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Bohlin

Gemini & CVO

Rheometer user manual

Malvern Instruments Limited
Enigma Business Park
Grovewood Road, Malvern
Worcs, WR14 1XZ, U.K.
Tel: +44 (0) 1684 892456
Fax: +44 (0) 1684 892789

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Gemini & CVO Rheometers

User Manual

MAN0329 Issue 4.0 November 2010

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Head office:

Malvern Instruments Ltd.
Enigma Business Park,
Grovewood Road,
Malvern,
Worcestershire WR14 1XZ
United Kingdom.

Tel + [44] (0)1684-892456
Fax + [44] (0)1684-892789

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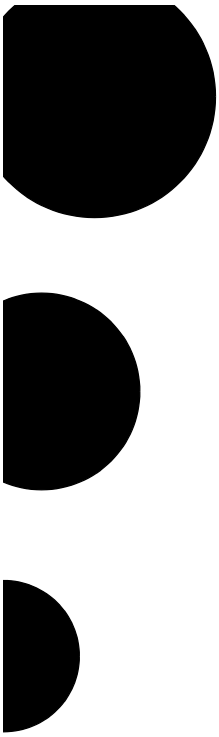
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Part 1 - Operator's Guide

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1

Introduction to this manual

Introduction

This manual covers the operation and maintenance of the Bohlin Gemini and CVO rheometers from Malvern Instruments. These are precision instruments designed to provide accurate rheological measurements on a wide variety of materials. The instruments offer a broad range of torque and measurement capabilities in a single integrated package, controlled by a software application running on a standard PC.

The Malvern Bohlin instruments covered by this manual are:

- Gemini HR nano
- Gemini II
- CVO 100

The aims of this manual are to:

- Explain what the Gemini/CVO rheometers are and how they work.
- Describe the Gemini/CVO hardware components.
- Describe the software and the tests it can run.
- Explain how to set up the instrument before making a measurement.
- Explain how to use the instrument to make a measurement.
- Identify the user maintenance and troubleshooting procedures.
- Show a supervisor how to set up users.
- Explain all Health and Safety issues.

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How to use this manual

This guide should be read in conjunction with the **Gemini/CVO Accessories Guide,** which provides detailed information about all compatible temperature controllers and geometries.

Users must read the Health and Safety information in **Appendix B** before operating the instrument itself. Additionally, if using the ETC/LTU option, users should read the **Liquid Nitrogen Safety Guide**, and the relevant chapter of the **Gemini & CVO Rheometers Accessories Guide**.

We recommend reading this manual fully before starting the first measurement.

The manual is divided into the following three sections.

Part 1 – Operator's guide

The Operator's guide contains all the information required by an operator using the Gemini/CVO. Topics covered are:

- What the Gemini/CVO does.
- The hardware components of the Gemini/CVO.
- The software and the available tests.
- Initial procedures – what needs to be done at the start of the day before the rheometer can be used. This includes pre-start checks and setting up the instrument.
- A tutorial on making a measurement.
- Basic maintenance procedures and troubleshooting information.

Part 2 – Supervisor's Guide

The Supervisor's guide contains all the information required by a supervisor using the Gemini/CVO. Topics covered are:

- Site requirements.
- Instrument setup (for the purposes of moving the instrument).
- Setting up users in the software.

Part 3 – Appendices

Appendix A contains the instrument specification, **Appendix B** contains essential Health and Safety information which all users must read. **Appendix C** provides troubleshooting information. Other appendices contain supplementary information not necessary for the general operation of the system.

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Access to the instrument

This manual refers to the various people who will have access to the instrument, as follows.

Malvern personnel

Malvern personnel (service engineers, representatives, etc.) have full access to the instrument and are the only people authorised to perform service procedures that may require the removal of the covers.

Supervisor

The supervisor is the person responsible for the management and safety of the instrument and its operation. The supervisor is responsible for training the operators. The supervisor can also perform all user maintenance routines identified in **Chapters 4**.

Operator

An operator is a person trained in the use of the system. All operators should read **Chapters 1-3** and perform all routines identified in **Chapter 3**.



Warning!
Do not remove the main cover of the instrument. Failure to follow these guidelines could result in exposure to hazardous voltages. The front cover of the instrument should only be removed for transportation purposes by a supervisor in and strict accordance with the procedure in **Chapter 2**.

Health and Safety

For all Health and Safety information, refer to **Appendix B**, the **Accessories Guide** and the **Liquid Nitrogen Safety Guide**.

Assumed information

Naming convention

The Gemini/CVO is referred to either in full as the Gemini/CVO, or as “the instrument”.

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Menu commands

Menu commands in the software are always shown in bold text in this form:

main menu-menu item-submenu item.

For example, the command **Tools-Options** refers to selecting the **Options** command from the **Tools** menu.

Where to get help

Other manuals

The following additional manuals are supplied with the system:

Accessories Guide

This guide gives details on the specification, connection and use of all temperature controllers as well as the geometries available to use with the rheometer.

Liquid Nitrogen Safety Guide

This guide is provided as a starting point to users in helping to establish a safe regimen for working with liquid nitrogen, which is used as a coolant in the Low Temperature Unit (LTU) option.



Warning!
It is essential that full staff training on the safe use of liquid nitrogen is organised through a specialised agency before using the LTU.

Manual and online help

The primary source of information on the Gemini/CVO system is this manual and the software online help, which gives more detailed information. Each dialog within the software has a **Help** button giving information specific to that dialog.

Help desk

All queries regarding the system should initially be directed to the local Malvern Instruments representative. Please quote the following information:

- Model and serial number of the instrument – located on its back panel.
- The software version. To find this choose, **Help-About** from within the software.

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Contact the United Kingdom help desk if the local Malvern Instruments representative is not available. Its direct line is +44 (0) 1684 891800. Its email address is **helpdesk@malvern.com**.

Note
This help line is primarily English speaking.

Remote support

Malvern Instruments offers a remote support service, delivered by an Internet connection. Benefits include fast and efficient fault diagnosis, reducing downtime and costs.

On-line user training is also available, plus software updates. A high speed Internet connection is recommended for making use of this facility.

Malvern website - www.malvern.com

The Malvern website offers a comprehensive range of materials characterisation resources for use by customers 24 hours a day, seven days a week.

Resources include software downloads, frequently asked questions, a knowledge base and application notes, plus information on other materials characterisation solutions that Malvern can provide.

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2

Hardware features

Introduction

This chapter provides an overview of the rheometer's main hardware features and the connections required for its various accessories.

What do Bohlin rheometers do?

Bohlin rheometers can control the shear stress; that is they apply a torque (force) and measure the resultant displacement (movement). They can also control the shear rate; that is they regulate the motor speed (movement) and measure the resultant torque (force). Torque and displacement are converted to "rheological format" by means of the measuring system constants.

The data produced by the system can be provided in tabular format or plotted graphically for use both on screen or in hard copy. Data can also be exported to other programs for further analysis and presentation.

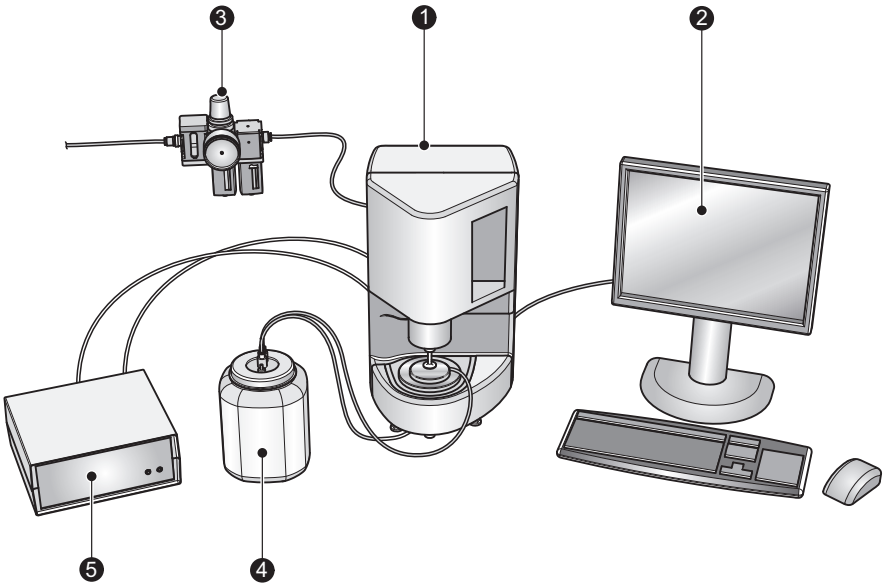
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Typical rheometer system

Whilst a range of temperature controllers exist to allow the instrument to measure samples at both low and high temperatures, the following illustration shows the interconnections of a typical rheometer system with a Peltier plate installed. When other temperature controllers are used the overall system will differ. See the **Accessories Guide** for more information.

The computer is central to the system and should always be the first item to be switched on and the last to be switched off.



① **Rheometer** – high specification air bearing motor with torque, position, gap and Normal force control, and also measurement control.

② **Computer** – running the Bohlin software.

③ **Air supply** – provides air to the air-bearing inside the rheometer.

④ **Peltier water supply** – provides water to the peltier plate/cylinder.

CVO only:

⑤ **Electronics control unit** – provides the necessary electronics control for **peltier plate/cylinder** units.

