
 UNIVERSITY OF KWAZULU-NATAL	<b>Standard Operating Procedure</b>  <b>PRG</b> pollution research group	<b>Effective Date:</b> 20 June 2013	<b>Version:</b> <b>004</b>
<b>SOP_MP_01 Mechanical Properties_ Rheometer_Viscosity and Sheer Stress</b>		<b>Reviewed:</b> 30 March 2017	<b>Page #:</b> <b>1 of 16</b>

## Standard Operation Procedure – Rheometer Use for Testing of Faecal Matter

### Introduction

An Anton Paar MCR72 rheometer is used to carry out a number of rheological tests on faecal samples. These include flow curves, amplitude and frequency sweeps, variable temperature tests and stress recovery tests. A number of different measuring systems exist (cone-cup, plate-plate, building materials cell) – each is suited to a different type of sample.

### 1. Scope and Application

- Excreta samples are obtained from several sources including **(i)** segregated faeces samples from individual donors, **(ii)** mixed excreta samples from community ablution blocks and **(iii)** mixed excreta samples from household urine diversion toilets.
- Characterisation of the rheology (flow properties) of samples is necessary for the accurate design of waterless toilet systems.
- Human excreta can potentially host significant levels of pathogens, and as such is classified as a biologically hazardous material. Suitable precautions must be taken when handling samples.

### 2. Apparatus

- Anton Paar MCR51 Rheometer.
- 27 mm cone-cup attachment.
- 32 mm cone-cup attachment.
- Plate-plate attachment.
- Building materials cell.

### 3. Materials & Equipment Required

- Metal trays (preferably non-stick).
- Paper sheets for cleaning faeces, equipment and general cleaning.

- Laboratory spoons for loading the rheometer cup with the sample.
- Rubber spatula to scrape any sample out of a cup.
- Brushes for washing instruments after use.
- 70% ethanol for disinfection of equipment splashes and spills.

## 4. Safety Precautions

### General

The following general safety precautions should be taken:

- Cover any small open wounds with waterproof dressings – if large open wounds then do not carry out laboratory work.
- Always use gloves, laboratory coat and closed shoes while working in the laboratory.
- Wear a face-shield when disposing of samples down the sluice (risk of splash-back).
- Dispose of samples as specified by the Faeces Sample Disposal SOP.
- Clean all soiled equipment thoroughly after use.
- Any equipment that will be taken out of the laboratory into a 'clean' environment (e.g. camera) should be handled only with clean gloves and disinfected using 70% ethanol spray after use.
- Dispose of the used gloves in the appropriate waste bin after sample handling and disposal and cleaning of equipment is complete.
- Clean hands using antiseptic soap.
- Disinfect hands after washing with soap.

Where mixed samples are being handled (i.e. those from field location sources such as community ablution blocks), additional care must be taken as sharps may be present in the faecal matter. Samples should not be handled directly with gloved hands, but rather with a spoon or spatula.

### Specific safety precautions for the rheometer:

- Use metal trays as the work area for loading the rheometer cup with the sample and for the placement of tools, which are in direct contact with the sample, in order to prevent any environmental contamination from the sample.
- Clean and disinfect all equipment after use.

## 5. Procedure for Measurement

For a **cone-cup setup**, the following procedure applies:

- Ensure all equipment and apparatus is clean and clear of obstructions.
- Switch on the instrument.
- Remove the cap protecting the instruments coupler.
- Load about  $\frac{3}{4}$  of the sample into the cone cup.
- Attach the cone cup into the rheometer plate.
- Run the Anton Paar Rheometer Software.
- Open the control panel tab to initialise the instrument, Figure 7.

- Insert the measuring system into the coupler; do not touch the sensor on the measuring system.
- Manually enter 25°C for (P-PTD200) rheometer plate and select set value.
- Manually enter 23°C for the VT-2 tower and select set value, the VT-2 tower switches on, Figure 9.
- Close control panel and check that the application software is running on Rheology basic mode.
- Select the desired test template, Flow curve: logarithmic.
- Open control panel and lower the measuring system using the drop down arrow.
- Close control panel, once the gap distance is zero, return to test home page.
- Press start to enter sample details, select continue.
- Test begins and graph window appears.
- At the end of the test, lift up the measuring system and detach from the machine.
- Open control panel and select the up arrow to set the gap up to 30 mm.

### **Saving report**

- Click on the window tab, select new report, select landscape format and then select ok for pop ups.
- First report appears as report 1 highlighted in orange.
- Click on the report tab, using the diagram dropdown menu, select diagram 2.
- Move cursor under the graph on report 1 window, and click once an upright arrow appears.
- Diagram 2 appears.
- Click on the report tab and click on create PDF, save report on desired location.
- Combine graphs by clicking on diagram tau (one).
- Check boxes will appear on the right side panel.
- Check all of the boxes and proceed to save as normally.

### **Shutdown procedure**

- Open control panel.
- Select switch off to switch off the temperature towers.
- Close program and switch off computer.
- Switch off all power points.
- Replace cap on the coupler.
- Cover the instrument.
- Disinfect.

### **Notes:**

- A larger cone-cup diameter will produce more accurate results, since there is a larger surface area.
- Results for fluids with a low viscosity tested at low shear rates may be inaccurate due to the effects of surface tension (e.g. water).
- Samples can dehydrate over time. It is recommended that the cup is covered for long tests (over an hour in duration).
- All tests will be performed at a standard temperature of 25°C.
- Stool samples may have significantly different moisture concentrations on either end of the sample, in which case the sample must be separated and the two ends treated as different samples.
- 24.5ml of sample is required for a run with the CC27 setup (65ml for CC39XL).

## 6. Calibration

- Each instrument used in the rheometer must have a 'motor calibration' and 'inertia calibration' service performed at least every 90 days.

