

**Standard Operating Procedure for the
Discovery Hybrid Rheometer HR-3**

Coral Reservations

- The Discovery Hybrid Rheometer is on the CCMR Coral Equipment Reservation and Enabling System. To use the Discovery Hybrid Rheometer you must reserve and enable it through your CCMR user account.
- More Information about Coral can be found at:
<http://www.ccmr.cornell.edu/facilities/coral.html>

About the Rheometer

The Discovery Hybrid Rheometer is a stress controlled shear rheometer with a range of measurement options. It measures various properties including: viscosity, shear stress, storage and loss modulus, strain, and phase angle. A number of geometries are available including: various diameter parallel plate and cone plate; cup and rotor with options of a vaned or conical rotor; and a number of tribological accessories.

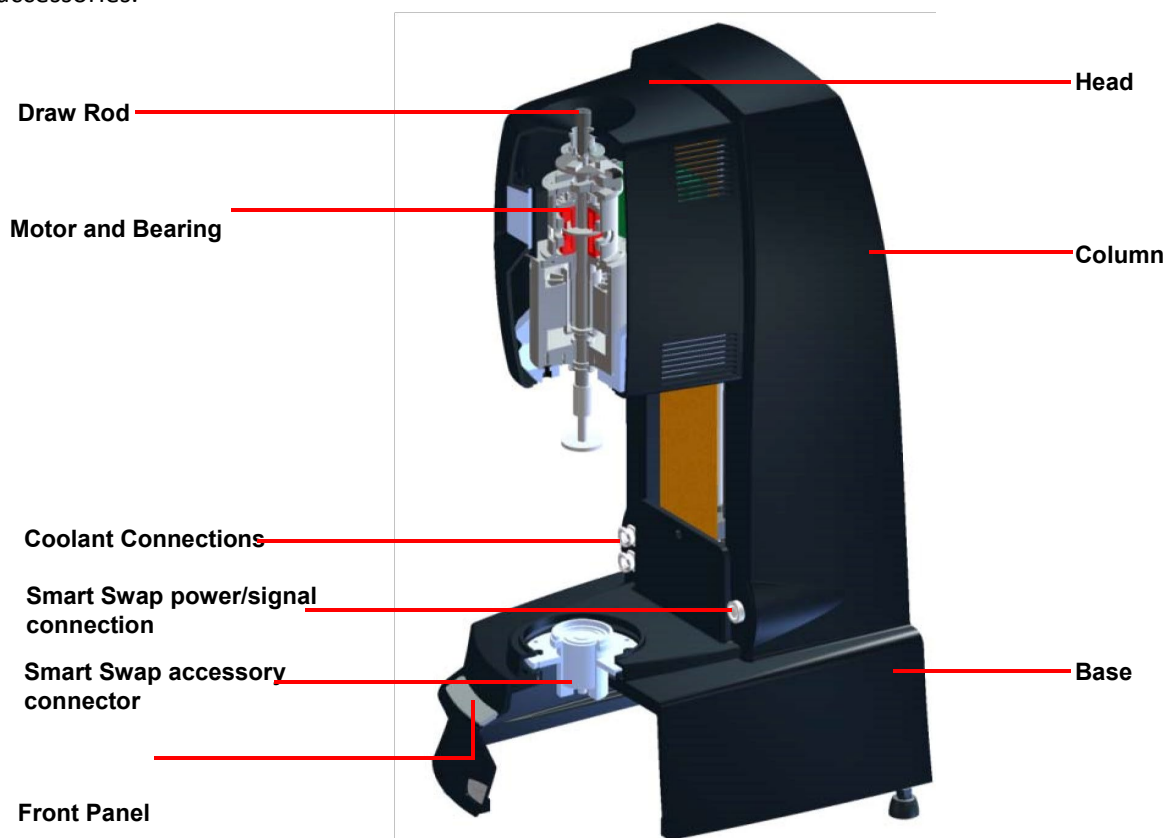



Figure 1: DHR-3 Rheometer

Getting Started

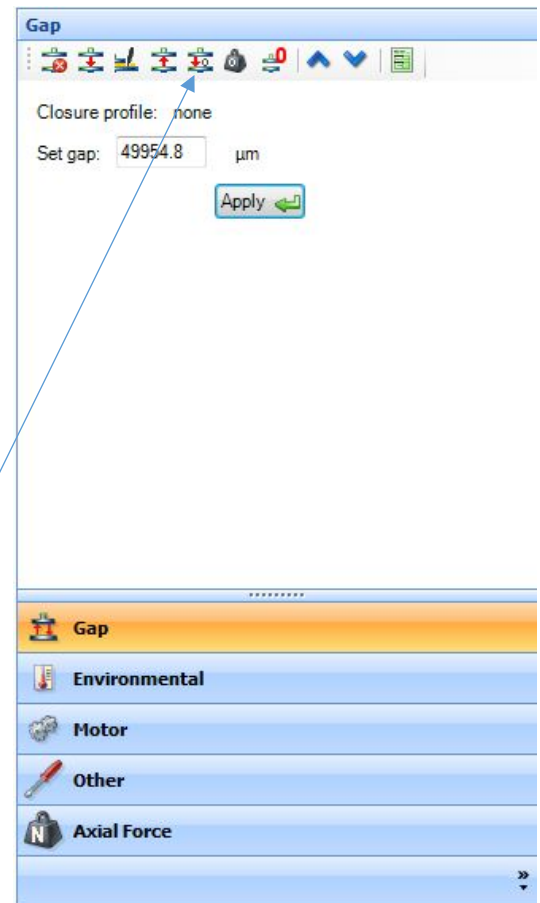
- Log into your Coral account on the main computer. Enable the Rheometer
- Log on to computer using User Account. The Password is Rheometer
- Double click the TRIOS icon

