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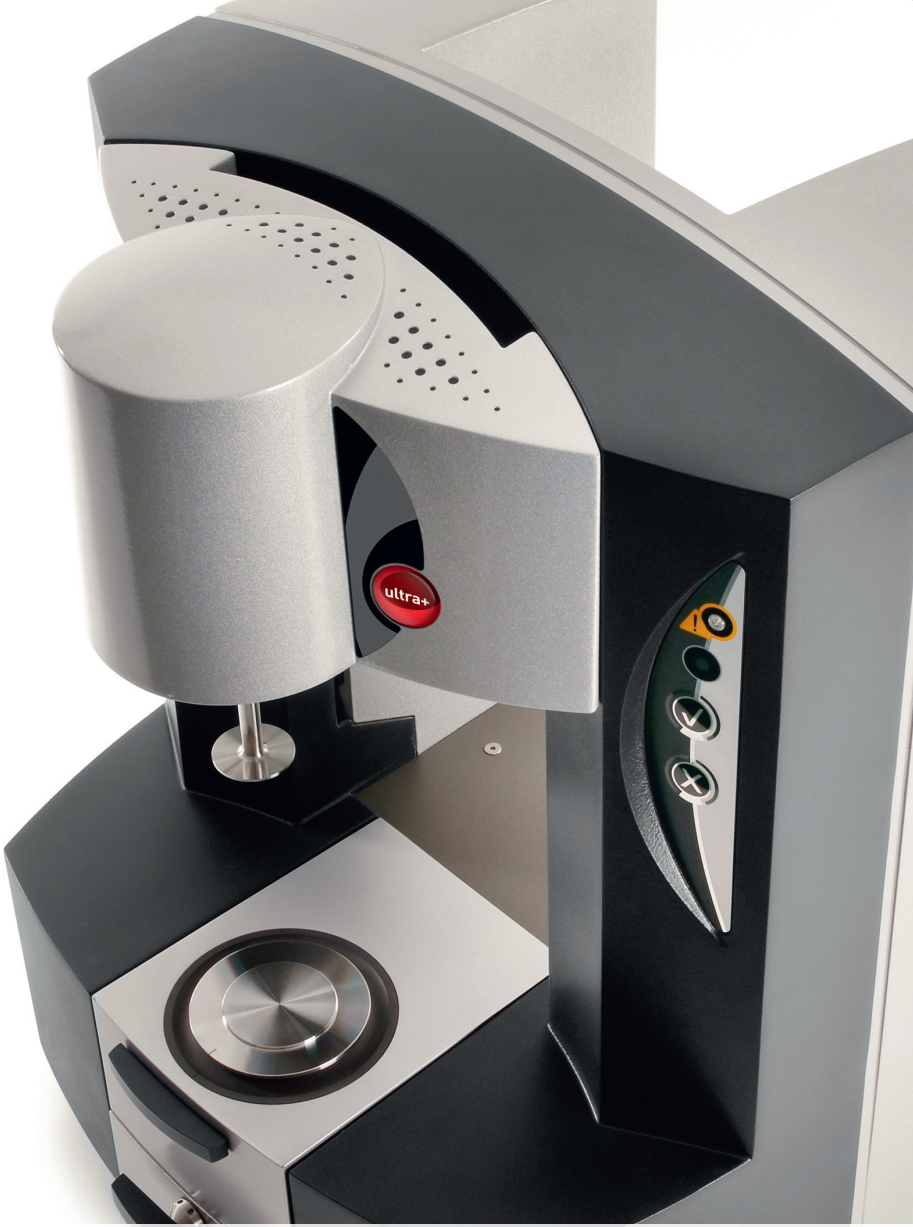

RHEOLOGICAL PROPERTIES

KINEXUS **SERIES**
USER MANUAL

Kinexus Series User Manual

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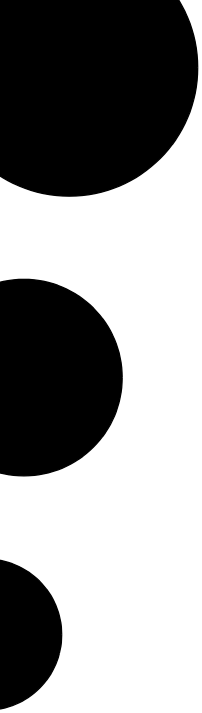


1

Introduction to this manual

Introduction

This manual covers the operation and maintenance of the following instruments in the Kinexus series:

Instrument	Part No.
Kinexus ultra+	KNX2310/KNX2312 (20N NF/50N NF)
Kinexus pro+	KNX2210/KNX2212 (20N NF/50N NF)
Kinexus lab+	KNX2110/KNX2112 (20N NF/50N NF)

A Kinexus system comprises:

- A rheometer.
- One or more Environmental Controllers which provide temperature control.
- The **rSpace** software package which controls the rheometer and allows measurement and analysis.

The aims of this manual are to:

- Describe the **Kinexus** rheometer hardware and how the instrument works.
- Describe the **rSpace** software including **rFinder** and measurement sequences.
- Explain how to use the instrument to make a measurement.
- Explain how to display the result data and run analyses.
- Show how to perform supervisor tasks – managing sequences and the materials, geometry and parameter databases.

This manual accompanies the **Kinexus Series Basic Guide**, which all users must read, as it provides important Health and Safety information.

This manual gives basic information on the Environmental Controllers. For more details refer to the **Kinexus Environmental Controllers Manual** as necessary.

Using this manual

Warning!
The instrument and the samples to be measured may be hazardous if misused. Users must read the **Health and Safety** information in the **Kinexus Series Basic Guide** before operating the system.

We recommend reading this user manual fully before starting the first measurement. Those who are more familiar with rheometers can jump straight to **Chapter 5,** the practical tutorial on making measurements.

This manual has the following three sections.

Part 1 – Operator's guide

The **Operator's guide** contains all the information required by an operator using the instrument. Topics covered are:

- What the **Kinexus** instrument and the **rSpace** software do. This includes fundamental information on the way the software is designed to help users of varying skill levels and needs.
- The Kinexus hardware features.
- The **rSpace** software features.
- A tutorial – how to make a measurement.
- Viewing results – how to display, analyse and manage (export, merge and print) data.
- Loading the sample – guidelines for loading different types of material.

Part 2 – Supervisor's guide

The **Supervisor's guide** concentrates on administration and making full use of the instrument's capabilities. Topics covered are:

- Advanced features – analysing results live, modifying sequences and using the Parameter dictionary.
- Using the Materials database.
- Using the Geometries database.

The supervisor should also read the **Operator's guide** part of this manual.

Access to the instrument

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

Malvern Instruments personnel

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

Warning!
Removal of the covers by unauthorized personnel will invalidate the warranty of the instrument. Unless advised within the content of the manuals, only Malvern Instruments trained personnel are permitted to remove the main cover of any part.

Supervisor

The supervisor is the person responsible for the management and safety of the instrument and its operation. The supervisor is responsible for the training of the operators. The supervisor can perform all user maintenance routines identified in the **Kinexus Series Basic Guide**.

Operator

An operator is a person trained in the use of the system. The operator can perform the simpler user maintenance routines identified in the **Kinexus Series Basic Guide**.

Warning!
Under no circumstances should the supervisor or an operator remove the main cover of the instrument. Failure to follow these guidelines could result in exposure to hazardous voltages.

Assumed information

To make full use of this manual, the user should understand the following points.

Naming convention

The Kinexus instrument is referred to in full, as “the rheometer” or as “the instrument”. The **rSpace** software is referred to in full or as “the software”. The combination of the rheometer, the Environmental Controller, the computer and the **rSpace** software is referred to as “the system”.

Menu commands

Menu commands from the **rSpace** software are always shown in bold text and in the form:

main menu-menu item-submenu item.

As an example, the command **File-Open-Data file** refers to selecting the **Data file** submenu item under **Open** in the **File** menu.

Where to get help

This section describes the available sources of information on the system.

Manuals and online help

The primary sources of information on the system are this manual, the **Kinexus Environmental Controllers manual,** the **Kinexus Series Basic Guide** and the software’s online help.

Basic Guide

The **Basic Guide** covers:

- **Site requirements** – all the physical requirements for positioning the system. Information is given on service requirements (air, supply number of power sockets, etc.), environmental requirements (temperature, humidity, etc.) and physical requirements (space needed, etc.).

Note
The system **must** be initially commissioned by a Malvern-trained representative.

- **Health and Safety** – this **must** be read by all users of the system. It details all safety issues for the instrument and samples.
- **Maintenance** – this includes cleaning, service information and troubleshooting.
- **Installation** – this gives enough information to allow the user, for example, to move the system from one laboratory to another. Instructions are also given on how to install the Malvern software if the user upgrades the computer system.
- **Measurement tutorial** – gives a simple introduction to the system and explains how to make a measurement.

Kinexus Environmental Controllers manual

This describes the use of the Environmental Controller cartridges, sample cover and heat exchangers.

The online help

The online help system gives detailed information on the software. The **rPages** menu opens the help at useful locations giving information on samples and processes. Otherwise start the help by using the command **Help-Help Topics**. Software dialogues and **Properties window** displays have **Help** buttons giving information specific to those.

rSolution Application Notes

The **rSolution Application Notes** detail use of the system for specific applications/industries. Each note refers to a sequence and data. New **Application notes** are regularly added. The current list of notes and the individual notes can be accessed from the website.

Note
Malvern Instruments may respond to requests for **rSolution Application Notes** and sequences covering new areas; contact a Malvern representative.

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 or obtained by clicking on the instrument icon in the software's status bar.
- The **rSpace** software version. To find this run the command **Help-About rSpace** or click on the instrument icon in the software.

Contact the United Kingdom help desk if the local Malvern Instruments representative is not available:

- **Telephone**: +44 (0) 1684 891800
- **Email**: 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.

www.malvern.com

The Malvern Instruments website offers a comprehensive range of rheological and particle characterization resources for use by customers 24 hours a day, seven days a week.

Resources include software downloads, frequently asked questions, rSpace downloads and Application Notes, plus information on other particle characterization solutions from Malvern Instruments.

2

The Kinexus/rSpace system

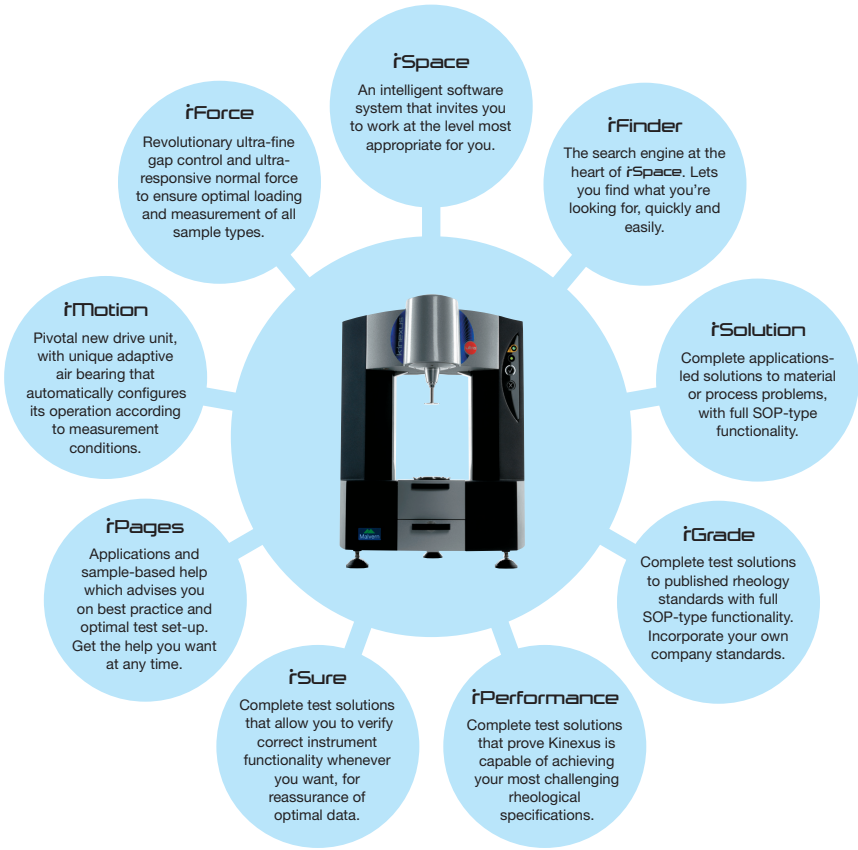
Introduction

This chapter describes:

- Introduction to the Kinexus system.
- Using the **rSpace** software – the way the software is designed to help users of varying skill levels and needs, and the types of **measurement sequence** each kind of user will want to use.
- Viewing results – how data is presented and what a user can do with it. This includes creating new tables and charts, also running analyses on the data.
- Searching for the best sequence – what to search for and how to use the overviews provided to get the best **rFinder** results.
- The **Results browser** window and saving results.

Introduction to the Kinexus system

Kinexus is an advanced rotational rheometer platform, integrating innovative instrument design with revolutionary software to provide accurate and precise measurements with ultimate flexibility and ease of use. It is a modular, highly intelligent and robust rheometer that sits at the centre of a linked system of novel features and innovative technology. The advanced features of Kinexus are referred to collectively as rWorld, and are summarized below:



rSpace

Central to Kinexus is rSpace; an intelligent software system based on one flexible interface that can be configured for the user's rheological requirements. rSpace is a fully integrated information system based around complete applications solutions

and intelligent sequence-driven (Standard Operating Procedure (SOP)-type) test functionality. At the heart of rSpace is the rFinder search engine, which allows the user to locate information and appropriate tests relevant to a particular application, and to search for past results.

Example process overview

1. Find and open an appropriate Solve sequence (sequences are described in the following section).
2. Fill in the sample details and any test requirements which are not preset, for example the temperature.
3. As prompted, load the sample between the lower and upper geometries. (The top geometry is attached to the air bearing stress-head motor assembly and the lower geometry is attached to an Environmental Controller cartridge inserted in the rheometer base.)
4. The rheometer automatically sets the gap between the geometries.
5. The measurement is made and data collected and displayed in an appropriate format for the test.
6. The data is analysed appropriately.
7. As prompted, unload the sample and clean the geometries.
8. The data is saved.

The rheometer hardware is described in **Chapter 3**.

Environmental Controllers

Several types of Environmental Controller are available, described in detail in the **Kinexus Environmental Controllers Manual**. These hold the lower geometry and heat or cool the sample as required. They are:

- **Plate cartridge** – holds a flat plate for testing samples ranging from low viscosity materials through to pastes and semi-solids.
- **Active Hood cartridge** – holds a flat plate as above but has an integral hood to cover the sample.
- **Cylinder cartridge** – holds a cup to contain liquid samples or pastes.

