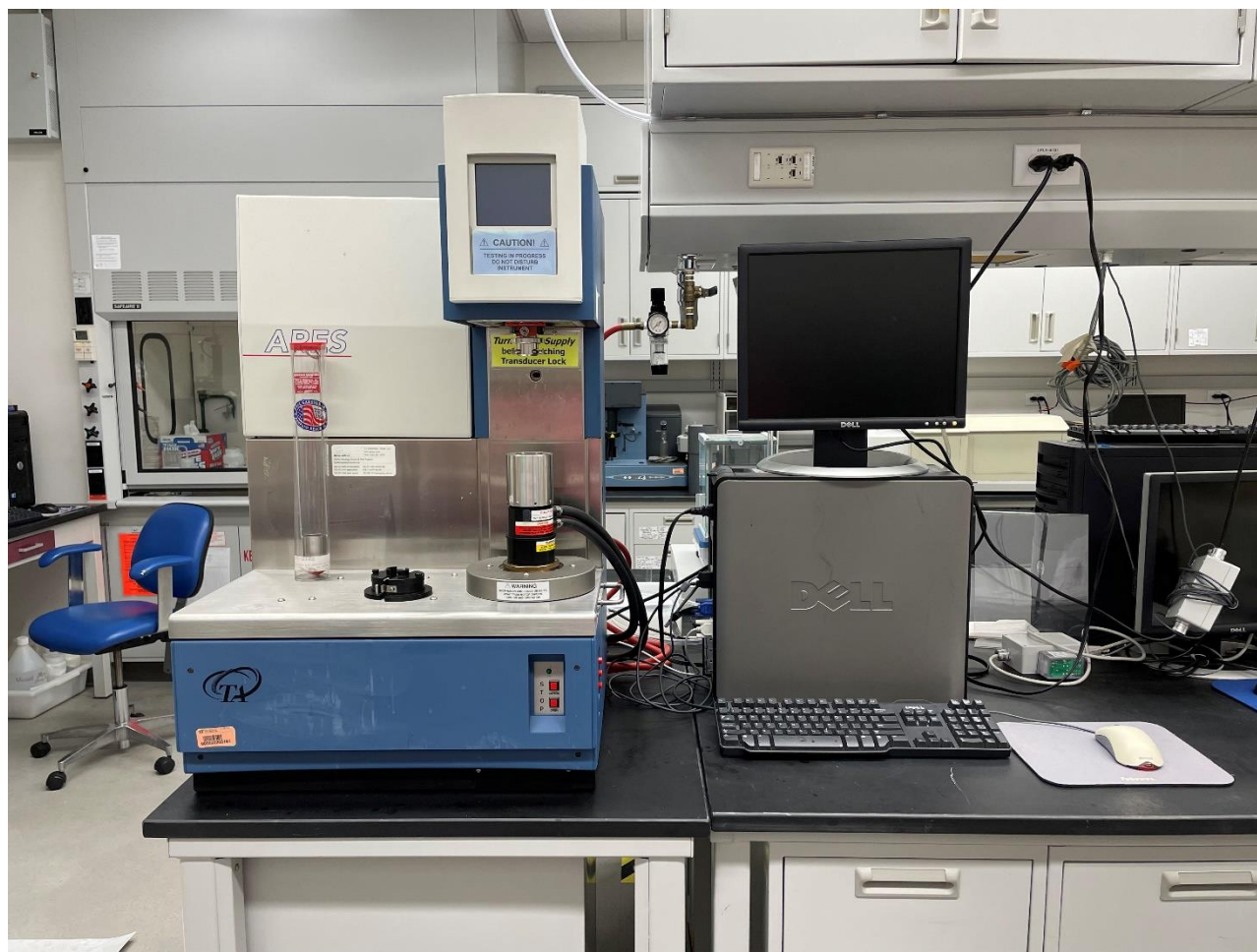


# TA Instruments ARES LS1 Rheometer

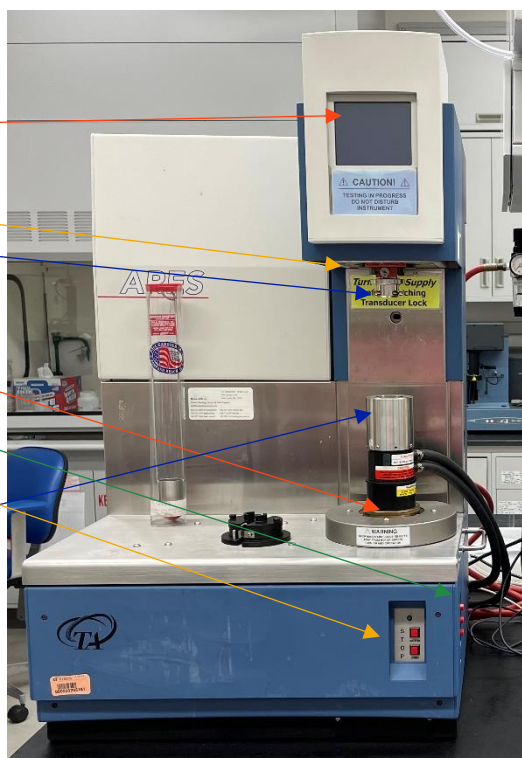
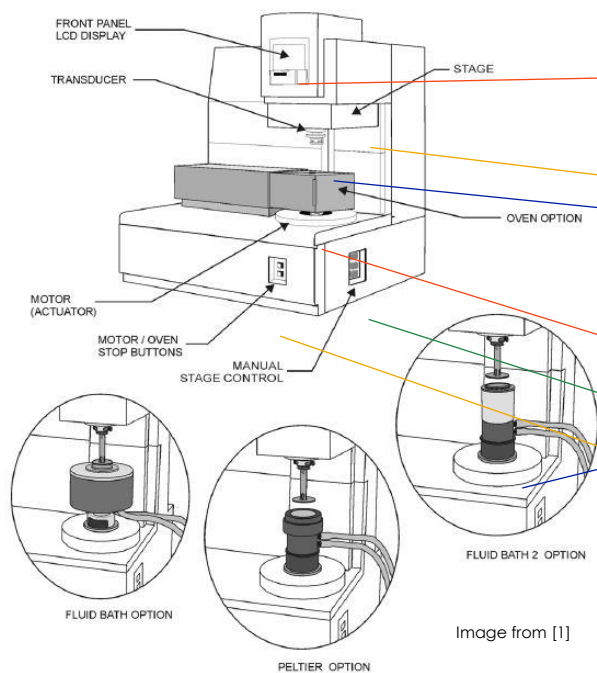
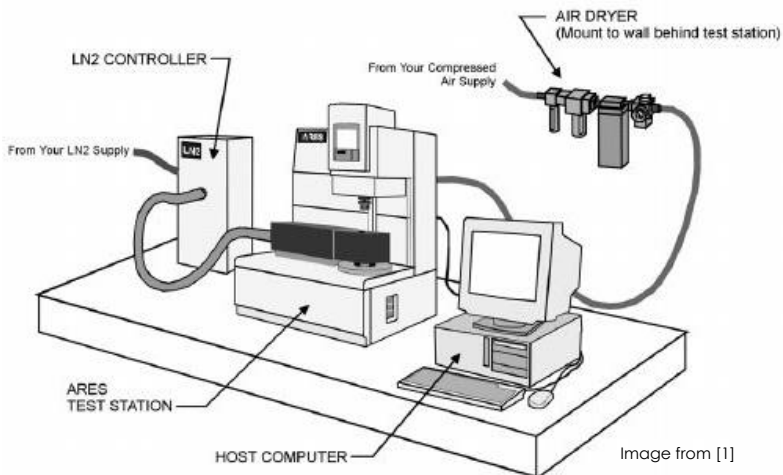
## RSC Standard Operating Procedure (SOP)



<b>Details:</b>	TA Instruments ARES LS1 Rheometer		
<b>Location:</b>	NRF 239	<b>Room Phone:</b>	352-273-2254 (NE corner)
<b>Contact:</b>	Gary Scheiffle gscheiffle@eng.ufl.edu	Alison Trachet aat425@ufl.edu	
<b>RSC Equipment Page</b>	<a href="https://rsc.aux.eng.ufl.edu/ccb/resource.asp?id=105">https://rsc.aux.eng.ufl.edu/ccb/resource.asp?id=105</a>		

# 1. Equipment Overview

## 1.1 HARDWARE



## 1.2 TESTING GEOMETRIES

8, 25, and 50 mm parallel plates

8 mm cone at 0.1 radian

25 mm and 50 mm cone at 0.04 radian

16.5 mm bob/17 mm cup

32 mm bob/34 mm cup

## 1.3 CAPABILITIES OF EQUIPMENT

Motor	High Performance LS
Angular Velocity Range	$2 \times 10^{-6}$ - 200 rad/s
Strain Amplitude	5 $\mu$ rad - 500 mrad
Angular Frequency	$10^{-5}$ - 200 rad/s
Transducer	1KFRTN1
Torque Range	0.2 $\mu$ N.m - 100 mN.m
Normal/Axial Force Range	0.002 - 20 N
Auto Gap Set	Standard
Motor Bearings	Jeweled Air
Bath	-10 to 150 °C

## 2. Safety & Prerequisites for Equipment Use

### 2.1 PERSONAL SAFETY

Do not touch the motor when it is moving.

Be careful when testing at temperatures other than ambient. The test setup can become very hot or cold. If possible, wait for equipment to return to room temperature before touching tools.

Do not put your hands near the upper and lower tools when lowering the head.

### 2.2 PROCESS & EQUIPMENT SAFETY

Do not drop the upper and lower tools.

Do not drive the upper tool into the lower tool when lowering the stage/head.

NEVER unlock the transducer without the air on.

Avoid contamination of the instrument by having clean hands/gloves and cleaning up any spills.

The areas marked with the yellow and black tape are assumed contaminated with mercury. You will need to enter this area to turn on the equipment. Before leaving the area, step on the sticky mat to clean your shoes.

### 2.3 FACILITY SAFETY

If hazardous waste disposal is required (liquids and solids), please notify RSC staff at [rscinfo@mail.ufl.edu](mailto:rscinfo@mail.ufl.edu) and wait for a written reply **BEFORE** beginning your test.

### 2.4 PREREQUISITES FOR USE

User of the RSC facilities.

Up-to-date hazardous waste training.

Training by staff.

User will be responsible for lost or damaged equipment due to negligence. Negligence means not following the SOP, not asking staff for assistance, intentionally damaging items, etc.

## 3. Sample Preparation

Typically, very little sample preparation is required. You may want to use a vortex mixer or other type of mixer before testing to make sure your sample is well mixed.

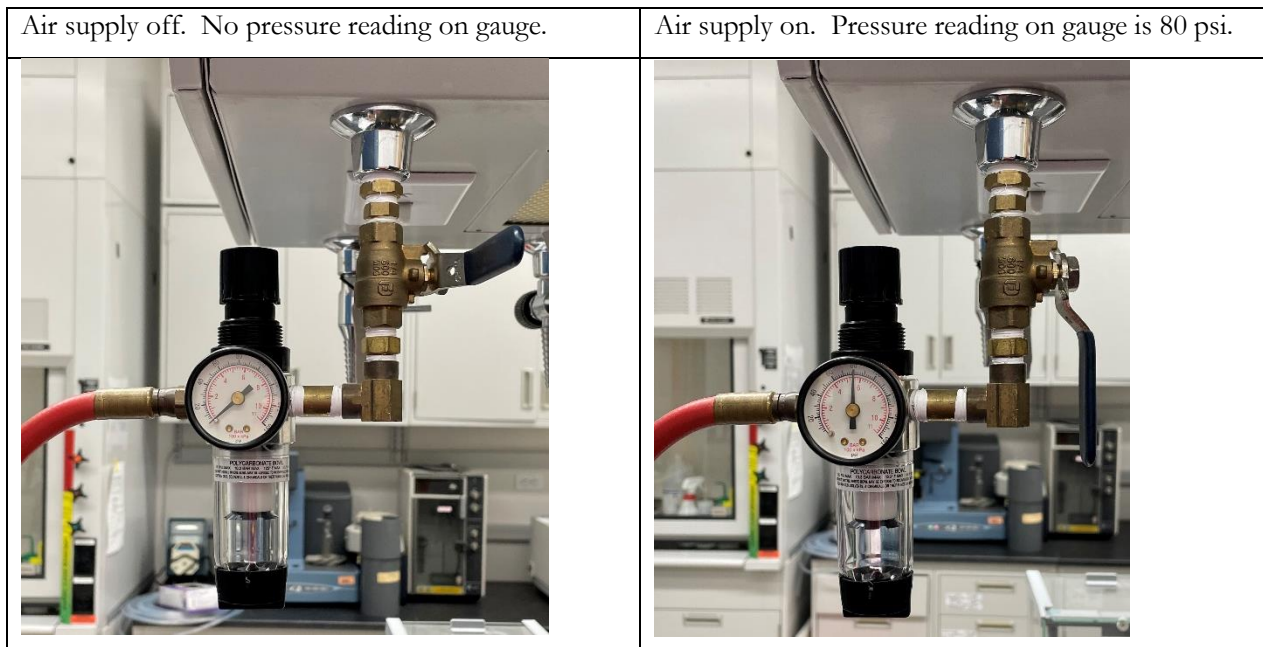
## 4. Procedure

\*\*\*While the equipment has many testing options, this SOP only covers the shear rate sweep test in steady mode for a cone and plate tool setup. If you would like to conduct additional testing, please ask.\*\*\*

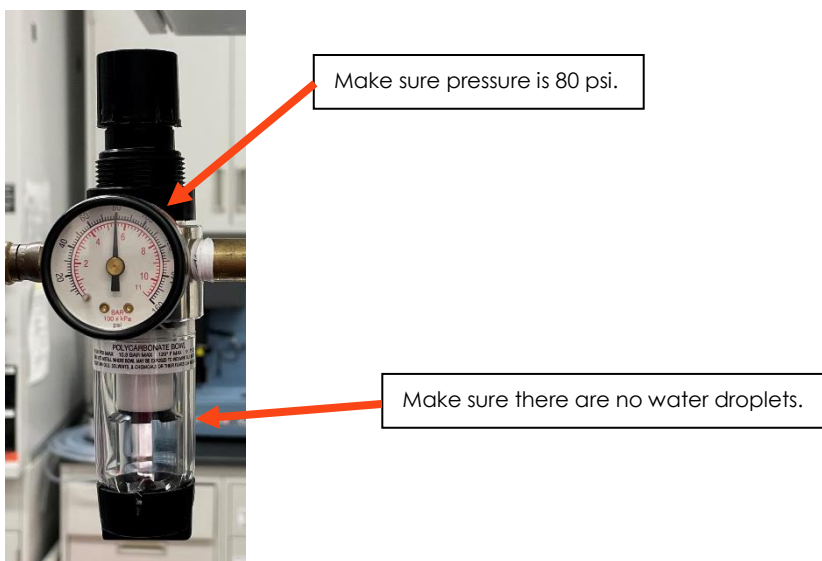
### 4.1 SET UP EQUIPMENT

#### 4.1.1 Turn on air supply

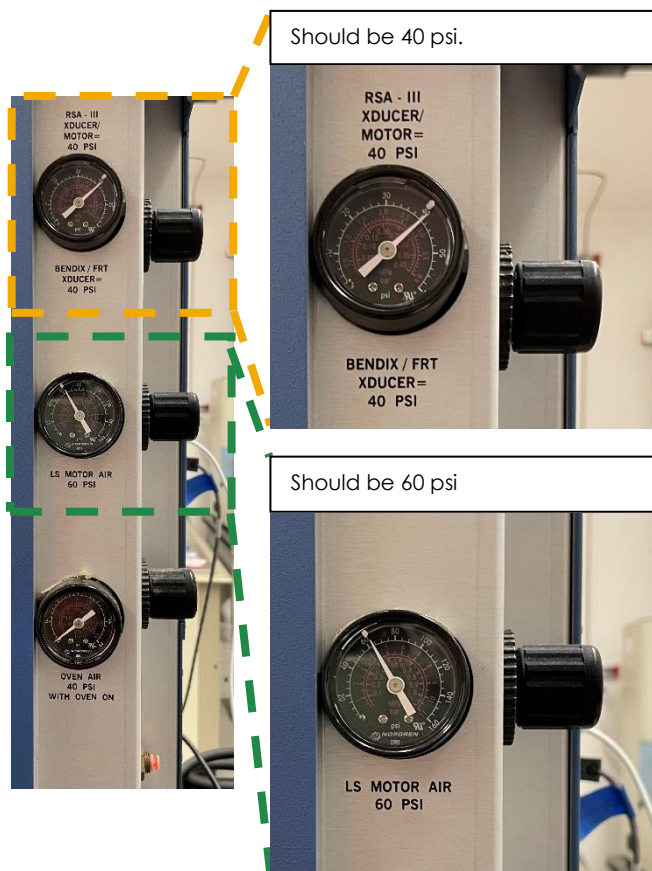
Rotate the air supply lever 90 clockwise to turn on the air. You will see pressure gauge increase to 80 psi. If the regulator does not read 80 psi, please contact staff.



