

1. Hardware Setup

1. Connect the USB cord and power cord to the rear panel of the *m*-VROC unit. **DO NOT** connect the other end of the USB cord to the computer until the USB driver has been installed (Step 5):



2. Plug the *m*-VROC unit's power cord into a power source. Leave the *m*-VROC unit powered off.
3. Connect the bottom of the VROC Cell assembly to the plug from the base of the *m*-VROC unit:

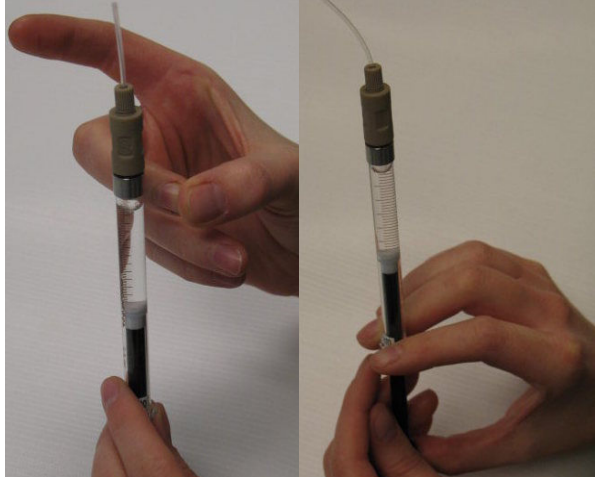


2. Precautions

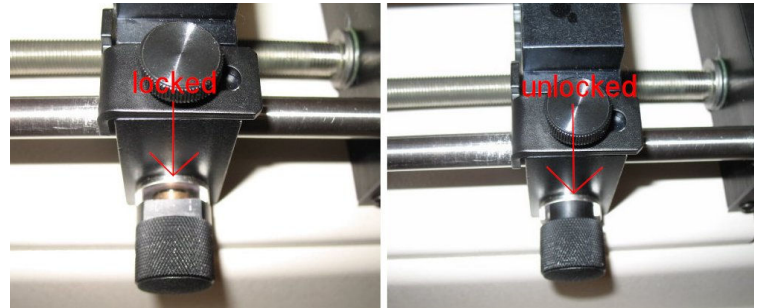
1. **Always** use the provided software package with the VROC Cell. The software has built-in safety features that prevent pressure from overloading the VROC Cell.
2. Only syringes from the Hamilton Company can be used in the *m*-VROC unit. These may be purchased from RheoSense, or directly from the manufacturer.
3. **Always** clean the VROC Cell thoroughly after each use, and before storing the VROC Cell. Refer to section 7 for cleaning procedures.
4. Particles larger than 10% of the flow channel gap should be filtered out of the sample to avoid clogging the VROC Cell.
5. Keep the inside of the tubes and the flow channel of the VROC Cell wet **at all times**. Dried sample in the flow channel could cause irreversible damage to the VROC Cell.
6. Keep the inlet valve closed when not using the VROC Cell.
7. **Never** test immiscible samples back to back. Permanent damage may result.
8. **Always** leave the waste tube connected to the VROC Cell assembly. Removing this tube exposes the sensor area inside the VROC Cell, which may cause damage or clogging.
9. **Always** operate the system with the VROC Cell assembly properly positioned.
10. If the pusher block becomes jammed during operation, use the clear stall button in the software to unjam it. Do not attempt to unjam it manually.

3. Sample Loading

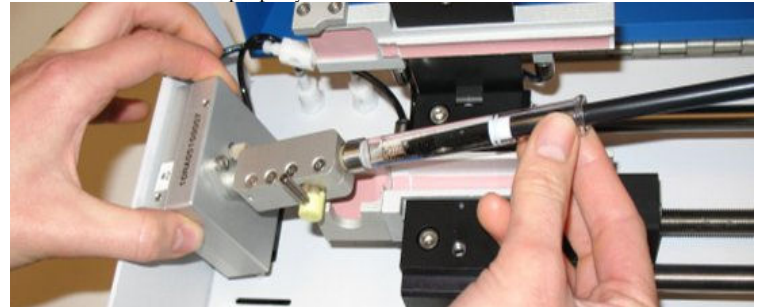
1. Connect the plastic intake tube (plastic needle) and union to the syringe.
2. Use the plastic intake tube to load the sample solution into the syringe.
3. Remove any air bubbles visible in the syringe:



4. If necessary, slide the pusher block on the *m*-VROC unit back. Make sure the drive nut is unlocked:



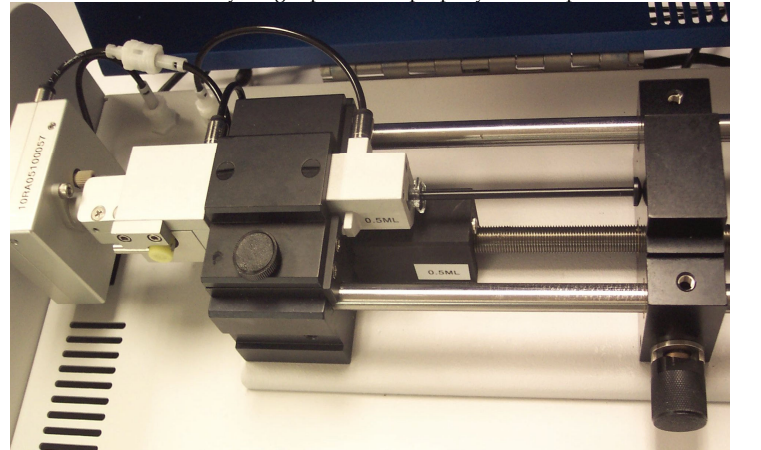
5. Remove the Teflon intake tube and plastic coupler from the syringe.
6. Screw the end of the syringe into the valve block on the VROC Cell assembly, grasping the end of the syringe body (near the plunger entrance point). Make sure the valve to the VROC Cell is closed (the small arm will be vertical).
7. Place the syringe in the bottom of the syringe jacket, making sure the hinge of the valve seats in the cutout properly:



8. Slide the pusher block along the guide rods until the block is close to the end of the syringe plunger, then lock the drive nut by pulling it out and rotating it:



9. Open the VROC Cell valve. Close the syringe jacket lid, and tighten the thumb screw. Make sure the waste tube from the VROC Cell assembly is inserted into the waste bottle. When everything is positioned properly, the setup will look like this:



4. Temperature Control

The *m*-VROC provides the option of controlling the temperature of a sample within a given range using an external water bath. Please see the *m*-VROC User's Manual for details on the recommended bath and instructions on using this feature.

5. Installing the Software

1. Insert the installation CD into your PC's CD-ROM drive. If the CD does not run automatically, navigate to the CD and open the "Start.html" file. Note that the installation CD **only** works with Windows Internet Explorer.
2. A pop-up window warning about active content may appear. If it does, click "Yes" to proceed.
3. Next, a software installation window will appear. First install the driver; click on the button that displays the operating system being used by the computer.
4. After the driver installation is complete, click on the "*m*-VROC Installation" button. Follow the prompts to install the *m*-VROC control program. After the installation is complete, re-start the computer.

6. Using the Software

Connect the USB cable to the computer and power on the *m*-VROC unit. Open the control software by double-clicking on the "mVROC_Control" icon. If temperature control is desired, please refer to the manual for instruction. The program consists of 4 tabs:

1. **Measurement Setup:** This tab is where all the measurement parameters are entered and a measurement is started.
2. **Data Graphs:** This tab contains all the graphs of the data, which are plotted as the measurement proceeds.
3. **Results Summary:** The average values from all the measurement segments are displayed in table format in this tab.
4. **Temp Ctrl/Measurement Advisor:** The sensor temperature may be monitored in this tab. Additionally, this part of the software gives shear and flow rate ranges, recommended syringe size, and minimum sample volume requirement information for the in-place sensor as well as other available RheoSense sensor types.