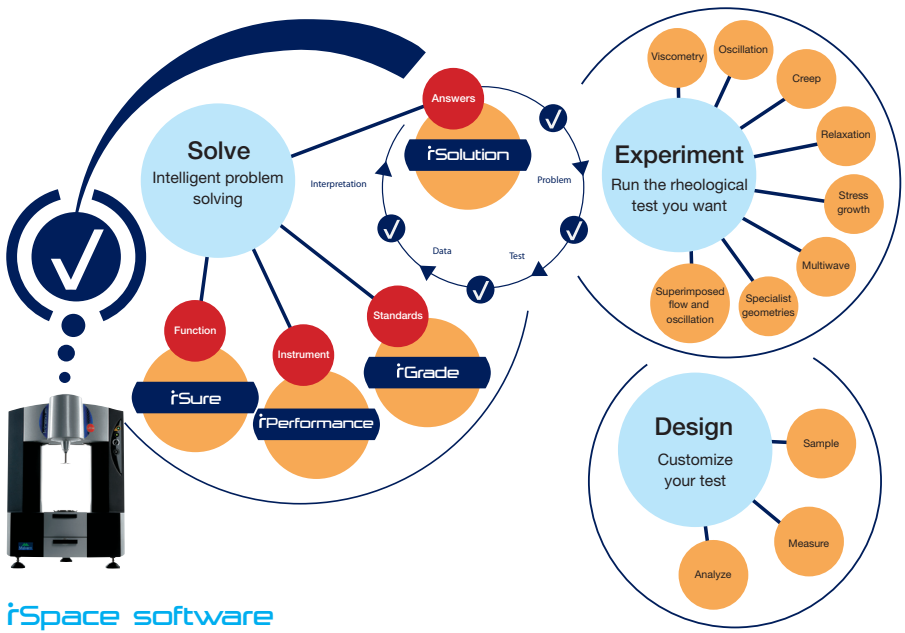
All the cartridges support a range of suitable solutions. Special cells and solids fixtures are also available.

Using the rSpace software

This section describes the fundamentals of the **rSpace** software.

User modes

The **rSpace** software invites the user to work at the level most appropriate for their rheological requirements. This might be to **solve** a material or process problem using an application-led approach, **experiment** using a library of established rheological methodologies, or **design** or customize tests with the ultimate flexibility in rheological measurement and analysis.



Measurement sequences

To control the instrument using the **rSpace** software, the user runs a **measurement sequence**. A sequence is a structured arrangement of one or more specific actions, put together to fulfil a particular measurement task. An action is the specific operation performed by the rheometer as part of a measurement task. For example:

A specific action might be:

1. Set the correct gap.

A simple measurement sequence might be:

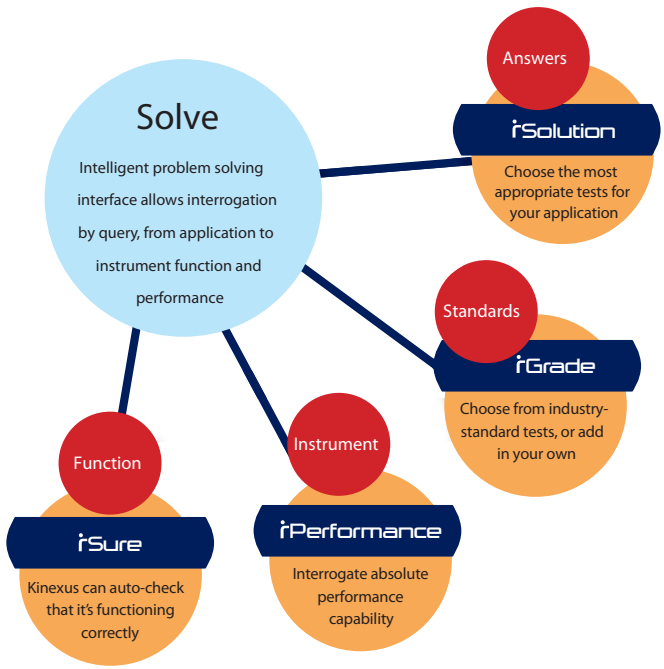
1. Set the correct gap.
2. Make a viscometry shear sweep measurement.
3. Present results as appropriate charts and tables.
4. Export data to a file.

Sequence types

Kinexus provides three types of software sequence – **Solve**, **Experiment** and **Design**. Each sequence has an **Abstract** explaining its design and how the user can change it. The **Abstract** is seen when a sequence is opened. Solve sequences also have an **Application Note** explaining their use.

Solve sequences

Solve sequences provide quick solutions to applications problems.



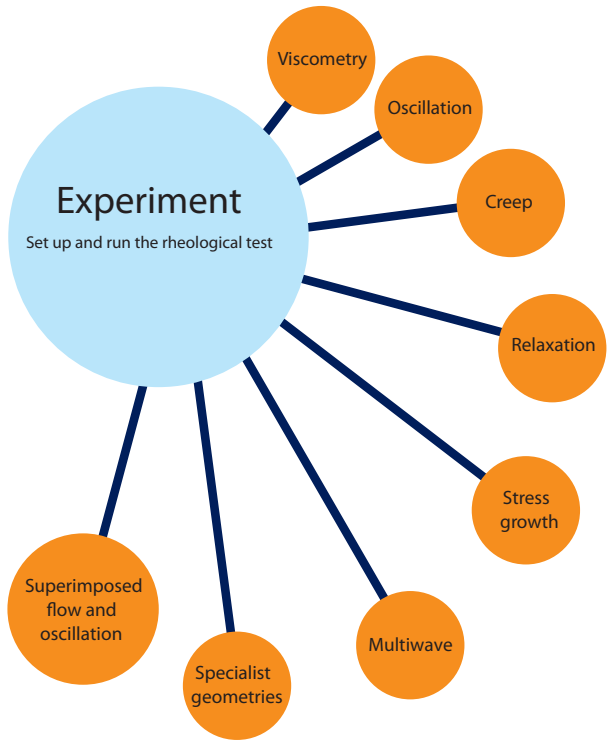
Malvern Instruments provides four types of Solve sequence:

- **rSolution** sequences – solve processing and characterisation problems. Areas include paints, pharmaceuticals, polymers, etc.
- **rGrade** sequences – make routine measurements to standards including ASTM, BS, DIN and ISO.
- **rPerformance** sequences – prove the specification of the instrument.
- **rSure** sequences – calibration and verification sequences to check that the instrument is working at full performance.

The sequence does everything required; the user just has to follow the instructions it displays.

Experiment sequences

For users experimenting with new samples, **Experiment sequences** make it easy to run a rheological test on a sample. The sequence has all the building blocks needed: running a test and analysing the result data. The user can easily change the sequence to meet their exact requirements (see **Chapter 8** for more details on modifying sequences). For these sequences it is assumed that the user will use the **Manual actions toolbar** buttons: **Load sample** and **Unload sample**.

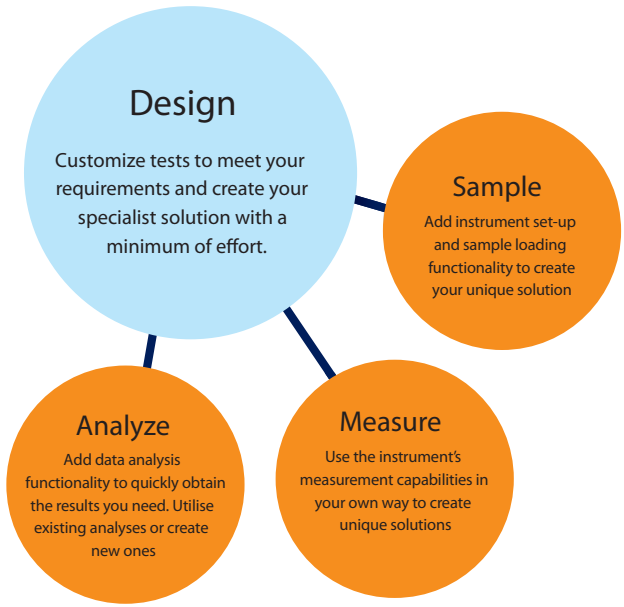


Examples of Experiment sequences are:

- In the **Viscometry** category:
  Viscometry_0002 Shear stress ramp with yield stress analysis.rseq.
- In the **Creep recovery** category:
  Creep_0001 Creep end by steady state with creep analysis.rseq.

Design sequences

Design sequences are for advanced users designing bespoke sequences. They are **subsequences** which the user can modify (if necessary), then link together to build a full sequence meeting their needs. They allow complex sequences to be created quickly to run tables of shears, isothermal temperature measurements, etc.



There are three categories:

- **Analyse** – rheological (and other) analyses set up to use the correct types of data and output results to the Live display or a chart or table. An example is **Analyse_0001 Determination of the cross over point between G' and G".rseq**.
- **Measure** – using rheological measurements to create bespoke solutions. An example is **Measure_0007 Shear stress ramp.rseq**.
- **Sample** – specifying what data to record and how to load samples consistently, allowing the user to enter sample properties. An example is **Sample_0003 Change geometry and index.rseq**.

Advantages of using sequences

Using sequences ensures that measurements are repeatable and consistent. A sequence is self-contained and includes instructions for its use, as well as design information. A single sequence file can be emailed to all sites where users need to measure the same material in the same way.

Existing sequences can also be modified by the user in slightly different ways. Instead of creating a new sequence each time, copy an existing sequence and just change the required parameters. This reduces the risk of making errors in the settings.

Sequences allow user-controlled choices. Users can only change the parameters the sequence designer wants them to access.

Sequence components

Sequences have three types of component: **properties** (the abstract, etc.), **actions** and the **Live display**.

Properties

These describe how the sequence is run and include any notes for the user.

Actions

Actions are the building blocks of a sequence. There are several types of action:

- **Analyses** – perform analyses on selected data.
- **Data** – handle data management (saving, exporting, etc.).
- **Devices** – control accessories or external devices.
- **Measurements** – these actions control the instrument and make rheological measurements.
- **Questions** – these pause the measurement and wait for the user to provide information. They may prompt the user to do something, enter information or choose from a list of set options.
- **Sequence** – these are automatic actions that control the sequence flow without needing to ask the user questions.

The Live display

The **Live display** has three purposes:

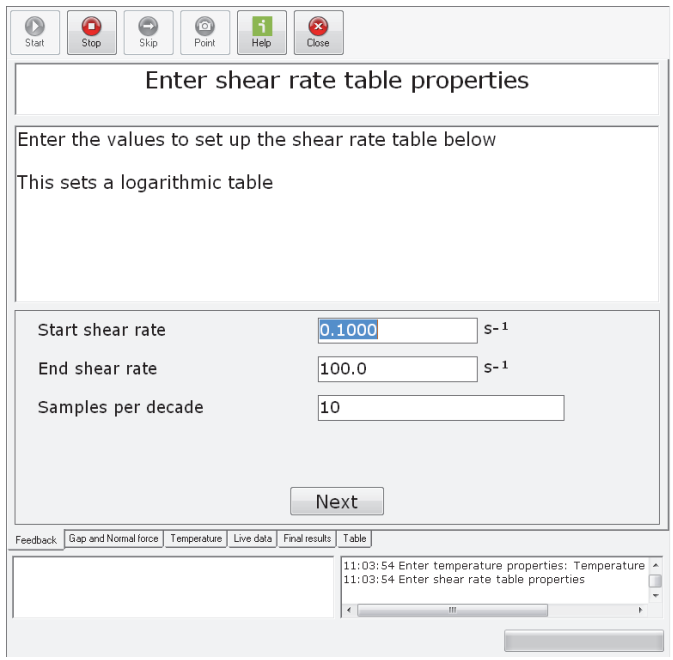
- Providing control buttons for the user running the sequence.
- Asking the user for feedback if necessary, or prompt them to do something, for example load the sample.

- Displaying all data produced by the sequence, using multiple pages as required.

Each Malvern sequence shows Live display tabs, set up as follows:

- **Gap and Normal force** – recorded throughout the sequence.
- **Temperature** – recorded throughout the sequence.
- **Live data** – live data from rheological tests.
- **Table** – final sampled data in tabular form.
- **Final results** – final sampled data in graphical form.
- **Analysis** – results of any analyses used, presented on graphs and tables. This is normally referred to as "<analysis type> results". For example, this tab is named **Point statistics results** in the example shown below.

This example shows a feedback tab in the **Live display**:

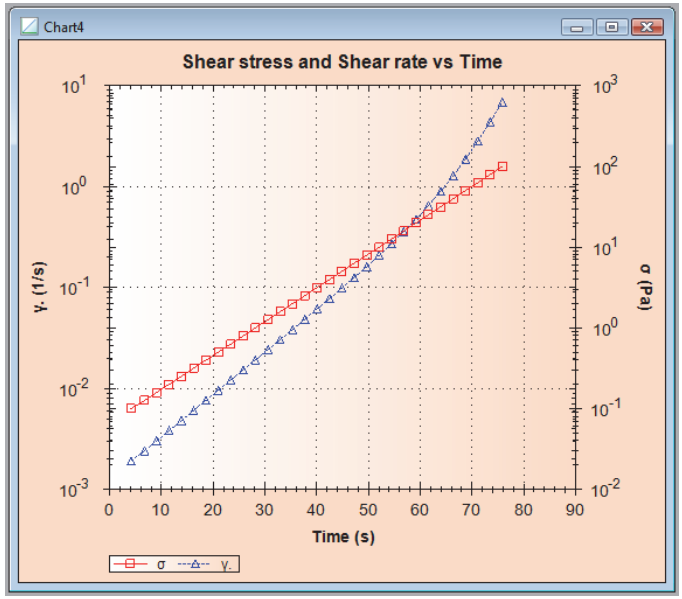


Three types of data are available:

- **Live data** – rheological parameters measured continuously.
- **Raw data** – instantaneous data from instrument. This is temperature, gap, Normal force, torque, position and time.
- **Final results** – the final measurement data equilibrium values, where appropriate.

