

ARES Rheometer Manual:

Parallel Plate Testing

-McCoy Group, NMT-
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Introduction

The ARES rheometer measures the materials response under certain stresses and/or temperatures. There are 2 ARES Rheometers: an older, tan one in Jones 130C referred to as ARES-1, and a newer, blue one in Jones 128 referred to as ARES-2. Both ARES instruments have parallel plate and torsion testing functions; ARES-2 is the easiest to add a LN2 tank to for sub-ambient experiments. This manual regards ARES-2 specifically, though there is abundant procedural overlap with the operation of ARES-1.

Parallel Plate samples are usually in the liquid or gel phase, and are “squished” between the plates. A shear strain is applied to the sample from the motor below, and the upper transducer senses the torque response from the sample, thus characterizing various moduli and flow behaviors. This manual will detail how to perform a parallel-plate test on the ARES.

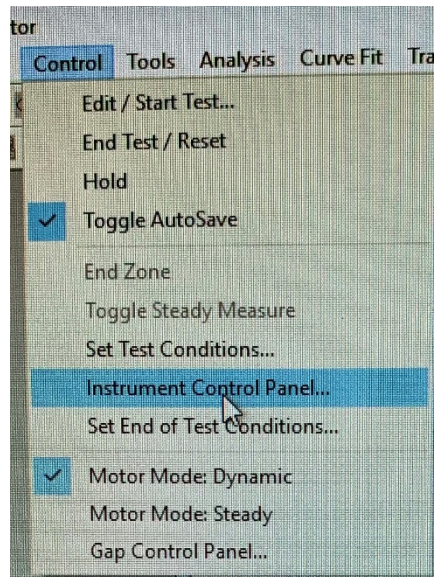
Parallel Plate Test Setup:

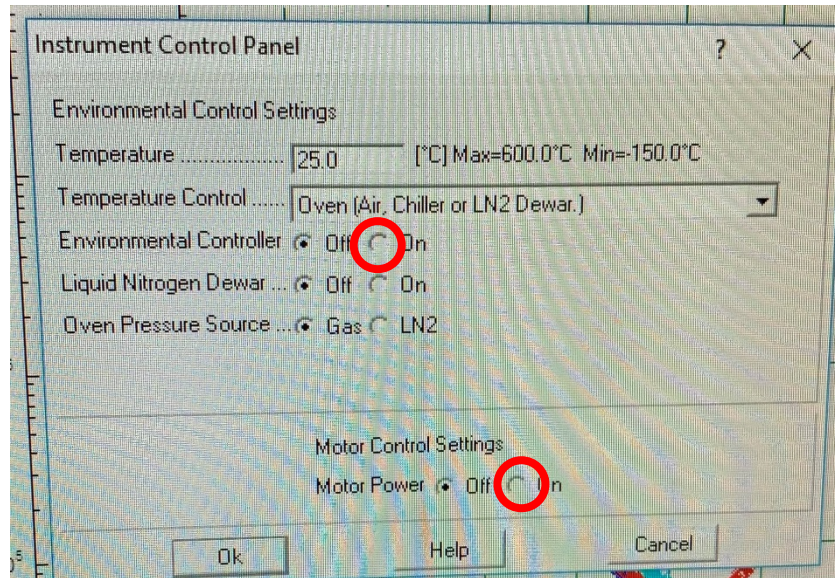
1. Complete the ARES startup procedure stipulated in the “Apparatus, Startup, Shutdown, and LN2” manual. **Instrument MUST NOT be used without the compressed house-air being turned on.**
2. Install the external temperature sensor (pictured below) if desired:
 - a. The bulky silver end fits into the motor, while the narrow end slides into the lower parallel plate fixture. Insert the sensor into the motor first before and then firmly push the lower fixture into the motor when installing. When the sensor is first installed, turn until it drops slightly indicating that it is properly orientated.
 - b. The specific readings of this thermocouple can be found by going to the **Utilities** tab, selecting **Service**, and then **Check Instrument Address**. Enter address 040E.
 - c. Go to **Utilities** in the RSI software, hover over the **Service** section, and **select Instrument Configuration**. Go to the **Temperature Control Loop** menu. Select Mode 2 (“Sample Tool”) **Keep Temp Calibration Table as Default**.