Gemini only:

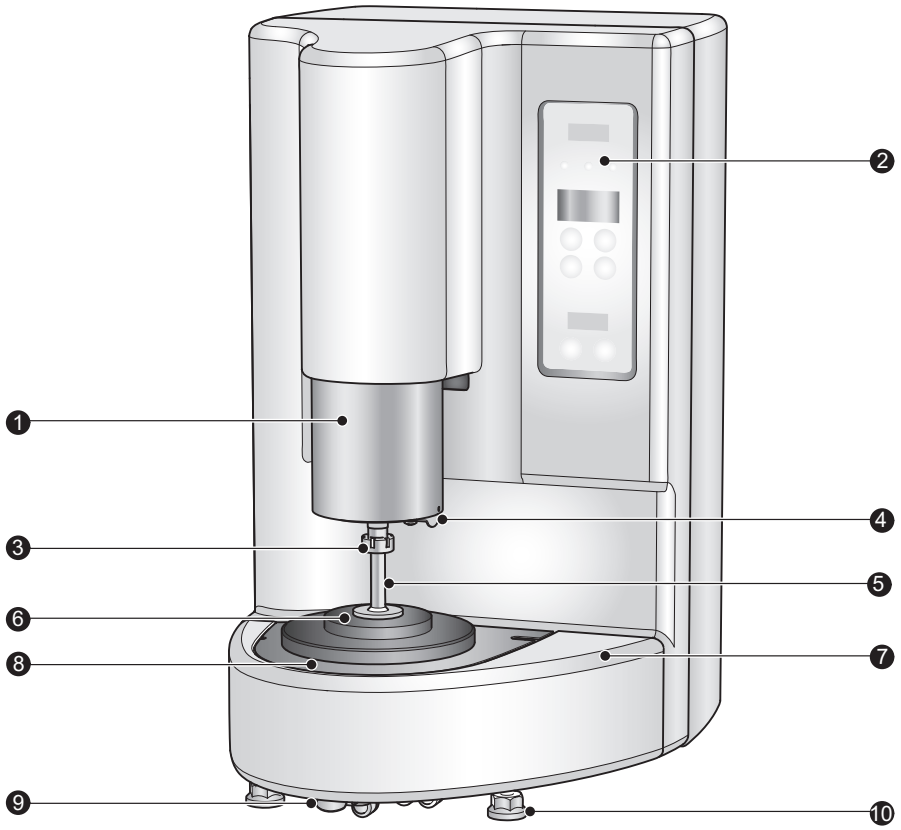
Motor cooling kit (not shown) – provides water cooling for instrument motor.

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The rheometer

The main parts of the instrument are as follows:



ill 8573

① **Bearing** – high specification air bearing motor with torque, position, gap and Normal force control, and also measurement control.

② **Control panel** – provides keypad access to control the instrument - described in the next section.

③ **Chuck** – secures the upper geometry in place.

④ **Chuck lock** – locks the chuck so that the bearing is not damaged when the instrument is transported.

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⑤ **Upper geometry** – the upper geometry is inserted into the chuck.

⑥ **Lower geometry** – this is held in place by the Easy Swap geometry clamp.

⑦ **Plastic cover (or bib)** – covers the **lower plate (temperature controller) clamping mechanism**. It also covers the **temperature controller 16 pin 'D' connection input (Gemini only)** that allows temperature controllers (see **Accessories Guide**) to be controlled by the instrument. On CVO rheometers this is accomplished through a separate control box, which is connected to the rear of the instrument.

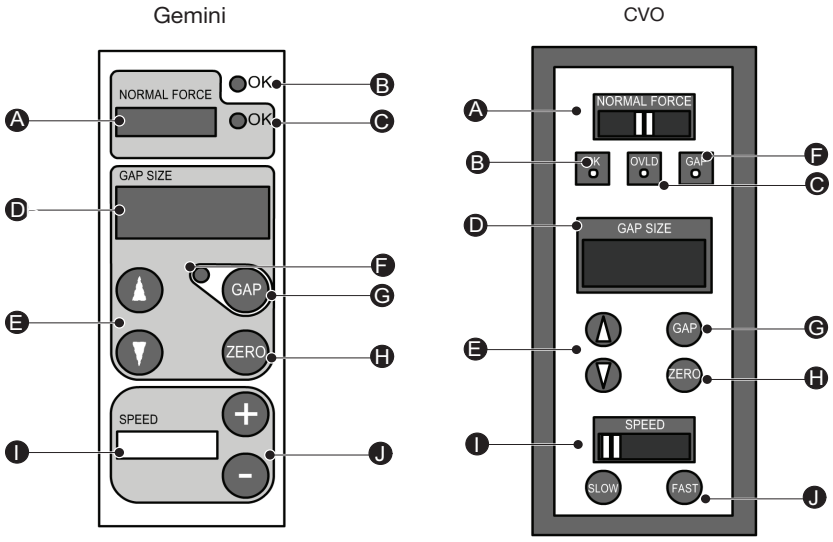
⑧ **Metal trim** – this protective cover (sometimes referred to as a "bib") protects the lower casing of the instrument from sample spillage.

⑨ **Plastic cover release catch** – when pressed downwards, allows the plastic cover to be removed.

⑩ **Adjustable feet** – for levelling the instrument.

Control panel

The CVO/Gemini share the same functions, but the arrangement of the control panel differs slightly as shown in the illustrations below:



Ⓐ **Normal force indication** – a double bar in the centre shows no normal force (+/-500g). Bars to the left show a negative normal force (i.e. pulling down on the geometry), whilst bars to the right indicate a positive normal force (pushing up on the geometry). Each bar indicates a load of 500g. If the normal force becomes too large (in either direction) the overload light © illuminates. When

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overloaded, the motor will not move up or down, until the normal force has reduced.

Ⓑ **OK light** – indicates that the instrument is ready to make a measurement or set the gap.

Ⓒ **Overload warning light** – indicates if normal force becomes too great. The rheometer will not move up or down in this state.

Ⓓ **Gap size** – with the OK light Ⓑ lit, the value displayed is the current gap. If the OK light is off and the gap light Ⓕ is lit, the required gap is shown. This display also shows status messages.

Ⓔ **Raise/lower head** – move the measurement head and geometry up or down. When moving downwards, the head will continue until the gap value is met. If the head is moving up or down, a brief press of the opposing direction key on the control panel will stop the head from moving.

Ⓕ **GAP light -** lit when the gap is not yet set or is being set. When the gap light is lit, the display Ⓓ can be adjusted to set a new value using the down and up arrows Ⓔ for the required gap. If the gap light is flashing, the instrument is in 'gap capture' mode and the actual gap is being adjusted.

Ⓖ **GAP** – set the gap. There are two methods of use:

Gap setting mode: briefly press the GAP button to enter gap setting mode. The display shows the required gap, which can be adjusted by use of the up and down arrows. Whilst in gap mode the OK light Ⓑ is off and the GAP Ⓕ light is on. Press the GAP button again to accept the value on the display. The GAP light will go off and the OK light will come on.

Gap capture mode: press and hold the button to enter gap capture mode. The OK light will go off and the GAP light will flash. Use the up and down arrow keys, to adjust the current gap. The head will move to match the displayed value. Press the gap button again to accept the new gap. The GAP light will go out and the OK light will come on.

Ⓗ **Zero gap** – automatically zero the gap. This button also allows you to 'force zero' if you are in the Gap mode.

Ⓘ **Gapping/vertical movement speed** – indicator providing information on the vertical gapping speed of the geometry - all lights lit indicates maximum speed.

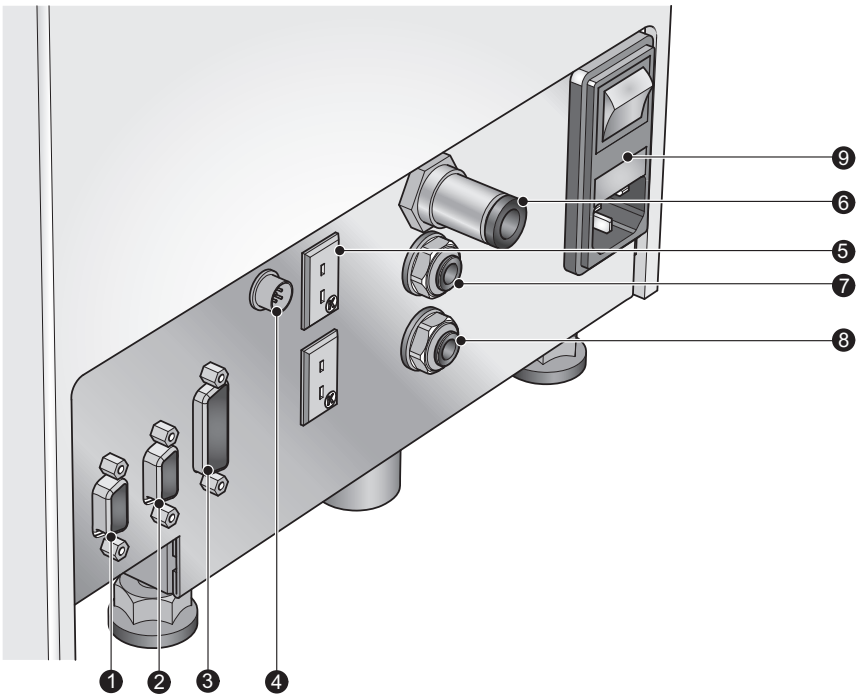
Ⓙ **Increase/decrease vertical movement/gapping speed (+/- or SLOW/FAST)** – **FAST** or **+** increases the vertical movement/gapping speed of the geometry. **SLOW** or **-** decreases the speed. The speed setting is only effective when the upper geometry within approximately 5mm of the lower geometry.