Viewing results

Results are shown as charts and tables as in the following examples:

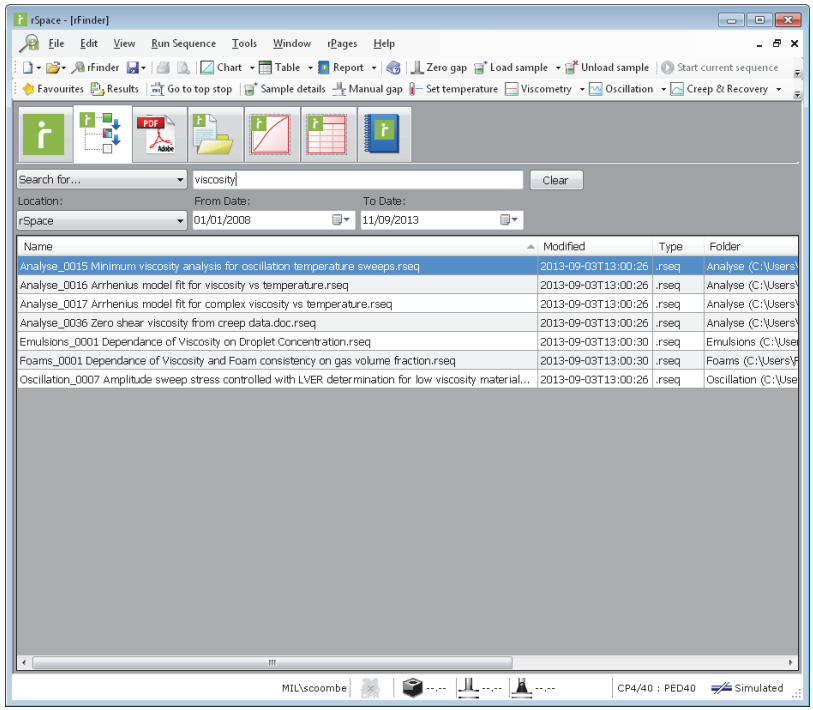


Table

	Indx.	Samp.	Actn.	t exp(s)	Time(s)	T(°C)	σ(Pa)	γ̇(1/s)
	1	1Pas Oil	Viscometry	833.156	4.110	25.000	0.100	0.002
	2	1Pas Oil	Viscometry	835.765	6.718	25.000	0.126	0.002
	3	1Pas Oil	Viscometry	838.136	9.089	25.000	0.158	0.003
	4	1Pas Oil	Viscometry	840.523	11.476	25.000	0.200	0.004
	5	1Pas Oil	Viscometry	842.894	13.847	25.000	0.251	0.005
	6	1Pas Oil	Viscometry	845.265	16.219	25.000	0.316	0.006
	7	1Pas Oil	Viscometry	847.652	18.605	25.000	0.398	0.008
	8	1Pas Oil	Viscometry	850.039	20.992	25.000	0.501	0.010
	9	1Pas Oil	Viscometry	852.472	23.426	25.000	0.631	0.012
	10	1Pas Oil	Viscometry	854.843	25.797	25.000	0.794	0.015
	11	1Pas Oil	Viscometry	857.199	28.153	25.000	1.000	0.019
	12	1Pas Oil	Viscometry	859.633	30.586	25.000	1.259	0.024
	13	1Pas Oil	Viscometry	862.004	32.957	25.000	1.585	0.030
	14	1Pas Oil	Viscometry	864.391	35.344	25.000	1.995	0.038
	15	1Pas Oil	Viscometry	866.762	37.715	25.000	2.512	0.049

Searching for the best sequence

The **rFinder** tool is a vital part of the **rSpace** software that can be used to find appropriate sequences. You can search on keyword(s), for example an industry, an application or sample name, or a technique. In this example, the user has searched for sequences with the keyword “viscosity”:



Double-click on an item in the list to run the sequence or open the file.

Note
Also use **rFinder** to search for Application notes, chart and table templates, results data, etc.

To make it easier to search effectively, overview files are provided for each area/ industry that has been covered by Malvern Instruments. This list gives an idea of what is available, using **rSolution** sequences as examples:

- **Section overview** – explains what this type of sequence is for and explains how to **Search** for overviews at the next level down.

  Example: **rSolution section overview.pdf** (to find this search for **rSolution overview**).

For **rSolution** sequences the **Application Notes** show the results (and the data files where possible) obtained at Malvern Instruments by using the sequences on representative samples. These sequences help to investigate the problems presented by the sample as outlined in the industry overview.

- **Industry overview** – briefly describes the problems a sample from the industry faces during its lifetime and refers to ways these problems can be investigated. Search keywords for each area are given. The example below shows some of this information from the Inkjets overview (the overview has six process stages in all):

Stage of process	Description	Challenges	Search for
Components	Water, solvents, pigments, dyes, resins and surfactants are all used in the manufacture of inkjets.	It is vital to ensure the quality of incoming raw materials is correct, especially when they are sourced naturally and may differ due to growing conditions/ harvesting time.	Raw materials QC test Cole-Cole plots
Filtration	Ink is filtered through a small size filter to remove particulates that might clog up the printer head.	Filtering is a high shear activity that may cause agglomeration etc.	Manufacturing Filtration
Application	To jet at inkjet speeds, inks must have a variety of properties: correct rheology, surface tension etc.	Viscosity must be correct at the jetting temperature, the ink must produce the correct shape drop during the jetting process, etc,	Viscosity Drop formation Dot retention

Examples for industries:
rSolution Industry overview - Inkjet inks.pdf,
rSolution Industry overview - Analytical colloids.pdf

A quick way to access key overviews is to use the commands **rPages-rSolution, rPages-rPerformance**, **rPages-rGrade** or **rPages-rSure**.

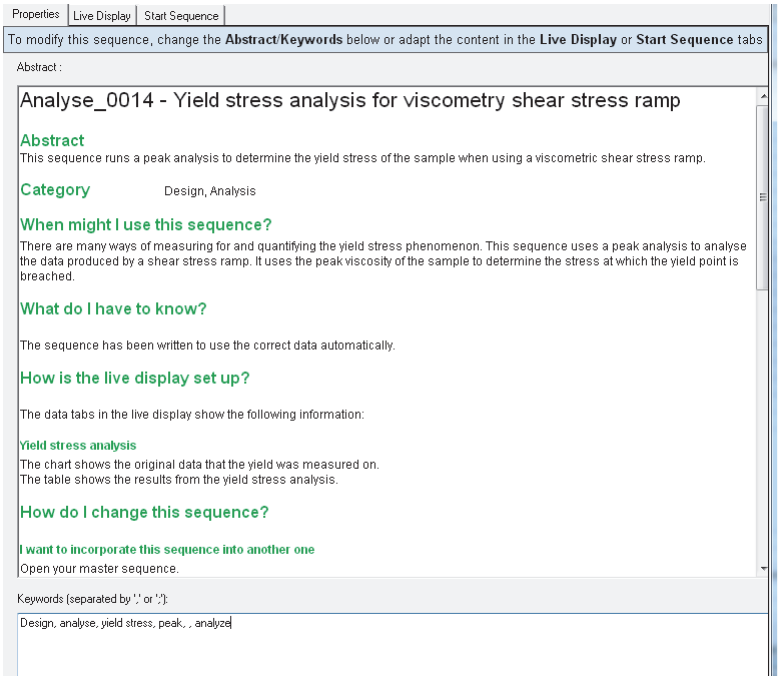
Using the online help

To find information about a sample or process which doesn't fall into the current industry list use the command **rPages-My Sample** or **rPages-My Process**.

These open the online help at overview pages which have links to many materials and application pages. Alternatively, open the help and **Search** for your sample type or process type.

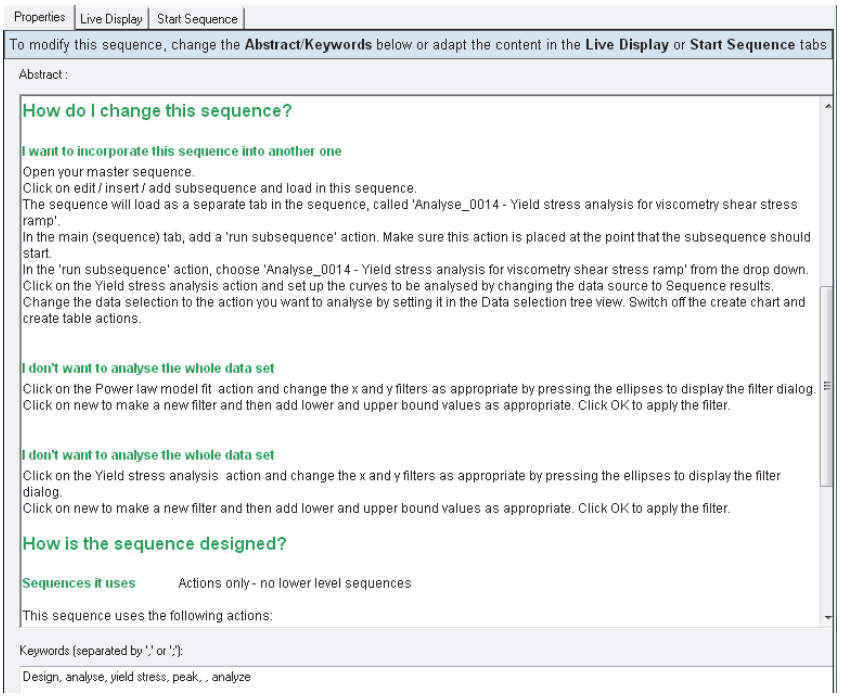
Application Notes and Abstracts

These provide information on specific sequences and are updated by Malvern periodically so check the website for newer versions. The example below shows part of the Abstract for a sequence, showing how comprehensive the information is:



This shows everything the user needs to run the sequence.

The next part of the note, shown below, explains how to change the sequence. These depend on the sequence level:



Sequence reference numbers

All sequences have reference numbers, which are formed as follows:

Analyse 0014-1 Yield stress analysis for viscometry shear stress ramp

The parts are:

- Analyse – the sequence area.
- 0014 – the sequence reference number.
- Yield stress analysis for viscometry shear stress ramp - the description.

The Results browser and saving results

All **Solve** sequences save data as part of the sequence, but users running their own experiments may need to use the **Results browser** to specify this. **Chapter 6** gives full details.

Different types of sequence save differently:

- **Solve** sequences – save automatically.
- **Experiment** sequences – do not save automatically.
- **Design** sequences – do not save automatically.

Results are saved as **.rdf** files. Data can be exported from the system as part of a sequence or from charts and tables at any time.

3

Hardware features

Introduction

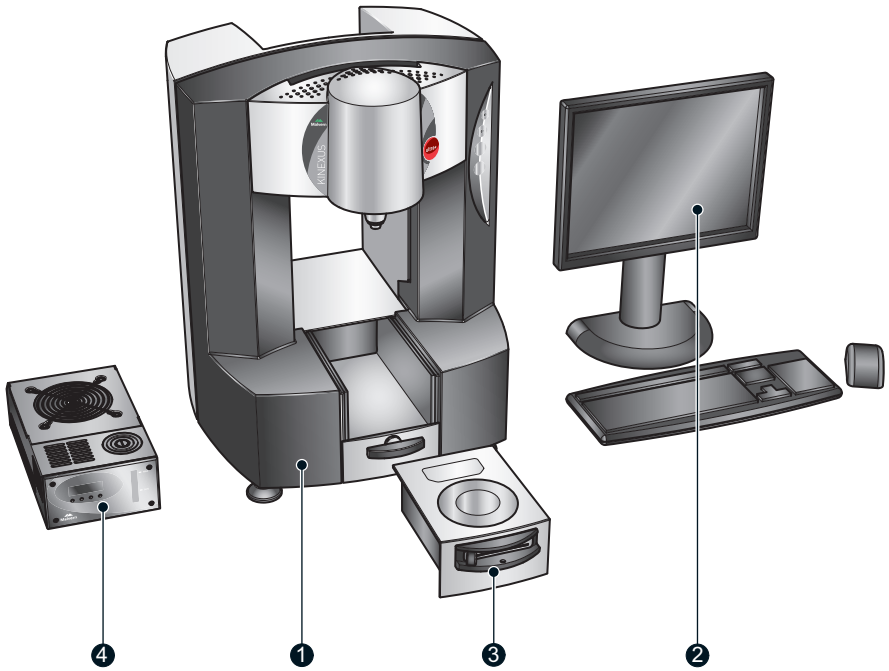
This chapter introduces the system's hardware components. It describes the key components of the system in detail, as follows:

- Key components – the main parts of the system. These are the rheometer, the computer, the Environmental Controller and the heat exchanger.
- The rheometer – describes all the main components of the instrument.
- The computer.
- Environmental Controllers – the Plate, Active Hood and Cylinder cartridges, the sample cover and heat exchangers. This section describes the components and how to fit cartridges and lower geometries. For all other aspects see the **Kinexus Environmental Controllers manual**.
- Geometries – the available geometry types and how to fit the upper geometry.

The software package is described in **Chapter 4**.

Key components

This diagram shows the key components of a typical system:



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These components, detailed in the remainder of this chapter, are:

① **Rheometer** – advanced modular rheometer with rigid cast frame giving the maximum working area.

② **Computer** – used to control the system.

③ **Environmental Controller cartridge** – a module which slots into the rheometer, holding the lower geometry. The example shows a Plate cartridge.

Note
Environmental Controller is the term for the combination of cartridge, sample cover and heat exchanger.

④ **Passive heat exchanger** – this circulates fluid to the plate or cylinder enabling temperature control. The example shows the simplest option but a digital circulator option (**Active heat exchanger**) is also available.

The rheometer

This diagram shows the key components of the rheometer:

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These are:

① **Head** – contains a high specification air bearing motor with torque, position, gap, Normal force control, and also measurement control. This is held in place by the **crossbar**.

Caution!
Do not rotate the spindle/geometry without the air pressure applied; it may damage the bearing.

② **Keypad** – indicates when the air supply to the bearing is available, has a status light and allows interactive control of sequences while stood at the instrument.

③ **Cartridge** – all Environmental Controller cartridges fit here, holding the lower geometry on which the sample is placed. The graphic shows a Plate cartridge in the slot. Cartridge insertion is simple.

④ **Cartridge lock** – used to secure the cartridge in place.

⑤ **Chuck** – used to secure the upper geometry.

Caution!
During transport, even over short distances, the chuck must be secured to prevent damage to the air bearing from vibration. To secure the chuck, fix the **Air bearing protection lock** as described in the **Kinexus Series Basic Guide**.

⑥ **Upper geometry** – the upper geometry is pushed into the chuck. The system detects what the geometry is (using the geometry's RFID tag) and relates this to its database. The two geometries provide the interface to the sample.

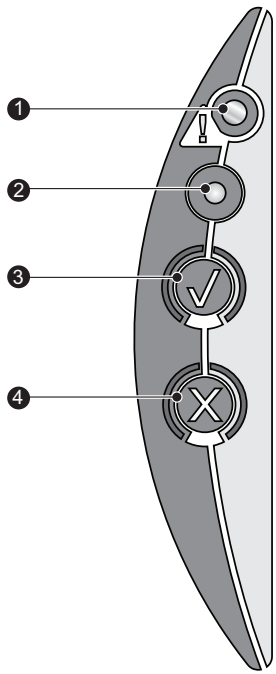
⑦ **Lower geometry** – this is held by the cartridge. The sample is placed on or in it, depending on the geometry type. The example shows a plate geometry.

⑧ **Feet** – these are adjustable for levelling the rheometer on the bench.

⑨ **Upper/lower casting** – support structure for the crossbar/head.

Keypad

The keypad is used for basic control of the instrument.



ill 8228

Its components are:

① **Air Pressure indicator** – this is mechanical so works when the power is off. **When this is white do not operate the instrument;** check the lab air supply then call Malvern.

Caution!

When this is white there is not enough air pressure for the instrument; do not use it.

② **Status indicator** – this has three states:

- green - set up correctly and communicating with the software.
- amber - software not running or no communication with computer (check the cables).
- red - error; contact Malvern.