Check the filter/separator for water droplets. If you see any, please contact staff.



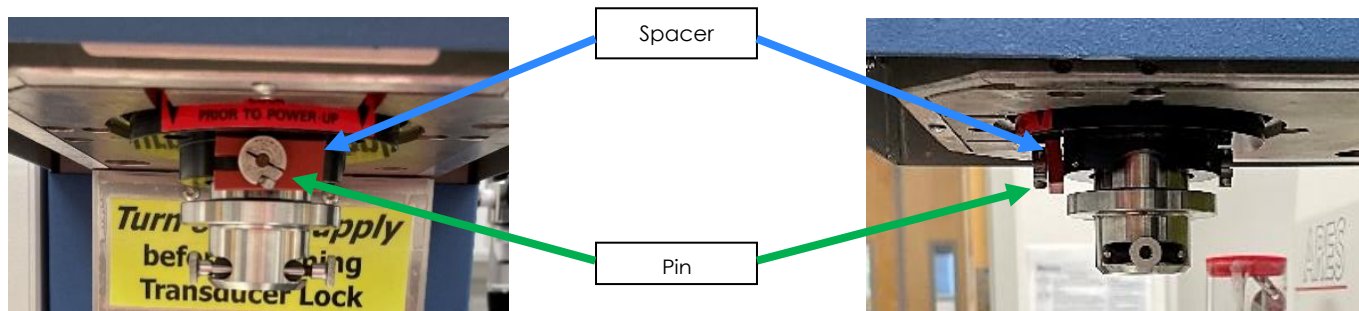
Check the air pressures for the two components on the right side (assume you are facing the equipment). They should be 40 and 60 psi, respectively. The bottom gauge will read zero.



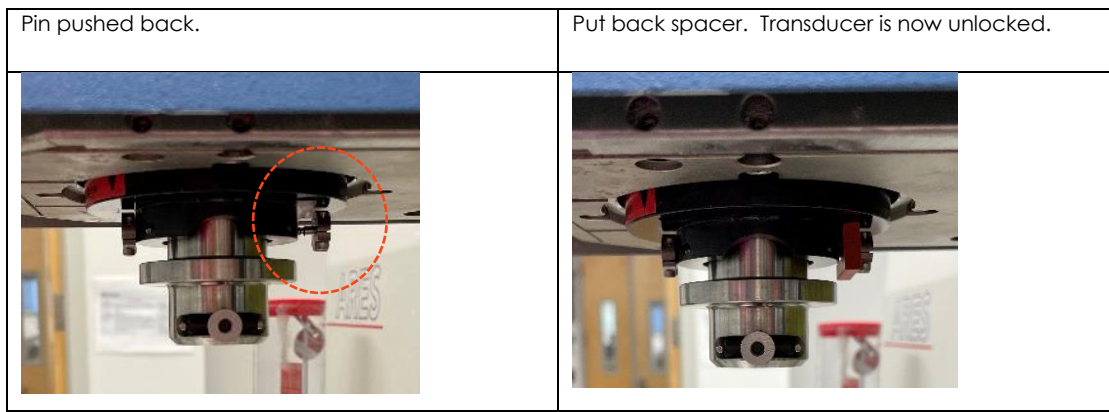
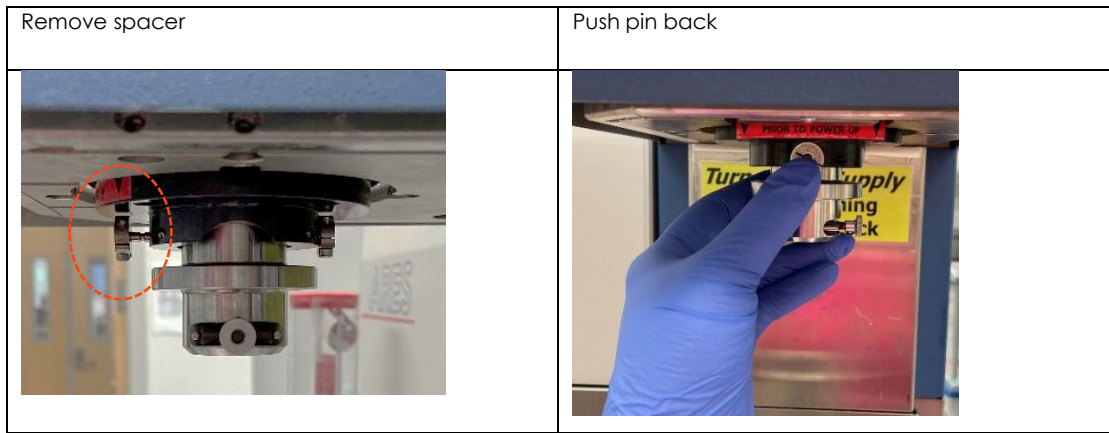
#### 4.1.2 Unlock the transducer

\*\*\* DOUBLE CHECK THAT AIR IS ON BEFORE UNLOCKING TRANSDUCER \*\*\*

When the transducer is locked, the pin will be pushed toward the front, and the rubber spacer will be at the front of the equipment.



Remove rubber spacer. Push pin to back of transducer. It should move relatively freely. If you are having trouble moving the pin, please alert staff. Insert the rubber spacer between the back of the transducer and the pin.



#### 4.1.3 Turn on instrument

Turn on the power switch on the lower right panel of the instrument.

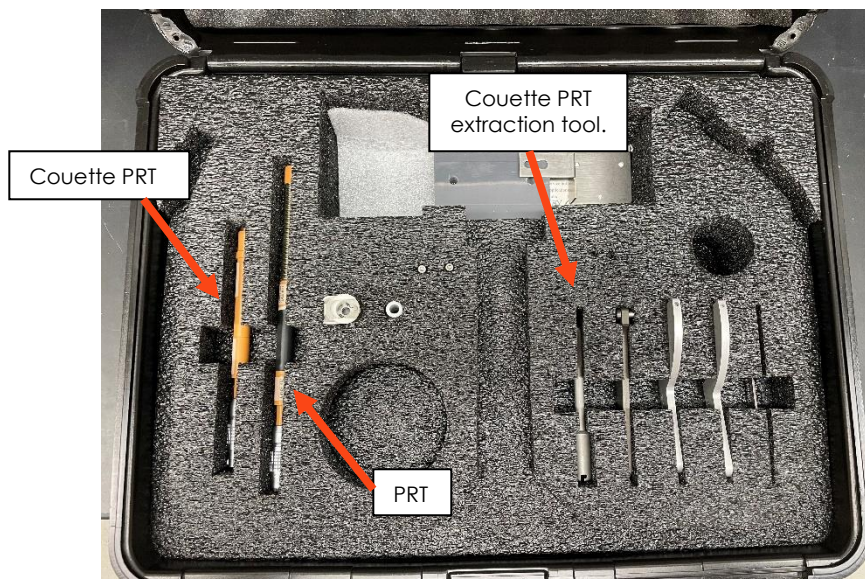


Check the LCD screen. It should be on but will not be reading the temperature of the equipment.



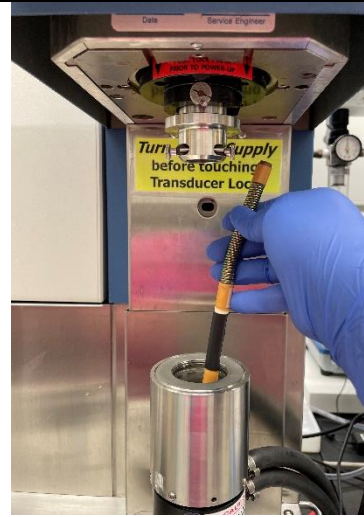
#### 4.1.4 Insert PRT (thermometer)

The PRT reads the temperature of the bottom tool. It is used in the feedback loop to control the temperature of the experiment. For this SOP, we are using the “PRT”. The “Couette PRT” is shorter and is used with the couette tools.



Slide the silver end of the PRT into the bottom of the tool. The top of the PRT is flexible so you can slightly bend it to avoid damaging the air bearing. There is a keyed opening at the bottom of the PRT which aligns with the plug at the bottom. Once the PRT is inserted, lightly rotate the PRT until the PRT clicks into place (it will drop down slightly).

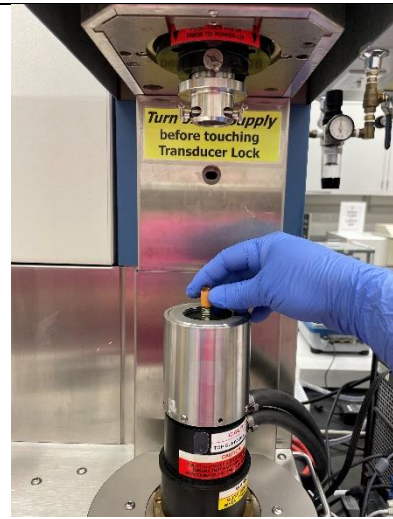
Inserting PRT taking care not to touch the bearing.



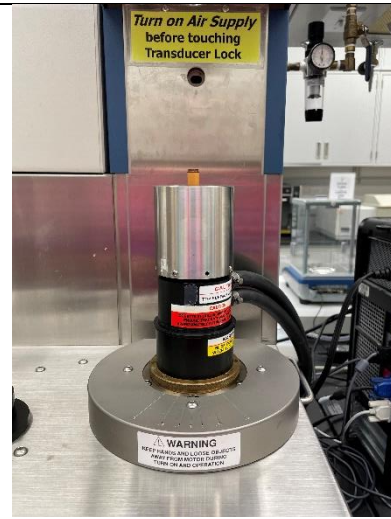
PRT at bottom but not locked into place





Lightly rotate the PRT to align the pins and keyed opening.



PRT in place.


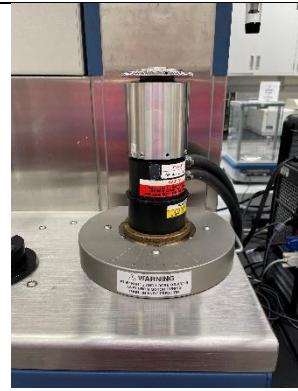
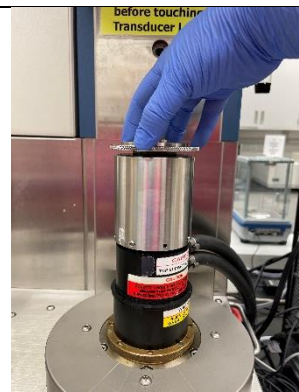
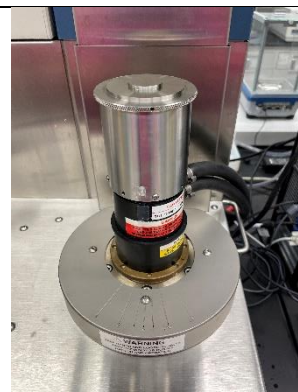


The LCD screen should now be reading room temperature.

Before PRT	After PRT
	

#### 4.1.5 Install lower tool

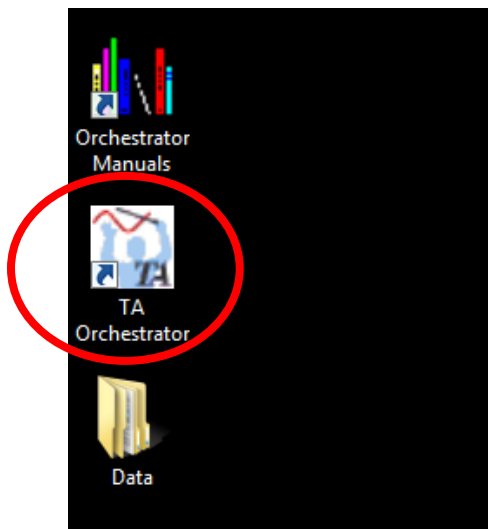
Remove lower tool from box. This is the 25-mm plate. Put tool over PRT and screw down.