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Back panel

The following illustrations provide details on the connections located on the back panel of the instrument.



① **Instrument port** – connection to one of the computer's COM ports that provides the main interface with the rheometer. The COM port number to which this is connected is required by the Bohlin software under **Options-Instrument Serial Port**.

② **Gap control** – connection to one of the computer's COM ports dedicated to gap control. The port number to which this is connected is required by the Bohlin software under **Options-Auto Gap Control-Serial Port**.

③ **TCU** – connector for controlling with Temperature Control Units.

④ **PT-100** – connector for a PT-100 temperature sensor cable.

⑤ **TC1/2** – inputs for thermocouple sensors from external temperature controllers.

⑥ **Air-3 bar (2 bar on Gemini HR Nano)** – air-bearing air supply.

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Note:
The air supply must be 3 bar (or 2 bar on a Gemini Nano HR) and meet the specification in **Chapter 4**. If the pressure falls below 2 Bar, the motor is disabled and an alarm sounds.

⑦ **Cooling Air/Water** – optional motor cooling for the system - input or output (see **Chapter 4**).

⑧ **Cooling Air/Water** – optional motor cooling for the system - input or output. (see **Chapter 4**)

⑨ **Power - supply in/switch** – provides power to the rheometer.

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3

Basic operation

Introduction

This section assumes that the instrument has already been installed. It is also assumed that the user has access to a standard sample of mineral oil. This is included in the **Verification Kit** if purchased with the rheometer. Further supplies of these samples are available from your nearest Malvern representative.

Information relating to the software and hardware that is not covered in this section, is available either in the **Accessories Guide** or the software Help system.

For further information about rheology, please refer to **A Basic Introduction to Rheology**, which accompanies this manual.

Setting up the rheometer

This section covers all the necessary steps involved to correctly set up the rheometer in preparation for running a test.

Starting the system

It is important that the rheometer system is started in the correct sequence to ensure correct operation.

1. Turn on the compressed air line and check that the pressure is accurately set on the regulator unit, in line with the pressure specifications shown in **Chapter 4**.
2. Switch on the computer and printer (if a local printer is connected).
3. Switch on any attached temperature unit control boxes, such as the ETC control box or the Peltier control box on the CVO only. The Gemini instruments contain a built-in Peltier controller.
4. Switch on the instrument.

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5. Press the up arrow on the instrument panel to start the initialisation. (This is the default behaviour of the up arrow on the keypad if "Do not initialize" has been selected in the **Options-Auto Gap Control-General** settings.) This raises the air bearing to a reference height and then lowers it to a rest position.
6. Start the software by choosing **Start-All Programs-Bohlin-Bohlin RX.XX.X.X** (where X is the current release number). Alternatively, choose the Bohlin icon on the desktop if this option was selected during installation.
7. The software log in screen is displayed - enter your **User Name** and **Password** if required (the Supervisor will have set these up if necessary, as described in **Chapter 4**) and also select the Instrument and Temperature Control, then click **OK**.

Selecting the correct geometry

Many different geometries can be used on the rheometer. These fall broadly into three categories:

- Cup and bob (coaxial cylinder)
- Cone and plate
- Parallel plate

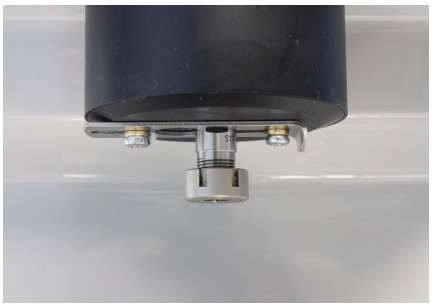
For more information on geometries, refer to the **Accessories Guide.**

Installing the geometry

The following example uses a Cone with a 4° angle and having a diameter of 40mm, as supplied with the rheometer. This is referred to as a CP 4/40.

If using the ETC accessory, please refer to the **Accessories Guide** for more details on using the upper geometry holder.

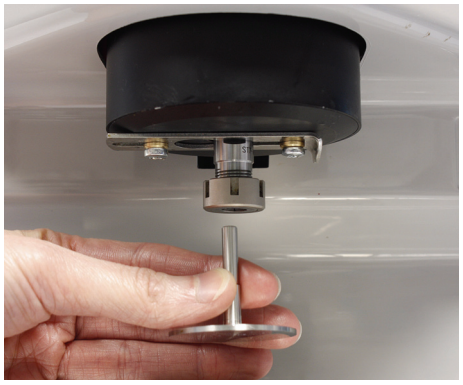
1. Turn the chuck so that one of the flats faces the front.
2. Slide the air bearing lock to the left to lock the chuck. If the lock will not slide freely, gently turn the chuck until the lock slides freely - see below.



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3. Loosen the chuck by turning it clockwise (looking down on the rheometer).
4. Insert the upper geometry. If it cannot be inserted freely, loosen the chuck further.



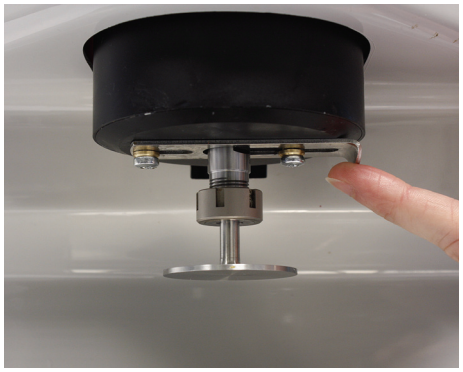
5. Push the geometry up into the chuck as far up as it will go, and then tighten the chuck. Lightly push the geometry whilst tightening the chuck to ensure correct fitting.



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6. Move the air bearing lock to the right to free the chuck. Gently set the spindle rotating by hand to ensure that it is free. (If setting the gap next, free the chuck only after loading the sample and zeroing the gap.)



Setting the correct gap

For accurate measurements it is essential to have the correct gap setting for each geometry. An incorrect gap will lead to errors in the results, especially when small gaps or small Cone angles are involved. For more explanation of the control panel, see **Chapter 2**.

Automatic gap setting for the 4/40 Cone

1. Insert the 4/40 Cone into the rheometer.
2. Ensure the chuck lock is in the locked position.
3. Press **ZERO** on the front panel. The instrument now finds the zero position (i.e. where the Cone just touches the lower plate) automatically. Wait until the **OK** light is shown on the instrument and '0000' is shown.
4. Press the **Up** button on the control panel to move the geometry up.
5. Load the sample.
6. Select the geometry from the software to set the required gap of 0.15mm.
7. Press the **Down** button to go to gap.
8. The **GAP light** switches off and the **OK** light switches on - the gap is now set. The GAP SIZE indicator reads "0150".

Note
150µm is the truncation height of the 4° Cone.

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Gap setting for other geometries

The following section gives information on gap setting for several of the more common geometries. See the **Accessories Guide** for more information.

Double gap

Use the supplied 'coin' to set the gap as detailed in the **Accessories Guide**.

Parallel plate

Use the same process as described previously in this section for the 4/40 Cone, but back off by the required gap (rather than 0.15 mm). Remember to ensure that the correct value for the gap is also used in the software.

Other geometries

Other angle Cones will have different the truncation heights as described in the **Accessories Guide**. Use this value instead of 0.15 mm in the above procedures. Other geometries will be supplied with specific gap setting instructions when purchased from Malvern.

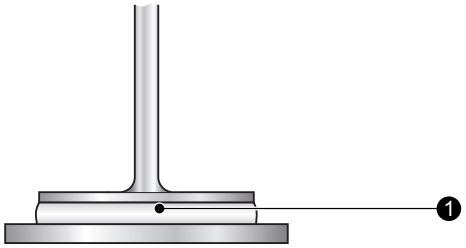
Sample loading

When applying a sample it is important that the correct amount is used. Over filling or under filling will result in errors in the data.

For samples where solvent loss or drying may be a problem, a solvent trap can be used with the geometry. Alternatively, a small amount of low viscosity silicone fluid (e.g. 2-5 mPas) can be placed around the geometry. If this is done it is important to ensure that the oil does not mix in with the sample during the test, and that the viscosity of the oil is much less than that of the sample being measured.

1. Place the sample on/in the lower geometry. With **cone and plate or parallel plate** geometries, it is normally easier to slightly over fill and then trim off any excess sample, after bringing the upper and lower geometries together.
2. Slowly lower the upper geometry into place by pressing the down arrow.

The illustration below shows a correctly filled cone and plate - sample is ①.



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Loading very viscous samples



For very stiff or elastic samples, it is possible that by trying to compress them, a large 'normal force' is generated. This will be seen as increasing bars on the **normal force** display.

If all bars illuminate, the overload indicator will activate and the instrument will stop the head from moving down. As the sample relaxes, the normal force indicators should gradually reduce to two bars (normal force) and the overload light will go out. The instrument will then compress again.

The speed of final descent can be adjusted by use of the speed control buttons on the front panel.

Experiment to find the best setting for your samples.

Note
By slowing the descent rate any damage to delicate materials, such as weak gels, is less likely. Normal force overloads are also more unlikely with a slower descent rate.

Gap Capturing

When using parallel plates it is possible to adjust the gap to the thickness of the sample (as opposed to preparing your samples to the thickness of the gap). Gap capture can be used to close the gap until the upper plate touches the sample, see **Chapter 2** for more details.