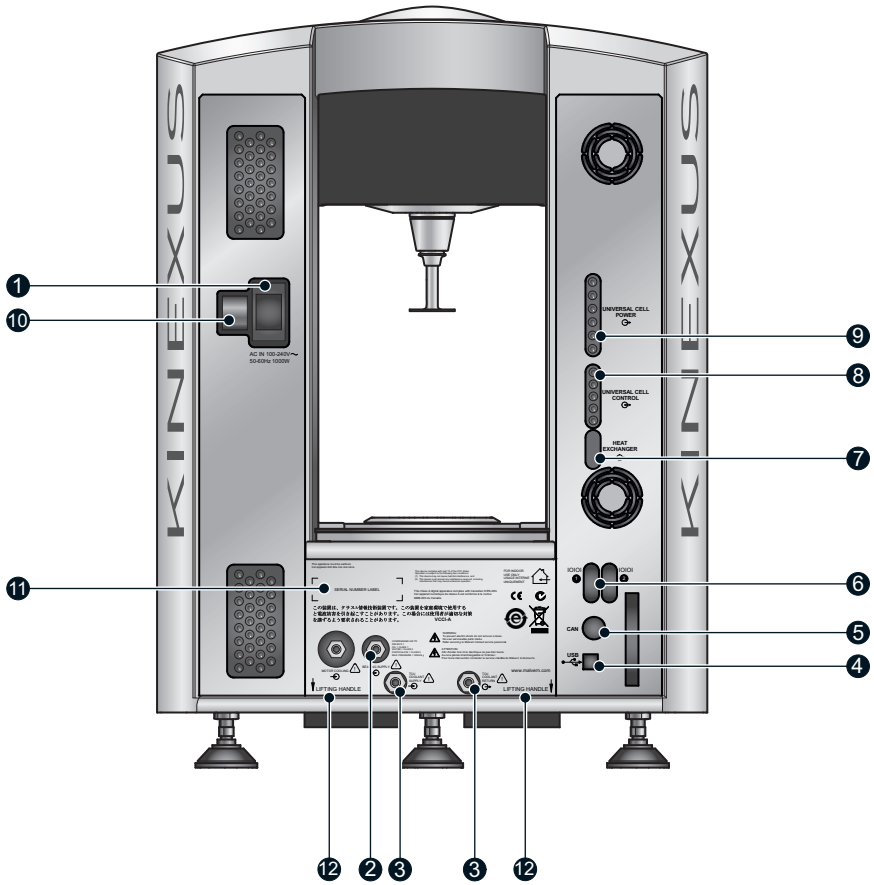
③  and ④  keys – press these to interact with a sequence running on the computer. Use the keys to make choices when prompted.

Note

Once a sequence has been started and the required information entered, most sequences can be run from the keypad, using the screen as a reference prompt. This reduces the need to return to the computer to perform parts of the measurement.

The back panel

This section describes the connections and components on the rheometer back panel, as shown below:



ill 8234

Connections

The back panel connections, indicated by numbers, are:

① **AC IN connector** – provides power to the rheometer.

② **Motor cooling** and **Bearing supply** – inlets for compressed air from the air filter/regulator. The 10mm inlet provides the air for motor cooling, the 6mm inlet provides air to the bearing.

Caution!
Air must be three bar and must meet the specification given in the **Kinexus Series Basic Guide**. If the air pressure falls below about two bar, the motor is disabled and an alarm sounds.

③ **TCU coolant supply, TCU coolant return** – these two ports provide the heat exchanger fluid for the cartridge. Connect these to the appropriate heat exchanger. **Connect the inflow to the left-hand port and the outflow to the right-hand port**.

④ **USB port** – connect this to the control computer.

⑤ **CAN port** – this may be used in future to connect CAN-enabled devices; contact Malvern for details.

⑥ **RS232** – these two connectors are for the Active heat exchanger and other serial interface devices.

⑦ **Heat exchanger** – signal and power connection to the Passive heat exchanger.

⑧⑨**Universal Cell control, power**

⑩ **Mains power switch** – use this to power the instrument on and off.

Caution!
Do not obstruct the air inlets or outlets.

⑪ **Serial number** – report this when contacting Malvern.

⑫ **Lifting handle labels** – these indicate the only places that should be used to lift the rheometer.

Computer

This runs the **rSpace** software which controls the rheometer and Environmental Controllers. The software is described in **Chapter 4**.

Environmental controllers

Environmental controller is the term for the combination of Plate, Active hood or Cylinder cartridge, Sample cover and heat exchanger.

The cartridge slots into the front of the rheometer and holds the lower geometry which the sample is placed on or in. The cartridge may use fluid circulated by a heat exchanger.

Note
The environmental control options are described in detail in the **Kinexus Environmental Controllers manual**.

The available environmental control cartridges are:

- **Plate cartridge** – holds a flat plate geometry for testing samples ranging from low viscosity materials through to pastes and semi-solids.
- **Active Hood cartridge** – holds a flat plate geometry for testing samples ranging from low viscosity materials through to pastes and semi-solids. It has an integral hood to reduce thermal gradients. This also allows a solvent gas to be fed into the area around the sample.
- **Cylinder cartridge** – holds a cup geometry to contain liquid samples/pastes.

The following are used with these cartridges:

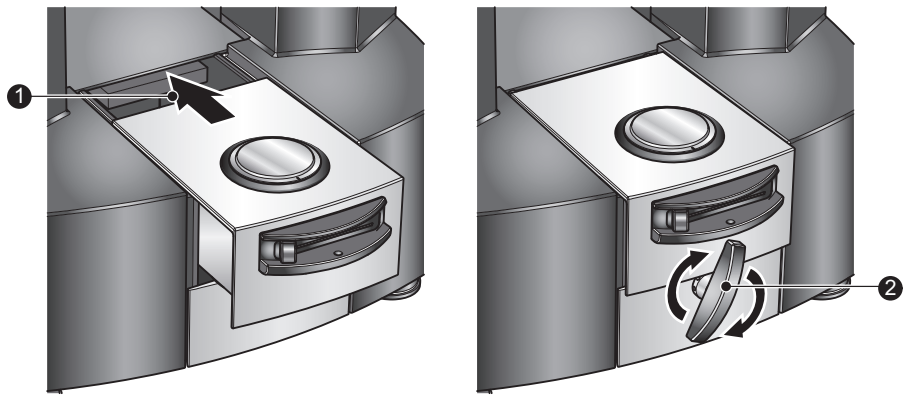
- **Heat exchangers -** there are two circulator options for removing excess heat from the cartridge. The **Passive heat exchanger** is a simple fluid circulator, the **Active heat exchanger** allows lower temperatures.
- **Sample cover** – a simple “clamshell” to cover the sample and reduce thermal gradients in it. We recommend that this is always used on cartridges without an Active hood.

Fitting cartridges

When fitted correctly, a cartridge is automatically recognised by the system. Geometries can be swapped in/out without removing the cartridge itself from the rheometer.

To fit a cartridge:

1. Push the cartridge gently most of the way into the slot ①. This example shows a Plate cartridge:



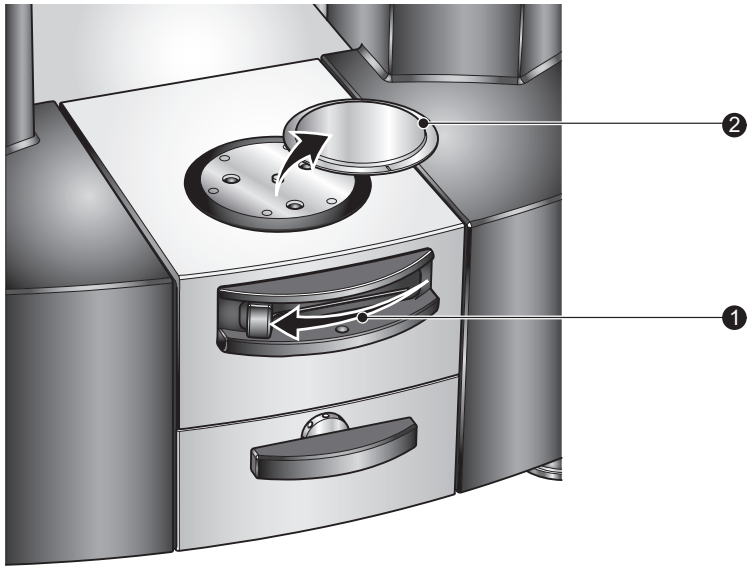
2. Turn the cartridge lock on the rheometer clockwise ②. This aligns and connects the cartridge.

To remove a cartridge:

1. Turn the cartridge lock on the rheometer anti-clockwise. This disconnects the cartridge and pushes it a little way out.
2. Pull the cartridge gently out of its slot.
3. Wipe away any drops of fluid which may escape from the inlets on the back of the cartridge.

To remove a Plate geometry:

1. Push the lever on the cartridge fully to the left ①.

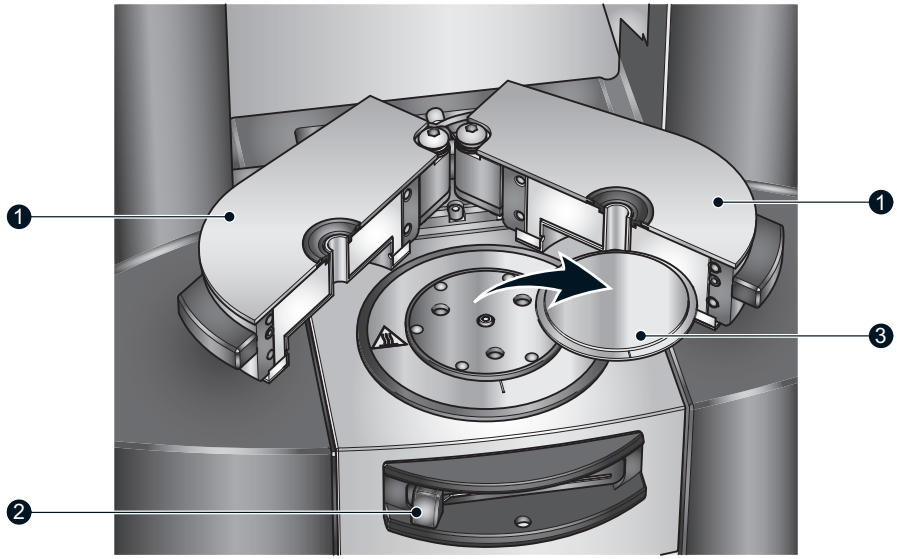


ill 8730

2. Using heatproof gloves as necessary, lift the plate off ②.

To remove a geometry (Active Hood cartridge):

1. Using the handles, open the Active hood ① to view the plate.
2. Push the lever on the cartridge fully to the left ②. This releases the geometry.



ill 8722

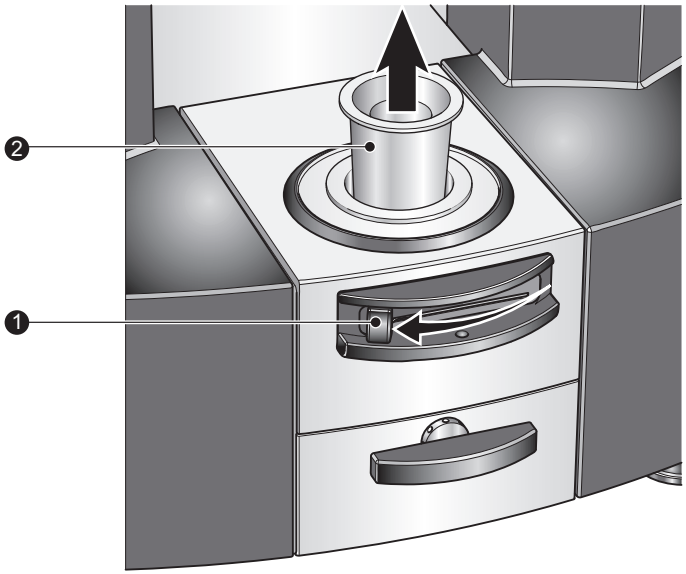
3. Using heatproof gloves as necessary, lift the plate off ③.

To insert a Plate geometry:

1. If using an Active hood cartridge, open the Active hood using its handles.
2. Using heatproof gloves as necessary, place the plate on the cartridge with its marker line at the front.
3. Push down gently on the plate.
4. Push the lever on the cartridge fully to the right.

To remove a Cylinder geometry:

1. Push the lever on the cartridge fully to the left ①. This releases the geometry.



ill 8227

2. Lift the cylinder out ②.

To insert a Cylinder geometry:

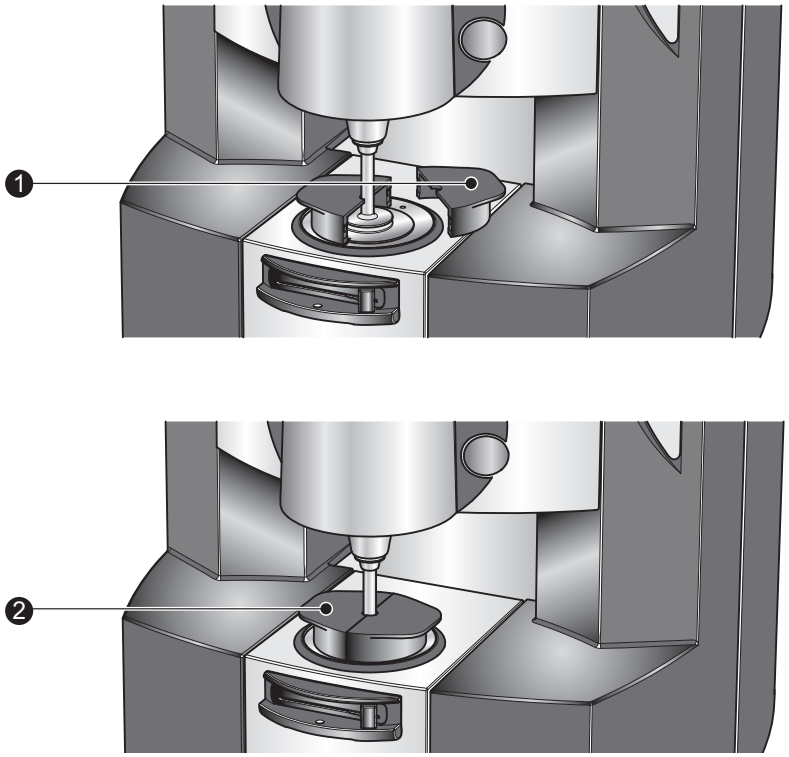
1. Place the cylinder in the hole in the cartridge, or gently drop it in.
2. Push the lever on the cartridge fully to the right.

Sample cover and Active hood

A sample cover should be used for all measurements on Plate and Cylinder cartridges, unless the sample needs to be watched.