<p data-bbox="100 974 435 1003">Placing lower tool on motor.</p> 	<p data-bbox="576 974 943 1003">Before lower tool is screwed in.</p> 
<p data-bbox="100 1421 451 1482">Tighten lower tool by rotating clockwise.</p> 	<p data-bbox="576 1421 818 1451">Lower tool installed.</p> 

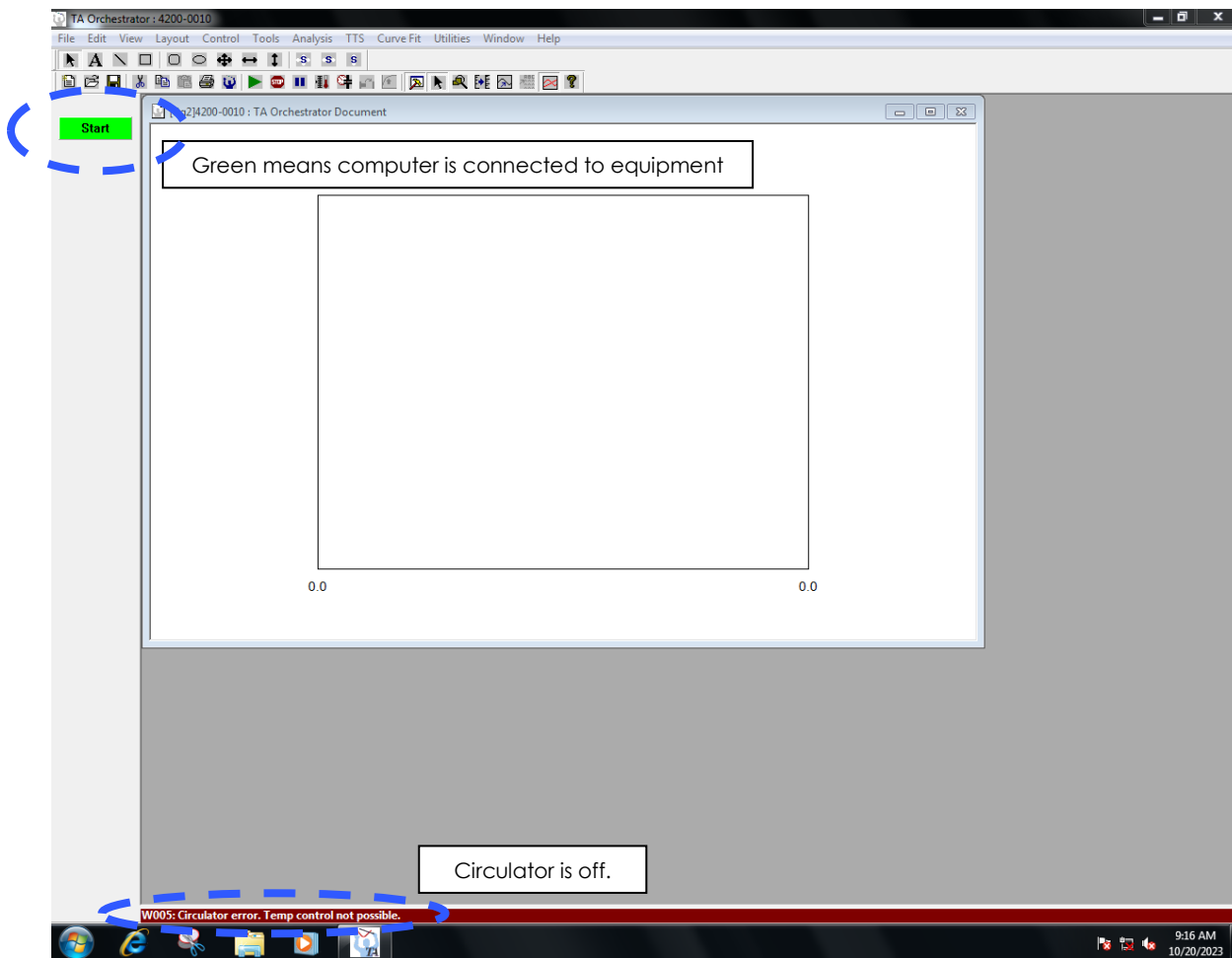
## 4.2 INITIAL STEPS OF SOFTWARE SETUP

Log into TUMI. This will turn on the computer monitor.

### 4.2.1 Open TA Orchestrator



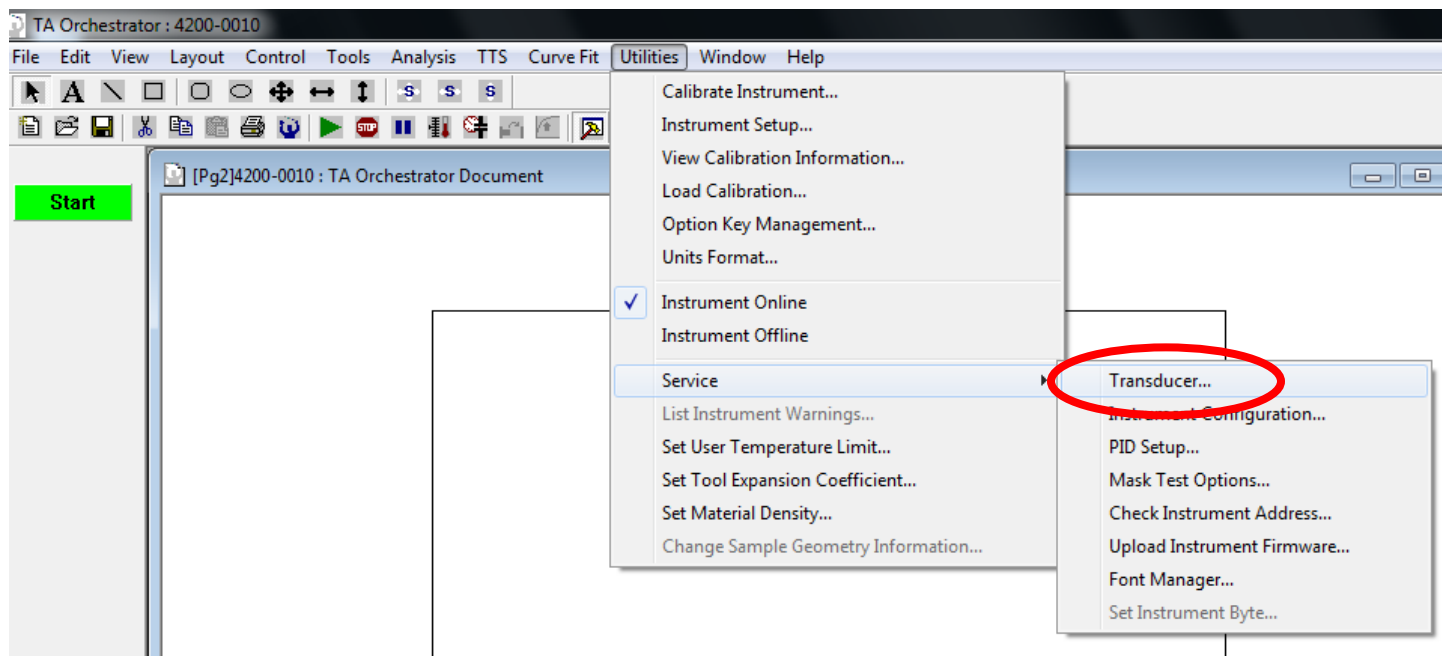
This is the screen you will see after opening the software. The “Start” button should be green, and it will likely have a red error bar along the bottom.



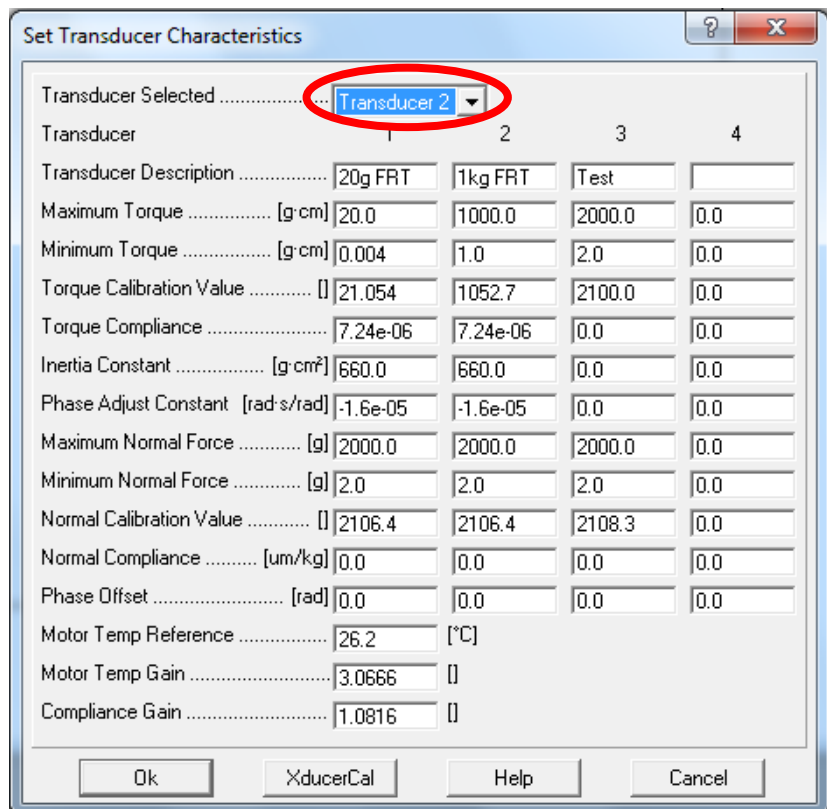
### 4.2.2 Select Transducer 2

The system has two transducers, one low and one high load. To avoid damaging the low-load transducer when inserting or removing tools, we want to make sure Transducer 2 is selected.

Open Utilities → Service → Transducer



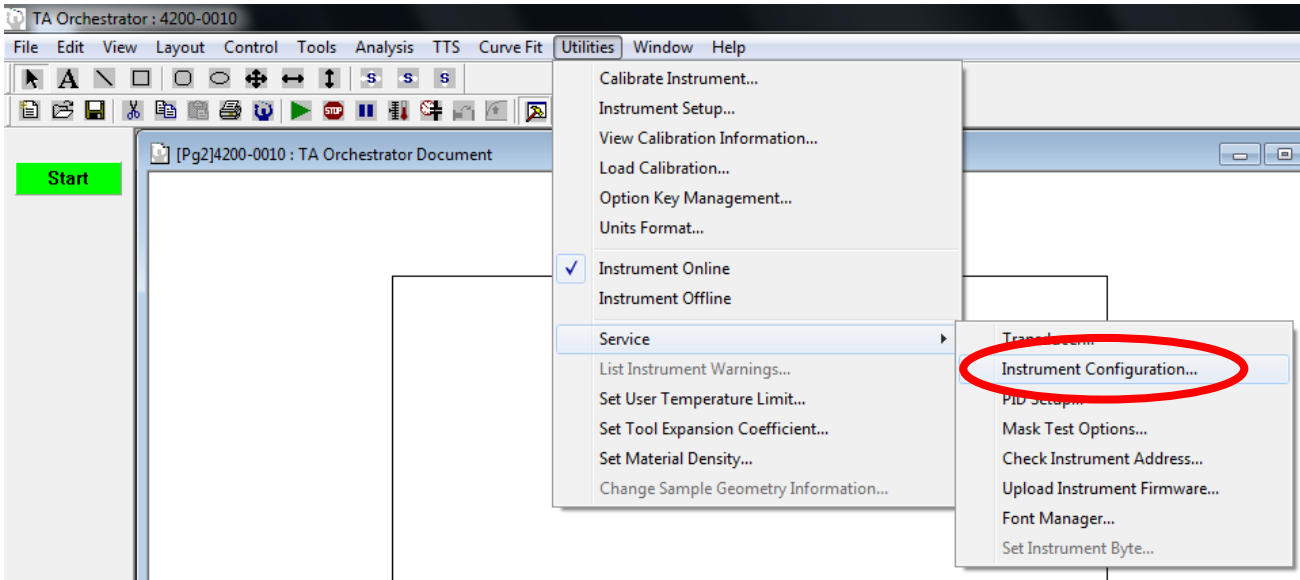
Select Transducer 2 from the dropdown menu if it is not already selected. Then click “Ok”.



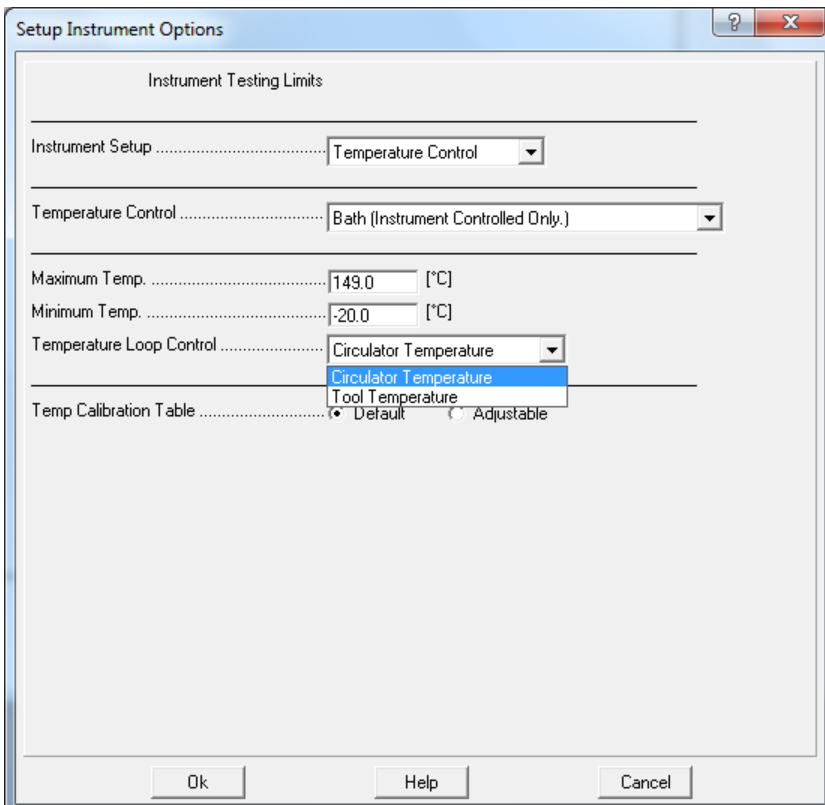
### 4.2.3 Set temperature control

The temperature of the equipment can be controlled by the circulator temperature or by the tool temperature. The circulator temperature will reach the desired temperature more quickly. The advised procedure is to use the “circulator temperature” to reach the approximate temperature and then switch to “tool temperature” to more precisely control the temperature.

Open Utilities → Service → Instrument configuration.

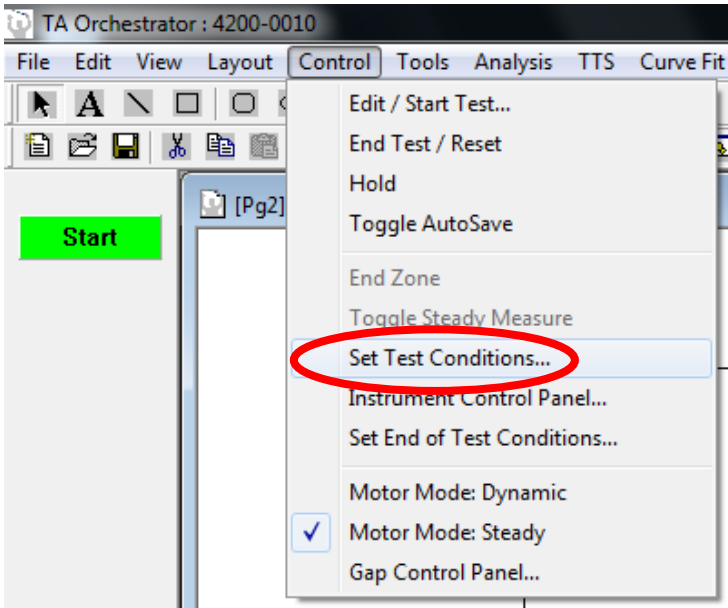


For now, select “Circulator Temperature” under temperature loop control. Then click “Ok”.

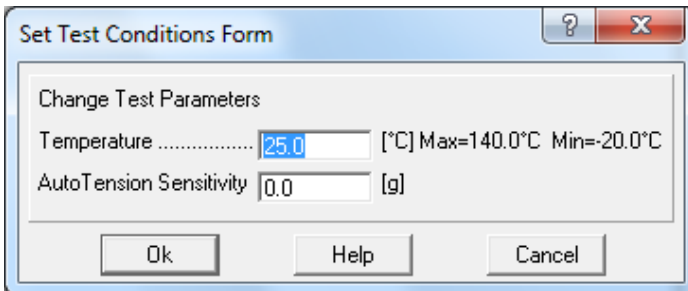


#### 4.2.4 Set test temperature

The testing temperatures possible range from -10°C to 150°C. To set the test temperature and start equilibrating the system, open Control → Set Test Conditions.