Zeroing at the Current Position

It is possible to 'force' a zero gap on the rheometer at any point. From either gap or gap capture mode (GAP light illuminated or flashing), press the ZERO button on the instrument panel - the current position is then taken as the zero reference point. To reset the instrument simply repeat the standard zeroing procedure described in **Chapter 2**.

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Software settings

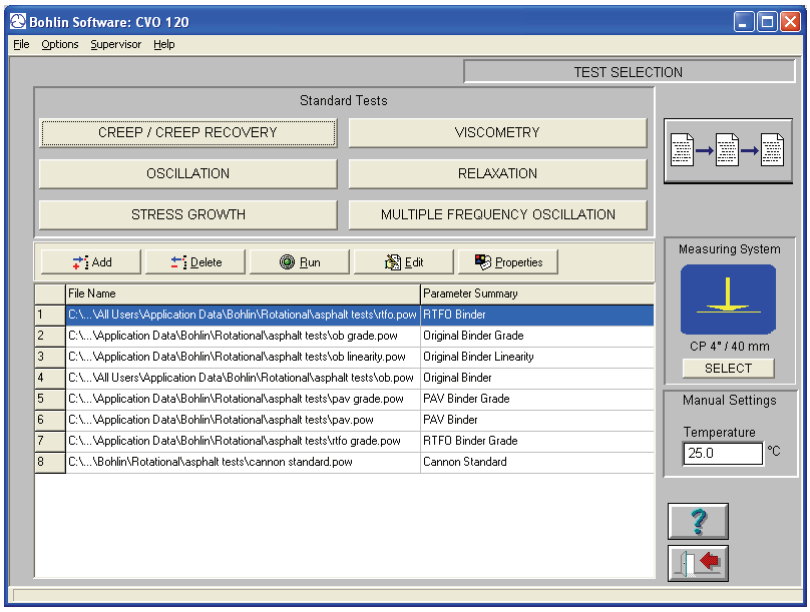
This section runs through the process of performing an example test.

Selecting a test protocol

The normal process for running tests is either to set up the required test parameters one by one or retrieve a pre-defined test. Alternatively a pre-existing test can be loaded and then modified. For the purposes of this example, the parameters contained in a file called EXAMPLE1 are used. This file was automatically installed along with the software.

Note
You may not see all of the information shown in this section if the Supervisor user has limited your access rights to the software. Additionally, the options shown on this screen vary depending on the instrument in use.

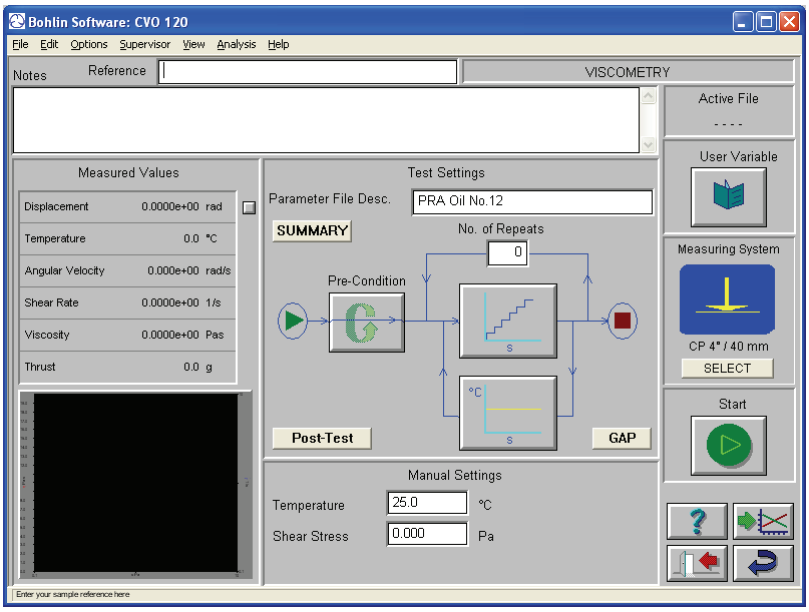
1. Click the **Viscometry** button in the Bohlin software.



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The stress viscometry window is displayed:



2. Select **File-Open Parameters** from the menu.
3. Browse to the following folder:

   Windows XP:

   `C:\Documents and Settings\All Users\Application Data\Bohlin\Rotational\Examples\PARAM`

   Windows 7:

   `C:\ProgramData\Bohlin\Rotational\Examples\PARAM`
4. Select the file named **EXAMPLE1.PVW** and click **Open**.

   The geometry display now shows the 4° 40mm Cone (CP 4/40).

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Configuring test settings

The following section explains the various items associated with the test. The information in this section is only intended as a brief introduction. For in-depth information, please refer to the Help system in the software by selecting **Help-Contents**.

Reference

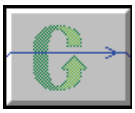
A heading for each sample can be entered here. This heading is displayed whenever you list files.

Notes

Sample notes and observations can be entered here.

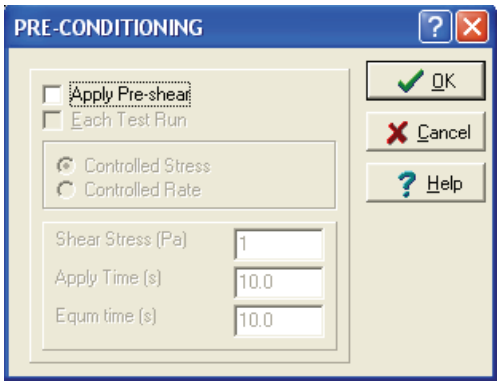
Pre-shear

The pre-shear function allows you to automatically pre-shear a sample before testing it:



This is useful for looking at materials with shear history dependence, i.e. thixotropic materials.

To use an equilibrium time without the pre-shear: select the **Apply Pre-shear** check box and set the **Apply Time** to **0**.

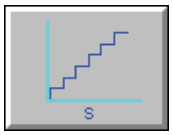


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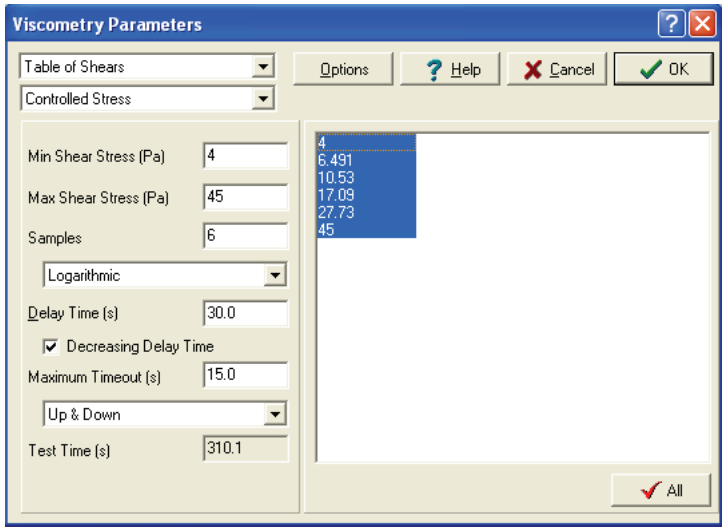
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Shear stress selection

The standard test you have loaded is a stepped shear stress test (table of shears).



1. Click the (above) button to display the **Viscometry Parameters** window:



2. Select each shear stress value in the table that is required for use in the test. (The usual Windows selection actions apply - e.g. CTRL and click for individual item selection/de-selection). Refer to the help system for more information. To select all of the values, click the **All** button.

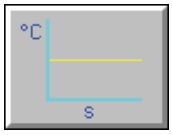
3. Click **OK** when the required values have been selected.

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Temperature control mode

The standard test is designed to work in isothermal mode (i.e. at one temperature). The other modes of operation are **table** or **gradient** operation.



Starting a test

1. Ensure that the sample is loaded in the instrument.
2. Check that the air bearing lock (chuck lock) is not on (see **Chapter 2**) and then click the **Start** button.



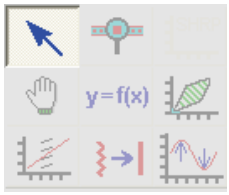
3. The test will now start.
4. Pressing the **Abort Test** icon will cause the test to stop immediately.



Modifying the screen display

It is possible to alter the screen graph to suit your requirements. When saving data, the layout of the graph will also be saved.

1. Select the Cursor (arrow) tool from the toolbar on the right panel:

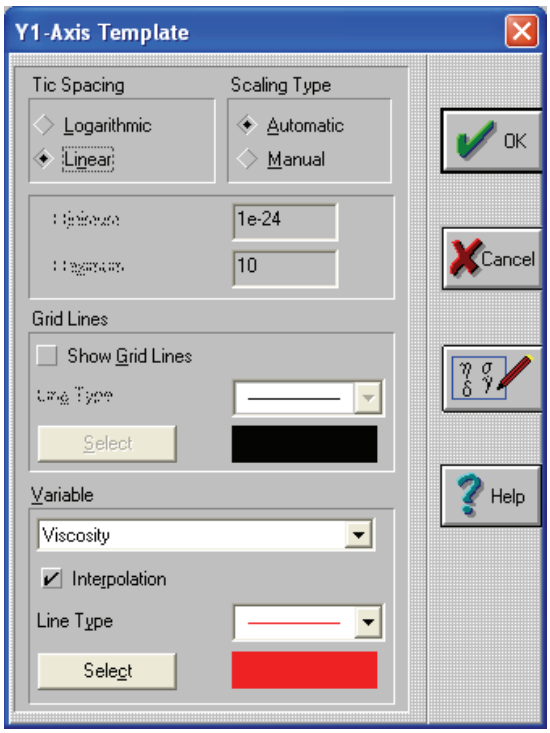


(Note: some of the options shown here vary depending on the instrument.)