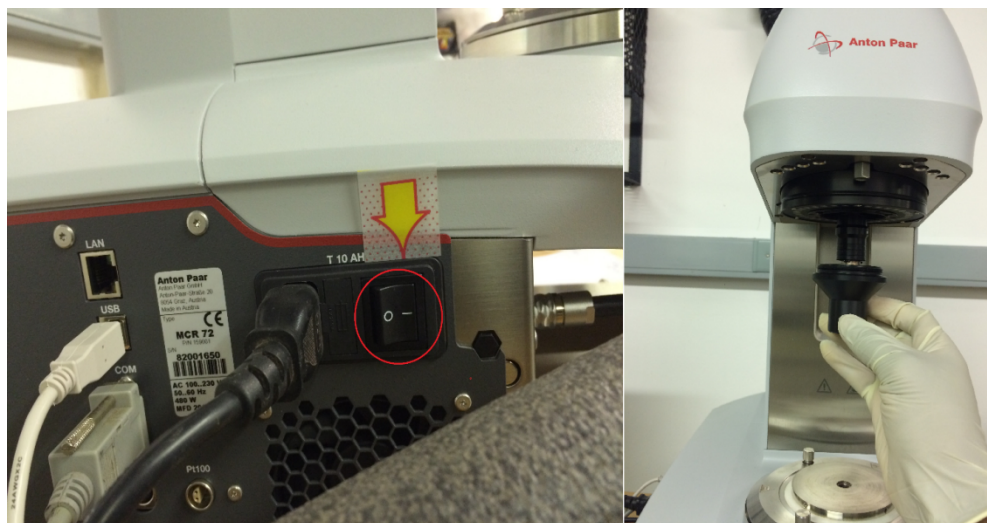


**Figure 1:** Check that the instrument is in good condition then switch on the plugs on the wall

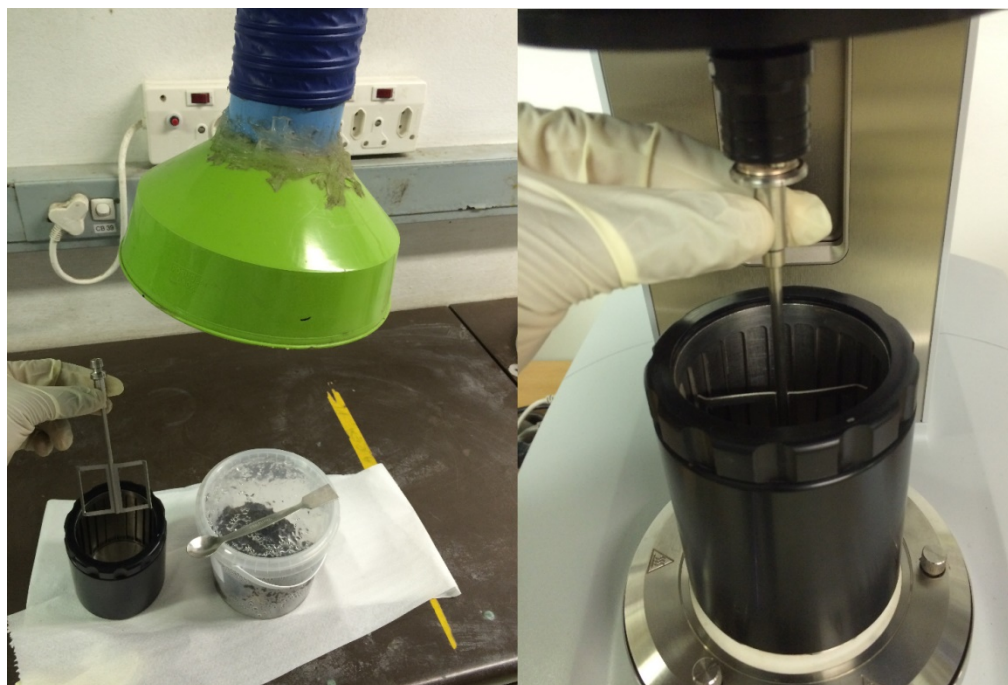


**Figure 2:** Switch on the tower under the table

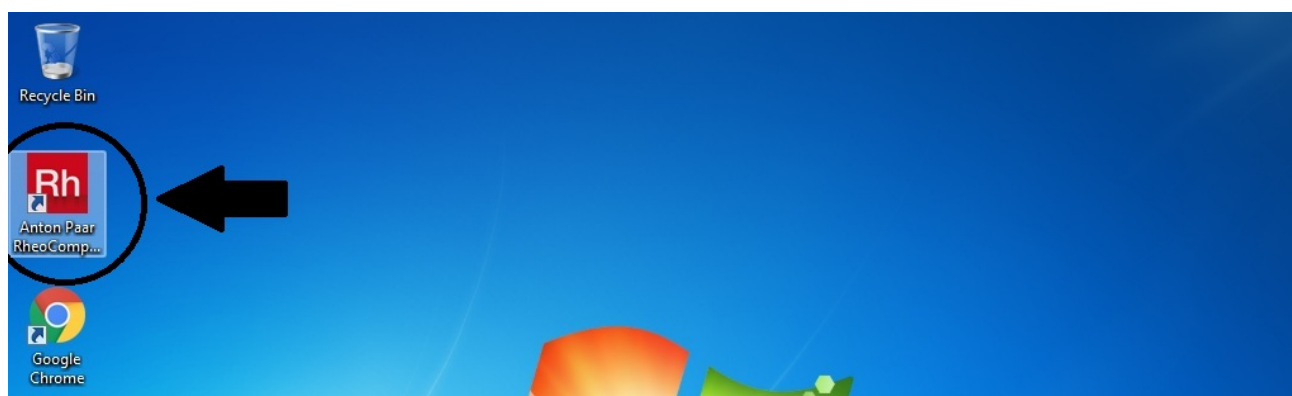




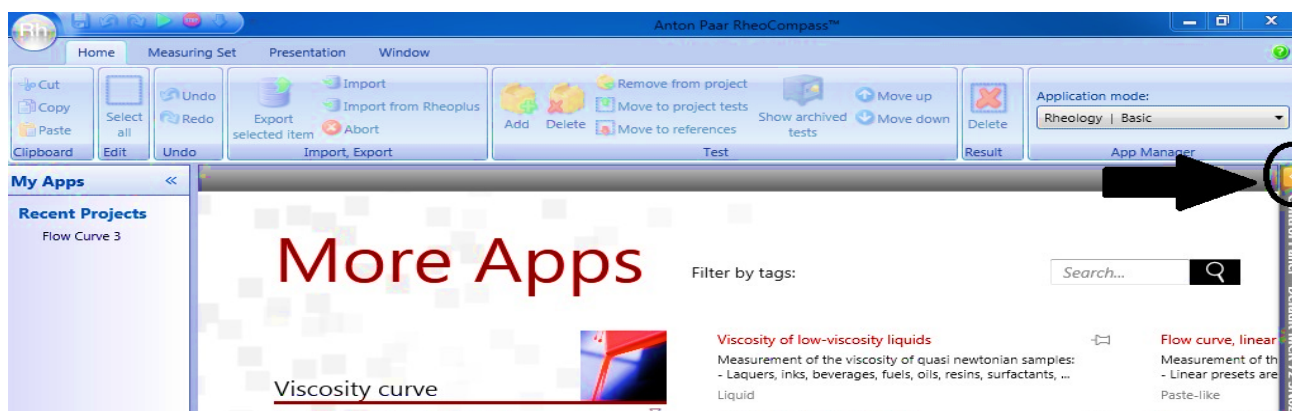
**Figure 3:** Switch on the rheometer power button and uncap the adapter