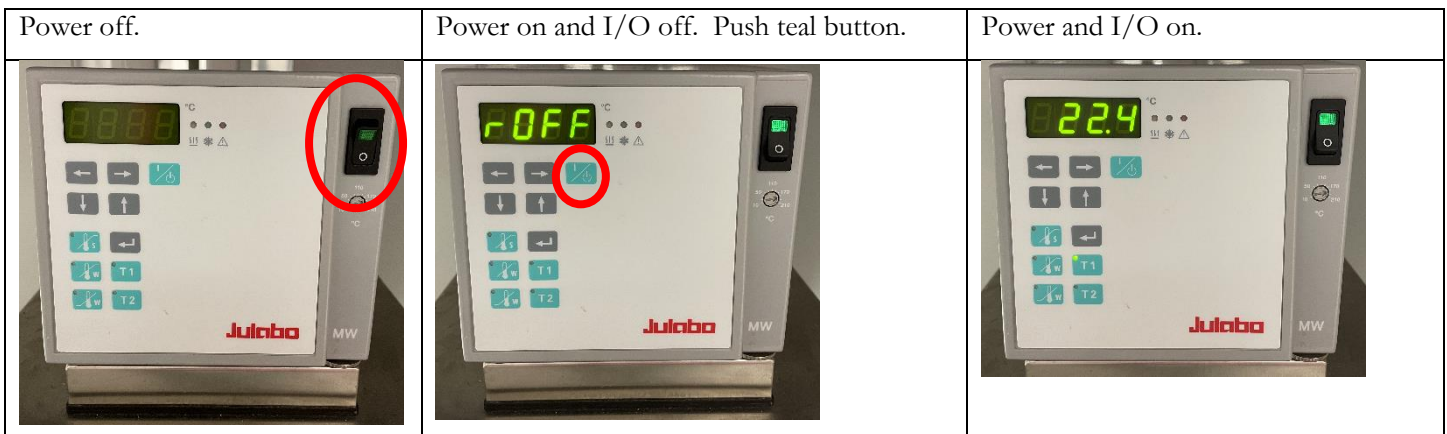


Put in your test temperature and click “Ok”.



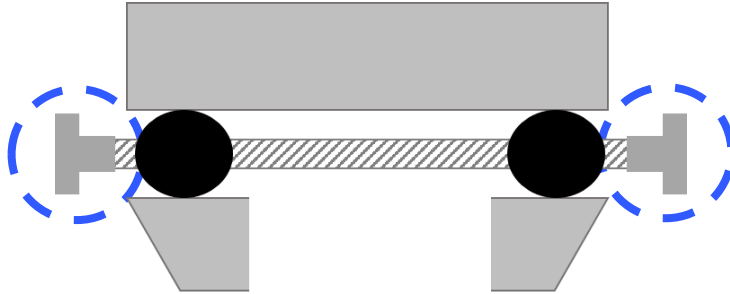
### 4.3 TURN ON CIRCULATOR

Flip the power switch to on and then push the control I/O if it is not already lit. The control and heating lights should now be on.



#### 4.4 INSERT THE UPPER TOOL

The upper tool is held in place with two thumbscrews on the side of the tool head. (Circled in blue)



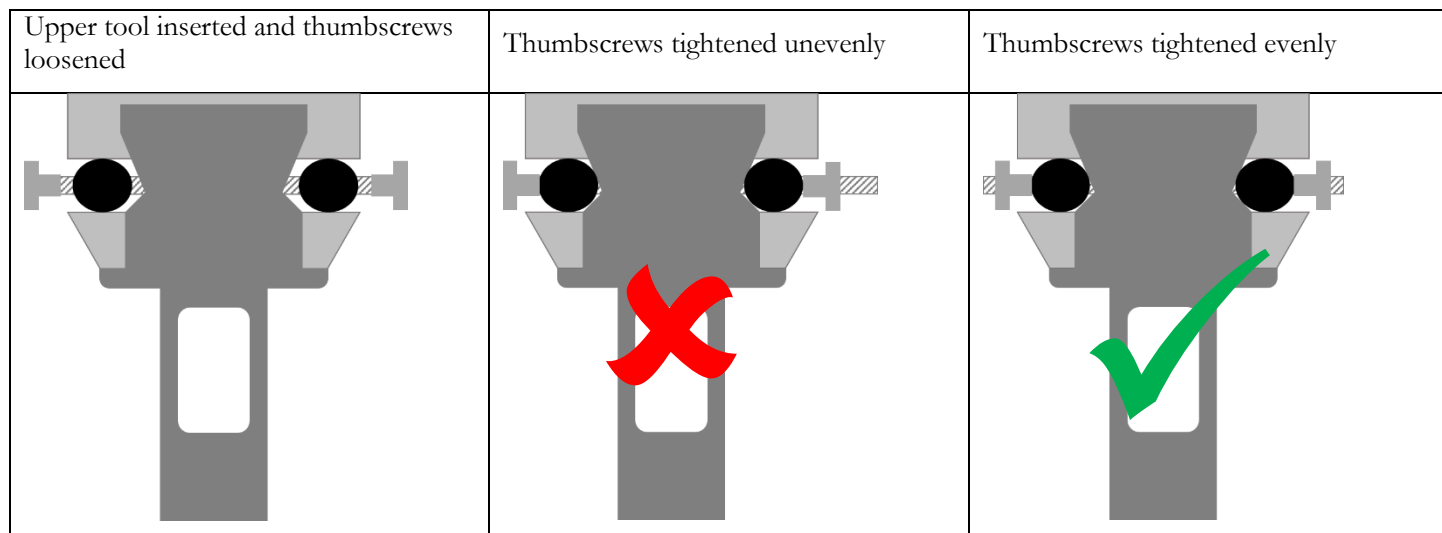
Align upper tool so that the groove/opening at the top is the same direction as the thumbscrews.



While supporting the upper tool (hold onto the shaft), carefully insert the upper tool into the head of the machine. Try to keep the normal load and torque as close to zero as possible.



After inserting the upper tool, evenly tighten the thumbscrews to hold onto the upper tool. Continue to hold onto tool shaft to prevent the upper tool from dropping.

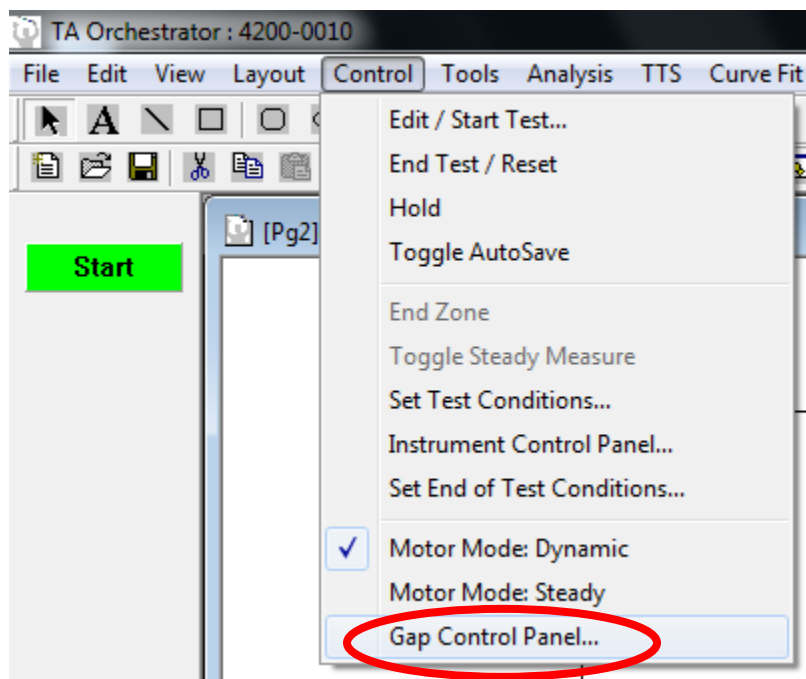


Let the system temperature stabilize and then continue.

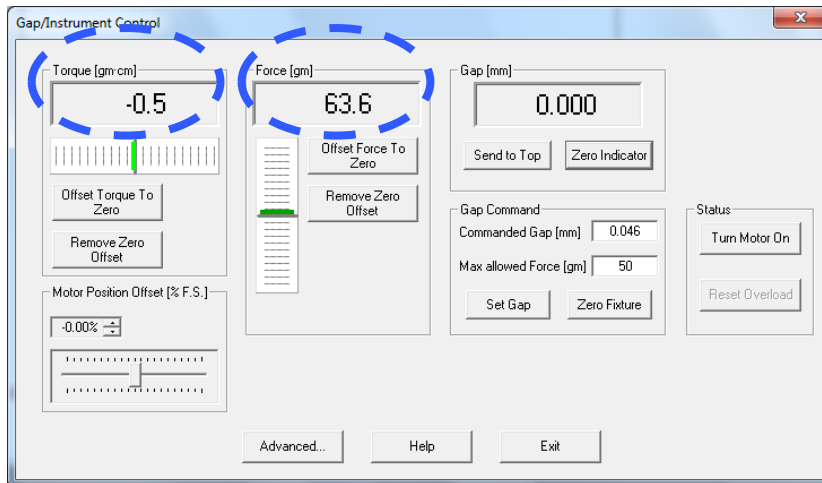
### 4.5 ZERO THE FIXTURE

Before starting a test, we need to tell the equipment what the expected gap should be and zero the fixture.

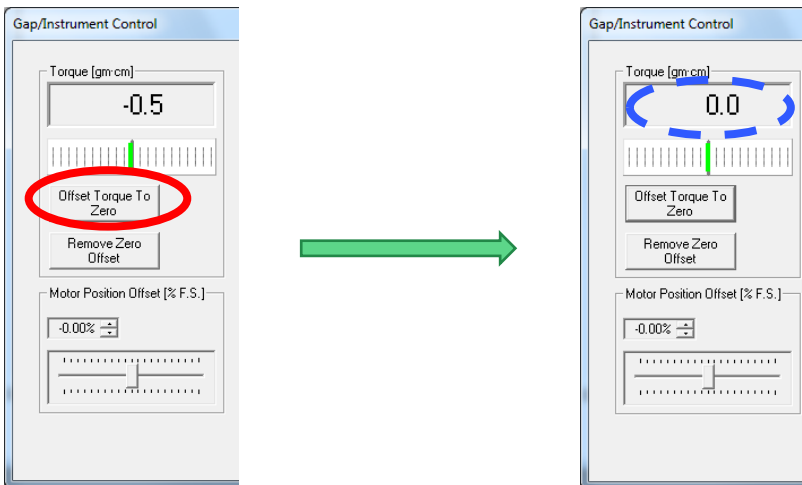
Open Control → Gap Control Panel



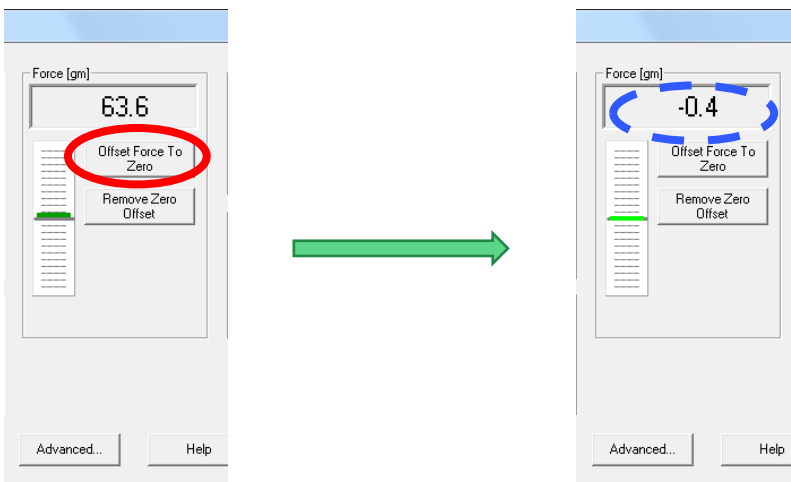
After installing the upper tool, we now have a normal force reading and a small torque reading (circled in blue). We want to zero both so that we can measure relative normal force and torque.



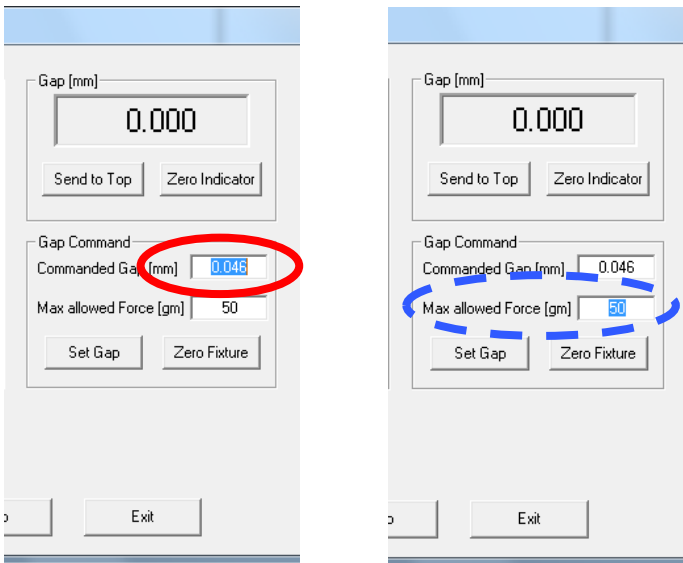
Click “Offset Torque to Zero”.



Click “Offset Force to Zero”



Put in the gap you plan to use. For the 25-mm cone-and-plate fixture, we're using 0.046 mm. The "Max allowed Force (gm)" should always be 50. The fixture figures out the zero point when it reads 50 grams. This is a small value and will not damage the tools.



After entering the gap value and checking the maximum force allowed, use the stage controls on the equipment (circled in gold) to lower the head.



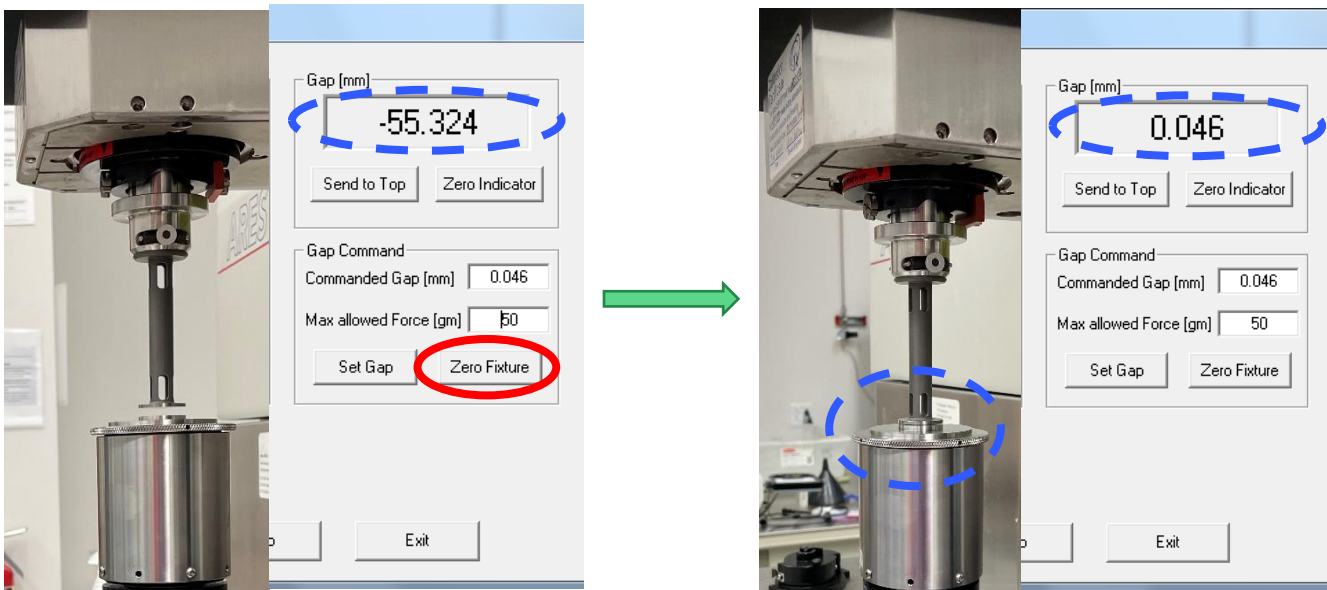
Pushing the single arrow down button moves the head down very slowly.



