



Tips and Tricks from Joe Flow

Calibrating and adjusting rheometer systems: Keep your rheometer fit!

To ensure the consistent quality of your measurement results, it is important to check your rheometer at regular intervals.

This guideline is valid for the UDS rheometer and all MCR xx0 and MCR xx1 series rheometers.

Introduction

Checking a rheometer requires an air measurement and measurement of a certified viscosity standard, also called a standard oil. The inertia of the used measuring system can also be determined.

The air measurement is carried out to check the quality of the motor adjustment and the condition of the bearing. During the motor adjustment the residual friction in the bearing is measured. The measured values are saved in the rheometer electronics and used for every measurement. With air-bearing-supported motors these values are extremely low. However, the friction can be noticeable at low torques, e.g. when measuring low-viscosity liquids.

The adjustment of the rheometer is checked by measuring a viscosity standard. Generally speaking, this check can be carried out with any measuring system if the standard chosen has a viscosity value suitable for the measuring system. However, it is best to use cylinder systems as they are least affected by the filling volume and fluctuations of the room temperature. As a reference, use the cylinder system CC27 and a viscosity standard in the range from 1500 mPas to 2000 mPas at 20 °C (2000AW from the German Calibration Service). The table below gives an overview of viscosity values suitable for other systems.

Type	ø [mm]	Viscosity [mPas]
Cylinder	< 17	5000 to 10000
Cylinder	≥ 17	1000 to 2000
Cone or plate	< 50	5000 to 10000
Cone or plate	≥ 50	500 to 2000
Double gap	-	50 to 100

If the check is carried out with a cone or plate, a temperature-controlled hood must be used as the viscosity values of the standard oils are generally very dependent on the temperature. If you want to check the temperature before the measurement, use a calibrated thermometer.

With cylinder measuring systems, the temperature sensor can be positioned in the wall of the measuring cup. Temperature plates have an opening for the sensor in the side.

Preparing the rheometer

Make sure the rheometer is located in a place without vibrations and air drafts. Check the alignment of the rheometer with the supplied level. During the air measurement and motor adjustment the environment around the rheometer should be as still as possible because extremely small torque values need to be measured. The rheometer should be switched on approximately one hour before starting the check. You can carry out the instrument initialization and set the target temperature for the viscosity measurement. Find the target temperature on the calibration certificate of the viscosity standard.

Air measurement and motor adjustment

For this step there are templates available in the RheoPlus software. These guide you through the check step-by-step. The names may vary depending on the software version you use. If you find no suitable template, contact your local Anton Paar representative.

1. Go to "File -> New" to open the RheoManager.
2. From the standard templates select the template for motor adjustment and air measurement for your rheometer type (air-bearing / ball-bearing) in the tab "Support".

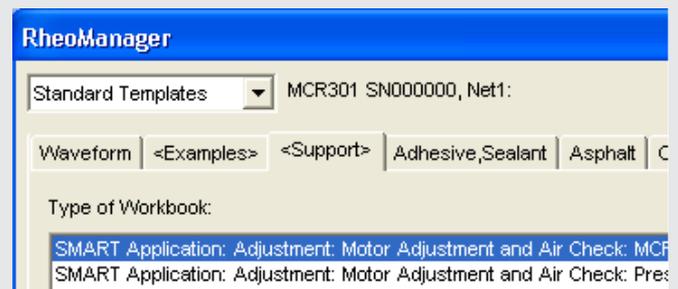


Fig. 1: RheoManager

If there is no template available for ball-bearing rheometers, select the template for pressure cells.

3. Click on the button "Control Panel" to open the device driver. If you have not already initialized the instrument, click the button "Initialize" and send the set temperature for the subsequent oil measurement.
4. Insert the measuring system but not the cup and close the control panel with "OK".
Only for cone/plates: After the rheometer has reached a stable temperature, carry out the zero-gap determination.
5. Click on the button "Go to calibration position" and wait until the rheometer has reached the target position.
6. Click on the button "Start air check". Save the workbook when the software requires it. The software now starts the air measurement and shows the values in a diagram and a table. The diagram contains the limit values within which the measurement values must be.



Fig. 2: Example of an air measurement with limit values

7. If the measurement values are outside the limits, click on "Stop" and "Perform motor adjustment".
8. In the control panel select "Service" and click "Motor adjustment".
9. Follow the instructions on the screen to start the adjustment. The adjustment takes approx. 3 minutes (RheoPlus 3.0 or higher) or approx. 12 minutes (RheoPlus 2.81 or lower).
10. After the adjustment is completed, close the motor adjustment with "OK".
11. Start the determination of inertia of the measuring system in the "Support" tab. After completion, click "Save" and close the device driver with "OK".
12. Click "Start 2nd air check".
13. If the measurement values are inside the limits, let the measurement run until the end. Then click "Quit".

If the measurement values are still outside the limits, make sure that the rheometer is not disturbed by outside influences (e.g. vibrations or air drafts). Repeat the motor adjustment and the air check. If it is not possible to achieve a good air measurement, contact your local Anton Paar representative.

Measurement with a viscosity standard

1. Go to "File -> New" to open the RheoManager.
2. From the standard templates select the template for "Measuring System Verification and Calibration with Standard Oil" in the tab "Support".



Fig. 3: RheoManager

3. Click on the button "Rheometer: Control Panel" and drive the measuring head to the lift position.
4. **Cylinder systems:** Fill the cup with the viscosity standard up to the marking. When you can see no more bubbles in the cup, insert it into the measuring chamber. If necessary, remove the measuring system and replace it after inserting the cup.
- Cone/plates:** Apply slightly too much sample onto the lower plate. The required sample amount can be found on the data sheet for the measuring system or under "Tools -> Setup -> Device and Accessories".
5. On the Start screen of the workbook you created, click on the button "Setup reference curve and diagram".