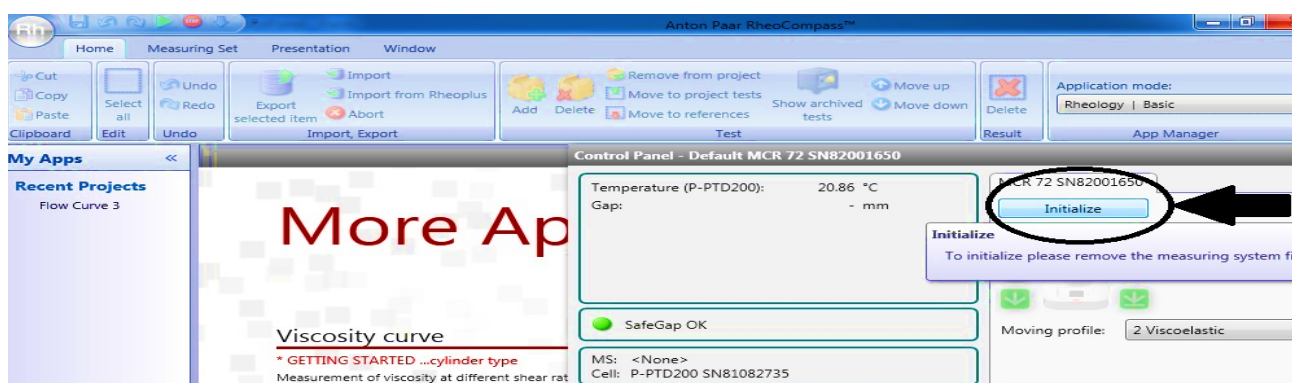
**Figure 4:** Load the sample into the cone cup and then to the plate of the equipment



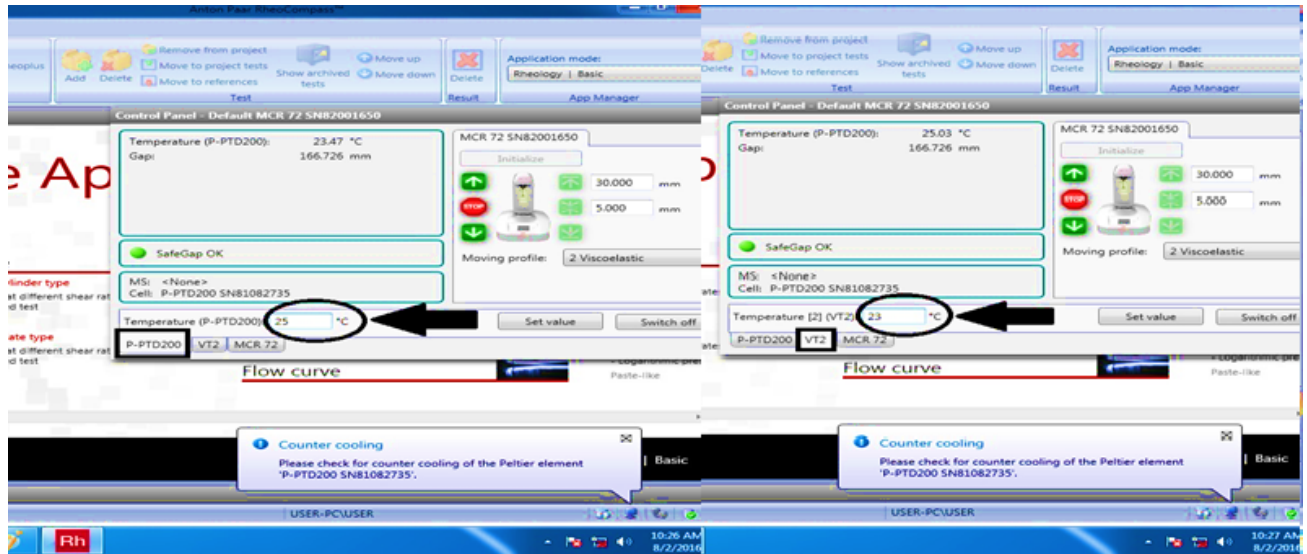
**Figure 5:** Click on the Rheoplus icon on the desktop to start the program



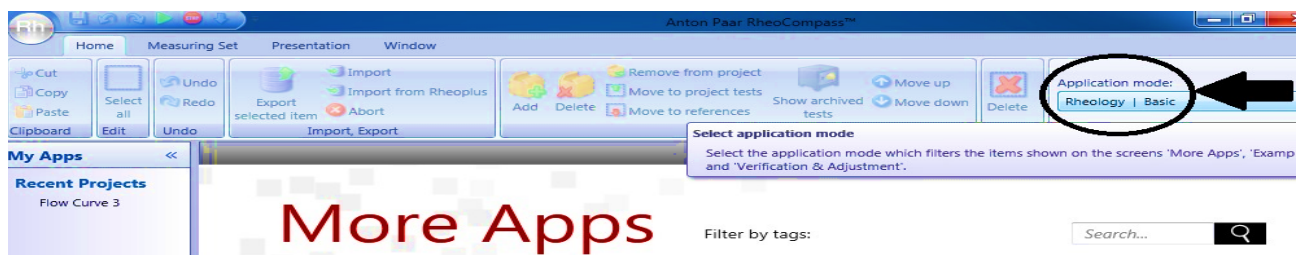
**Figure 6:** Open the control panel tab by clicking on the arrow on the top right corner



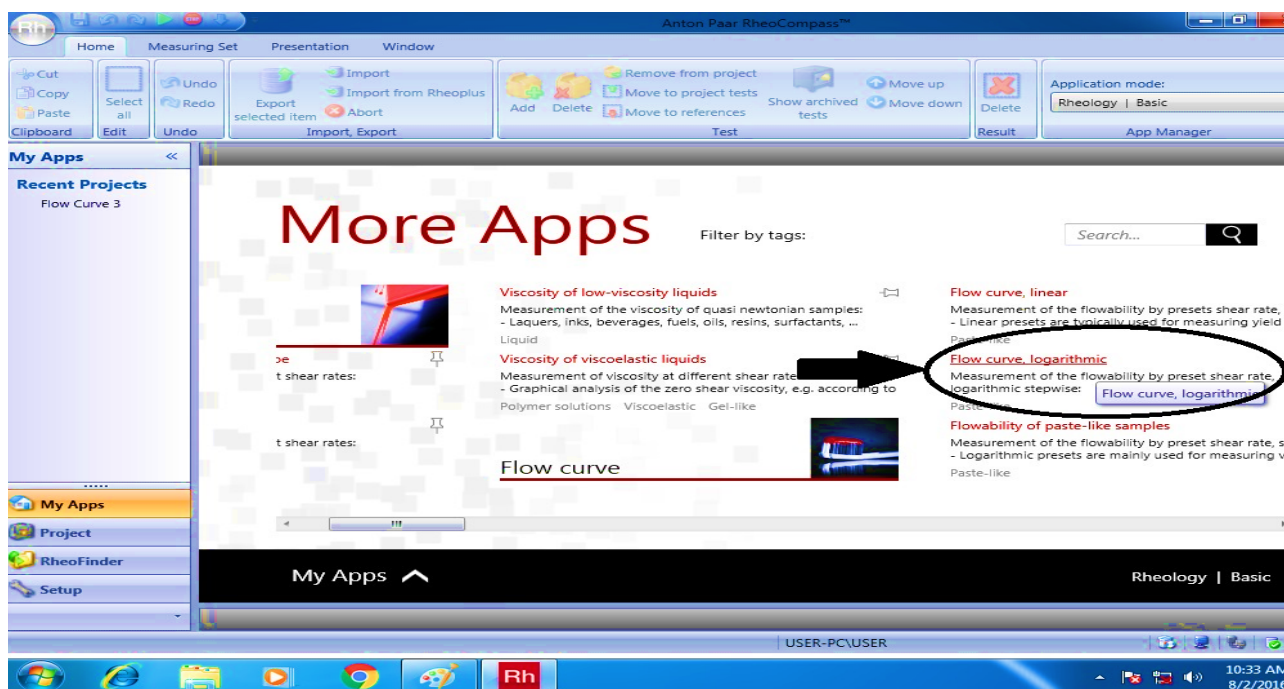
**Figure 7:** Initialise the instrument by clicking on the initialise button