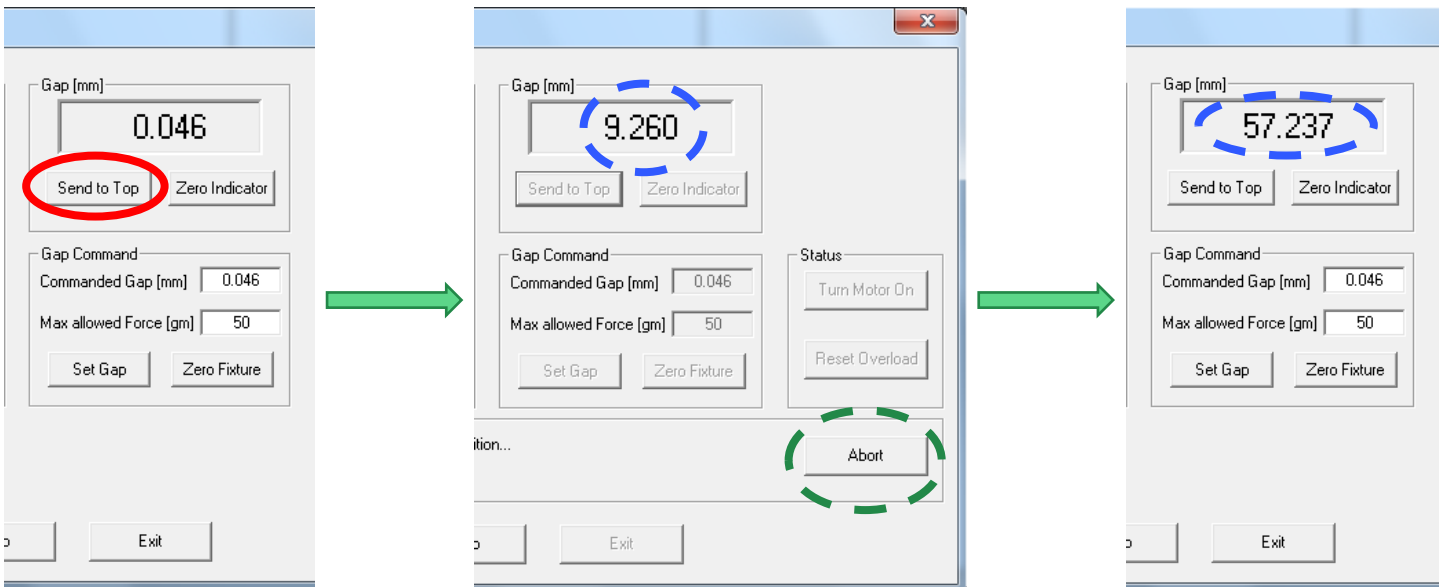
Pushing both the single and double arrow buttons at the same time will increase the speed of the head. Be careful when getting close to the lower tool.



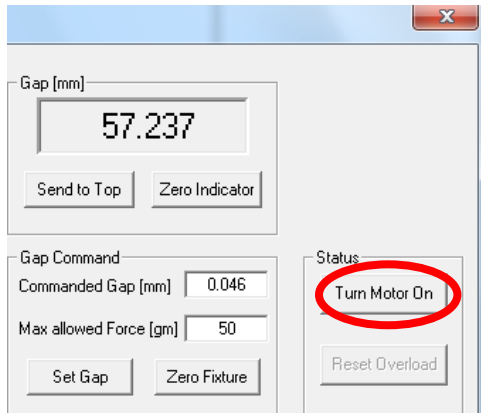
Bring the bottom of the upper tool down to about 1 mm above the lower tool. Note that the Gap reading has changed from 0 to -55.324. Click “Zero Fixture”. The head will continue to move down and will identify the zero point (upper and lower tools barely touching). After zeroing, the head will move to the commanded gap.



Click “Send to Top” or use the top two red buttons to raise the head to load your sample. Note the change in gap as the head moves up (circled in blue). There is an option to abort the process (circled in green).



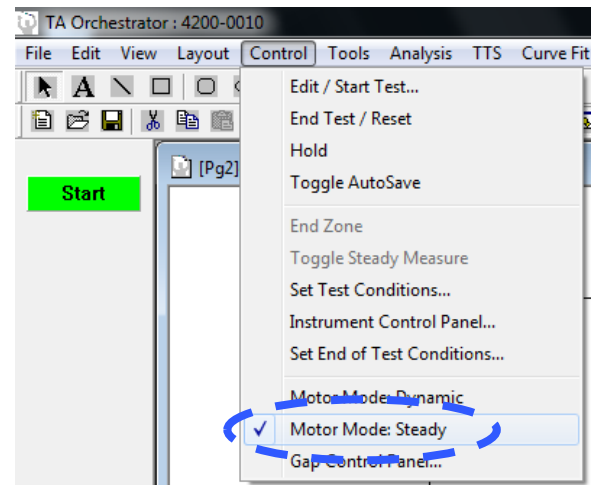
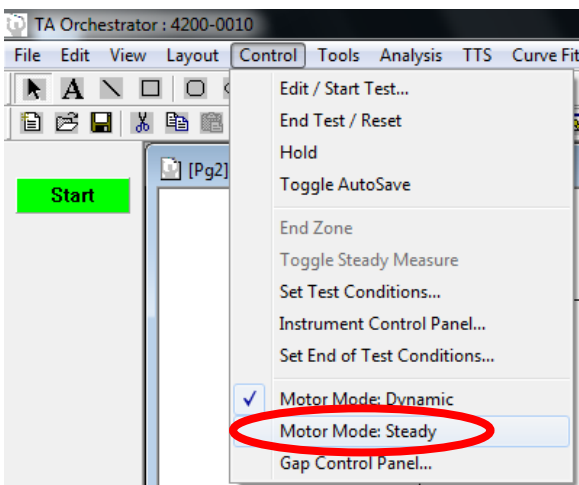
After the head has reached the top, click “Turn Motor On.” Exit the gap control panel by clicking “Exit”.



If the motor shakes when turned on, hit the stop button on the front of the equipment.

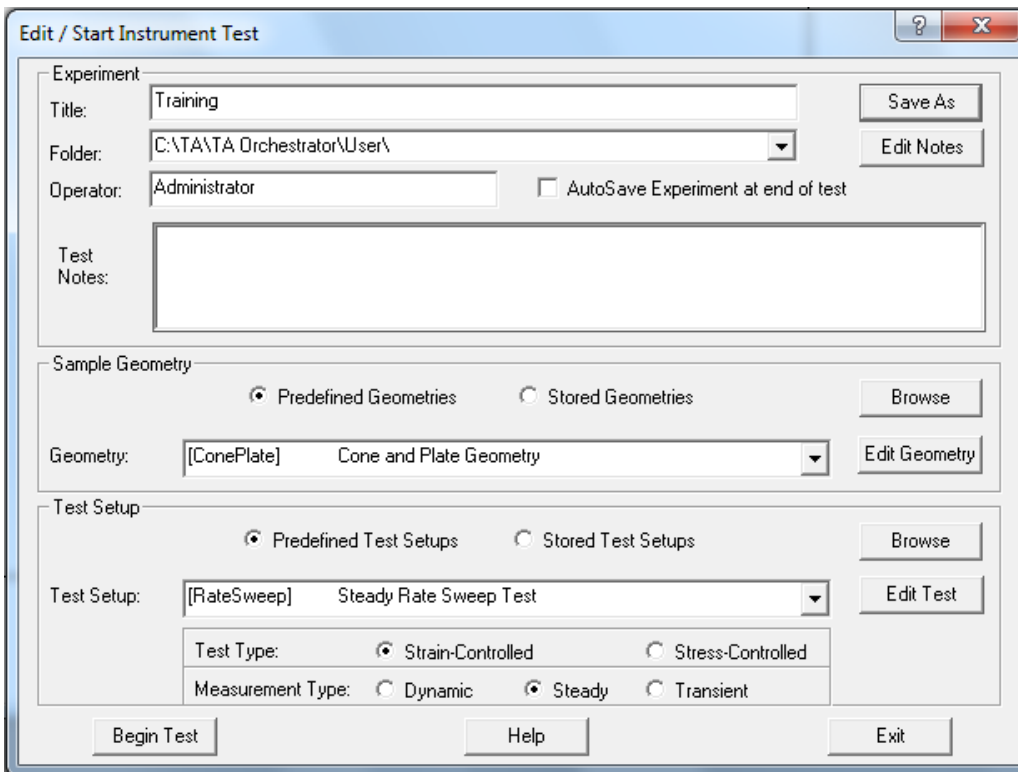
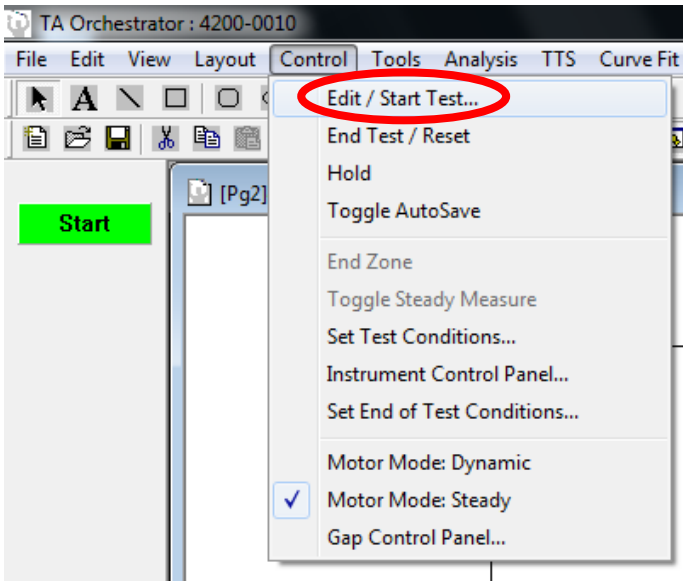


Toggle between steady and dynamic motor modes by clicking Control → Motor Mode: Steady. Make sure you turn the motor back on after choosing the mode. It should not vibrate this time.

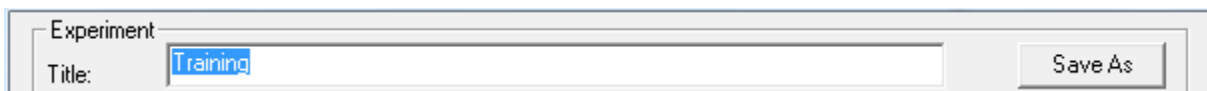


## 4.6 SETUP TEST

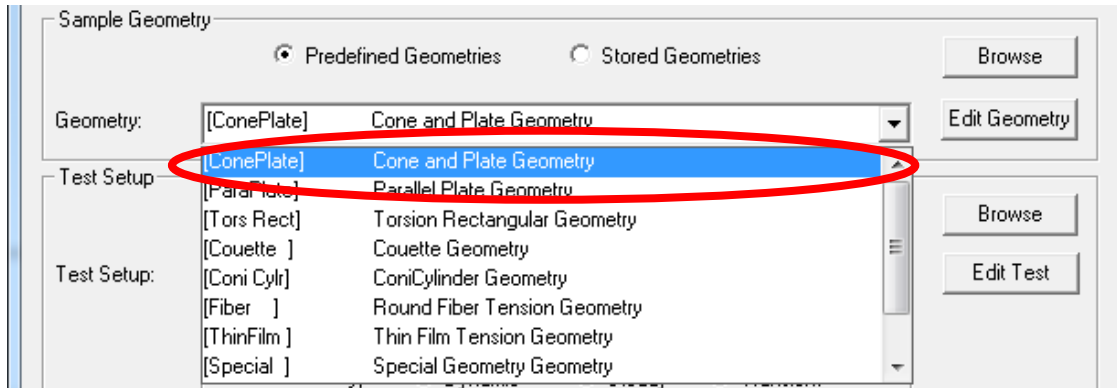
To input your desired test parameters, go to Control → Edit/Start Test.



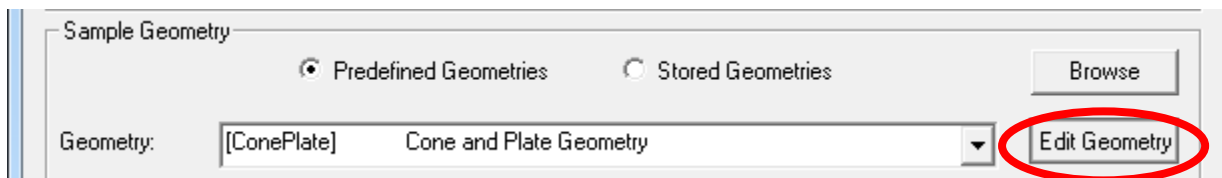
Navigate to your folder and then put in the title of your experiment.



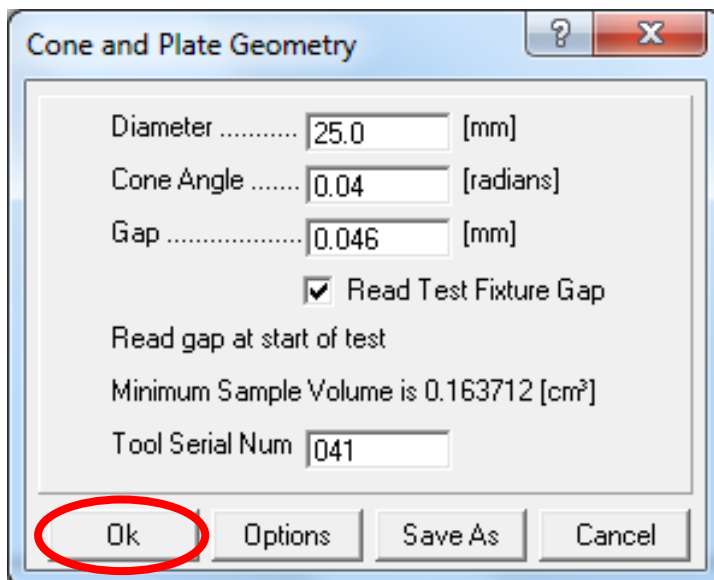
Choose sample geometry by click on the drop down arrow. For this SOP, we will be using the 25-mm cone and plate.