To use the sample cover:

1. Open the clamshell and carefully place the parts behind the upper geometry ①.

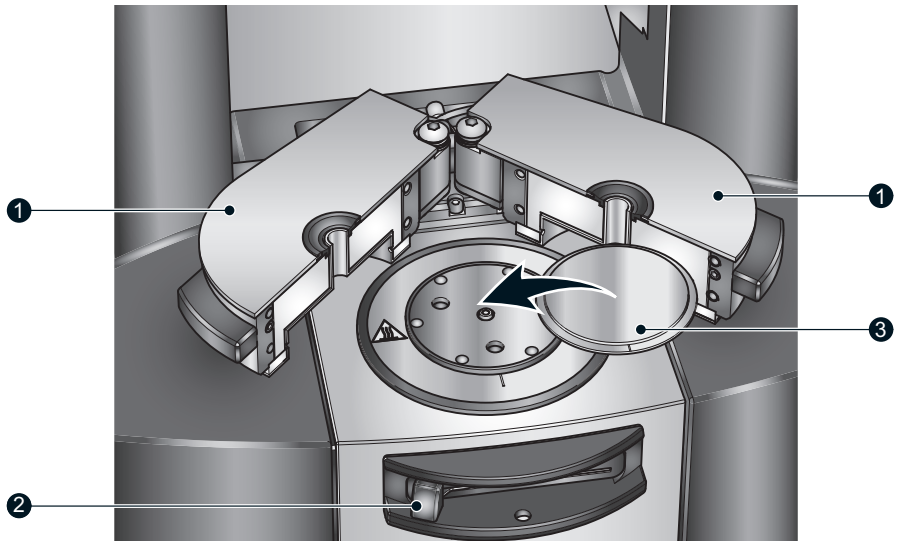


ill 8716

2. Taking care not to touch the sample or geometry stem, close the clamshell ②.

To use the Active hood:

1. Ensure the lever ② on the cartridge is positioned fully to the left.
2. Using the handles, open the Active hood ①.
3. Place the plate on the cartridge ③ with its marker line at the front.
4. Push the plate down gently:



ill 8418

5. Push the lever ② on the cartridge fully to the right to lock the geometry in place.
6. Taking care not to touch the sample or geometry stem, close the hood ① by pushing its handles together.

Heat exchangers

Heat exchanger setup and maintenance are described in the **Kinexus Environmental Controllers manual**.

Geometries

This section describes the geometries available, the geometry recognition system and how to fit a geometry. Supervisors adding geometries to the database should refer to **Chapter 10**.

The sample is placed between two geometries:

- **upper geometry** – usually a cone, parallel plate or a bob.
- **lower geometry** – usually a flat plate or a cylinder (cup).

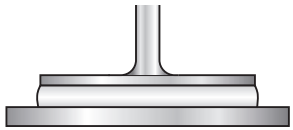
All Environmental Controller cartridges have removable/interchangeable lower geometries.

Types of geometry

This section describes the geometry types.

Parallel plate

Here the sample is placed between two flat plates:

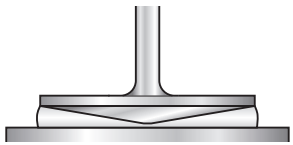


ill 7748

This type of geometry is named PU*nn*:PL*xx*, where *nn* is the top plate diameter and *xx* the bottom plate diameter. For example, PU40:PL65 is a 40mm plate above a 65mm lower plate.

Cone and plate

Here the sample is placed on a flat plate and below a cone:

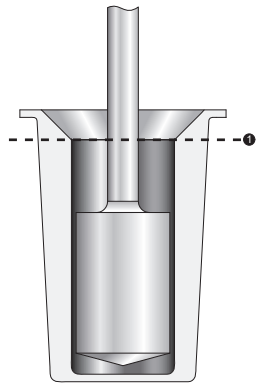


ill 7747

This type of geometry is named CP*a*/*nn*:PL*xx*, where *a* is the cone angle, *nn* the cone diameter and *xx* the bottom plate diameter. For example, CP4/40:PL40 is a 40mm diameter 4° angle cone over a 40mm plate.

Cup and bob

Here the sample is placed in a cylinder. A bob is lowered into this and sample added up to fill level ①:



ill 8220

This type of geometry is named C*nn*:CP*nn*, where *nn* is the bob diameter. For example, C14:CP14 is a 14mm bob in a 15.4mm cup.

Double gap

Here the sample is placed in a double cylinder. A second cylinder is lowered into this. This type of geometry is named DG*nn*:DO*nn/DInn*, where *nn* is the bob diameter.

Vane tool

Here the sample is placed in a cylinder. A vane tool is lowered into this. This type of geometry is named 4V*nn*:CUP*nn*, where *nn* is the bob diameter.

Geometry recognition

The system automatically recognises which upper geometry is attached. The **Geometries database** holds information on the geometry sets and will sort the lower geometries to show only the correct combinations.

If the upper geometry is new insert the USB key for the geometry in a USB drive then insert the geometry in the chuck. The system will locate the information on the USB key automatically and add it to the database as described in **Chapter 10**.

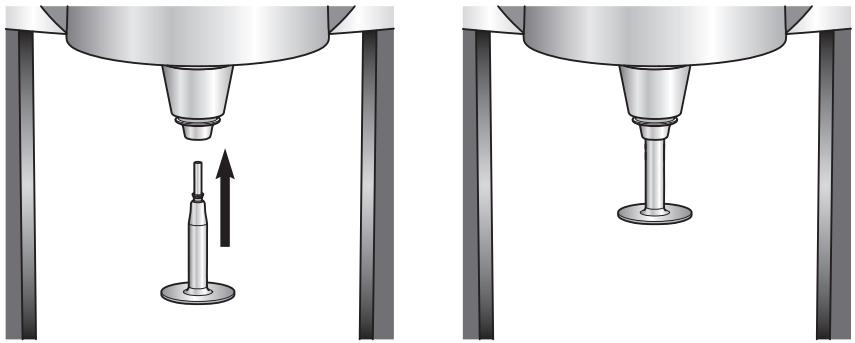
If the user does not insert the USB key supplied by Malvern, the software prompts for it. Geometry data can be added manually as described in **Chapter 10**.

Caution!
Take care with the top of the upper geometry as this contains a geometry recognition RFID tag. Keep upper geometries away from temperatures over 90°C and strong magnetic fields.

Fitting an upper geometry

Caution!
Do not move the chuck without the air supply turned on.

To fit a geometry, simply push it gently into the chuck collar as shown below. Always try to ensure that the serial number of the geometry is facing the user to ensure measurement consistency.



ill ill8226

To remove a geometry, hold it securely and push up the chuck collar.

Software features

Introduction

This chapter introduces the features of the **rSpace** software. It describes:

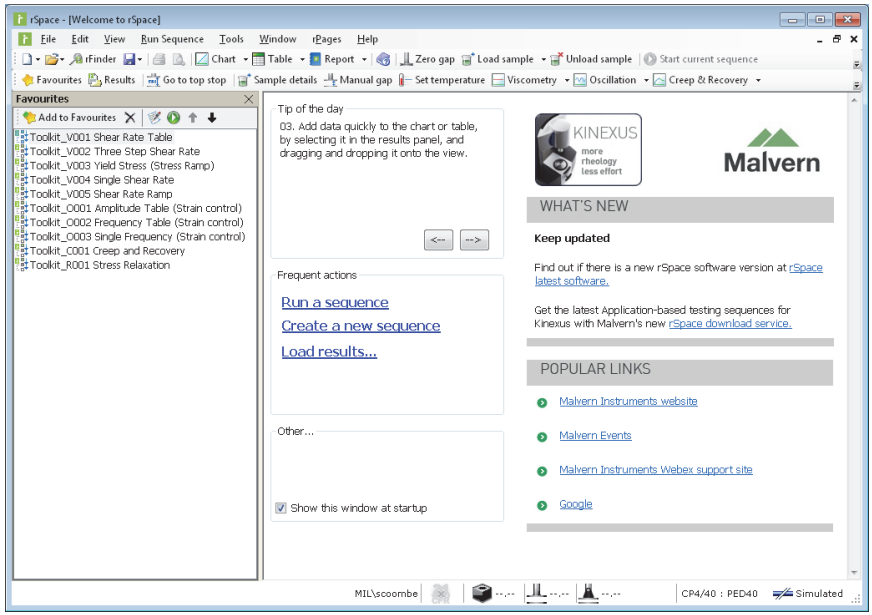
- The Welcome window.
- The main window – gives a quick introduction to what the software looks like at startup and after a measurement.
- **rFinder** – the key component for running the software.
- Running sequences – describes the components of the **Live display** window which is used to run sequences.
- Software reference – describes menu commands, the toolbars, status bar and other window components.
- Folders and files – describes the various folders and file types.

A complete measurement tutorial is given in **Chapter 5**. **Chapter 6** shows how to display, analyse and manage measurement results.

Note
Warnings, notes and errors which may be reported by the software are described in the online help.

The Welcome window

The Welcome window may be configured to appear at startup. Otherwise use **Help-Welcome** to open it.

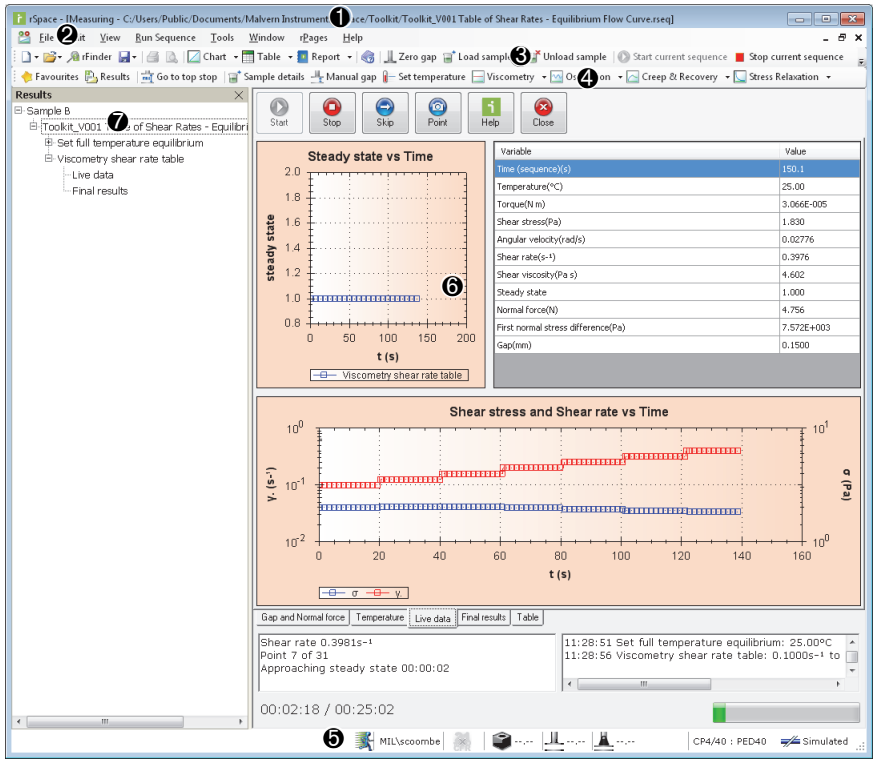


Its components include:

- **Tip of the day** – shows useful advice for the user.
- **Frequent actions** – one click shortcuts for commonly used actions like running a sequence and opening a data file.
- **What's new** – links to the Malvern website for the latest software and application test sequences.

The main window

This section describes the main **rSpace** window. This example shows a typical display with a sequence running:



The components are:

① **Title bar** – shows the product name and a file name relevant to any maximised working window.

② **Menu bar** – the commands are described in the **Software Reference** section.

③ **Standard toolbar** – contains shortcuts for common commands. To help identify a button, a tooltip describing its action is displayed when the cursor is moved over it.

④ **Manual actions toolbar** – used to run the instrument in “manual mode” for sample investigation.

⑤ **Status bar** – contains icons and text displaying information about the state of the system, as detailed below:

- Sequence currently running icon  .
- 21CFR status – shows whether 21CFR is enabled.
- The cartridge, shown as an icon. Move the cursor over this for its name.
- The temperature.
- The geometry combination used and the gap. Move the cursor over the geometry to view its name.
- The currently measured normal force.
- Instrument – this is full colour for an initialised instrument, greyed-out if the instrument is not initialised. It is  when no instrument is connected.

⑥ **Work area** – this area is used to display other windows containing charts, tables, sequence displays, etc. In the above example, a verification sequence is open in this area.

Data and sequence files can be dragged from Windows Explorer and dropped into this space, where they will open ready for use.

⑦ **Results panel/Favourites panel** – use the tabs to switch between these two. The **Results panel** shows a tree listing any currently loaded results data for analysis, viewing or printing.

The **Favourites panel** allows users to create a list of frequently used sequences so that they can be accessed more quickly, removing the need to locate them in rFinder first.

Some of these components are described in detail in the **Software Reference** section later in this chapter.

rFinder

rFinder is a key component used for running the software which indexes files in both the **rSpace** folder and **My Documents**. **rFinder** finds just **rSpace** files and **.pdf** files.

Use **rFinder** to quickly:

- Search for a suitable measurement sequence and run it.
- Search for **Application Notes** and other **.pdf** files covering a specific topic.
- Search for "overview" **.pdf** files giving more information on how to search in a particular industry or application area.
- Search for a string among data files.
- Search for a suitable chart or table template.

If a new sequence or template is required, we recommend finding one which is as close as possible to that desired and editing it, rather than starting from a blank file. **rFinder** allows the user to find the best file to edit.

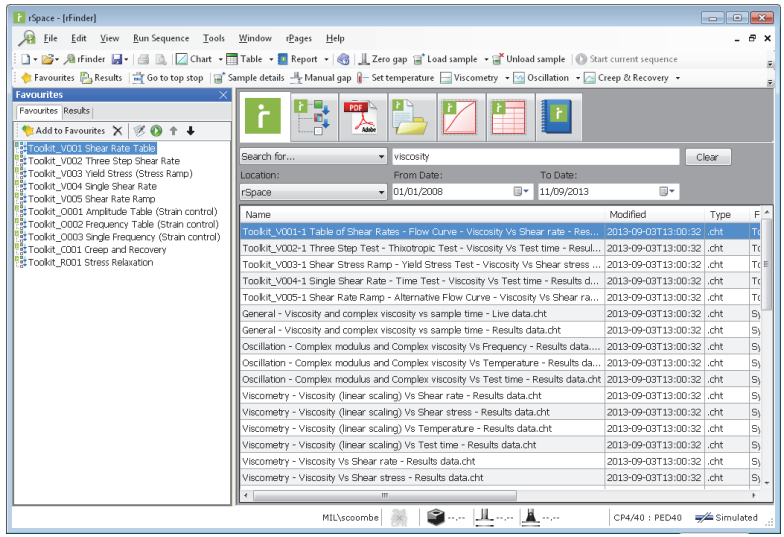
Once **rSpace** is running, **rFinder** can be opened in several ways. Each of these opens **rFinder** in a different format.