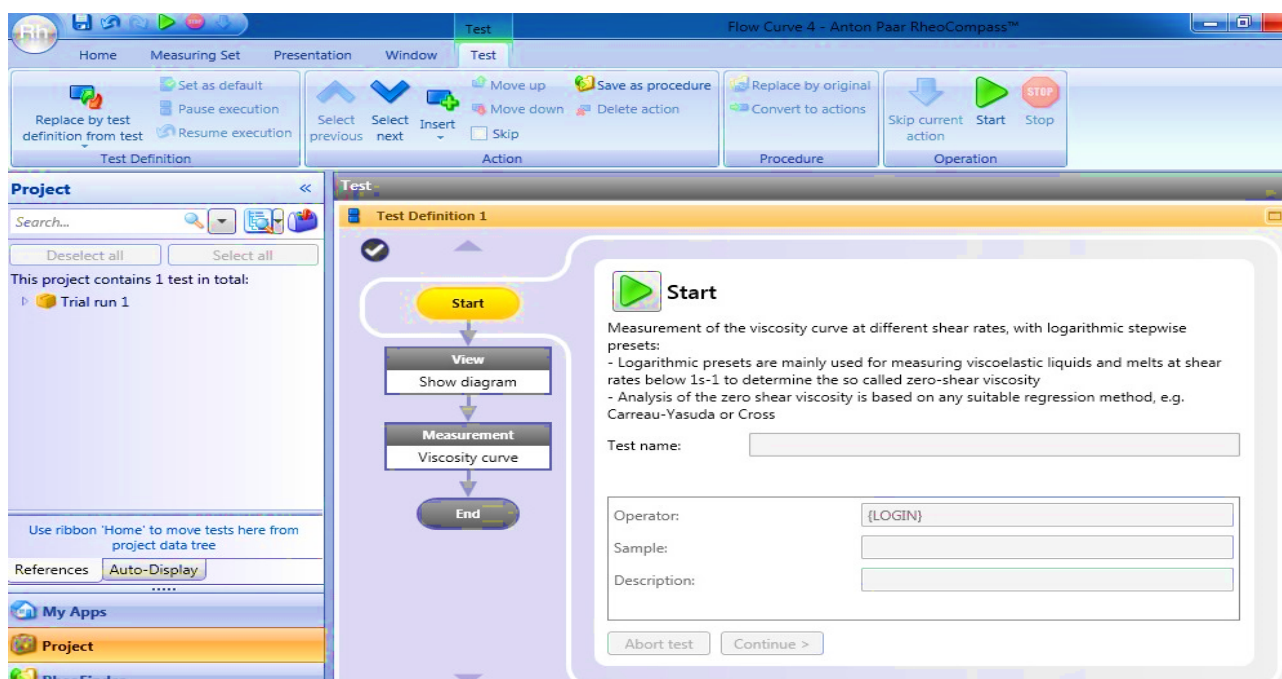
**Figure 8:** Manually enter the desired temperatures for (P-PTD200) 25°C and VT-2 23°C tower temperature in control panel