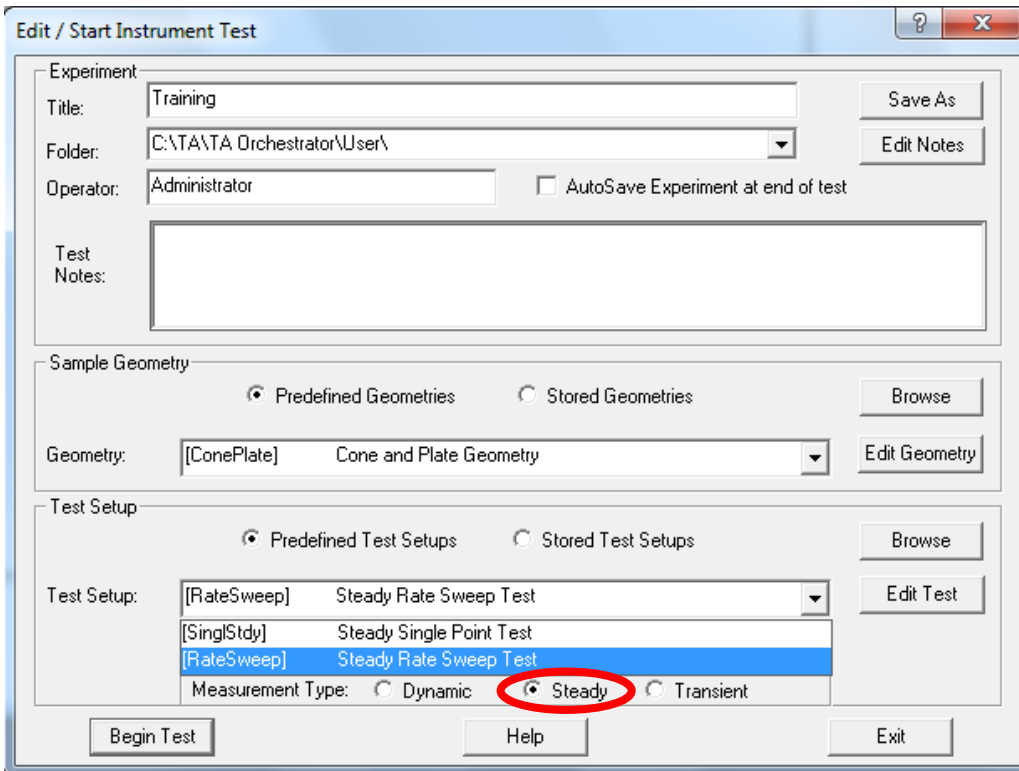
Click “Edit Geometry” to change the cone and plate parameters.



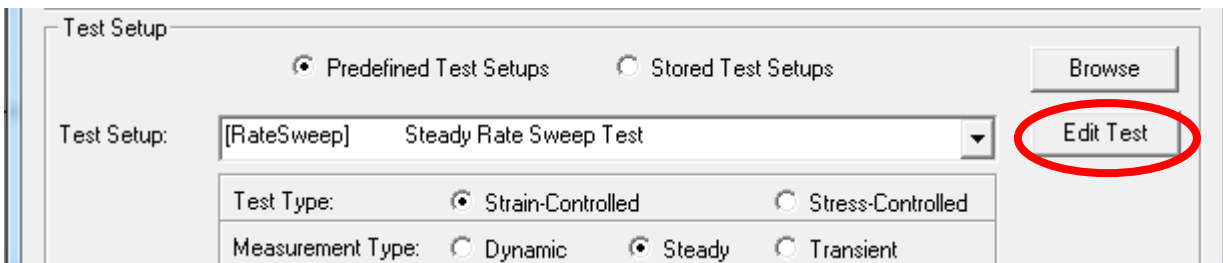
Put in 25 mm for the diameter and 0.04 radians for the cone angle (this is included in the storage box of the upper tool). You can leave the “Read Test Fixture Gap” checked- we have already set the gap to be 0.046 mm. Click “Ok”.



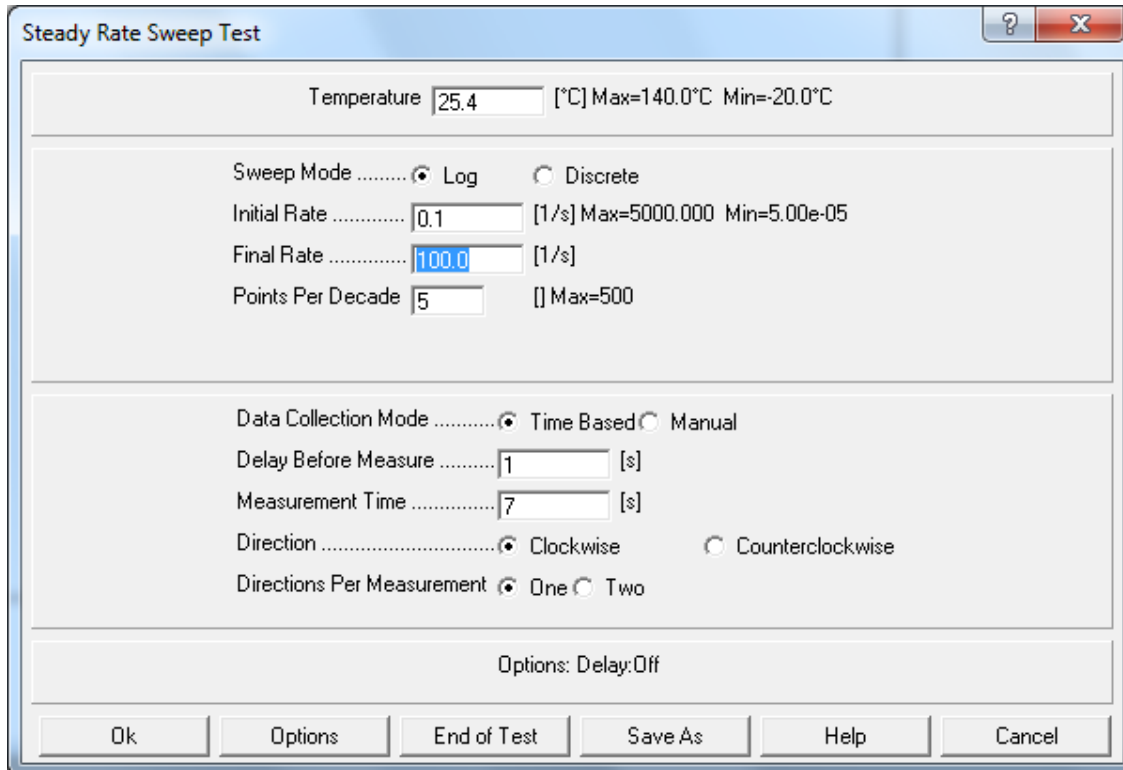
Choose the test you'll be using. For this SOP, we'll be using the "Steady Rate Sweep Test". The "Measurement Type" should be selected as "Steady".



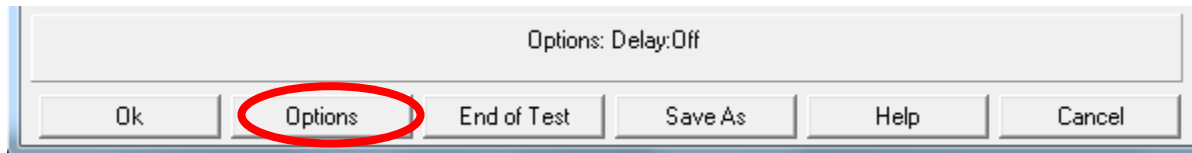
Click "Edit Test".



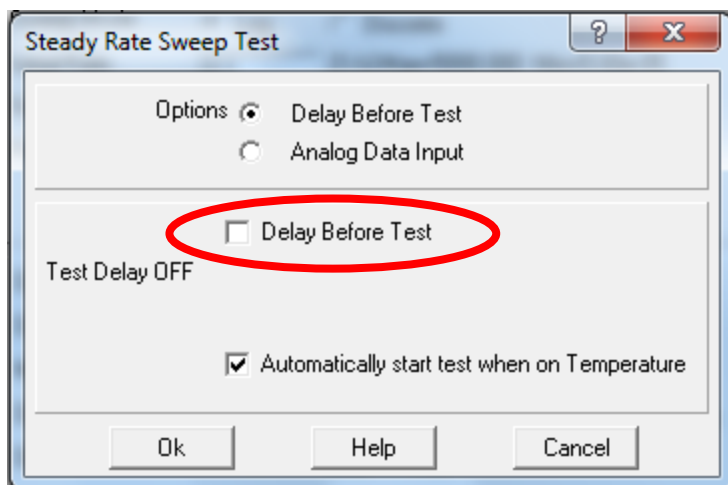
Change test parameters as desired. For this SOP, we'll be using the parameters in the screenshot below.



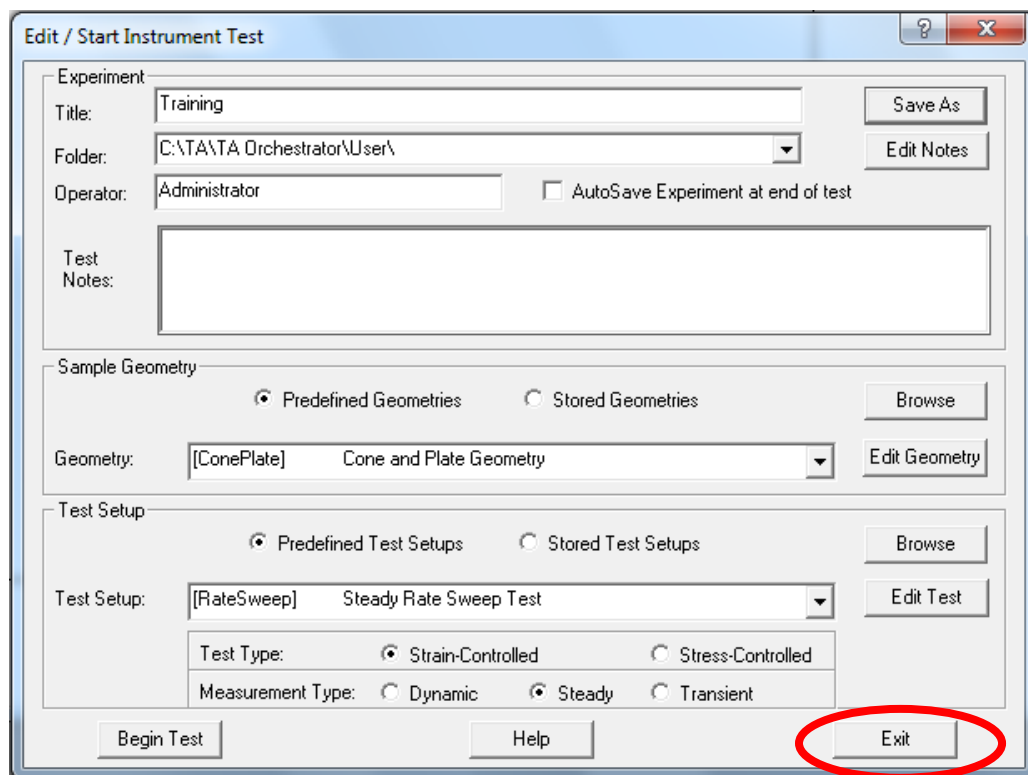
If you would like to add a delay before the test begins, click “Options”.



If you check the box for “Delay Before Test”, it gives you the options to delay the test based on a time delay or when the equipment reaches the testing temperature. Click “Ok” to return to the test parameters.

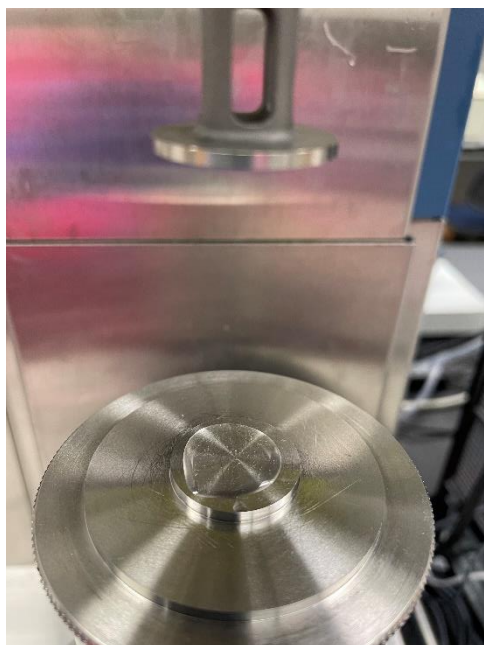


Click “Ok” to close the Test Setup box. We still need to load the sample, so we are not ready to start the test yet. Click “Exit”.



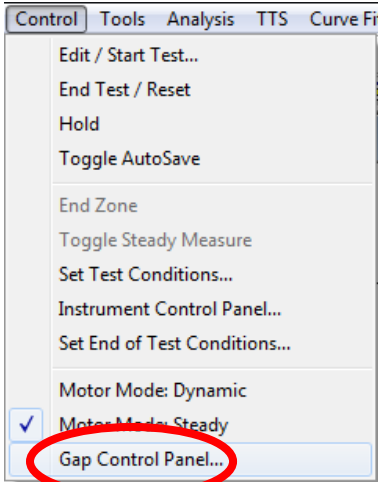
## 4.7 LOAD SAMPLE

Using a pipette or spatula or other tool, place your sample on the top of the lower tool. The sample volume required for this geometry is 0.17 ml. In order to ensure the sample reaches the edge of the tools, more sample is added then required and then wiped away.