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2. Click on or near to the axis you wish to change. The **Axis Template** window is displayed, which allows you to select the variable for the axis, the scaling type (manual or auto) and logarithmic or linear.



3. To change the variable displayed on this axis, click:



4. Then select the variable, and click **OK**. Each axis can accept up to nine variables as long as they have the same unit.

Saving data and recording results

To save the data after running a measurement:

1. Click **File-Save As** from the menu bar.
2. Enter a name to describe the results e.g., MYDATA.
3. To print a hard copy of a data table select **File-Print**, alternatively choose **File-Plot** for a graphical printout of the data.

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Data processing

The software allows you to compare data, fit models and perform many other functions with your data. For more information, refer to the on-line help system.

The following section shows how to compare the data generated by the test with the reference data supplied as part of the example data.

1. Select **File-Merge** from the menu.
2. Set the directory to:

Windows XP:

```
C:\Documents and Settings\All Users\Application Data\Bohlin\Rotational\Examples\UMEXAMP
```

Windows 7:

```
C:\ProgramData\Bohlin\Rotational\Examples\UMEXAMP
```

3. Click on the file name OILREF1, and then click **OK**.
4. The graph showing both sets of data is displayed.



Note
The calibration value of the oil supplied to you may be slightly different to the one on the example disc. The main consideration is that the data is a straight (horizontal) line and has the same value as shown on the verification document supplied (±5 %).

To obtain a print and plot of this data, follow the instructions given previously. To return to the main menu, click the return button twice (once to switch back to the test screen then again to return to the standard tests page).



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Final rheometer processes

Finally, the sample and geometry must be removed and the rheometer shut down correctly - follow the procedures given in this section.

Removing the sample and geometry

It is important to clean the rheometer after use. Samples left behind may attack the surfaces of the geometries.

1. Lift the upper geometry clear of the lower one. For very stiff or 'stringy' samples it is better to undo the upper geometry before lifting the rheometer.
2. Remove the geometries from the instrument.
3. Clean the geometries. Do not use abrasive or sharp implements as these may scratch or pit the surface.

Some geometries can be taken apart. Pay special attention to cleaning the threads. Also make sure any 'O' rings on these geometries are not displaced from their recesses.

Shutting down the rheometer system

1. Remove the upper geometry.
2. Ensure that the air bearing lock is in place as described earlier in this chapter.
3. Exit the software and switch off the instrument (switch at the back) and temperature control unit.
4. Shut down Windows and then switch off the computer.
5. Lastly, turn off the compressed air line if required (however it is acceptable to leave the air supply on, even when the instrument is not in use).

Routine maintenance

Please observe the following maintenance precautions for your Rheometer. They should be performed regularly and at least within the periods stated below.

Before use

Make sure that the geometries are clean and free from deep scratches. Never try to attach or use any geometry with obvious visible damage.

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After use

- Clean up any spillage of samples on the rheometer and clean the geometries used.
- Remove the geometry and if necessary clean the instrument.
- Remember to make backup copies of your data files.
- Switch off the instrument and accessories and remove mains lead(s) before cleaning. Use a soft cloth dampened with a mild detergent solution. In extreme cases isopropyl alcohol or acetone may be used – take appropriate precautions when using these solvents. Do not spray cleaner directly onto the instrument and do not use abrasive cleaners.
- Where the air supply is part of the site services, this can be left on if required. If using a compressor, turn off the air supply and the mains to the compressor then open the drain valve on the compressor.
- Check the geometries for damage. Any visible scratch may cause erroneous measurements. Be sure to observe great care in handling the geometries. Attach and remove them carefully. Always store them in their boxes.

Weekly

Check the air-line and filters for any signs of water or oil. Change filters if necessary.

Monthly

Run a calibration reference sample (oil), from the Malvern-supplied verification kit, to confirm that the rheometer is still within calibration.

Bi-annually or annually

A service visit from a Malvern Instruments representative is recommended - this depends on the level of instrument use. There are no user serviceable parts in the instrument or accessories – **on no account should adjustments be made unless by a Malvern Instruments approved engineer**.

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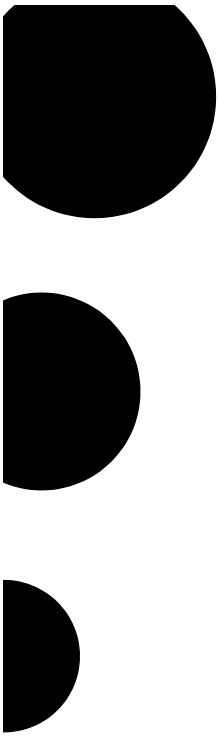
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Part 2 - Supervisor's Guide

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4

Site requirements and setup

Site requirements

Space required

Provide enough space to allow easy access to all components. The minimum bench space required is 1500mm wide and 800mm deep. We recommend that the computer is positioned to the right of the instrument, with its screen at the same height as the rheometer keypad.

If a Heat exchanger is used place it on the bench on the left of the instrument or on the floor. If an Active heat exchanger is used place it on the floor.

Allow at least **800mm** above the bench surface for access to the instrument.

The system dimensions are given below:

Component	Width	Depth	Height	Weight
Rheometer	490mm	485mm	680mm	47kg
Water cooling kit	180mm	288mm	258mm	8.75kg (full)
Dewar flask (LN2 option)	950mm	950mm	850mm	27.6kg (full)
Computer and printer	See manufacturer's documentation			

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Environmental conditions

The site must be:

- Indoors and away from strong light (windows)
- Away from heat sources like radiators.
- Well ventilated (if noxious materials or solvents are used).
- On a horizontal vibration-free bench that can support the weight of the instrument (28kg)

Operating environment

The instrument is designed for correct operation under the following conditions:

Altitude	Up to 2000m
Operating temperature	+10 ... +35°C
Storage temperature	-20 ... +50°C (for storage and transportation)
Air humidity	10 ... 90% (non-condensing)
Protection class	IP20 (IEC 60529)
Power supply	Corresponds to Class I; according to VDE 0106 T1. Not for use in an explosive atmosphere. Max. mains fluctuation of ±10% are permissible.
Overvoltage category	II (IEC 60664)
Pollution degree	2 (IEC 60664)

Power requirements

The power supply must be clean and filtered. If necessary, fit an Uninterruptible Power Supply (UPS) to remove any spikes or noise. The power requirements are:

Component	Power requirement	Power sockets required
Rheometer	~ 100-240V, 50-60Hz 16A single phase supply	1
Active heat exchanger	~ 110V, 60 Hz ~ 230V, 50 or 60Hz	1
Computer	See manufacturer's documentation	
Computer monitor	See manufacturer's documentation	
Printer	See manufacturer's documentation	

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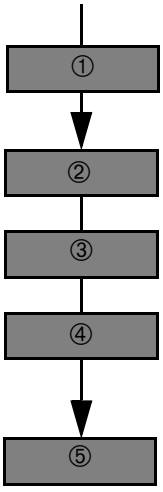
Air / nitrogen Requirements for System

The motor must be operated with a supply of compressed air at 3 Bar connected to the unit. If the air supply pressure falls below about 2 Bar, the air pressure sensor disables the drive to the motor and an alarm sounds.

Parameter	Specification
Specification	[ISO Standard 8573.1, quality class 121].
Maximum size for dirt	0.1 microns
Maximum size for oil	0.01 microns
Maximum moisture dew point	-40ºC
Air delivery at 25 litres/min	[ISO Standard 8573.1, quality class 121 air]
Air delivery	60 litres/min at 5 bar

Filter setup

The filter setup is shown in the diagram below:



This shows the following:

① Compressor - provides the initial unfiltered air or Nitrogen supply.

② General air filter - Malvern can supply a JUN-AIR filter. The top section of this has a high efficiency filter and a drier. The bottom section has a dust/oil filter.

③ Domnick Hunter filter system to further improve quality. Malvern can supply this.

④ Parker filter/regulator - supplied as standard, this regulates the air to the correct pressure for the air bearing.

⑤ Rheometer.

Note the following:

- If the existing supply already meets the ISO Standard 8573.1, quality class 121, the only new part required is the Parker filter/regulator ④. Malvern supplies this.
- If the supply does not meet the requirement, the additional filters ② and ③ are also required to bring the supply up to the standard. Malvern can supply these. The filters in the above components are user-replaceable; refer to the manufacturer's documentation for each filter.

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- Air/nitrogen requirements for optional accessories - an additional regulator tap on the filter is supplied for these:

Option	Air requirements
Extended Temperature Cell (ETC)	5 bar of nitrogen/air at 25 litres/min
Extended Temperature Option (ETO)	5 bar of air at 50 litres/min [or optionally 7 bars at 120 litres /min, for cooling to –10 °C

If the ETC is to be supplied by the same air/nitrogen source, an additional regulator may be attached to the main filter/regulator. See the ETC section in the **Accessories Guide** for more information.

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Transporting or moving the instrument

First installation is always carried out by a Malvern representative - this information is provided for reference should the rheometer need to be moved or the software re-installed or installed onto a new computer. Retain all packing materials in case the instrument has to be transported.



Caution!
Failure to follow the correct transport procedures outlined in this section could result in permanent damage to the instrument.



Caution!
The air supply should be connected and switched **on** before commencing these procedures.

The following processes vary depending on the type of instrument that you have - contact Malvern Instruments to confirm this if in doubt.