To use rFinder:

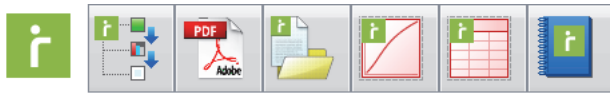
1. If searching for a sequence to run, select **File-rFinder** (or press **F3,** or click the rFinder button on the toolbar).
2. Type a phrase to look for in the text box. This could be a material name, a more general term like "overview" or "viscosity" or an application area like "personal care". Alternatively, select one of the keywords from the **Search for...** drop down list.

Note
As described in **Chapter 2**, numerous overviews are provided, giving guidance on how to use **rFinder** efficiently (what to search for).

3. The **rFinder** window then lists all applicable results:



4. To switch the view between file types, click the button for the type of item to search for (from left to right: All, Sequences, Application notes, Results, Chart templates, Table templates, Report templates):



5. If desired, refine the search by specifying locations or file creation/modification dates. **Location** allows the selection of just Malvern files or just user files, rather than the default of showing all files of the chosen type. **Date** allows selection of files based on creation or modification dates.

6. Run any listed sequence file by double-clicking it in the list.

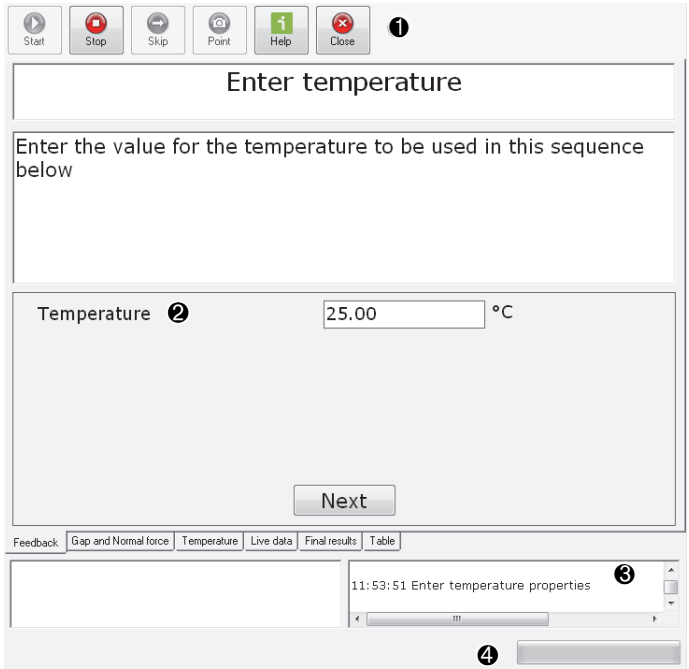
   (The 'double-click to run' behaviour of this list can be set to 'double-click to edit' instead: select **Tools-Options-User** and then set the **Default action for rFinder sequence**.)

Running measurement sequences

This section describes the windows displayed while running a sequence.

The Live display window

The **Live display** window is the user interface when a sequence is run. It asks relevant questions, gives instructions, reports real time information including live data and final results, etc. Here is an example showing a feedback page from a standard Malvern Instruments sequence:



Malvern displays all have multiple pages as described below.

The window can be designed by advanced users using the **Sequence Designer**'s **Live display** tab; see **Chapter 8**.

The window components are described in the following section.

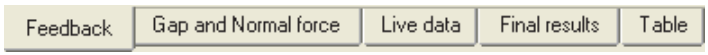
① Button bar

The button bar controls the measurement operation as detailed below:

Button	Function
	**Start** – starts the sequence, although most sequences start automatically when run. (In a started sequence the **Pause** button replaces this.)
	**Stop** – stops the sequence. To shut it down completely, follow this with **Close**.
	**Skip** – jumps to the next action in the sequence.
	**Point** – takes a sample point then continues the current action.
	**Help** – opens the online help.
	**Close** – aborts the sequence. If **Close** is pressed while a measurement is in progress, the user can choose to continue or abort.

② Pages

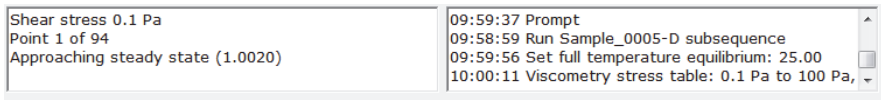
The display can feature numerous pages, selected by clicking on their tabs. The main page types used in standard Malvern Instruments sequences are:



- **Feedback** – text on this page asks the user to supply information, for example sample details, to make choices or complete a task. This page is automatically displayed when feedback is required.
- **Gap and Normal force** – shows these parameters changing over time.
- **Live data** – displays live updates of data in one or more charts or tables.
- **Final results** – displays sampled data (usually equilibrium data) for use in analysis/presentation.
- **Table** – shows sampled data in tabular form.
- **Analysis** – shows results of analyses performed on the data.

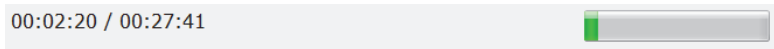
③ Progress area

The Progress area reports on progress of the sequence at each data point, as shown below. The left-hand box shows the action status; the right-hand box shows the sequence log:



④ Status bar

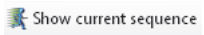
The left-hand side of the status bar is used to display time elapsed. The right-hand side normally shows a progress bar:



③ Standard toolbar

This toolbar, located below the menu bar, provides buttons for performing common operations. Each button has an equivalent menu command. For example, clicking the button is the same as using the **File-Open** command. This toolbar has the following buttons:

Button	Function
	Creates a new data file or sequence.
	Opens an existing data file or sequence.
rFinder	Opens the **rFinder** window.
	Saves the current data file or sequence.
	Prints the current chart or table.
	Print preview.
	Displays help information.
Report	Opens rFinder in report finding mode (other Report options are also available from the drop-down menu)
Zero gap	Runs a sequence which zeroes the geometry gap.
Load sample	Runs a sequence that guides the user through loading a sample.
Unload sample	Runs a sequence that guides the user through unloading a sample.
Start current sequence	Runs the current sequence. (The sequence must be the selected window.)

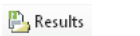
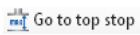
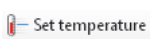
Button	Function
	Stops the currently running sequence.
	Displays the currently running sequence.

Note the following:

- To identify a button's function, move the cursor over it. A tooltip is displayed.
- If a command is not available its button is shown "greyed out".
- Display of any toolbar can be turned on/off using the **View** menu.

④ Manual actions toolbar

This toolbar allows the user to control the instrument and gather data when investigating new samples. Its buttons, which give a quick way to perform tasks, are:

Button	Function
	Display the favourites panel.
	Display the results panel.
	Runs a sequence that moves the geometry to the top stop.
	Select either: Manual viscometry, Table of shear rates, Shear rate ramp or Yield stress ramp.
	Select either: Manual oscillation, Strain amplitude sweep, Amplitude sweep with LVER determination or Frequency sweep with crossover.
	Runs a set temperature sequence.
	Runs a gap sequence (changes absolute or relative gap, or sets Normal force).
	Runs a Creep/Recovery sequence (set stress or torque).
	Runs a relaxation sequence (set strain or position).

The data from these sequences can be saved.

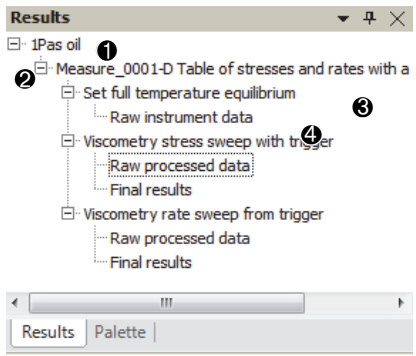
⑦ Favourites panel

The **Favourites panel** allows users to create a list of frequently used sequences so that they can be run and edited more quickly, removing the need to locate them in rFinder first.

- **To add a sequence to the Favourites list**, use rFinder to locate and open the sequence you wish to add as a favourite, and then click the **Add to Favourites** button Add to Favourites. Remove an item by selecting it and then clicking the **Remove from Favourites** button ✕.
- **To edit a sequence in the Favourites list**, double click on a sequence name in the list, or select the item and then click the Edit Sequence button on the Favourites panel's toolbar.
- **To run a sequence in the Favourites list**, click once on the sequence to select it and then click the Run Sequence button on the Favourites panel's toolbar.
- **To change the order of the items in the Favourites list**, select the item and then click either the up or down arrow on the Favourites panel to move it to the required position.

⑦ Results panel

The **Results panel** shows a list of the results obtained for the sample loaded or when a data file is opened. The sample name ① is the top level in the tree. The sequence ② is next. Sequence actions ③ run on the sample form the third level branches and below each of these is the results produced ④. When a new sample is loaded, a new top level entry appears in the list with the sample's name. Use the ⊞ and ⊟ buttons to expand or contract the tree structure.



Right-clicking on items opens a menu (options depend on what is clicked):

- **Delete** – deletes the item.
- **Rename** – changes the name of the item.
- **Save as** – saves the item and all its parent items in the tree to a new data file.

- **Sample properties** – for sample items only, opens a dialogue describing the sample properties (the batch number) and the full properties of the sample material. These can be edited here if required.
- **System information** – for sample items only, shows details of the instrument configuration when the data was produced.

Note
The **Palette** window usually occupies the same area. It lists the available actions for building sequences.

An **.rdf** file can also be opened by dragging it into the browser from Windows Explorer.

Folders and files

The default locations for all files are folders are, in Windows 7:

`C:\Users\Public\Documents\Malvern Instruments\rSpace`

These files are by default held in the following folders (though these may change as areas are restructured):

Top level directory	Subdirectory
Design	Sample
	Measure
	Analyse
Experiment	Creep recovery
	Oscillation
	Relaxation
	Viscometry
rSure	Calibration
	Verification
rSolution	Adhesives
	Complex fluids
	Ink
	Paint
	Personal care
	Pharmaceutical

In all folders:

- **.rseq** = sequence file.
- **.pdf** = Application note (instructions).

The other system folders are:

File type	Extension	Function
System Templates	**.cht, .tbl**	Standard chart/table templates
User Results	**.rdf**	Result data
User Sequences	**.rseq**	User created sequences.
User Templates	**.cht, .tbl**	User's own chart/table templates

Other files used are the following:

File type	Extension	Function
Exported data	**.csv**	For use in other applications (**.csv** is best for spreadsheets)
Geometries	**.rgde**	Single geometry file or Geometries database

Files can be placed elsewhere on the C:\ drive or network and accessed by browsing to the location.

5

Measurement tutorial

Introduction

After reading this chapter, a user should be able to make simple measurements.

This chapter initially describes:

- **Getting started** – preparing the instrument for a measurement. Guidelines for sample preparation are given in **Chapter 7**.
- **Making the measurement** – running a measurement sequence. This section covers all the steps from placing the sample to saving the results, running the standard **rSure** verification test on an oil sample using the plate cartridge.

It then describes the next things users may want to do:

- **Measuring new samples** – guidelines for measuring the user's own samples. This concentrates on using the **rPages-My Sample** and **rPages-My Process** help and rFinder to select a suitable sequence.
- **Making manual measurements** – for users going beyond Solve sequences who wish to design their own sequences.

Getting started

This section covers preparing the instrument.

To prepare the instrument:

1. Turn on the air supply, the Nitrogen (if used) and the circulator fluid supply (if an Active heat exchanger is in use).

Caution!
Powering on the instrument without sufficient air pressure may damage it. Refer to the air and air quality notes in the **Kinexus Series Basic Guide**. Turn on the compressed air line and check that the pressure is accurately set at 3 bar (300 KPa) on the regulator unit. Check that the air pressure indicator on the keypad is not white.

2. Remove the Air bearing protection lock, if it is fitted (see the **Kinexus Series Basic Guide**).
3. Check that the rheometer is level on the bench surface. If necessary adjust the feet (see the **Kinexus Series Basic Guide**).
4. Turn on the rheometer at its power switch. It runs various self checks.

Note
Leave the rheometer powered on for five minutes before any measurement is made. This allows it to stabilise.

5. Insert the appropriate Environmental Controller cartridge as shown in **Chapter 3**. If necessary a sequence will prompt for a different controller when run.
6. Power on the Active heat exchanger, if one is used.
7. Double-click the **rSpace for Kinexus** desktop icon to start the software.

Note
If the icon is not on the desktop, open the Windows **Start** menu and select **Programs-Malvern Instruments-rSpace-rSpace for Kinexus** to start the software.

8. The software opens, displaying the **Welcome** window.
9. The rheometer performs an initialisation routine, **during which the rheometer head moves**. This takes a few seconds, during which some menu options are unavailable.

Allow it to complete before proceeding. If a geometry is fitted, the instrument will zero it and set the sample loading gap. Also Service reminders or Verification prompts may be displayed.

Note
If the user cancels at this point the rheometer will not be properly initialised. To recover from this, run the command **Tools-Instrument-Initialise**.

Making the measurement

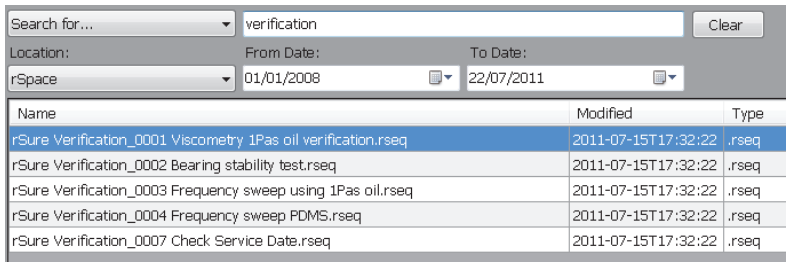
This section describes use of verification tests using standard oil and PDMS samples. These are **rSure sequences**. These are the same tests described in the **Quick start Guide**.

Oil verification test

This uses a standard 1Pas oil.

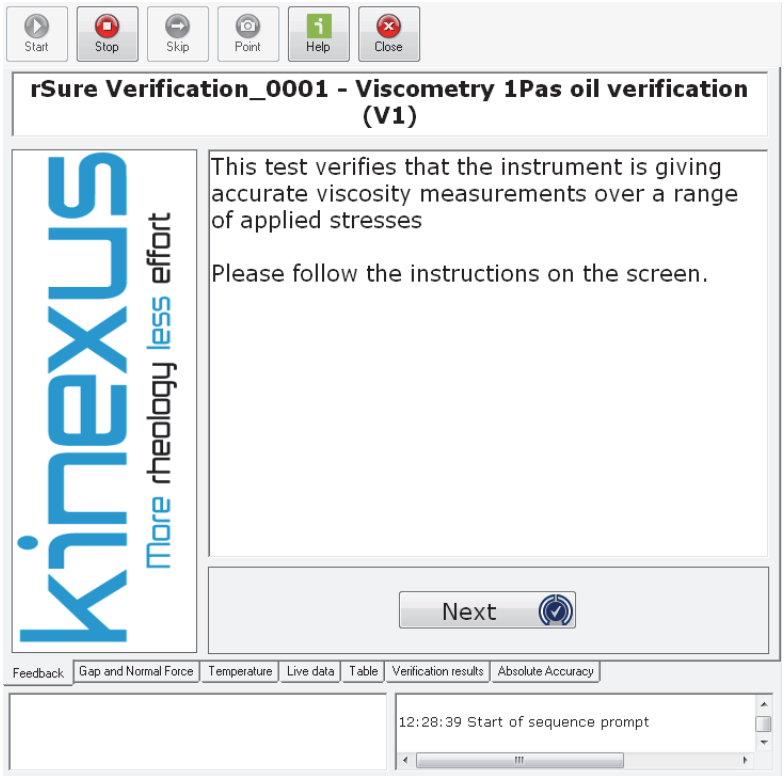
To measure an oil sample:

1. Select **Run Sequence-Run from rFinder** to open **rFinder**. Type **Verification**.
2. The list of sequences found is shown:



3. Double-click the sequence named **rSure Verification_0001 Viscometry 1Pas oil verification.rseq**. This opens and starts the sequence.