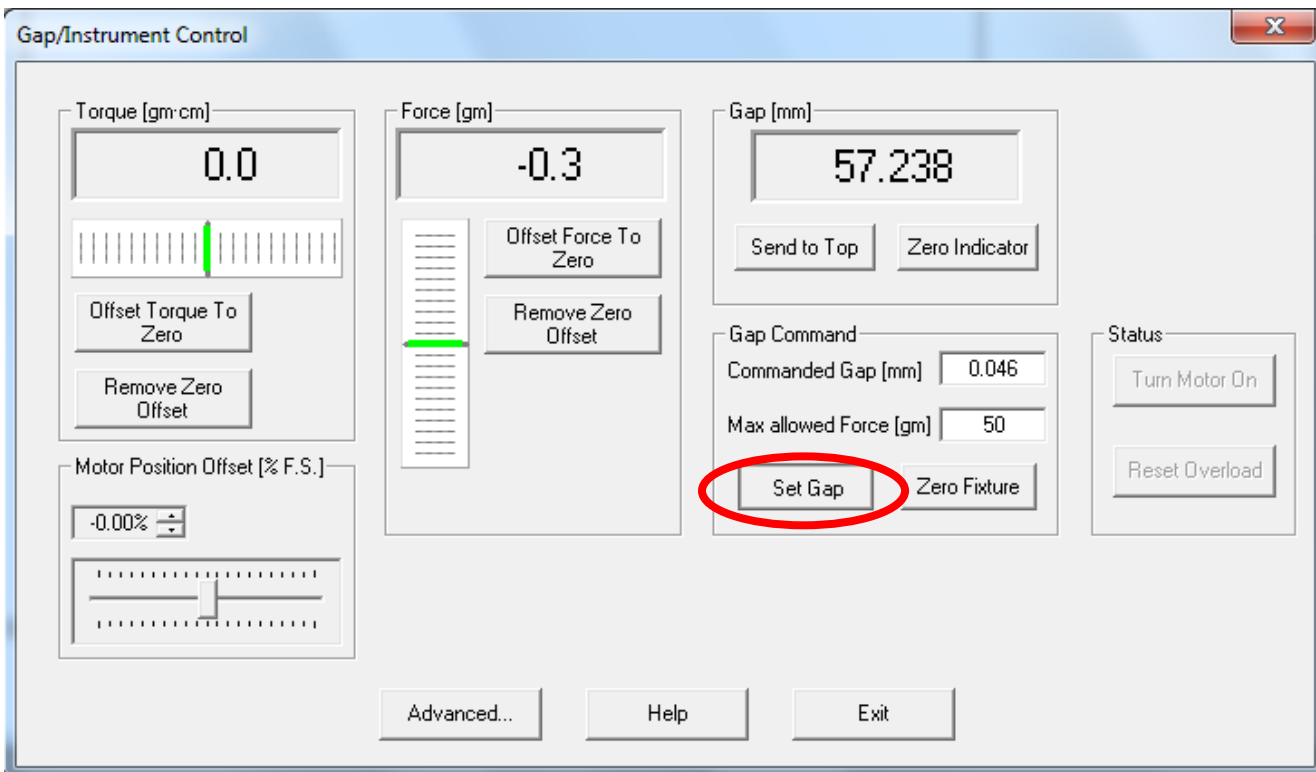


4.7.1 Set gap

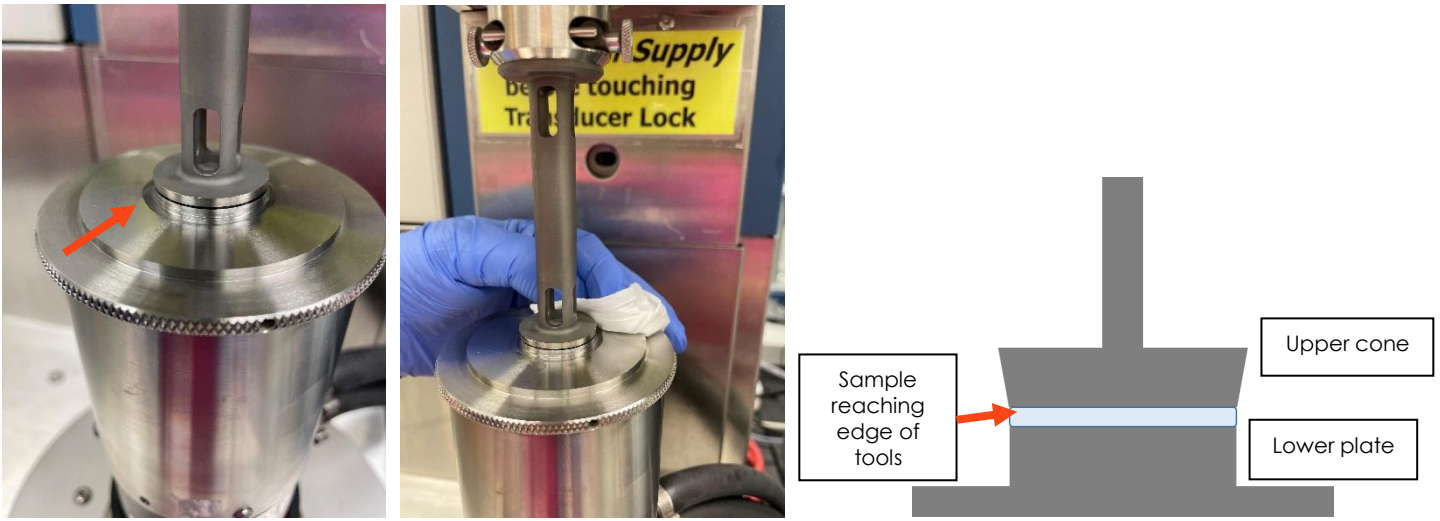
Go back to Control → Gap Control Panel.



Click “Set Gap.” The head will move down to the specified gap.

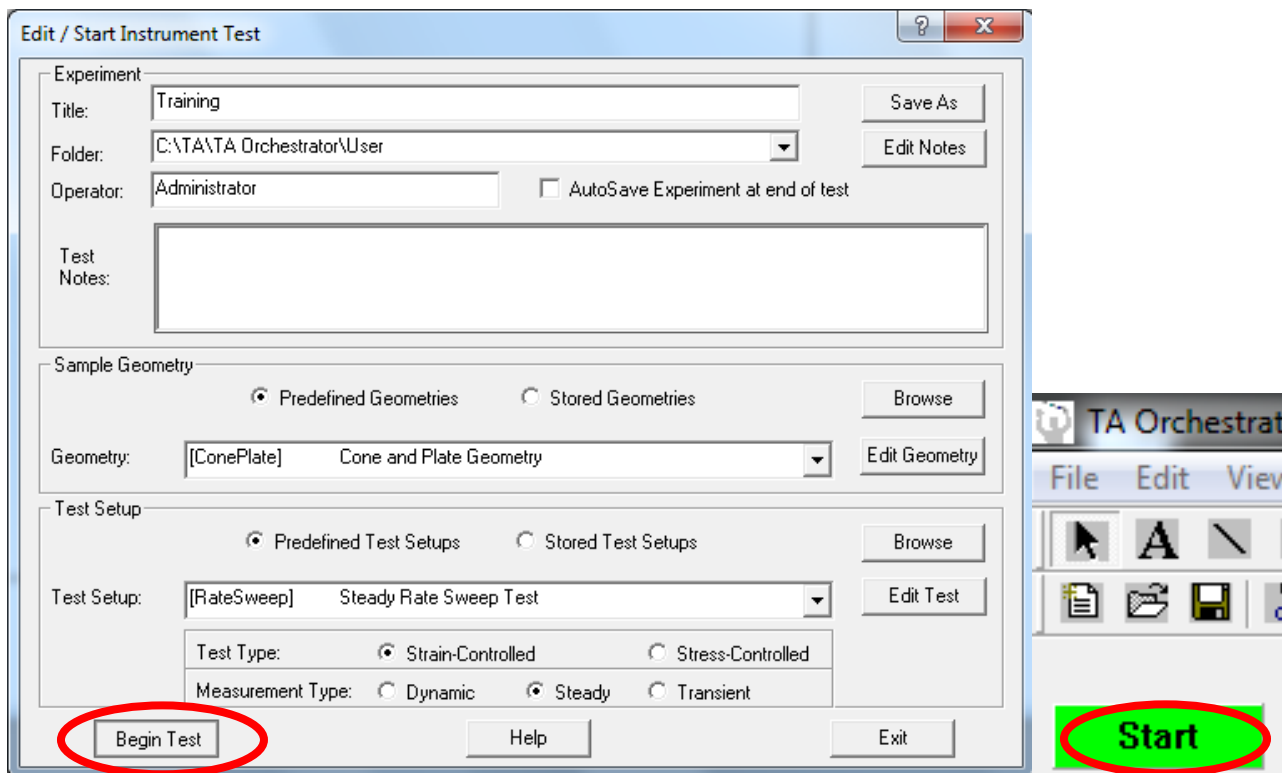


Using a paper towel, clean up excess sample (see arrows). Ideally, your sample will be perpendicular to the edge of the upper and lower tools (see schematic). Note: If your sample contains hazardous materials, the paper towels and pipette will need to be disposed of as hazardous waste.

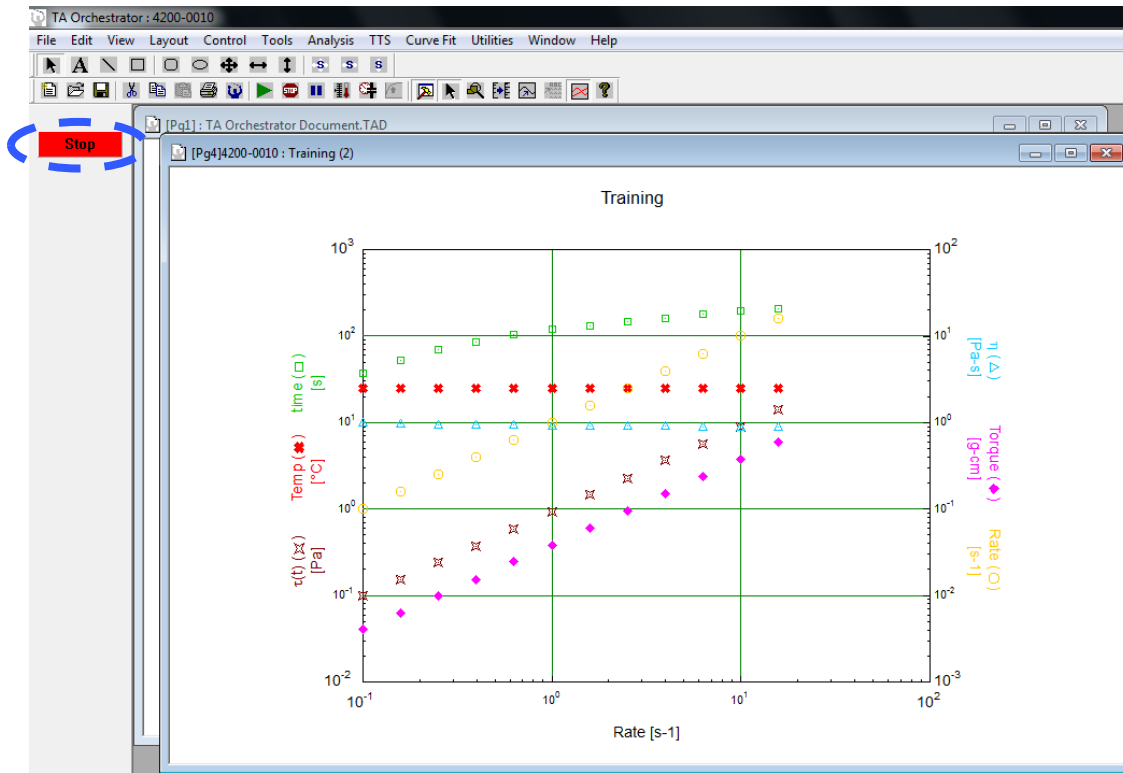


### 4.8 RUN TEST

Go back to Control → Edit/Start Test. Then click “Begin Test”. Alternatively, you can click the green “Start” button on the left side of the screen.

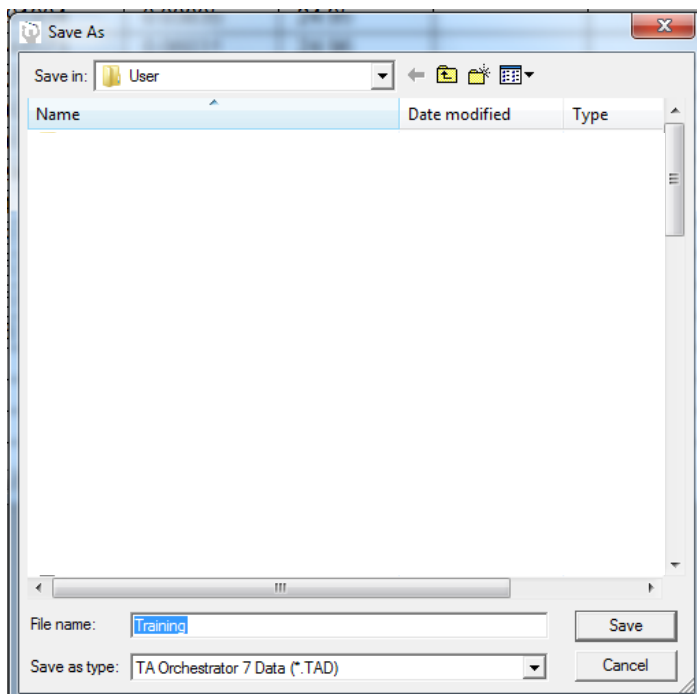


You will start to see data points appear in the plot. In addition, the green start button is now a red “Stop” button. Clicking Stop will interrupt the test.



#### 4.8.1 Save data

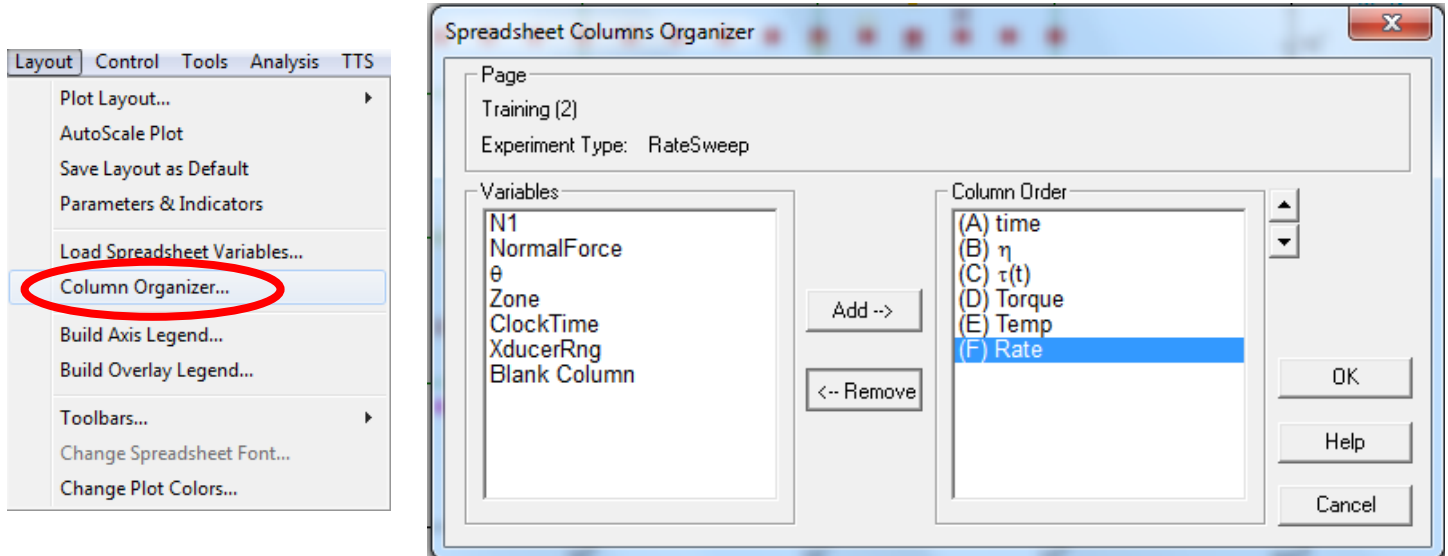
After the test is complete, go to File → Save As and save your data as a TA Orchestrator 7 Data (.TAD) file. This is a proprietary file type and will only open in Orchestrator.