(If the external sensor is not used, select Mode 3 for the Temperature Control Loop.)

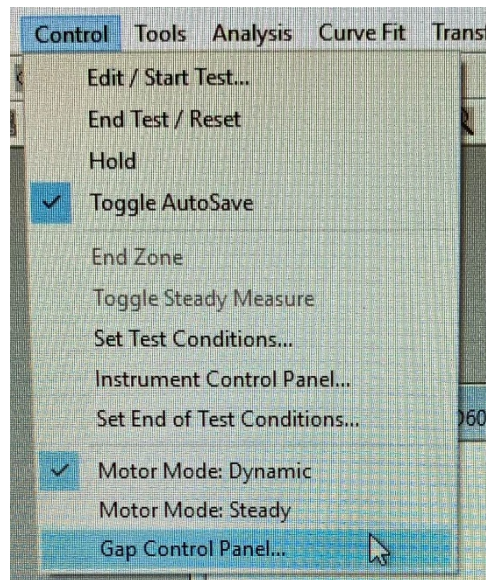


3. Attach the plate fixtures to main machine. Hand-tighten the screws. **Do not install the fixtures if the ARES is not turned on and/or does not have air.**
4. Under the **Control** menu, open **Instrument Control Panel** and set the motor (and environmental controller, if oven is to be used) to **On**. Set the desired oven temperature.