**Figure 9:** Ensure that the Rheometer application mode is running on Basic mode

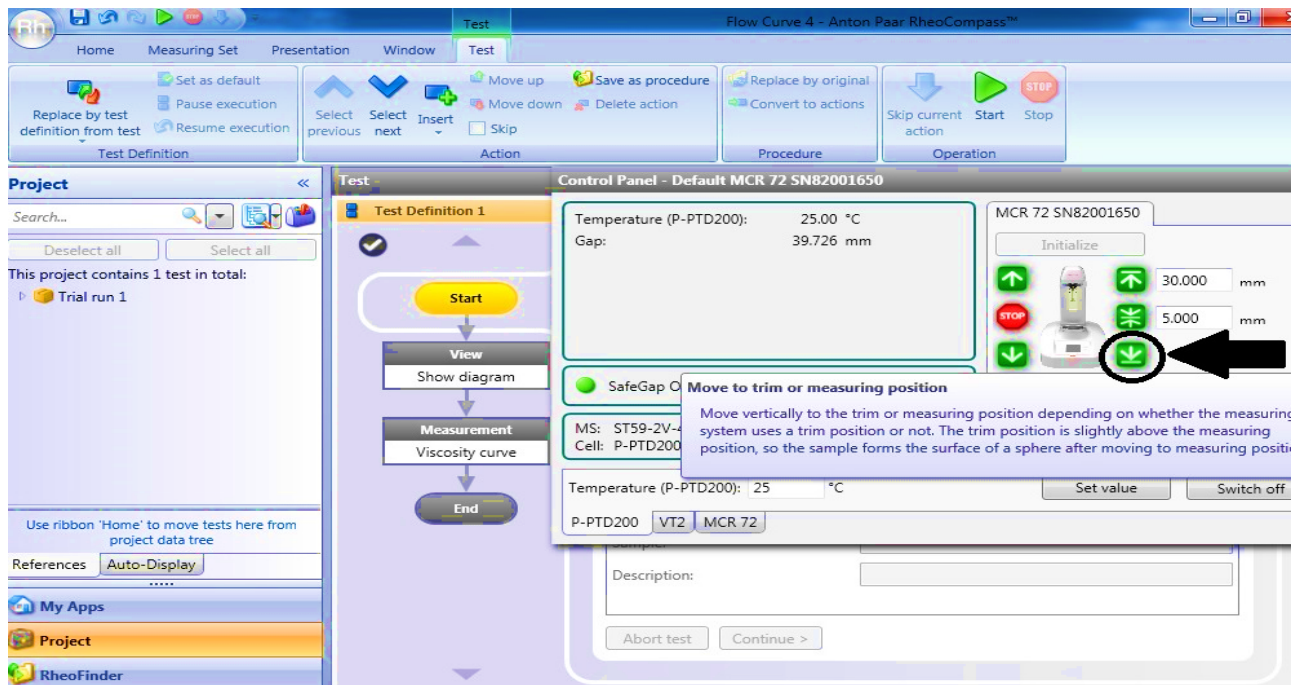


**Figure 10:** Select the testing method: Flow curve, logarithmic

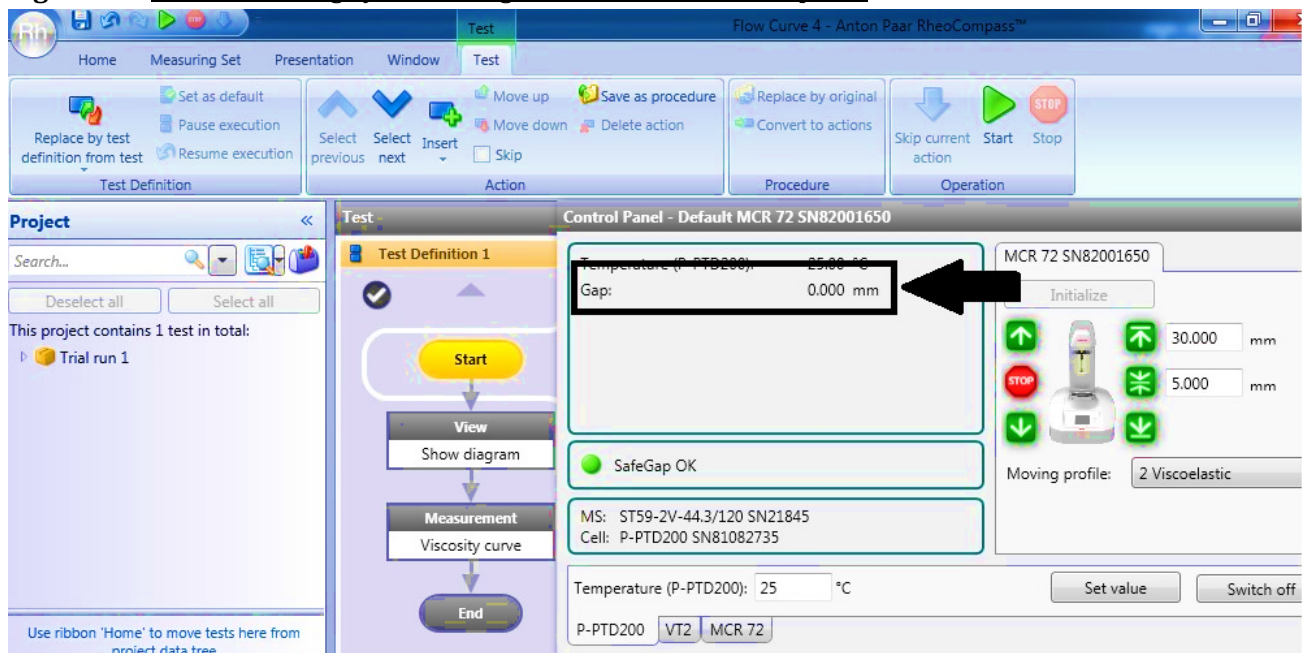


**Figure 11:** This is the test home screen that can be used to enter sample details after adjusting the measuring tool in control panel as in step 2

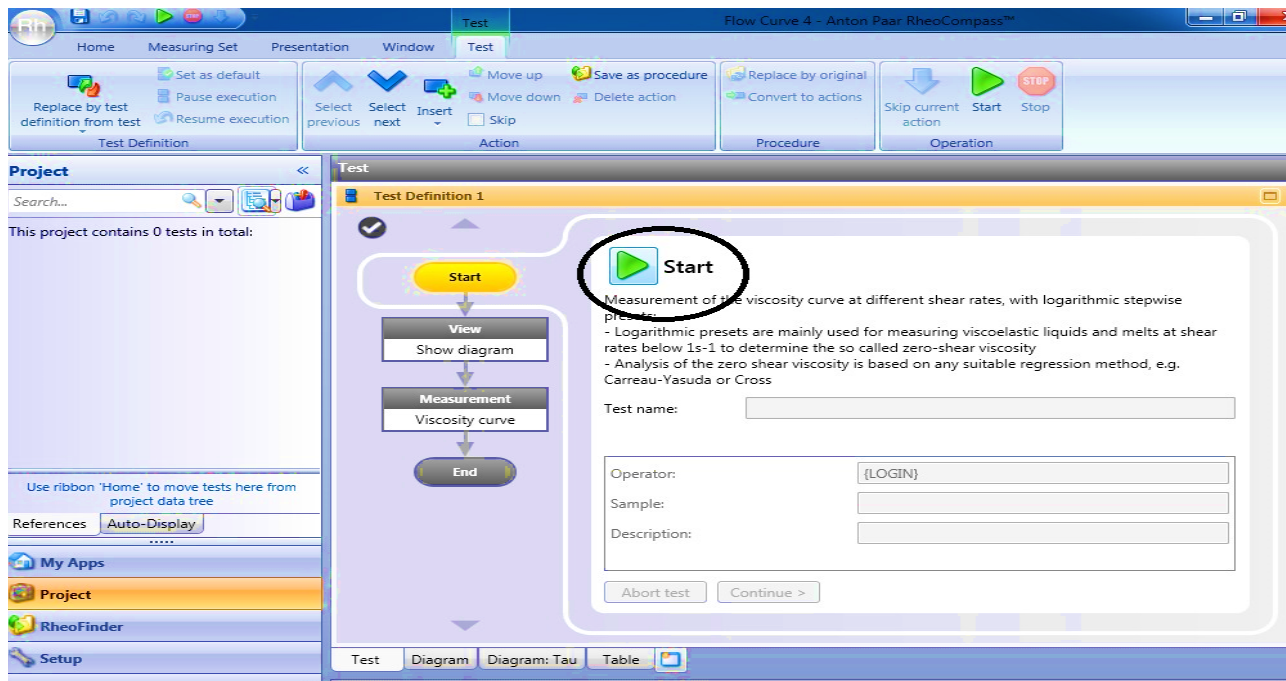




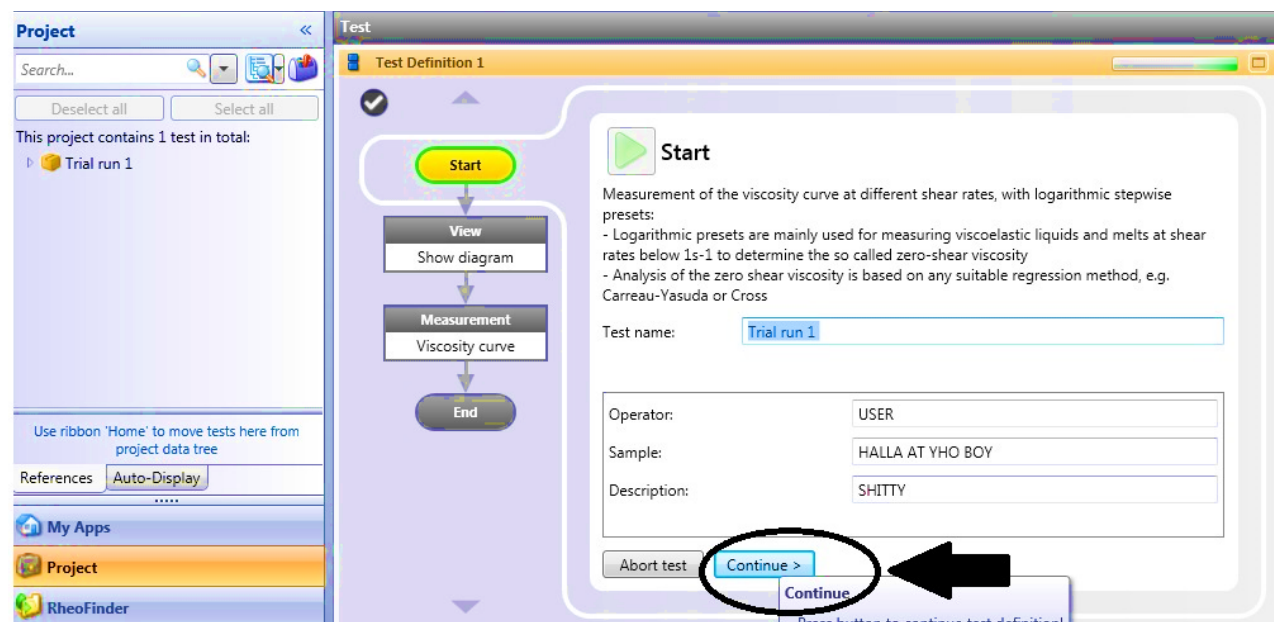
**Figure 12: Low measuring system using the arrows on control panel**