# 5. Processing, Exporting, and Copying Data

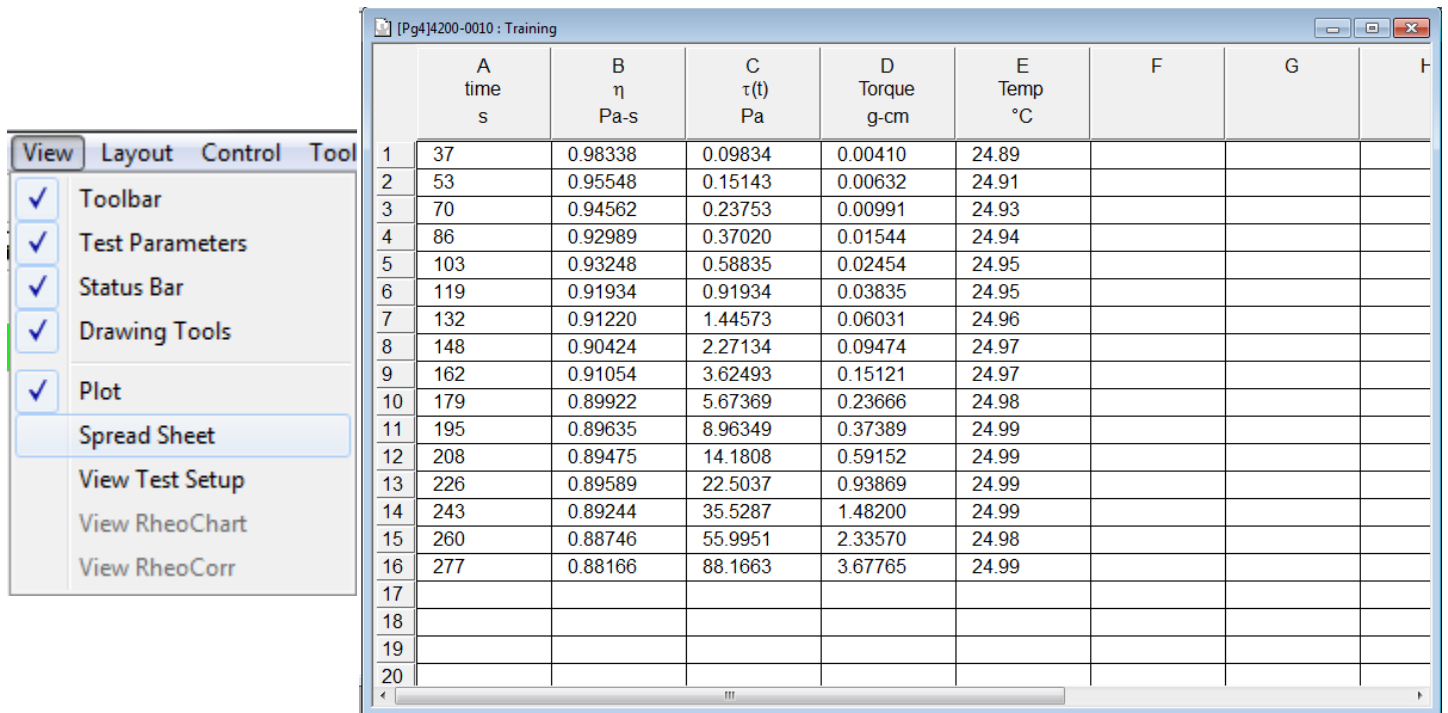
## 5.1.1 Change plot layout

There are several data processing options in the Orchestrator software. If you'd like to add or remove variables shown on the plot, go to Layout → Column Organizer. Click “Add” or “Remove” if you don't want to display a particular variable. Click “OK” after you're happy with the variables.



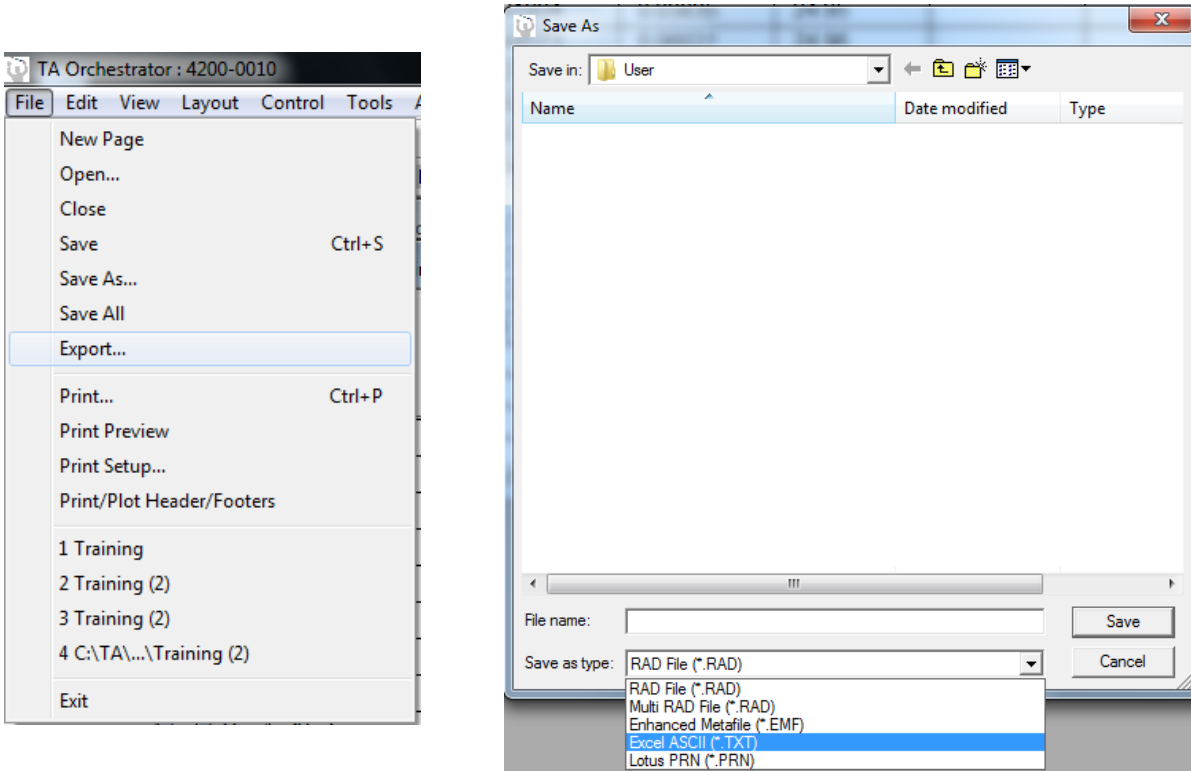
## 5.1.2 Viewing data as a spreadsheet

If you'd like to see your data in spreadsheet form, go to View → Spread Sheet.

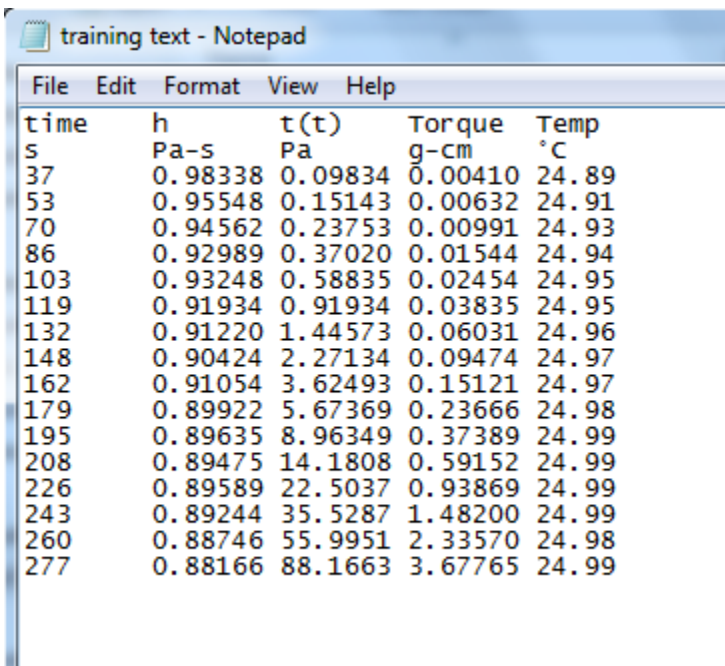


### 5.1.3 Saving data as a .txt file

Go to File → Export. Choose ASCII as the “Save as type”.



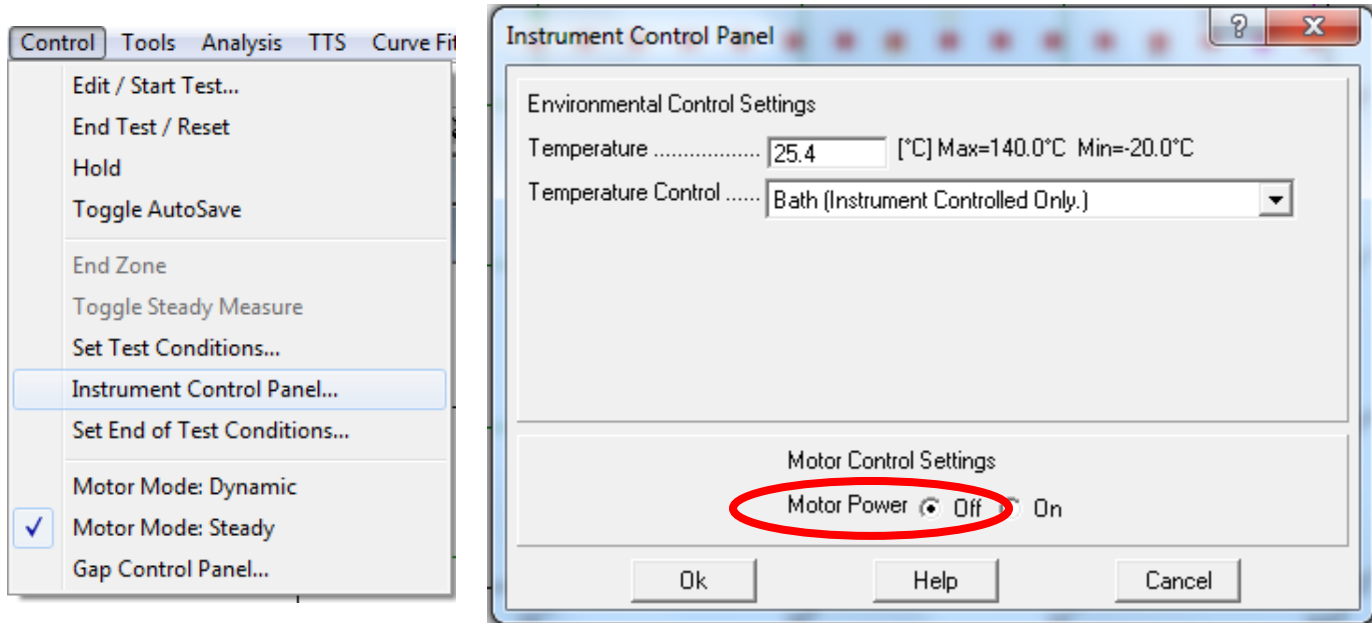
Open the text file to make sure you have all the data needed to analyze later.



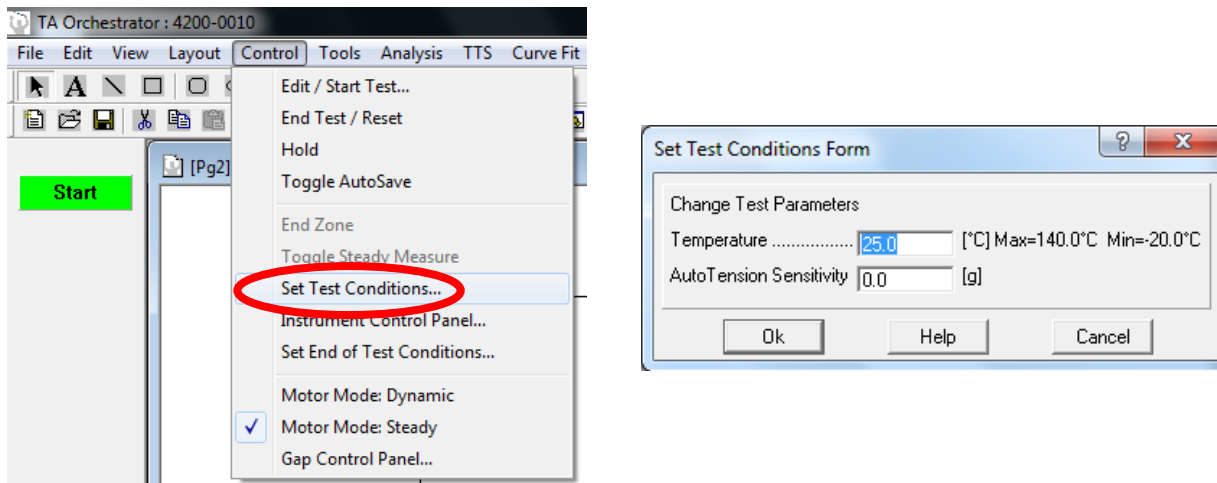
## 6. Equipment Shutdown

Send head to top using the top two red arrow buttons or in the gap control panel.

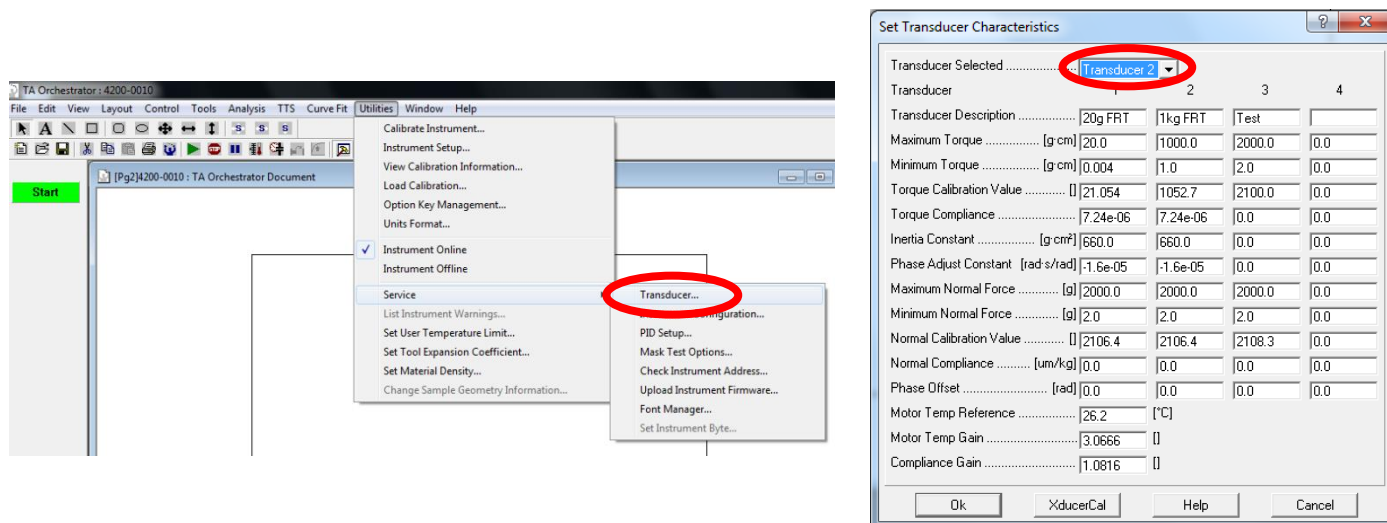
Turn off motor by opening Control → Instrument Control Panel.



If working at any temperature other than ambient, return to “Set Test Conditions” and change temperature back to 25°C. Wait until equipment reaches ambient temperature before proceeding.



Make sure Transducer 2 is selected and then remove upper tool. Be careful to support the upper tool when removing it.



Remove lower tool.

Remove the PRT and put back in box.

Close orchestrator.

Turn off the circulator.

Turn off instrument power.

Clean and dry tools. The tools can be cleaned with soap and water or ethanol. Rinse with DI water and then use the nitrogen line to dry. Once the tools are dry, put them back in the boxes and put the boxes away.

Lock the transducer. Remove the spacer and push the pin toward the front of the instrument. Reinsert the spacer.

Turn off air supply.

## 7. Waste Disposal

If using samples that do not require hazardous waste disposal, please clean up area and put all waste in trashcans. If hazardous waste disposal is required (liquids and solids), please notify RSC staff at [rscinfo@mail.ufl.edu](mailto:rscinfo@mail.ufl.edu) and wait for a written reply BEFORE beginning your test.

## 8. References

1. Ares Manual