Instruments without normal force capability

Whether shipping the instrument or relocating to another location:

- **Fit the chuck immobiliser only** - this is done before switching off the air.

Instruments <u>with</u> normal force capability

Instruments with a strain gauge ('normal force' capable instruments) are very sensitive to movement and require the following preparation to avoid damaging the bearing before moving:

Moving an instrument over smooth floors on a trolley:

- **Fit the chuck immobiliser only** - this is done before switching off the air, as described in the next section.

Shipping an instrument, or moving over rough ground:

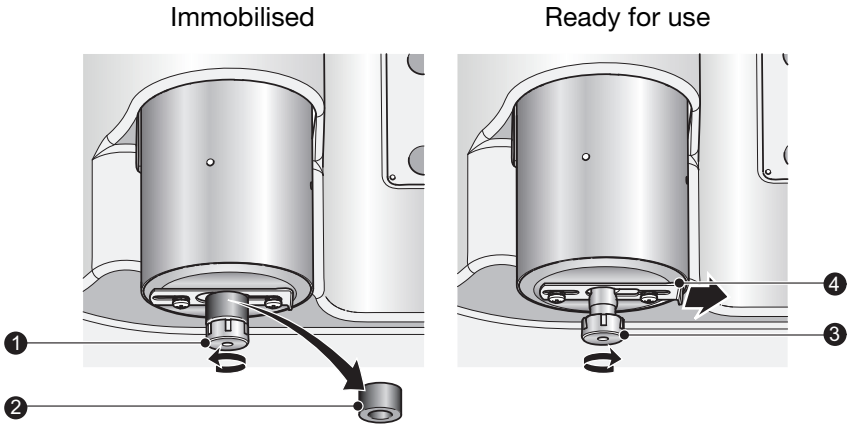
1. **Fit the chuck immobiliser** - this is done before switching off the air, as described in the next section.
2. **Tighten the strain gauge locking screw** - contact Malvern Instruments Support for details and supervision on this procedure.
3. **Fit the transit plate** - contact Malvern Instruments Support for details and supervision on this procedure.

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Fitting the chuck immobiliser

The motor shaft is locked with a small piece of plastic tubing to prevent damage during transportation. Once the air supply has been connected to the rheometer, the bearing immobiliser tube may be connected as shown below:



ill 7898

The procedure is:

1. Ensure the shaft lock ④ is locked, as shown in the left-hand picture.
2. Unscrew anti-clockwise the collet ① from the chuck assembly and remove.
3. Insert the immobiliser tubing ②.
4. Replace the collet ③ (screw it clockwise).
5. Removal of the chuck immobiliser is a reversal of this process.

Re-Installation Procedure

Not all of the following steps may be applicable to your instrument. **Refer to the illustration of the back panel in Chapter 2**. Each step is described in more detail further below.

1. **Make all instrument connections** - for example, air and communications cables. This is detailed later in this chapter under **Rheometer Connection**.
2. **Level the instrument** - this needs to be as accurate as possible and requires the use of a precision level.
3. **Instruments with a strain gauge (normal force capability) that have been recently relocated** - it is necessary to first remove the transit locking plate and then loosen the strain gauge locking screw. **Contact Malvern**

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Instruments Support for information on this and be sure to retain the transit locking plate for future use.

4. **Remove the chuck immobiliser** - this is a reversal of the fitting process detailed in this chapter.
5. **Verify the instrument** - use the Verification Kit and run appropriate tests - contact Malvern Instruments for more information.
6. **Torque mapping** - it may be necessary to undertake a torque mapping procedure on Gemini instruments. This can be performed by supervisors - contact Malvern Instruments for more information and support.

Rheometer connection

Use the following process for making the connections on the rheometer:

1. **Connect the air supply** to the air bearing via the connector on the back of the rheometer marked 'AIR' ⑥. This is the upper pipe connector of the three. The air supply is at a pressure of 3 bar (or 2 bar on Gemini HR Nano instruments) and should follow the filtration specification given later in this chapter.



Caution:
Never connect a water supply to the AIR input – it will irreparably damage the air bearing.

2. **Connect the motor cooling kit, if supplied**. This is an air cooling kit comprising a Tee-piece, an extra length of pipe and a silencer.

   On some instruments a water cooling kit is supplied comprising a small tank with integral pump. On the back of the rheometer there are two pipe connectors labelled 'Cooling' or 'Motor Cooling' ⑦/⑧. **If installing an air cooling kit**, fit the exhaust into one connector and use a Tee connector from the main air supply into the other. **If installing a water cooling kit** connect two pipes from the pipe connectors to the tank's pipe connectors.
3. **Ensure the chuck lock is in place**.
4. **Switch on the air supply**, then unscrew the chuck mechanism and remove the plastic tube from the motor shaft and replace the chuck. Retain the tube for future use.
5. **Install the software onto the PC**.
6. **Connect the cables between the PC and the instrument**. This requires two serial ports. Connect one serial cable to the Instrument Port ① on the instrument, the other to the Gap control ② input. Alternatively a USB to serial port converter can be used to connect to the Gap control on the instrument.

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Connection of air bearing cooling fluid

The bearing is supplied with a water adapter kit for use when high motor torque is applied. This cooling system is essential for high stress experiments, or where controlled shear rate or strain is required with digital instruments.

Connect the water bottle to the 'Air/Water Cooling' connectors on the back of the instrument using the green pipe provided. Use a mix of **99.5% De-ionized water** with **0.5% Ethylene Glycol**.

Setting up the software

Installation usually carried out by a Malvern representative. If this is not the case follow the instructions supplied with the installation media.

The following section gives information relating to configuring the software.

Starting the software

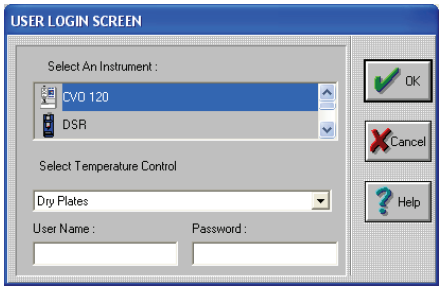
The installation program will have created an icon in the programs group.

- To run the software, click:
  Start-All Programs-Bohlin-Bohlin RX.XX.X.X (where X shows the current version number of the Bohlin software), or just double click the desktop icon.



Logging in

When the Bohlin software starts, a user log in screen is displayed:



- To leave the system 'open' so that anybody can use it, click **OK**.
- To make the system more secure, login with the User Name **SUPERVISOR**, and then add users as detailed below.

The software does not require a password to be entered at this point, however it is recommended that one be assigned to the supervisor account.

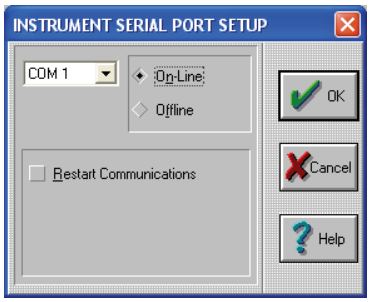
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Instrument Serial Port - COM port

Before using the software to control a rheometer, you must configure the communications (COM:) ports as follows:

1. Select **Options-Instrument Serial Port**.



2. Select the correct COM ports (1 to 4) for the instrument and gap control (if used). Also, ensure that the mode is set to **On-Line**. Ideally, the Windows link should be connected to the lowest available COM port.

   If a USB to serial adapter is used - the COM port is assigned automatically by Windows. Establish which port is being used and then enter this number into the Bohlin software.

General Heading (for printouts)

This option, places a heading on each printed sheet in any printout of data (table of results or graph), for example the company or departmental name. To do this:

3. Select **Supervisor-System Settings**.
4. In the **General Heading** field enter the company name and department if required.
5. Click **OK**.

This heading is then shown on all prints and plots of data.

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Setting up users

The following section provides details on how to set up user accounts.

About user accounts

The log in screen serves two purposes. Its main use is to enable system settings and preferences to be stored on a 'per user' basis. After a user has successfully logged in to the software, any changes that they make to tests, graphs or options are stored. The next time they use the software, all their settings will be restored, even if the program has since been used by someone else. The second (optional) use of the log in function is to control access to the software (and hence the rheometer). Access control determines who can use the rheometer, as well as being able to place restrictions on what the user can alter from within the software.

Creating user accounts

When the Bohlin software is first installed it is set up as an 'open system' i.e. no user name is required to log in and hence gain access to the rheometer. In this mode anyone can access the software. When a user is registered they retain their own preferences on the system. To create accounts for each user of the rheometer:

1. Log into the software as the supervisor (see above).
2. Select **Supervisor-User Configuration**.
3. Click the **Add** button. The software prompts for a new user name.
4. Enter the login name for this user - this can be up to 8 characters long and must consist only of the letters A to Z. For example, a user called James Smith might be given a login name of JSMITH.
5. Click **OK**.
6. With the new user selected in the **User List**, enter their **Full Name** (e.g. James Smith) and a Password (if required).
7. Each user can have unique analysis page colours, graph axes and instrument settings - on the first use, these will be set to the default settings.

Passwords

Passwords are case sensitive, so PASSWORD, Password and password are all perceived differently by the software. Ensure that all users of the software are aware of this fact.

It is generally a good idea to select passwords that are at least 5 characters long. Any key that can be typed can be used as part of the password.

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Although the supervisor sets up the initial password for each user, they can change this at any time (from **Options-User Preferences**). Should a user forget their password, the supervisor can read or change this from the **Supervisor** menu. Should a supervisor forget their password, they should contact Malvern Instruments for assistance.

