Operation of the MCR702 Rheometer

(Basic Operations using the single rotation mode)

(March 2024)

1) Control that there is enough air flow (60psi<P<100psi) coming to the rheometer. Unscrew the protective cap of the rotary shaft.
2) Software: RheoCompass (RheoCompass® software)
3) Go on "Measuring Set" and select as Current Configuration the option "Default MCR 702 SN80551386"
4) Open "Control Panel" of the instrument (is hidden as a grey "stripe" on the right side of the software screen)
4) Click Initialize (if the option does not appear, means you don't need to do this step)
5) Enter the measuring system at the notch signaling (there is a small black vertical sign on both the rotor and the measuring system. They need to be aligned when inserting the measuring system)
6) In the control panel:
   6.1) Reset normal force
   6.2) Set the temperature to the desired value before starting the test
   6.3) click "Set Zero gap"

   6.4) click "Lift" once the previous step is finished, i.e. press the upward green arrow  on the right of the instrument icon
7) Load the sample (schematic of a correct loading when using open geometries at the end of this document)
8) Again in the control panel, click "Measuring position" (downward green arrow  on the right of the instrument icon). When it is stopped, trim the sample, and then press OK to achieve the measuring position. if your sample is prone to evaporation, add silicone oil on the edges or use the "hood" (only for CP, PP).
9) Launch the desired Template
10) At the end of the measurement, "lift position"

$\dot{\gamma}_{PP} = \frac{r\Omega}{h}$ $\tau_{xy}^{PP} = \frac{M}{2\pi R^3}\left[3 + \frac{d\,lnM}{d\,ln\dot{\gamma}_R}\right]$ $\dot{\gamma}_{CP} = \frac{\Omega}{\beta}$ $\tau_{xy}^{CP} = \tau_{\phi\theta}^{CP} = \frac{3M}{2\pi R^3}$

β=cone angle [rad] *1 rad=57.29°* *1°=0.0174 rad* *1Hz=6.28 rad/s* *1 rad/s=0.159 Hz*

Attention:

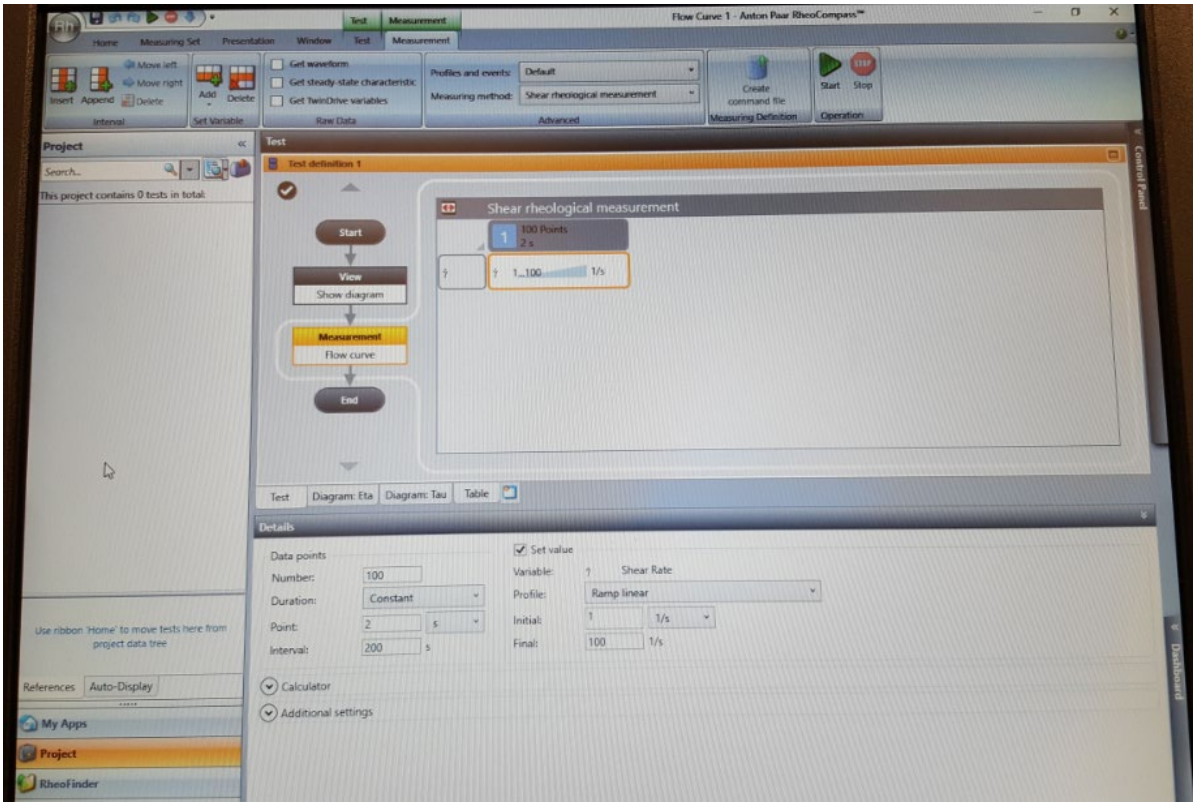
i) Contact someone in the IAC facility to figure out if your sample is harmful for the rheometer and/or its instrumentation
ii) Do not use PP (parallel plate) or CP (cone-plate) for shear rate larger than 1000 s^{-1}. If you need, you can access higher shear rate by using PP and small gap size. In general, for high shear rate, use Couette or DG (double-gap).
iii) When washing the geometry, do NOT WET sensor on top of the rotor
iv) Do not clean with corrosive agents
v) When changing the bottom geometry, switch off the thermostatic bath and then switch on again once the bottom geometry has been correctly installed.
vi) periodically check the coolant level in the thermostatic bath

How to create a Template (i.e. how to set the measurements to be performed):

1) Click on the line "My Apps" in the software screen

2) Type in the “Search” option, on the top right, the test you want to perform. The software has a variety of test already pre-set, where you can just type your own range of either stress, strain, frequency and temperature to vary.