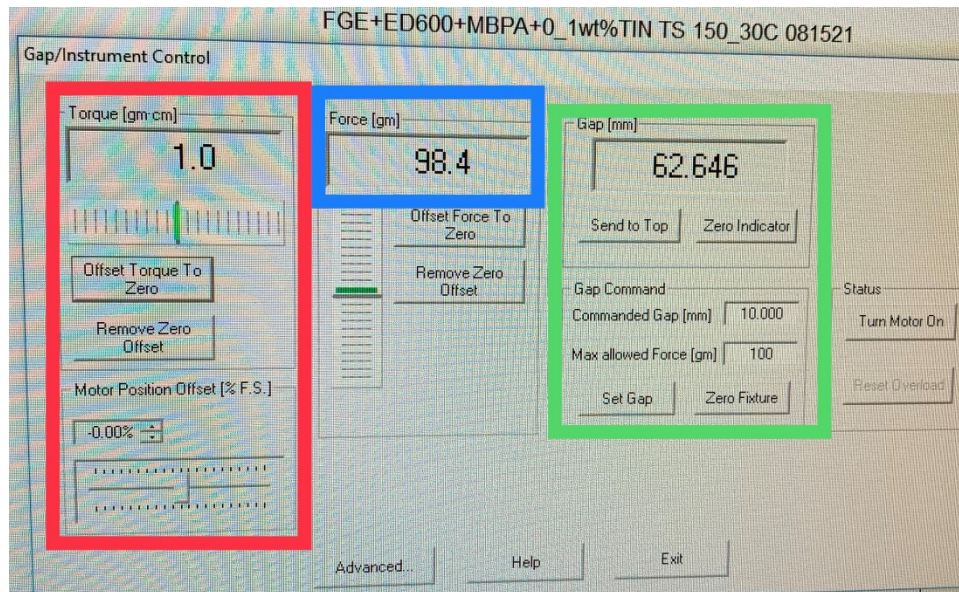




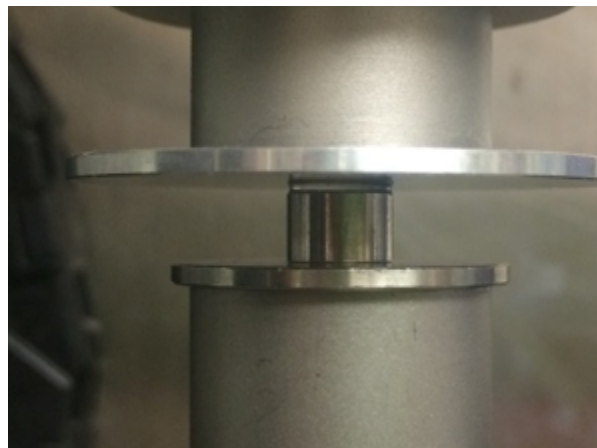
- Lower the top fixture to a near-zero gap using the buttons on the side of the main machine. Then, zero the gap in the RSI software. Go to **Control** and select **Gap Control panel**.



Select "Offset Torque to Zero" and "Offset Force to zero" The section of the window (pictured below) boxed in green has to do with the fixture gap. Select **Zero Fixture**, and wait for the gage to read 0.00 mm and then the value in "Commanded gap". Make sure the normal force, boxed in blue, did not spike as the instrument goes to zero gap.



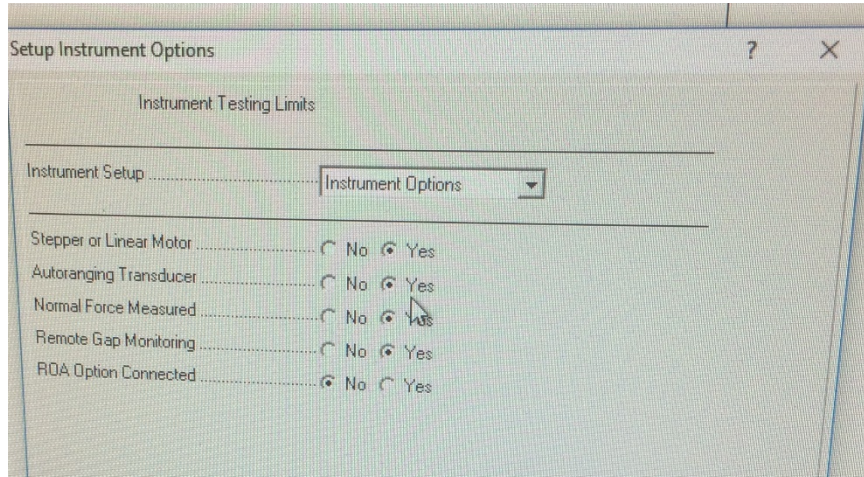
6. Jog the top plate back up (using buttons on side of instrument). Add a thin layer of the liquid/gel sample to the bottom plate, covering a wide enough area to make full contact with the entirety of the upper plate.
7. Jog down the top plate using both the bottom and middle arrow keys until the top fixture barely makes contact with the sample. Then, use only the bottom arrow until the sample is uniformly cylindrical, and does not dip inwards or outwards at its center. The sample sandwiched between the two plates should be about 1 to 2 mm thick.



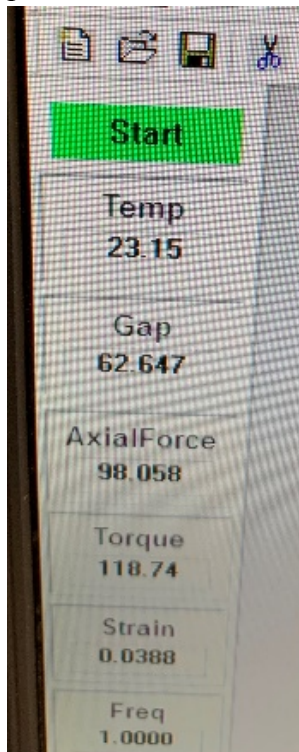
Setup is now complete.