**Figure 13: Gap becomes zero**

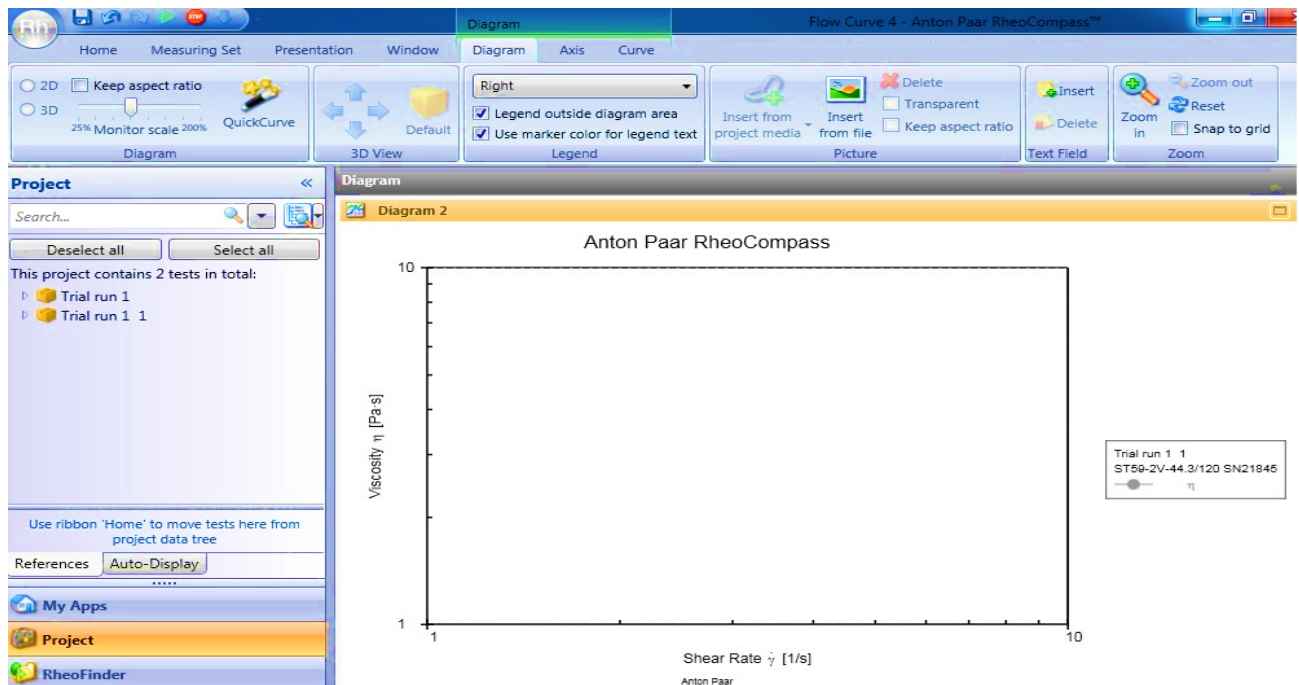


**Figure 14:** The start button is enabled, proceed to enter sample and test details

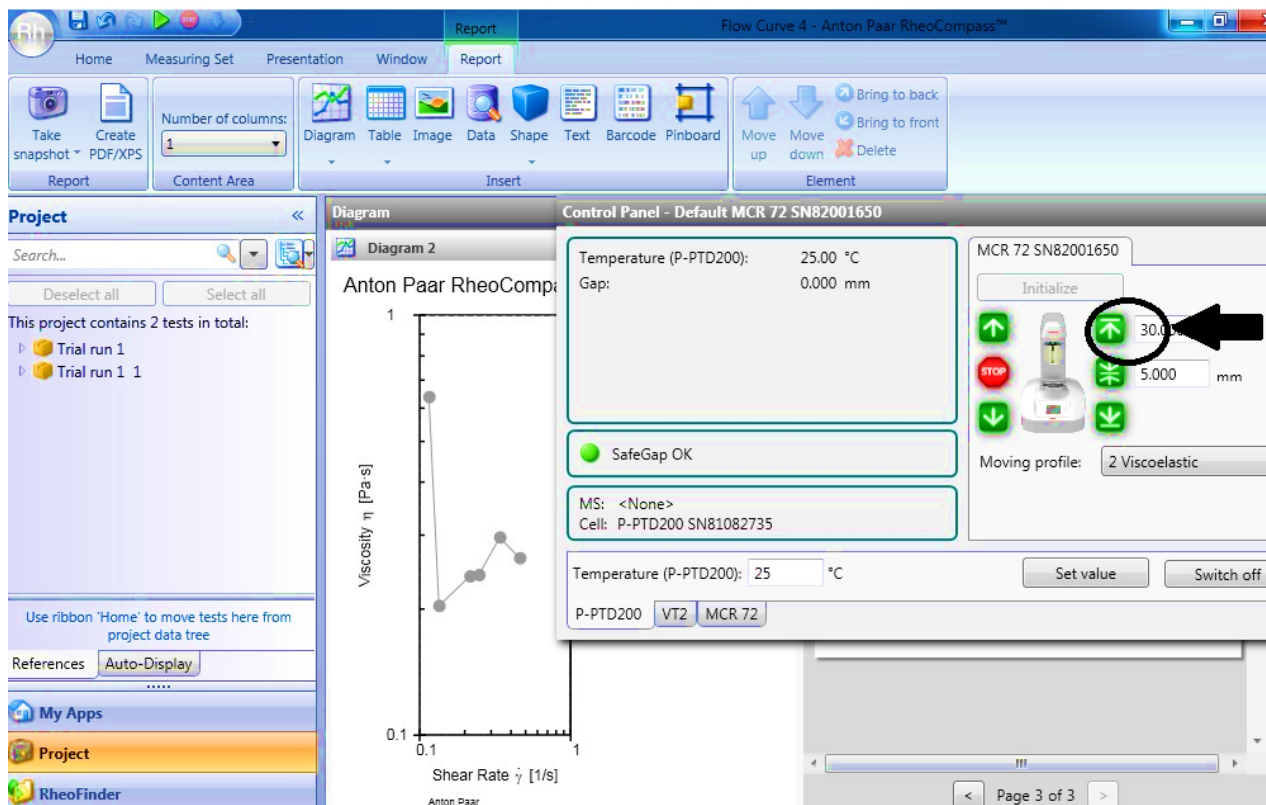


**Figure 15:** Fill in details. After filling in the