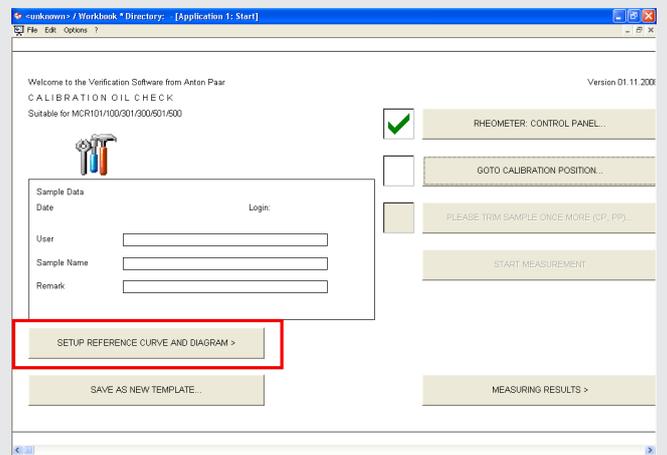


Fig. 4: Start screen for an oil measurement

6. Click on the button "Setup calibration oil boundaries". Enter the target value of the viscosity in the dialog box and select the measuring system and the rheometer. Close the dialog box by clicking "OK".

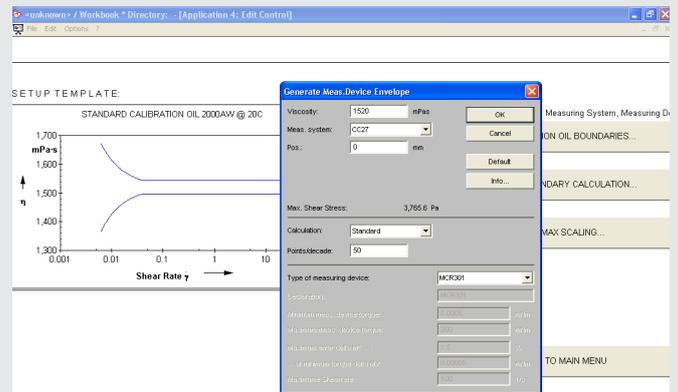


Fig. 5: Setting up the reference curve (oil boundaries)

7. Click on the button "Start new boundary calculation" and return to the main menu. If necessary, you can change the axes of the diagram under "Edit min-max scaling".

- Click on the button "Go to calibration position". For cones (CP) or plates (PP): Trim the sample when the software requires it and confirm this with "Continue". After the measuring position has been reached, trim the sample again and click on the button "Please trim sample once more".

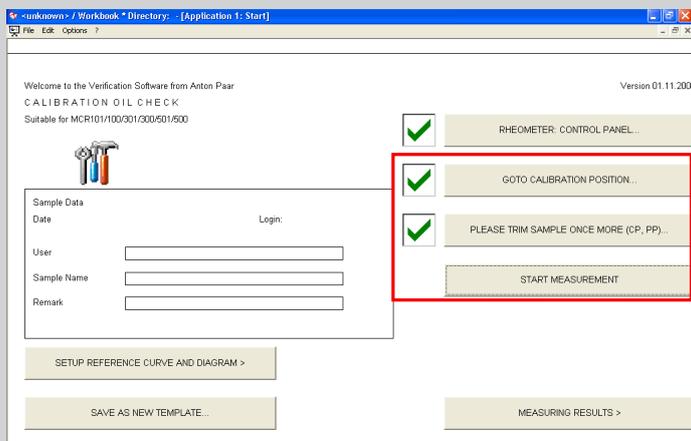


Fig. 6: Main menu

- Click on the button "Start measurement". Save the workbook when the software requires it. RheoPlus now starts to measure the viscosity standard and gives the resulting viscosity curve and the previously calculated boundaries.

The viscosity curve must be inside the boundaries. If this is the case, let the measurement finish and click on the button "Analysis: check result". The determined viscosity value is shown under the diagram. The instrument check is now complete. You can close the workbook with "Quit".

If the measured values deviate from the target values, stop the measurement and check the sample volume, the temperature and the boundaries.

Make sure that the used oil has not exceeded its expiry date and was not contaminated. Start the measurement again.

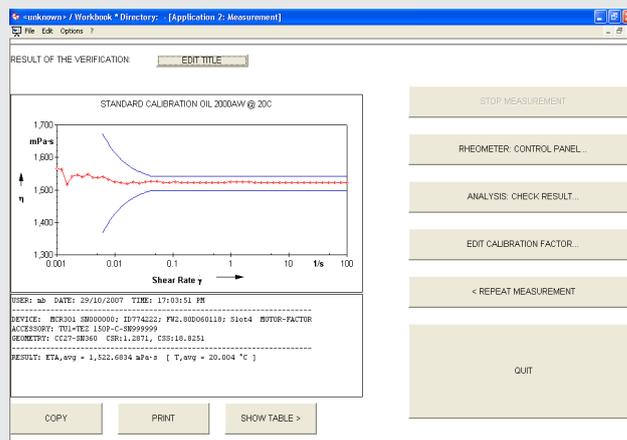


Fig. 7: Measurement of the viscosity standard with boundaries

It is possible to change the conversion factors of the measuring system to adapt the measured viscosity values. This option is for the adjustment of special measuring systems and should only be used for standard measuring systems after consultation with your local Anton Paar representative.

Instruments for:

Density & concentration measurement
Rheometry & viscometry
Chemical and analytical techniques

Colloid science
X-ray structure analysis
CO₂ measurement
High-precision temperature measurement