Parallel Plate Test:

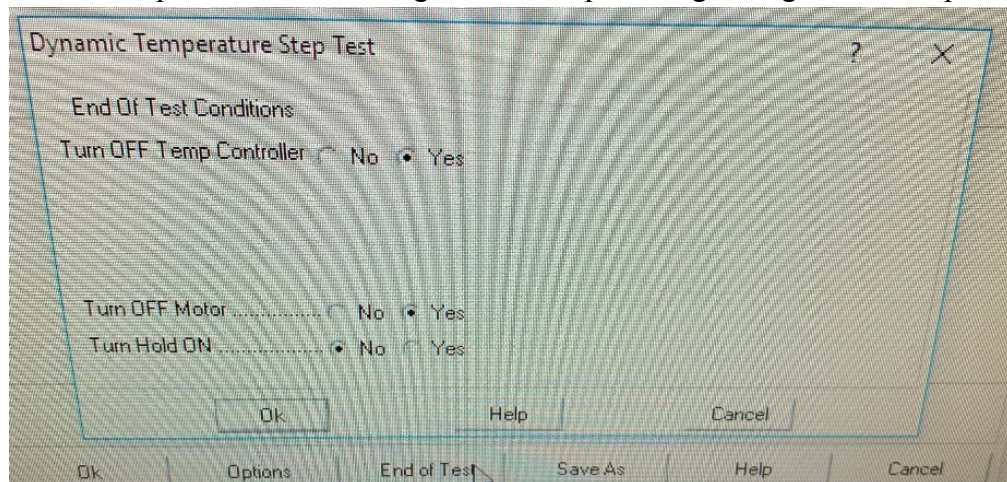
1. Before test is set up, consider whether you would like to implement multiple ranges for the transducer. If so, go to **Utilities** in the RSI software, hover over the **Service** section, and select **Instrument Configuration**. Under the Instrument Setup menu, select **Instrument Options**. Check “Yes” to **Autoranging Transducer**. This will permit both high and low moduli to be measured during a single test (e.g., as would occur in a temperature ramp for a glassy polymer)



2. Click the green **Start** button, pictured below.



3. Name and save the file to the correct location.
4. In the *Sample Geometry* section, select **Parallel Plate Geometry**. Click **Edit Geometry**, and input the plate diameter and the instrument gap. Uncheck “Read Test Fixture Gap”.
 - a. Click **Options**, and enter the **Tool Thermal Expansion Coefficient** as 2.67 $\mu\text{m}/\text{C}$. Check the **Change Gap to Match** option.
5. In the *Test Setup* section, choose your test type. Click **Edit Test**, and set the test parameters. Under **Options**, many features can be implemented if desired:
 - a. There can be a **Delay Before Test**, if you would like to start once the chamber is a certain temperature, or if you would have the sample soak for a certain amount of time.
 - b. **AutoTension** and/or **AutoStrain** can be set to keep a constant normal or torque force on the sample. For AutoTension, the usual parameters are 10g Initial Force and 2g Sensitivity. Use “Compression” for parallel plate testing. AutoStrain is not typically used, and may be set to 0 g/cm.
 - c. The time per measurement can be adjusted. This may be set to a higher interval for long experiments. Note that measurements cannot be taken more often than the motor frequency dictates (i.e. a 1Hz test cannot take more than 1 measurement per 1 second).
6. Once the Options have been set, open the **End of Test** menu:
 - a. It is recommended to check **Turn OFF Motor**.
 - b. If **Turn OFF Temp Controller** is selected, please also select **Turn Hold ON**. This will prevent motor damage as the sample changes length with temperature.



7. After all test parameters have been set, click **Begin Test**. If the test must be stopped for whatever reason, click the **Stop Test** button (pictured below)



8. **Log the run in the ARES logbook.** Include the date, the project for which the test is performed, and the duration of the run in hours.
9. Wait for the test to complete, and then perform the shutdown procedure stipulated in the “Apparatus, Startup, Shutdown, and LN2” manual.