details, press continue

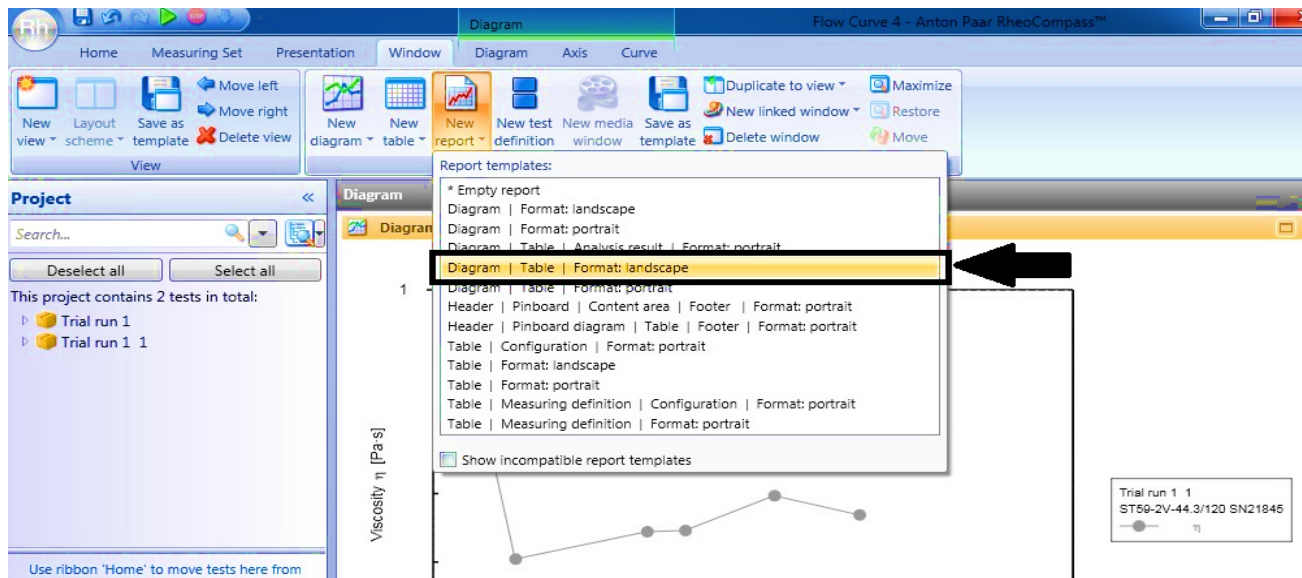




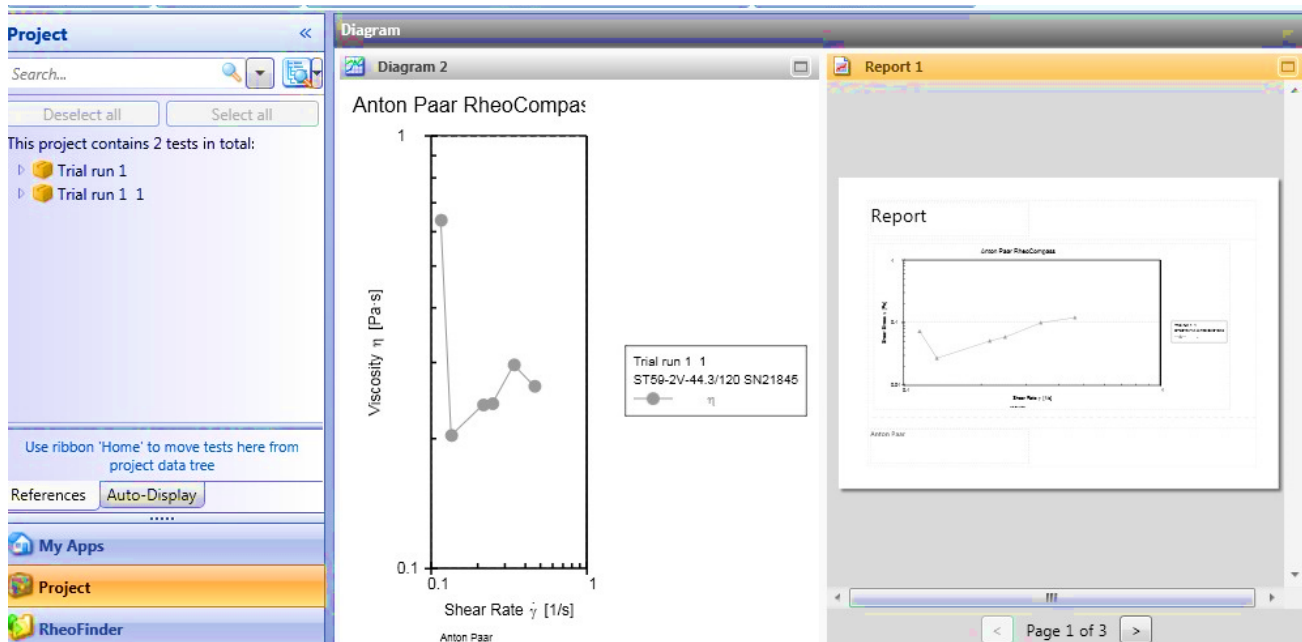
**Figure 16: Testing begins**



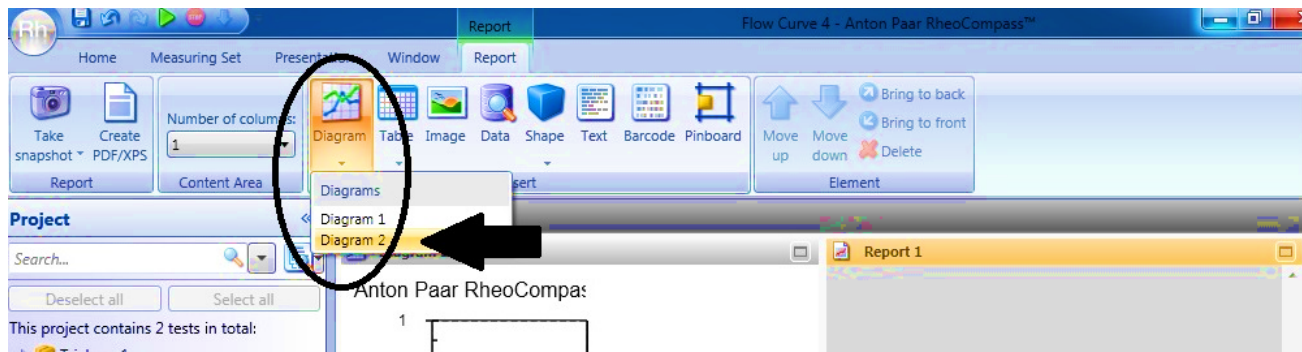
**Figure 17: Lift up the coupler (measuring tool) by using control panel**