- **Choose the Geometry and update software:**
 - Select the geometry that is correct for your experiment.
 - Locate the geometry serial number either on the case or printed directly on the geometry near the top.
 - Select the appropriate geometry in the software by selecting the Geometry button  and choosing the geometry with the correct serial number from the dropdown menu. If you don't see the appropriate geometry in the dropdown, click the last entry labelled "geometries..." to open an expanded menu of options.

Installing Geometry


- Check and make sure the air pressure gage for the bearing is at 30 lbs. If not contact the facility manager
- Carefully install the top Geometry
 - Make sure the head is fully raised so there is enough space to attach the accessory
 - With one hand, raise the Draw Rod up to relieve any air pressure created when installing the geometry
 - With the other hand, carefully place the Geometry on the motor shaft
 - Lower the draw rod and screw the draw rod into the accessory. Tighten to ~7in-lb of torque. Tight but not too tight.
- Other Equipment
 - If using any of the Peltier geometries you must turn on the chiller
 - The chiller is located under the desk flip the switch on the left side of the chiller
 - If using the environmental test chamber you must turn on the air
 - The flow meter is located on the wall to the left of the rheometer Turn the knob until it is at 10 l/m
- Zero the rheometer by clicking the zero gap button in the trios software.

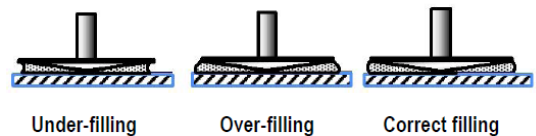
NOTE: Make sure that there is nothing located on the lower plate and that the environmental test chamber doors are completely open or the Rheometer head will not operate properly.



Sample loading

- Raise the upper geometry to the loading gap either manually or through the software.
- Place your sample on the bottom plate or in the cup.
 - For the parallel plate or cone: put enough of your sample on the plate that when it lowers the sample squishes out from all sides.

- Press the trim gap button in the software 
- For the parallel plate or cone plate, trim your sample so that it is even with the edges of the upper plate, ideally leaving a perfect cylinder of material.



Proper loading of sample after closing the gap for cone and parallel plate geometry systems



- Go to the geometry gap 
- Close the environmental test chamber doors if applicable

Figure 4: Loading Sample

Experimental setup

- Click experiment in the bottom left corner 
 - In the central window of Trios you will see three sections: Sample, Geometry, and Procedure.
 - **Sample:** allows the user to name their data file, add notes and change directory. All data should be saved in the user's folder or sub directory.
 - **Geometry:** Changes in this section should be made with care. There are many constants for particular geometries that should never need to be changed. Unless you have specific permission from the facility manager, the only value that can be changed in this section is the measurement gap and this in general can only be Adjusted in the range of 500 and 2000 μm
 - Under procedure you can choose what type of test you are running and other parameters
 - The parameter options vary per test
 - There are some values that are limited
 - torque should not go above 200 mN*m

Sample: 20mm_Collagen_60% strain

Name: 20mm_Collagen_60% strain

Operator: nl452

Project:

Notes:

Advanced

File Name: D:\users\sc2237\12-27-18\20mm_Collagen_60% strain.tri

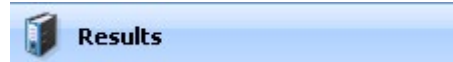
Geometry: 8mm parallel plate, ETC steel - 108283

Procedure: PF Amplitude Sweep

1: Step (Transient) Stress Relaxation 25°C, 500s, 60%

- Normal Force should not go above 50 N

- **Results**



- The results screen should come up when you have started the experiment
- If it doesn't click Results on the bottom left
- There are three options for viewing the results can be found as tabs on the bottom of the page.
 - Experimental parameters
 - Spreadsheet
 - Graph
- Spreadsheet
 - You can edit the variables displayed in your spreadsheet by choosing Select Variables on the top left
 - You can add equations to your spreadsheet by choosing Add User Column on the top left and entering your equation , All possible variables and functions are given
- Graph
 - You can also adjust the variables shown on your graph
 - Choose select on the top left and choose your variables
 - All of the Y values can have more than 1 variable associated with it
 - All of Y1 and Y3 are shown on the left and Y2 and Y4 are shown on the right
 - For more variable options check Show extended list or Show user variables on the lower left
 - To overlay two graphs right click on the graph and click New Overlay Document
 - You then can drag the graphs you wish to overlay from the File Manager on the left to the overlay graph

Finishing up

- Make sure to clean the sample off the accessories
- To uninstall the top accessory
 - Holding the accessory unscrew the draw rod, lift the draw rod and remove the accessory.
- Make sure the accessories are thoroughly cleaned before putting them away
- **Please be sure to set the temperature system idle when you done!!**
- Make sure to save your results
- Please log off the computer when finished