To perform a measurement at a single shear or flow rate:

1. In the Measurement Setup tab, enter values into these fields: "Sample ID", "Est Viscosity, mPa-s", "Sample Vol, ul".
2. Select the syringe size from the pull-down menu.
3. Select the rate type, either shear or flow.
4. Enter a rate in the left column of the table between the minimum and maximum values listed under "Run Parameters".
5. Leave the "Measmt Time" and "Pause Time" columns blank and both set to "Auto". A value will be entered automatically.
6. At this point, both the "Start" button and 'move block to plunger' icon will become bright, indicating they are available. The Status Bar will display "Click on "Start" button when ready...".
7. Click on the 'move block to plunger' icon to remove the gap left between the pusher block and the syringe plunger when the syringe was loaded.
8. Click on the "Start" button to start the measurement. The program will change to the Data Graphs tab to display the results as the measurement progresses.
9. After the measurement completes, the data will automatically be saved to the '\... \ (My) Documents \ LabVIEW Data \ Test Logs' folder. The measured viscosity value will be displayed on the Data Graphs tab in the field labeled "Average Vis, mPa-s", as well as on the Results Summary tab in the blue highlighted column.
10. It might be necessary to perform a second measurement if the sensor channel was not fully primed during the first one. The basic indicators that the measurement result is accurate are:
 - The background of "Min Slope Fit Rsqrd" should be green, indicating the minimum value is above 0.98.
 - The plot of "Viscosity vs. Time" in the upper left corner of the Data Graphs tab should be a level, continuous line (minor oscillations will not adversely affect the results) for the highlighted green portion.
 - The "% Full Scale" indicator in the lower left corner of the Data Graphs tab should be green.

To perform a measurement at multiple shear or flow rates:

1. Follow steps 1-3 from the previous section.
2. Enter multiple rates in the table manually or automatically populate the table using the 'Generate Rate Sweep' function.
3. Leave the "Measmt Time" and "Pause Time" columns blank and both set to "Auto".
A value will be entered automatically.
4. Click on the "Start" button.

7. Cleaning the VROC Cell After Use

 **Always use the provided software with the *m*-VROC for any testing and cleaning. Do not attempt to manually push cleaning fluid through the VROC Cell.**

Drying of a sample solution inside the VROC Cell after a prolonged period of inactivity carries a high risk of permanently clogging the VROC Cell, and causing irreversible damage. To avoid clogging, it is very important to clean the VROC Cell thoroughly with a compatible solvent to remove sample solution after use. The recommended procedure for cleaning is:

1. Unload the syringe filled with the test sample (reverse the steps in section 3).
2. Wipe and clean the sample solution from the inlet fitting on the VROC Cell assembly.
3. Connect a solvent-filled syringe to the VROC Cell.
4. In the Measurement Setup tab, enter a flow rate (this should not exceed the maximum used during sample testing) that will command the software to push a minimum of 250 μ l of solvent through the sensor. This will remove the majority of the sample solution from the VROC Cell.
5. Now increase the flow rate and flush the VROC Cell two to three more times with a minimum of 1cc of solvent.
6. Repeat step 5 as many times as necessary (the number of repetitions will depend on the type of sample solution). Please see Appendix II in the *m*-VROC User's Manual for more on the suggested cleaning procedure.
7. Finally, test the viscosity of the solvent with the VROC Cell to verify that the Cell is clean.
10. After cleaning the VROC Cell, unload the syringe (reverse the steps in section 3).
11. Wipe and clean the inlet fitting on the VROC Cell assembly again, and make sure the valve is closed (the small arm will be vertical). Rheosense recommends that only lint-free swabs and wipes be used (contact Rheosense for availability information).

Note that there is a special cleaning procedure for high viscosity fluids. Please refer to the *m*-VROC User's Manual for instruction. If clogging persists, do not attempt to force a flow as this may cause permanent damage to the VROC Cell. If there is any sign of clogging, please contact RheoSense for assistance.

Note: Please refer to the *m*-VROC User's Manual (on the software CD) for detailed information on all aspects of the *m*-VROC system.

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