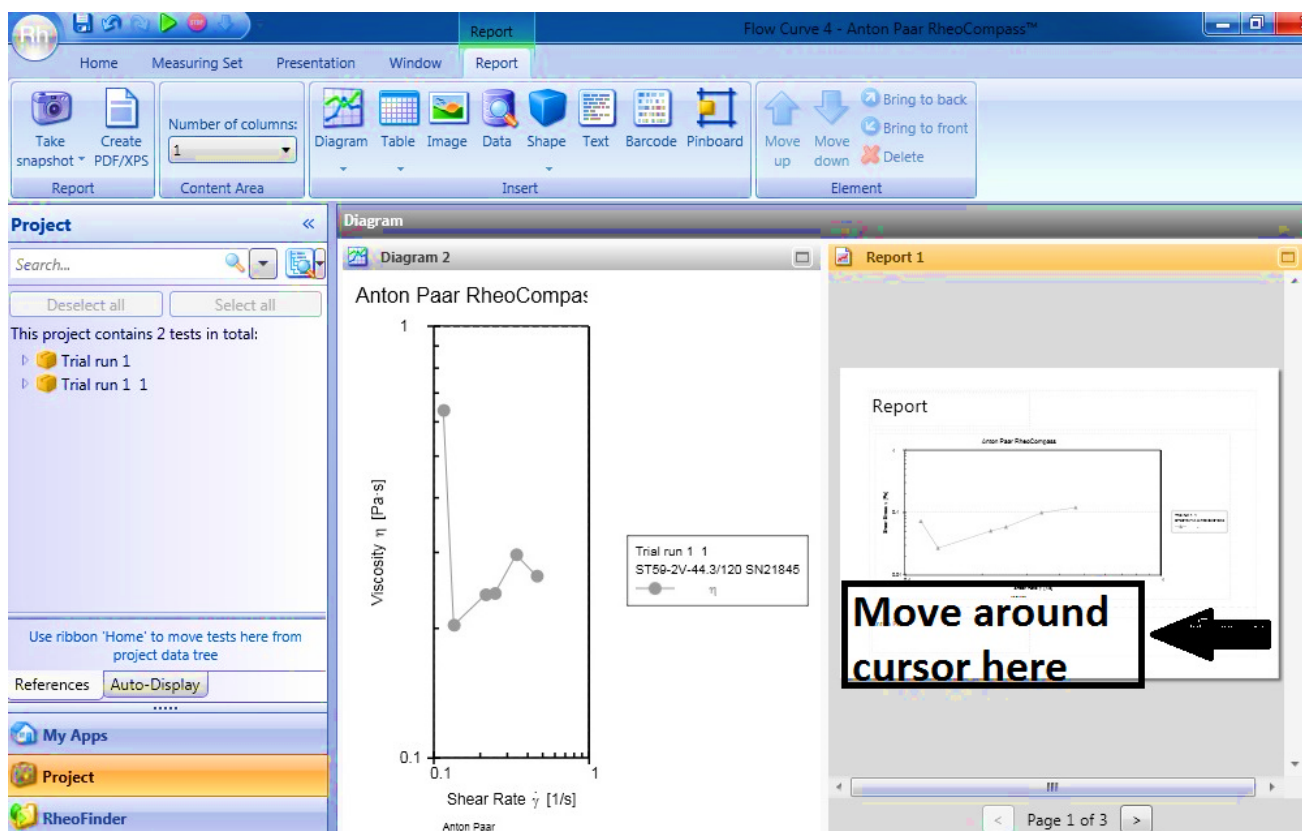
**Figure 18:** Once test is completed, click on the window tab and select new report followed by the report format



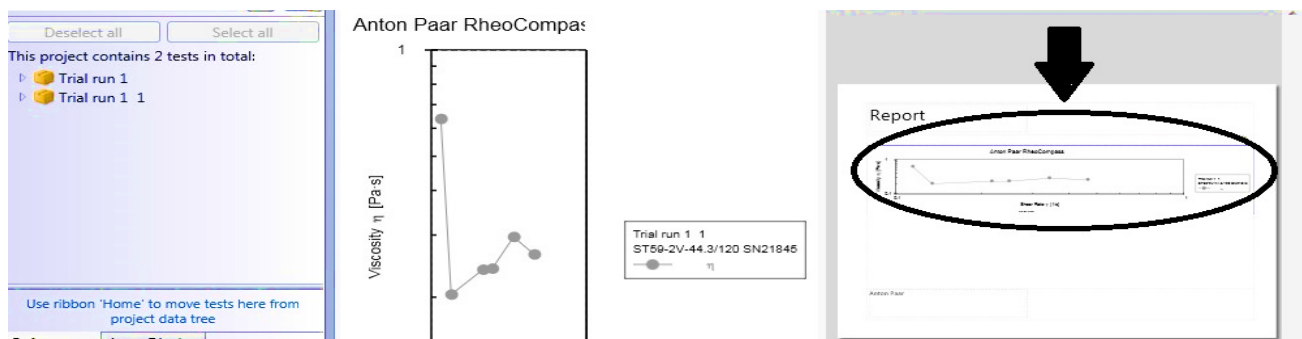
**Figure 19:** First report 1 will appear with the heading highlighted in orange



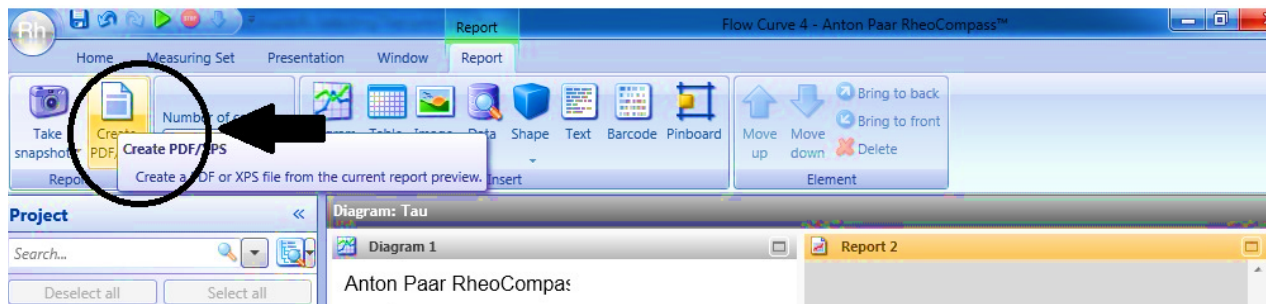
**Figure 20:** Click on the Report tab, Insert diagram 2 using a dropdown arrow



**Figure 21:** Move the cursor under diagram 1, a cursor appears and click to insert diagram 2



**Figure 22:** The graph is inserted and it appears the end of report 1



**Figure 23:** Save the report in XPS or PDF format using the dropdown arrow

## APPROVAL OF STANDARD OPERATING PROCEDURE

PRG Head: Prof C.A. Buckley

Signature: .....

Date: .....

Author: Merlien Reddy

Signature: .....

Date: .....