4. The **Live display** shows the first step of the sequence:

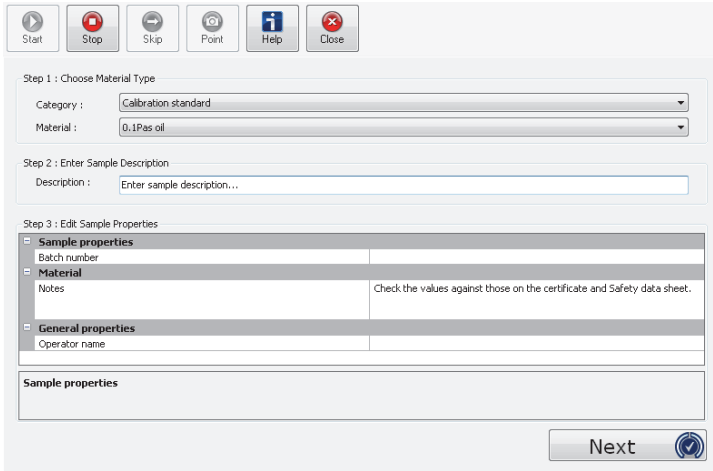


5. Click the button.

Note

Whenever this instruction is given, the user can click the button in the dialogue or on the instrument keypad. Use whichever is easiest.

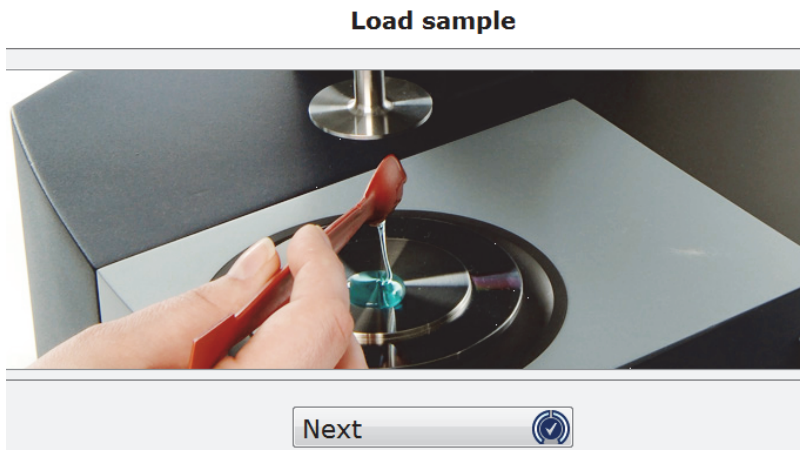
6. After a reminder, the **Enter Sample Details** dialogue is displayed:



Select the material in the **Material** pull-down list then type the sample **Description**. The parameters for this material from the Materials database are shown. Click .

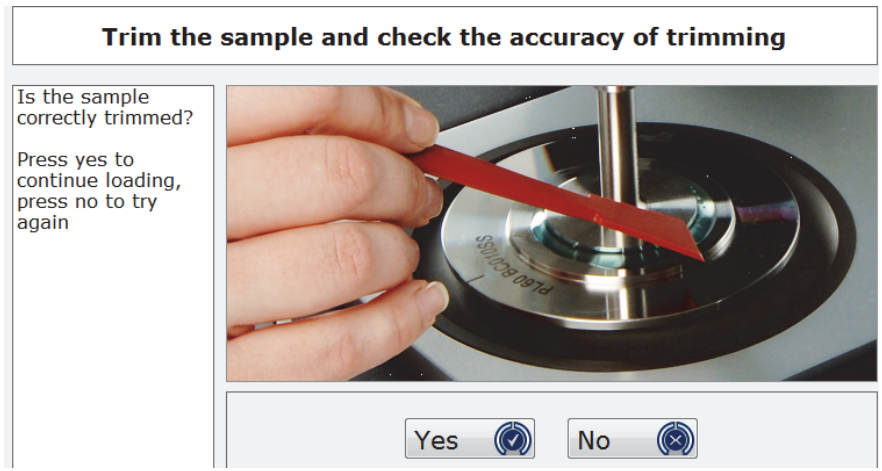
7. If prompted, insert the Plate cartridge with a suitable plate fitted then insert a CP4/40 upper geometry. (If the correct cartridge and geometry are already fitted, no prompt is displayed.)

8. The sequence sets the sample loading gap then prompts the user to load the sample:



9. Load the sample as described in **Chapter 7**. Click .

10. The sequence sets the gap then prompts the user to trim the sample:

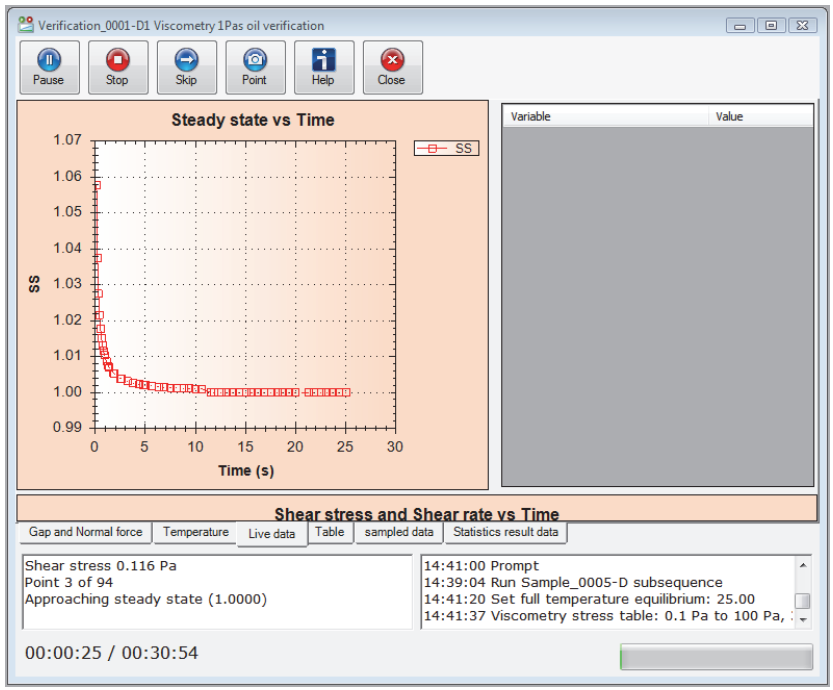


If the sample can be trimmed correctly, do this then click . If not click , unload it and try again.

11. The next page prompts the user to cover the sample:

Place the sample cover over the sample and click

12. The measurement begins. Switch to the **Live data** tab. As the measurement runs, data is displayed as shown below:



The status bar reports progress. The test will take about five minutes.

13. A dialogue reports whether the measurement passed or failed. If it passes click **Next** then the **Close** button to close the sequence. If it fails, check that the sample is loaded correctly then repeat the test. If it fails again contact Malvern Instruments help desk.

14. The results, including the date, time and sample details are automatically saved in a data file (**.rdf**).

15. Click the **Unload sample** button on the toolbar and follow the sequence this runs to unload the sample and clean off the geometries. Wipe the geometries gently with a cloth and clean them with alcohol. If further cleaning is required, follow the procedures in the **Essentials manual**.

PDMS verification test

This uses a PDMS sample. It is vital that PDMS samples are kept clean so do not touch the sample with the fingers as it is removed from the bottle and applied to the lower geometry.

To measure a PDMS sample:

1. Select **Measure-Start Sequence-rFinder** to open **rFinder**. Type **Verification** and click the **Sequences** button.
2. Double-click the sequence rSure **Verification_0004 Frequency sweep PDMS.rseq**. This opens the sequence.
3. The sequence displays a similar set of pages to those shown above for the 1Pas oil test. Respond to prompts in the same way.

Closing down the instrument

When all work is complete, shut down in the following order:

1. Select **File-Exit** to close the **rSpace** software.
2. Power off the rheometer.
3. Fit the **Air bearing protection lock** as shown in the **Basic Guide**.
4. Turn off the air supply.

Measuring new samples - rSolution

To measure a new type of sample, proceed as follows:

1. Use **rFinder** to find a suitable sequence among those provided by Malvern. Search criteria can include sample type, application, etc. Remember to use the **Overview** pages if required.

   If a suitable sequence is found, skip the rest of the steps.

2. Use **rPages-My Sample** and **rPages-My Process** to evaluate what is needed.

   The **My Sample** help identifies a wide range of sample types as either **Complex fluid**, **Polymer**, **Inorganic compound** or **Asphalt/fuel/oil**. Follow the link to the page for the correct group; here there is comprehensive information on rheological properties and processing issues.

   The reason for using these categories is the sheer number of different samples that can be tested. For example **Inorganics** includes cements, ceramics, silicones and metals. Each has different physical and rheological properties and therefore different processing and testing issues. Once the user has established what category their sample is, it is easy to follow the correct procedure and select a suitable sequence for the sample.

For example, mayonnaise is an emulsion (colloid). Use the help to establish this, then choose a suitable sequence from those in the **Emulsions (colloids)** group.

The **My Process** help presents a process matrix for each of the Complex fluid, Polymer, Inorganic compound and Asphalt/fuel/oil groups. Follow the link to the process matrix; here there is comprehensive information on processing issues. This covers time scales, whether the process is shear stress, strain/rate or extensional, effects of elasticity and shear history, and the temperature to use.

3. If no completely suitable sequence is found, use **rFinder** to look for one which is as close as possible so it can be modified easily. Sequence **Abstracts** describe what may be changed easily; **Chapter 8** gives more information for advanced users.
4. Consider asking Malvern Instruments to create a sequence or, if advanced users are available at the site, ask them for advice.

Making manual measurements

Those going beyond Solve sequences who need to design their own sequences should use the buttons on the **Manual actions toolbar** described in **Chapter 4** and in the online help.

6

Viewing results

Introduction

This chapter covers:

- Data types – live data, sampled data and raw data.
- Saving data.
- Displaying data using charts and tables.
- Running analyses on data.
- Editing/creating chart templates.
- Managing data – moving data between charts and tables, exporting to files, merging data and extracting the sequence used.
- Printing charts and tables.

Data types

Several types of data can be used/are produced.

Raw data

Raw data from the instrument measures the Gap, Normal force, Temperature, Torque, Position and the Time since a measurement began. It is updated at up to 5kHz, the point rate being set by the sequence action.

This data is not processed into rheological units.

Live data

This is calculated "live" rheological data, updated once per period in oscillation and at up to 10Hz for creep, viscometry and relaxation.

Final results

The final result data with equilibrium values where appropriate. This is the data that should be used for model fits, etc.

Saving data

Use **File-Save Data** or **File-Save Data as** to save results as a **.rdf** file. This does not save any open charts or tables; these need to be opened/set up separately if the **.rdf** file is reopened in future.

Right-clicking on a single item in the **Results browser** and selecting **Save as** saves that item and all its parent items in the tree to a new data file. Other data in the tree is not saved. This allows saving of subsets of results.

Displaying data

During a measurement, data is displayed in the **Live display** on charts and/or tables used by the sequence. At other times, data can be viewed by opening it, then opening the relevant chart or table. This section describes using charts (zooming, selecting curves and points, hiding data, etc.) and tables (sorting columns, etc.).

Charts

Chart templates are provided for all standard rheological data views. These are saved as **.cht** files. The template chosen must be appropriate for viewing the variables in the data set. Advanced users can also design their own templates.

To display existing data using a chart:

1. Open **rFinder**, search for the data file and double-click it to open it in the **Results browser**. (Alternatively, use **File-Open-Data File** and select a file.)
2. In the **rFinder window** click the **Chart Templates** tab and double-click an appropriate chart template in the list displayed to open it.
3. Drag items from the results browser onto the chart to display the relevant data.

   Alternatively, double click on the data node that you want to display from the results browser to open a standard chart or table displaying the relevant data. (The templates can be changed in **Tools-Options-Configure Data Templates**.)

Selecting data in a chart

Before exporting or analysing data, select the appropriate data:

- To select a curve, right-click on the graph and select **Curve selection mode** then click on the curve.
- To select a point, right-click on the graph and select **Point selection mode** then click on the point.

Shift-click or Ctrl-click to select multiple curves or points.

The Chart menu

This menu appears on the menu bar when a chart is displayed. Right-clicking on a chart also displays it:

Command	Function
Point selection mode	Allows selection of points by dragging a box or clicking. Use Ctrl+click to select non-sequential points.

Curve selection mode	Allows selection of whole curves by dragging a box or clicking.
Zoom mode	The default mode. Drag a box around an area to zoom in on it.
Zoom in x2	Zooms in on the chart centre by a factor of two.
Zoom out x2	Zooms out from the chart centre by a factor of two.
Undo zoom	Restores the default sizing.
Show hidden data	Display any points that were hidden.
Hide selection	Hides the currently selected points or curves.
Clear selection	Removes any selection boxes.
Remove dataset	Removes the selected data from the chart.
Legend	Selecting **Hidden** hides the legend (key). **Left**, **Right**, **Top** and **Bottom** position the legend around the chart.
Copy as image	Copies the chart to the clipboard for use in other programs.
Apply template ▶	This has the following sub-options:
Blank template	Opens a new blank chart.
Open template	Opens the **System templates** folder.
rFinder	Opens **rFinder** listing chart files.
Recent chart templates	Lists recently opened chart templates.
Save template as	Save the chart template as a .cht file.

Right-clicking on a chart displays the above options plus the following:

Command	Function
Analyse ▶	A series of analysis options, including the user's own, is displayed; see the **Analyses** section below.
Export data	Creates a **.csv** file holding the selected data.
Send to Chart ▶	This has the following sub-options:
Selected template file	Opens the **System templates** folder listing charts.
rFinder	Opens **rFinder** listing chart files.
Generate from data selected	Creates a chart showing the selected data.
Generate from chart	Opens a new blank chart.
Send to Table ▶	This has the following sub-options:
Selected template file	Opens the **System templates** folder listing tables.

rFinder	Opens **rFinder** listing table files.
Generate from data selected	Creates a table showing the selected data.

