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

**Contents**

## 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: 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. The geometries available include 40mm parallel plate, 25/40mm 2 degree cones, and cup and rotor with options of a vaned or conical rotor. It has three heating system options, peltier plate, peltier concentric cylinders, and an environmental test chamber.

Specifications: Torque, minimum oscillation 0.5 nN*m, minimum steady shear 5 nN*m, maximum 200 µN*m; Torque resolution, 0.05 nN*m; Frequency, 1.0E-07 to 100 Hz, Angular velocity, up to 300 rad/s; Strain step time, 15ms; Rate step time, 5ms; Maximum normal force, 50N; Normal force sensitivity, 0.005N; Normal force resolution, 0.5mN


**Figure 1: DHR-3 Rheometer**

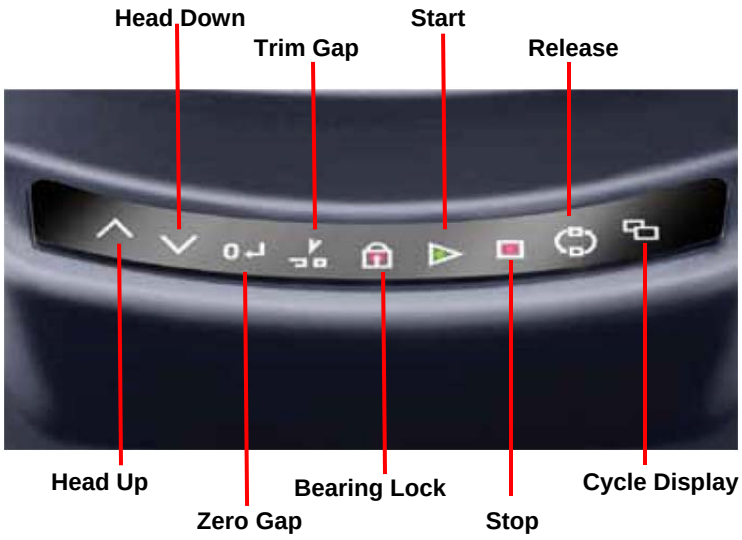



**Figure 2: Front Panel**

## 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
- Create a folder using your net id to save your work in. The folder should be located in D:\users\netID

## Trios Software

- Before running any experiments choose the accessories you will be using. Accessories are sorted into three categories as follows:
    - **Concentric Cylenders**: The concentric cylinder fixtures are as follows:
        - Concyl_Rotor_Smooth: Smooth bob
        - Concyl_Rotor_Vaned: vaned bob
    - **Custom**: The custom fixtures are screw in cones and plates. They are as follows**:**
        - Custom_25mm_PP_SB: 25mm sandblasted Parallel Plate
        - Custom_25mm_CP_2°: 25mm 2° Cone and Plate
        - Custom_40mm_CP_2°: 40mm 2° Cone and Plate
    - **Environmental test chamber (ETC)**
        - ETC_25mm_CP_2°
        - ETC_25mm_PP
- Click experiment in the bottom right corner


    - You have the ability to name your experiment and add relevant notes
    - Check the File Path and make sure that you are saving to your folder
    - There should be no reason to change any values under geometry, this has already been set

- 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 above200 mN*m
    - Normal Force should not go above 50 N

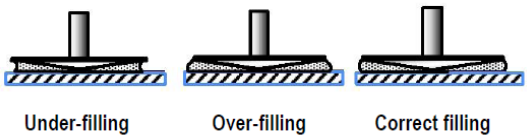
## How to Load a Sample

- Check and make sure the air pressure gage for the bearing is at 30 lbs. If not contact the facility manager
- Carefully install the accessories in the top and bottom
    - CAUTION: bottom plate is magnetic
    - To install the top accessory
        - Make sure the head is fully raised so there is enough space to attach the accessory
        - Hold the lock button on the rheometer  until you hear a beeping, this will line up the drive shaft
        - Carefully place the accessory on and orient the alignment marks on the accessory with those on the Rheometer. Screw the draw rod into the accessory.

**Figure 3: Installing Top Accessory**

    - To install the bottom accessory
        - Click the release button 
        - A green light should appear signifying you can load the accessory
        - Once you click the button you have 10 seconds to load the accessory
        - Once it is loaded you can attach all tubes and wiring
    - 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 side of the chiller
            - Press start after you have loaded the accessory but before you have begun the experiment.
            - Turn the chiller off before disconnecting the tubing
        - If using the environmental test chamber you must turn on the air
            - The flow meter is located on the wall next to the rheometer
            - Turn the knob until it is at 10 lpm
- Zero the rheometer by clicking 
  NOTE: Make sure the environmental test chamber doors are completely open
- 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.

  - For the cup: fill the cup 1/3 to 1/2 full, enough so that when the rotor is lowered the sample covers the rotor entirely
- Lock the bearing 
- Press the trim gap button 
- For the parallel plate or cone only
  - Trim your sample
  - Press the trim gap button again to lower the top plate to geometry gap
- If using concentric cylinders no trimming is necessary, go straight to the geometry gap
- Close the environmental test chamber doors if applicable

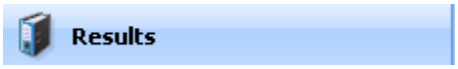



Proper loading of sample after closing the gap for cone and parallel plate geometry systems

**Figure 4: Loading Sample**

- Click either start on the computer, large green arrow on the upper left 

- Or, click start on the rheometer, green arrow in the center of the bar 

- 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
    - Experimental parameters
    - Spreadsheet
    - Graph
    - These three options can be found as tabs on the bottom
  - 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
- Geometries
    - This tab should be left alone
- Calibration
    - This tab should be left alone
    - If calibration is needed please contact the facility manager
- Home
    - Setup
        - Will bring you to the experiment screen
    - Start
        - Will begin the experiment
- View
    - Here you can create a new spreadsheet or graph
    - There is also a Help button on the top right
- Instrument
    - This tab should be left alone
- Engineering
    - This tab should be left alone
- Format
    - Allows you to select and create variables and edit your spreadsheet
- Edit
    - Allows you to select and edit your variables for your graph
    - Add shapes (Draw) or text (Annotate) to your graph
    - Adjust the scaling
- Curves
    - Adjust the appearance of your graph with options such as color and style of the lines
    - Adjust your curves using the custom curve mode under Mode on the top left
- Analysis
    - Gives analysis options such as different functions to compare, derivatives, and other options
    -

## How to Unload

- Make sure to clean the sample off the accessories
- To uninstall the top accessory
    - Holding the accessory unscrew the draw rod and remove the accessory.
- To uninstall the bottom accessory
    - Click the release button 
    - When a green light starts flashing you can unplug all cables and tubes
    - Push the button again to get a solid green light which means you can remove the bottom accessory
- Make sure the accessories are thoroughly cleaned before putting them away
- Make sure to save your results
- Please log off the computer when finished