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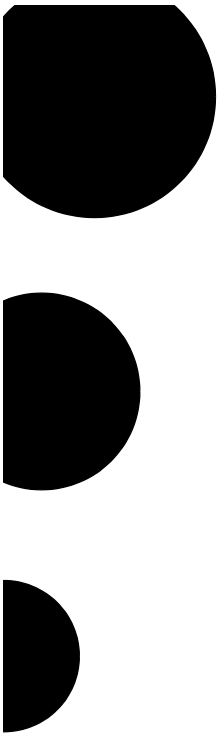
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Part 3 - Appendices

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A

Specification

Gemini II rheometer

Torque range	0.05µNm to 200mNm Controlled stress/rate viscometry. Controlled stress/strain oscillation.
Torque resolution	Better than 1nNm
Position resolution	50 nano radians
Frequency range	1 micro Hz to 150Hz
Controlled speed range (CR mode)	0.01 milli rad/sec to 600 rad/sec
Measurable speed range (CS mode)	10 nano rad/sec to 600 rad/sec
Normal force NI measurement range	0.001 to 20N (50N option)
Step change in strain	<10ms.
Temperature range (dependent on controller)	-150°C to 550°C
Nominal operating voltage	110 or 220V
Size (with Peltier plate)	52cm (H) x 33cm (W) x 37cm (D)
Weight (with Peltier plate)	28kg

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Gemini HR nano rheometer

Torque range	10nNm to 200mNm, controlled stress/rate viscometry. 3nNm to 200mNm, controlled stress/strain oscillation.
Torque resolution	Better than 1nNm
Position resolution	50 nano radians
Frequency range	1 micro Hz to 150Hz
Controlled speed range (CR mode)	0.01 milli rad/sec to 600 rad/sec
Measurable speed range (CS mode)	10 nano rad/sec to 600 rad/sec
Normal force NI measurement range	0.001 to 20N (50N option)
Step change in strain	<10ms.
Temperature range (dependent on controller)	-150°C to 550°C
Nominal operating voltage	110 or 220V
Size (with Peltier plate)	52cm (H) x 33cm (W) x 37cm (D)
Weight (with Peltier plate)	28kg

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CVO 100 rheometer

Torque range	0.5µNm to 100mNm .
Torque resolution	1 nano Nm
Position resolution	0.9 micro radians
Frequency range	10 micro Hz to 100Hz
Controlled speed range (CR mode)	50 milli rad/sec to 320 rad/sec
Measurable speed range (CS mode)	0.1 micro rad/sec to 320 rad/sec
Normal force NI measurement range*	0.001 to 20N (50N option)
Temperature range (dependent on controller)	-150°C to 550°C
Nominal operating voltage	110 or 220V
Size (with Peltier plate)	52cm (H) x 29cm (W) x 34cm (D)
Weight (with Peltier plate)	27kg

*Normal force option available

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B

Health and Safety

General warnings and regulations

Warning!
The instrument or the samples to be measured may be hazardous if misused. Read and fully understand this section before operating the system.

The instrument must only be stored or operated in environmental conditions conforming to the specification given in **Chapter 4 - Site requirements**.

Warning!
Use of the system in a manner not specified by Malvern Instruments may impair the protection provided by the system.

Electrical warnings and regulations

Warning!
Malvern Bohlin rheometers contain high voltage components. Only Malvern Instruments trained personnel are permitted to remove the main cover of any part.

Warning!
This product must be connected to a protective earth. The metal parts of the unit are earthed using a protective earth connection.

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The rheometer system components are mains powered devices and all power cables and electrical sockets should be treated accordingly. Do not place cables in positions where they are likely to become wet.

Crush hazard

Warning!
Keep hands out of the area between the plates when closing the gap.

Hot components

Warning!
The Peltier plates/cylinders, ETC, ETO etc. may become very hot. Take care when touching these, for example for cleaning. Wear heat proof gloves if required.

Warning!
Take care with all hoses and hose connections carrying hot fluids to/from Peltier plates/cylinders, ETC, ETO etc.

Fluids circulator

Follow all health and safety information in the circulator manufacturer's documentation. In particular observe the following warnings:

Warning!
Do not touch hot surfaces. Take care with liquids at high temperatures.

Warning!
Do not use any flammable or acidic liquids within the circulator's reservoir.

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Liquid nitrogen

The Low Temperature Unit (LTU) option available for the Extended Temperature Cell (ETC) uses liquid nitrogen to provide cooling. Strict safety guidelines and training must be employed when using liquid nitrogen.

Warning!
Before using liquid nitrogen read the safety guidance in the **Liquid Nitrogen Safety Guide**. If in doubt contact Malvern Instruments.

Warning!
Asphyxiating gas - use only in a well ventilated area which has been risk assessed.

Warning!
Extreme cold - wear hand, eye and foot protection.

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Power cords and Power safety

The notes in this section indicate best practice. Follow these when connecting the Malvern instrument to the power supply.

Power cord set requirements

Power cord sets must meet the requirements of the country where the product is used. For further information on power cord set requirements, contact a Malvern Instruments representative.

General requirements

The requirements listed below are applicable to all countries:

- The power cord must be approved by an acceptable accredited agency responsible for evaluation in the country where the power cord set will be installed.
- The power cord set must have a minimum current capacity of 10A (7A in Japan only) and a nominal voltage rating of 125 or 250 volts AC, as required by each country's power system.
- The area of the wire must be a minimum of 0.75mm^2 or 18AWG, and the length of the cord must be less than 3m.
- Route the power cord so it is not likely to be walked on, or pinched by items placed upon it or against it, or become wet. Pay special attention to the plug, the electrical outlet, and the point where the cord exits the product.



Warning!
Do not operate this product with a damaged power cord set. If the power cord set is damaged in any manner, replace it immediately.



Warning!
Do not use the power cord received with this product on any other products.

Power safety information

The following notes indicate guidelines to follow when connecting the Malvern Instruments power supply using single and multiple extension leads, connection via AC Adapters and use of Uninterruptible Power Supplies (UPS).

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Warning!
To prevent electric shock, plug the instrument or accessory into correctly earthed electrical outlets.

The power cord supplied is equipped with a grounding connection to ensure grounding integrity is maintained.

Advice on use of Extension leads

Follow this advice when using single or multiple socket extension leads. These are also called trailing sockets.

- Ensure the lead is connected to a wall power outlet and not to another extension lead. The extension lead must be designed for grounding plugs and plugged into a grounded wall outlet.
- Ensure that the total ampere rating of the products being plugged into the extension lead does not exceed the ampere rating of the extension lead.
- Use caution when plugging a power cord into a multiple socket extension lead. Some extension leads may allow a plug to be inserted incorrectly.
- Incorrect insertion of the power plug could result in permanent damage to the instrument or accessory, as well as risk of electric shock and/or fire. Ensure that the ground connection (prong/pin) of the power cord plug is inserted into the mating ground contact of the extension lead

Advice on use of AC adapters

Warning!
Do not use adapter plugs that bypass the grounding feature, or remove the grounding feature from the plug or adapter.

- Place the AC adapter in a ventilated area, such as a desk top or on the floor.
- The AC adapter may become hot during normal operation of the instrument or accessory. Use care when handling the adapter during or immediately after operation.
- Use only the Malvern-provided AC adapter approved for use with the instrument and/or accessory. Use of another AC adapter may cause a fire or explosion.

Advice on use of Uninterruptible Power Supplies (UPS)

To help protect the instrument and/or accessory from sudden, transient increases and decreases in electrical power, use a surge suppressor, line conditioner or UPS.

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Sample handling warnings

- Always handle all substances in accordance with the COSHH (Control Of Substances Hazardous to Health) regulations (UK) or any local regulations concerning sample handling safety.
- Before using any substance, check the Material Safety Data Sheets for safe handling information.
- Use the instrument in a well ventilated room, or preferably within a fume cupboard, if the fumes from the sample or dispersant are toxic or noxious.
- Wear personal protective equipment as recommended by the Material Safety Data Sheets if toxic or hazardous samples are being handled, particularly during sample preparation and measurement.
- Wear protective gloves when handling hazardous materials, or those that cause skin infections or irritations.
- Do not smoke during measurement procedures, particularly where inflammable samples are used or stored.
- Do not eat or drink during measurement procedures, particularly where hazardous samples are used or stored.
- Take care when handling glass (e.g. beakers). Hazardous materials may enter a wound caused by broken glass.
- Always test a new sample or dispersant for chemical compatibility before use.
- After measuring hazardous samples, scrupulously clean the system to remove any contaminants before making another measurement.
- Always label samples for analysis using industry standard labelling, particularly if they are handled by a number of staff or stored for long periods. Clearly mark any operator hazard and associated safety precautions that are required for the handling of dangerous materials.
- Keep a record of all hazardous substances used in the system for protection of service and maintenance personnel.
- Always adopt responsible procedures for the disposal of waste samples. Most local laws forbid the disposal of many chemicals in such a manner as to allow their entry into the water system. The user is advised to seek local advice as to the means available for disposal of chemical wastes in the area of use. Refer to the **Materials Safety Data Sheets**.
- The surfaces of the system may be permanently damaged if samples are spilt on them. If a spillage does occur, disconnect the system from the power supply before scrupulously cleaning it up.

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Moving the system

If it is necessary to move or transport the system, a supervisor must follow the procedures given in **Chapter 4**.