3) Alternatively, you can also set any kind of test by just starting with selecting “Flow curve, linear” in the section “My Apps” and then changing all the parameters within this template. Screenshot:



a. You see now a new software page. In the bottom left, the section “Project” is highlighted. In the main page you see a flow chart of your test.

b. On the right of the flow chart, you can see in a short column that the variable selected to be varied is “shear rate”. You can see also its pre-set range of variation. Such variable can be changed by selecting it and then going in the upward section “Set Variable”. Here, by clicking the option “add” or “delete” variable you can select whatever variable to be changed, ranging continuous and oscillatory flow options. You can also add (right click with the mouse, and then copy and paste on the right of the initial column) more columns to perform consecutive/multiple tests on your material, one after the other. The procedure to set a variable is always the same as mentioned before.

c. To change the range and the duration along which any point of a certain variable is measured, you can use the section “Details”, which is below the flow chart and is automatically shown when the “Project” window is selected.

d. Between the flow chart and the section “Details” there is a line where you can pick to show either the page “Test“, “Diagram Eta”, “Diagram tau” or “ Table”. With “Test”, the flow chart and a column resuming the variable and range to be investigated are shown. With “DiagramEta” and “DiagramTau” the plot of viscosity vs shear rate and stress vs shear rate are respectively shown. (However, you can click on the axis of the plot and change the variable to be shown). With “Table” the data acquired from the instrument during the test are shown. Also here, additional data to be shown can be selected.

e. The test is ready to be launched (the "play" button in the window "Operation" on top of the page. You can stop the test at any moment pressing STOP). You can possibly first select all of these options and then load the sample, bring the system in measuring position and then launch the test.

f. Additional tools can be added to the flow chart. You can select them by clicking on the icon "Show Toolbox"  and then just drag them into the flow chart.

CALIBRATIONS

Motor adjustment: every 90 days, right before starting a new measurement, a message reminds you to perform a motor adjustment. A motor adjustment is also suggested when performing measurements with torque of 1µNm or less.

3) **Calibrating air bearings noise (motor adjustment)**

3a) Double Gap: only cylinder (without cup). In measuring position

3b) CP or PP: SET ZERO GAP. Then, Whole system in measuring position at a gap of 1mm.

4) Go to the software main page. Nearby the option "My Apps", there is the option "Verification and Adjustment". Press it. Then select the test "Motor Adjustment…, single drive mode" is the first option available. Then, just press "play" and follow the instruction.

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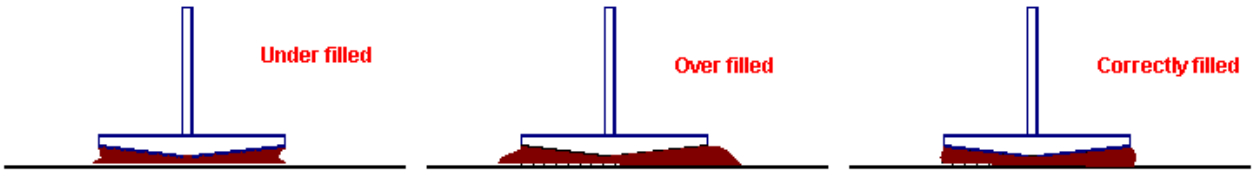
Examples of a sample properly loaded:



Suggested references:

Astarita G., Marrucci G. (1974). Principles of non-Newtonian fluid mechanics. McGraw-Hill Companies.
Bird R. B., Armstrong R. C., Hassager O., & Curtiss C. F. (1977). Dynamics of polymeric liquids
Macosko C.W. Rheology: principles, measurements, and applications. (1994), Wiley
Larson R.G., The Structure and Rheology of Complex Fluids, Oxford Univ. Press
Rubinstein M., Colby R.H., Polymer Physics, Oxford Univ. Press
Applied Rheology, Thomas Mezger, Anton Paar
Guidelines for checking the performance of the rheometer_Laun et al_2014
Official symbols the society of rheology_Journal of Rheology_2013

Safety requirements

The laboratory in room ACEE 027B is a wet chemistry lab, in which some researchers may handle hazardous substances. The lab safety requires that users wear **eye protection** (safety googles or glasses with side shields), **lab coats**, and **gloves** while using equipment in this room.

Emergency Information:

Medical Emergencies: Contact 911 and Public Safety (609) 258-1000
Room / facility emergencies: Contact Public Safety (609) 258-1000
Issues related to the instrument:

1. Contact IAC Staff.
2. Leave system as is.
3. Try to shut off system (computer & red button).

Audible/Siren Emergency Alerts:
Follow previous steps 2 & 3 and leave the building.

Emergency Contact Information:

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