Warning!
Use proper lifting techniques to avoid back injury. Always lift the instrument by holding it under its base. **Never** lift an instrument by precision parts such as the bearing, TCU or by its covers.

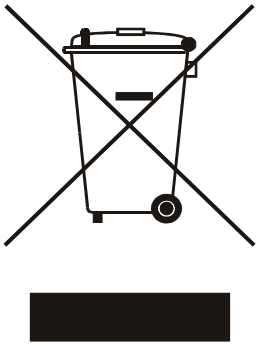
Disposing of the instrument

When the need eventually arises to dispose of the system, this should be done in a responsible manner. Follow these guidelines:

- Refer to any local regulations on disposal of equipment; in Europe refer to the information below.
- Seek advice from the local Malvern Instruments representative for details.
- Decontaminate the instrument if hazardous materials have been used in it.

Disposal of Electrical & Electronic Equipment

The following is applicable in the European Union and other European countries with separate collection systems.



ill 7610

This symbol on the product or on its packaging indicates that when the last user wishes to discard this product it must not be treated as general waste. Instead it shall be handed over to the appropriate facility for the recovery and recycling of electrical and electronic equipment.

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By not discarding this product along with other household-type waste, the volume of waste sent to incinerators or landfills will be reduced and natural resources will be conserved.

For more detailed information about recycling of this product, please contact the local city office, a waste disposal service, or a Malvern Instruments representative.

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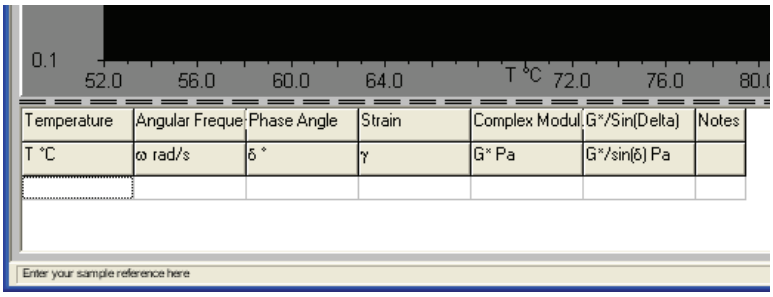
C

Troubleshooting

This section contains details on how to solve some of the common problems that may be experienced when using the system. For information on troubleshooting specific accessory problems, refer to the **Accessories Guide**.

Software notes

The software contains a **Notes** column in the table of results on the analysis page. This column is used to indicate a possible reason to doubt the accuracy of the result point in that row.



Note 1:

Target speed too low - below minimum stress - Viscometry: Constant Rate Mode.

The material is low in viscosity such that the torque required to achieve the speed is lower than the calibration limit. The validity of the result can not be guaranteed.

Note 2:

Target speed too high - above maximum stress - Viscometry: Constant Rate Mode.

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The material is high in viscosity such that the torque required to achieve the speed is higher than the maximum that the instrument is capable of. The result is not necessarily affected.

Note 3:

Strain very small - bottom end of the position sensor range. Oscillation Mode.

The material is high in modulus such that the torque applied gives a strain that approaches the resolution limits of the sensor. The rheological results may be adversely affected by this.

Note 4:

Raw phase angle too large.

The inertial effects of the system are increasing the raw phase angle to the point where the mathematical algorithm to calculate the modulus and phase angle could break down. The rheological results could be affected by this.

Note 5:

Peak speed too high in Oscillation Mode.

The combination of stress and modulus at the current frequency are generating instantaneous speeds greater than the highest speed that the hardware can track. The rheological results cannot be relied upon.

Note 6:

Torque error - instrument fault. Oscillation Mode.

Two possible reasons for this:

1. The hardware is faulty - a straight line for the raw torque in oscillation raw data on the graph indicates a faulty instrument. The rheological results are of no use in this case.
2. The frequency is high so the maths is introducing errors in the calculation. The rheological results may be affected.

Note 7:

Diagnostics only.

Note 8:

Approach to steady state out of range - Rejected. Viscometry: Constant Stress Mode.

The acceptance value of steady state (set up in **Options - viscometry**) has not been reached.

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The rheological results may be affected - but it can be solved by setting longer delay times and max. time outs or lowering the tolerance on the steady state acceptance.

Note 9:

Overspeed detected - Rejected. All Modes.

The maximum tracking speed of the instrument (in that mode) has been exceeded. The rheological results may be affected and the test may be aborted if no lower stress can be attained as part of the test.

Display panel error codes

The following is a list of possible error messages that can be shown on the instrument display panel.

E-1 - Unable to zero gap

Check that the electronics box is switched on, that a measuring system is correctly installed and that the air is at the correct pressure.

E-2, E-3, E-4, E-5 - Error on power supply

Check that the instrument mains power supply is functioning correctly. If so, contact your Malvern Instruments representative.

E-6 - Bad normal force when determining position

Check that both the air supply and electronics box is switched on. If the error persists, contact your nearest Malvern Instruments representative.

E-7 - Unable to find reference sensor

Switch off the instrument and manually move the bearing to the midway position. (To do this use the knob on the top of the CVO instrument or, if using a Gemini, remove the black stopper on the top of the instrument and insert the crank handle.) Switch the instrument on again. If the error persists, contact your Malvern Instruments representative.

E-8, E-9 - Bad normal force reading

Ensure that the air is at the correct pressure. Ensure that the measuring systems are not 'bonded' together i.e. a stiff sample between them. If so, loosen the upper measuring system before trying to raise the gap. If the error persists, contact your Malvern Instruments representative.

E-10, E-11 - Unable to initialise normal force system

This error means that the air is not switched on, or the electronics box is not switched on. If the error persists, contact your Malvern Instruments representative.

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E-12, E-13 - Stepper motor fault

Switch the instrument off and manually move the bearing to around the midway position, then switch on again. (To do this use the knob on the top of the CVO instrument or, if using a Gemini, remove the black stopper on the top of the instrument and insert the crank handle.) If the error persists, contact your Malvern Instruments representative.

E-14 - Normal force safety cut-out

When the instrument is heading towards the gap position, an excessive normal force loading will cause it to immediately reverse direction and lift the head. Remove the source of the problem and press the down arrow key.

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D

Regulatory statements

This appendix presents regulatory information.

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CE Declaration of Conformity

The CE badge on this product signifies conformance to European Commission Directives.

CE Declaration of Conformity

Malvern

In accordance with ISO/IEC 17050-1

Form : **0734F CE Declaration of Conformity**

Issue : 0002

Date : 09/03/2009

Supplier details

Document (NAME / NUMBER)

CE declaration of conformity for GEM-200-XXX Rheometer with integrated Peltier electronics

Issuer's Name (NAME OF MANUFACTURER)

Malvern Instruments Limited

Issuer's Address (ADDRESS OF MANUFACTURER)

Enigma Business Park,
Grovewood Road,
Malvern,
Worcestershire, WR14 1XZ, UK

Product details

Product description – name and model number(s)

Name: Gemini rheometer with integrated Peltier electronics

Model(s):

GEM-200-903	Description: Gemini 2 rheometer base unit with integrated Peltier electronics
GEM-200-913	Description: Gemini 2 rheometer base unit with integrated Peltier electronics and 50N Normal force option
GEM-200-900HR	Description: Gemini HR nano rheometer base unit with integrated Peltier electronics

Directive(s) and Standard(s) to which conformity is declared

EMC directive 2004/108/EC
Low Voltage Directive 2006/95/EC

BS EN 61326-1: 2006
BS EN 61010-1: 2001 and part 2 as required

Additional Information

Above rheometer base units have been assessed for conformity with the following Peltier plate and Peltier cylinder Temperature Control Units:

CVO2004	Description: Gemini 2 and HR nano Integrated Cone and Plate Peltier Mechanics
CVO2006	Description: Gemini 2 and HR nano Integrated Peltier Cylinder C25 Mechanics
CVO2007	Description: Gemini 2 and HR nano Integrated Peltier Cylinder C37 Mechanic

Declaration

I hereby declare that the product specified conforms with the provisions of Council Directive(s) and standard(s) listed above.

Signed for and the behalf of Malvern Instruments Limited.

Signature

Date of issue

24th September 2010

Place of issue

Malvern Instruments Limited (UK)

Name (Function)

Steve Anderson (NPI Operations Manager)

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The CE badge on this product signifies conformance to European Commission Directives.

CE Declaration of Conformity

Malvern

In accordance with ISO/IEC 17050-1

Form : **0734F CE Declaration of Conformity**

Issue : **0002**

Date : **09/03/2009**

Supplier details

Document (NAME / NUMBER)

CE declaration of conformity for CVO100 CVO120 CVO150

Issuer's Name (NAME OF MANUFACTURER)

Malvern Instruments Limited

Issuer's Address (ADDRESS OF MANUFACTURER)

Enigma Business Park,
Grovewood Road,
Malvern,
Worcestershire, WR14 1XZ, UK

Product details

Product description – name and model number(s)

Name: CVO

Model(s): CVO-100; CVO-120; CVO-150

Description: Rheometer

Directive(s) and Standard(s) to which conformity is declared

EMC directive 2004/108/EC
Low Voltage Directive 2006/95/EC

BS EN 61326-1: 2006
BS EN 61010-1: 2001 and part 2 as required

Additional Information

Declaration

I hereby declare that the product specified conforms with the provisions of Council Directive(s) and standard(s) listed above.

Signed for and the behalf of Malvern Instruments Limited.

Signature

Date of issue

Place of issue

Malvern Instruments Limited (UK)

Name (Function)

Alan Bragginton (Production Director)

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