Chart context menus

Right-clicking on either of the chart axes displays the following context sensitive menu:

Command	Function
X axis	Opens the chart properties on the selected x axis tab.
Y axis	Opens the chart properties on the selected y axis tab.
Legend	Opens the chart properties on the curves tab.
Title	Opens the chart properties on the general tab.

Tables

Table templates are provided for all standard rheological data views. They are saved as **.tbl** files. The template chosen must be appropriate for the variables in the data set. Advanced users can also design their own templates.

To display existing data using a table:

1. Open **rFinder**, search for the data file and double-click it to open it in the **Results browser**. (An alternative is to use **File-Open-Data File** and select the file.)
2. In the **rFinder** window click the **Table Templates** tab and double-click an appropriate table template in the list displayed to open it.
3. Drag data from the Results browser onto the table to display it. Alternatively double click on the data node that you want to display from the Results browser to display a standard chart or table with containing the relevant data. (The templates can be changed in **Tools-Options-Configure Data Templates**.)

Selecting data in a table

Before exporting or analysing data, select the appropriate data. These can be a subset of the whole table.

- To select a column, click in its header.
- To select rows, click in the blank left-hand column.
- To select cells, click in them.

Shift-click or Ctrl-click to select multiple columns, rows or cells.

The Table menu

This menu is shown on the menu bar when a chart is displayed. Right-clicking on a table also displays the menu:

Command	Function
Sort ascending	Places entries in the selected column in ascending order and sorts all other columns to reflect this.
Sort descending	Places entries in the selected column in descending order and sorts all other columns to reflect this.
Remove sort	Undoes any sort applied to a column.
Select all	Selects all points.
Show hidden data	Displays any points that were hidden.
Hide selection	Hides the currently selected points.
Edit columns	Changes the variables shown or add new columns.
Remove selected columns	Deletes one or more columns.
Symbols	Uses symbols only in headers.
Full names	Uses full variable names in headers.
Vertical	Displays variables in columns.
Horizontal	Displays variables in rows.
Show first point	Fits table in the window with the first rows showing.
Show last point	Fits table in the window with the last rows showing.
Parameter dictionary	Shows dictionary entries for the table parameters.
Analyse >	A series of analysis options, including the user's own, is displayed; see the **Analyses** section below.
Export data	Creates a **.csv** file holding the selected data.
Apply template ▶	This has the following sub-options:
Blank template	Opens a new blank table.
Open template	Opens the **System templates** folder.
rFinder	Opens **rFinder** listing table files.
Recent table templates	Lists recently opened table templates.
Save Template As	Save the template to selected location.
Send to Chart ▶	This has the following sub-options:
Open template	Opens the **System templates** folder listing charts. Select the chart to use.
rFinder	Opens **rFinder** listing chart files.

Generate from data selected	Creates a chart showing the selected data.
Send to Table ▶	This has the following sub-options:
Selected template file	Opens the **System templates** folder listing tables.
rFinder	Opens **rFinder** listing table files.
Generate from data selected	Creates a table showing the selected data.
Generate from table	Creates a blank table suitable for the data.

Running analyses

This section explains how to analyse data in a chart or table. Analyses pop up appropriate data on charts or tables. Note that many sequences do this automatically. Data can be analysed with the rheometer powered off or remotely from the rheometer.

Malvern Instruments supplies many analyses sequences but the user can add their own. All sequences in the folder **rSpace\User Analyses** are made available to the user when they right-click on a chart or table and select the **Analyse** command.

Analysis types

Analyses are grouped into general types which are then made application specific by use in sequences. The analyses provided by Malvern Instruments are:

- **2D model** – runs a model fit on data within the sequence. Models are convenient for characterising sample behaviour. Ranges can be set for the parameters, giving an easy way to determine pass/fail criteria. The online help describes the available models.

  The model used must be appropriate for the data type, and fit the standard or average curve of the data very closely. Otherwise erroneous model fit results will be calculated.

- **Point statistics** – measures the statistical data for a group of points, returning one set of statistics. This is useful for QC type analyses where all data should be within defined tolerances.

- **Curve statistics** – takes several sets of data and produces statistics for each point on the x axis. It is useful for nonlinear data such as most viscometry and oscillation data. It analyses curves point by point (in x axis order), producing separate statistical data for each point. The table shows an overview of the statistics data from the measured data sets.

- **Cross over** – determines the cross over point(s) between two curves. It is especially useful for determining the cross over frequency of a viscoelastic fluid by finding the frequency at which G' and G" cross over. The analysis shows other variables at the cross over point as well as the x and y variables.
- **Peak valley** – identifies peaks and troughs in a data set. This is useful for analysing yield stress using a stress ramp, glass transition temperatures, etc.
- **Smoothing** – smoothes a single xy data set for presentation purposes.
- **True/false** – analyses a data set to determine whether a condition has been met. This is useful for QC tests.
- **Calculate value** – users can calculate single values based on system parameters including cartridge and geometry parameters.

Analysis example

The technique for running each analysis type is similar. This section describes a **linear model** analysis for a chart or table. The online help describes how to run all the analyses.

To display a linear model:

1. Select the required data (it can be a subset of all the data) on a chart or table as described earlier before selecting the desired analysis option.
2. Right-click on the chart or table and select the Linear model option.
3. Coefficients will be displayed on chart or table as appropriate.

Editing/creating chart templates

This section shows how to edit a chart template or create a completely new one. To create a new template it is easiest to copy an existing one, modify its properties as described below, then save it with a new name.

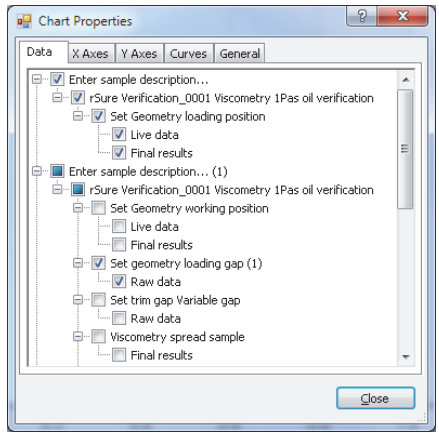
Note
Before creating a chart, use **rFinder** to check whether a suitable chart is available among those supplied by Malvern Instruments, or has been created by another user.

To edit a chart template:

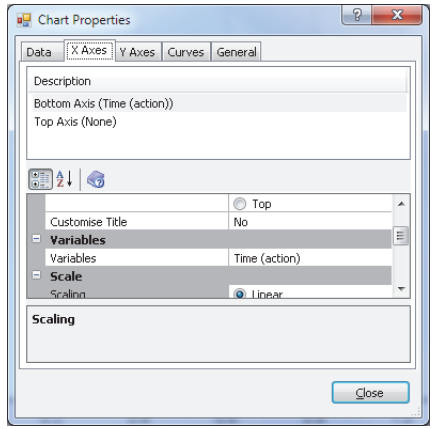
1. From **rFinder** click the **Chart Templates** tab and then select an appropriate chart template from the list displayed.

2. The chart template opens in the main window. Right click on the chart and choose **Chart Properties**, then change aspects of the template as required by using the different tabs.

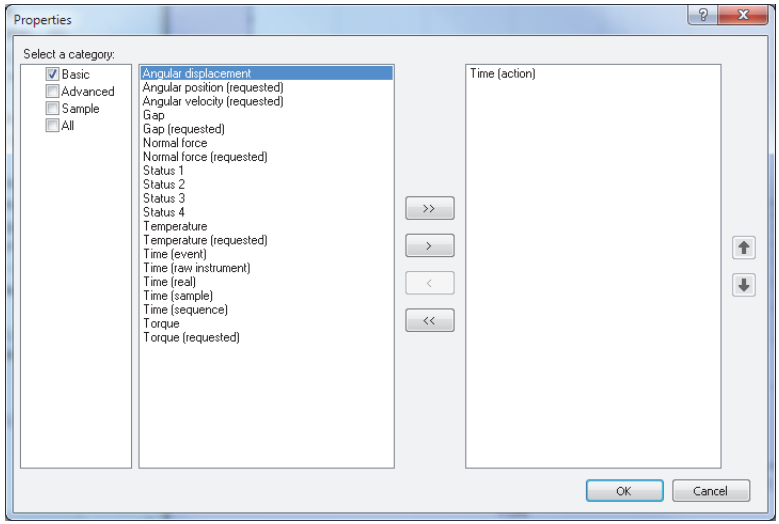
3. Use the **Data** tab to specify the data set to show. Alternatively, just drag items from the **Results** browser onto the chart.



4. To specify the variable(s) plotted on an axis, click on the X or Y Axes tab. If modifying the X axis, select the top or bottom axis:



5. Click in the **Variables** field. This displays a button; click this to open the **Properties** window:



If no properties are listed select the **Show all** check box.

6. The left-hand list shows the available properties, the right-hand list shows those selected for display. Move the required variable(s) to the right-hand side. To do this select each variable and click the > button. When the list is complete, click **OK**. Repeat the process for each axis in turn.

7. Configure other properties of the axes using the **Axes** tabs in the **Properties window** as described in the online help. For example, to name the legend on the X axis, select the **X Axes** tab, check the **Customise Title** box and type in its name in the **Title** field. Parameters controlling grid lines, linear or logarithmic scales, etc. are all available.

   Tip: To quickly show the axis properties, double click on the axis in the chart.

8. If required, use the **Curves** tab to change curve colours, etc. and the **General** tab to set up title, legend, background colour, etc. See the online help.

9. When all changes are complete select **File-Save Chart** and name the new template. It will be saved into the **User Templates** folder to distinguish it from system templates.

To create a completely new chart template:

1. Select **View-Chart-Blank chart**.

2. A blank chart opens in the main window and the **Properties** window for a chart appears. Use this to set up the chart exactly as described above for editing a template.

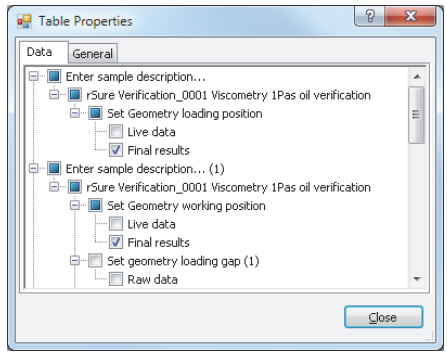
Editing/creating table templates

This section shows how to edit a table template or create a completely new one. To create a new template it is easiest to copy an existing one, modify its properties as described below, then save it with a new name.

Note
Before creating a table, use **rFinder** to check whether a suitable table is available among those supplied by Malvern Instruments, or has been created by another user.

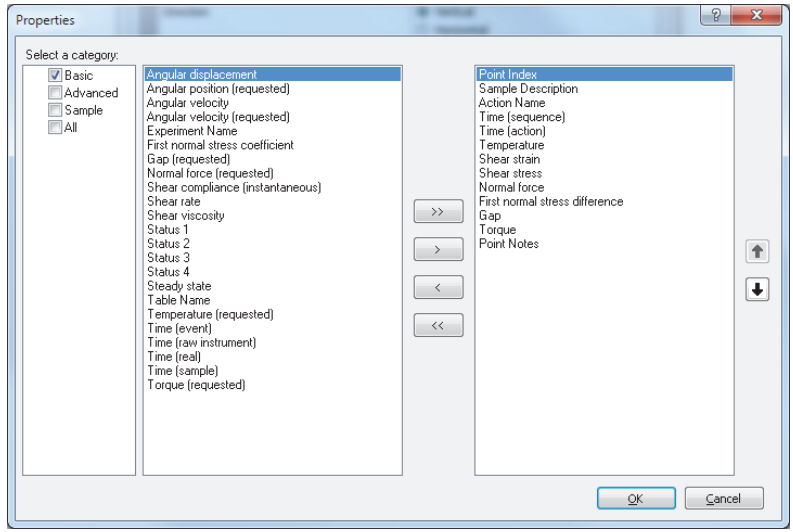
To edit a table template:

1. From **rFinder** choose the **Table Templates** tab and then double-click an appropriate table template from the list displayed.
2. The table template opens in the main window. Right click on the table and choose **Properties**. Then use the tabs in the **Properties** window to change aspects of the template as required.
3. On the **Data** tab specify the data set(s) to display by selecting their check boxes.



Alternatively, just drag items from the results browser onto the table.

4. To specify the variable shown in each column, use the **General** tab. Click the **Edit** button to the right of the **Columns** section to open the **Properties** window:

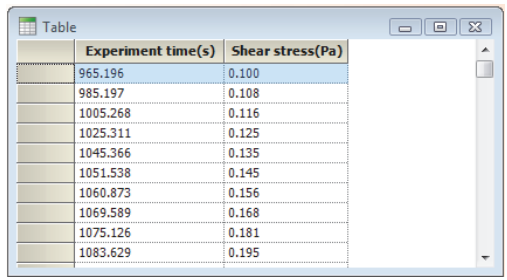


5. The left-hand side shows the available properties. Use the > button to move each required variable to the right-hand side. The parameter listed first will fill the first column in the table, and so on. Use the arrow keys to change the order of columns, if necessary. When the list is complete, click **OK**.

Note
To display row numbers select **Point index** as the first column.

---

6. The table shows a column for each variable selected:



7. Use the **General** tab to set up column descriptors, table direction, etc.
8. To save the completed table as a template (**.tbl** file), select **File-Save table**.

Managing data

This section describes moving data between charts and tables and also exporting data to files (usually done for use with a spreadsheet package like Microsoft Excel).

Moving data between charts and tables

This means exporting data from one chart to another, from a chart to a table, or from a table to a chart. When exporting data from a chart, a subset of the data can be selected for export.

To move data from chart to table:

1. Select the data to display, either the whole data set or a subset of it. On a chart select data using **Point Selection mode** or **Curve Selection mode**.
2. Right-click and select **Send to Table**. This displays several options.
3. To display the data on an existing table template, use either **rFinder** or **Selected template file** to specify the table to use.

   To display the data in a new table format suited to the data, use **Generate from data selected**. The resulting table can be saved as a template if required.

To move data from table to chart:

1. Select the data to display, either the whole data set or a subset of it.
2. Right-click and select **Send to Chart**.
3. To display the data on an existing chart template, use either **rFinder** or **Selected template file** to specify the chart to use.

   To create a new chart format suited to the data, use **Generate from data selected**. Select the data to display on the chart in the **Properties window**'s **Data** tab. The resulting chart can be saved as a template if required.

Exporting from chart/table to a file

Data can be exported from a chart or table to a **.csv** file for opening in Microsoft Excel or a similar spreadsheet. If required, a subset of the data can be selected for export.

To export this data to a file:

1. Select the data to display, either the whole data set or a subset of it. On a chart select this data using **Point Selection mode** or **Curve Selection mode**.
2. In a table select the data with the mouse, right-click and select **Export Data**.
3. In the **Save as** dialogue specify the file name.

Merging files

Merging files means combining two or more data sets in one file. To do this for two files:

1. Open the first data file.
2. Select **File-Merge Data** and select the second data file.
3. Select **File-Save Data As** to create a new merged file.

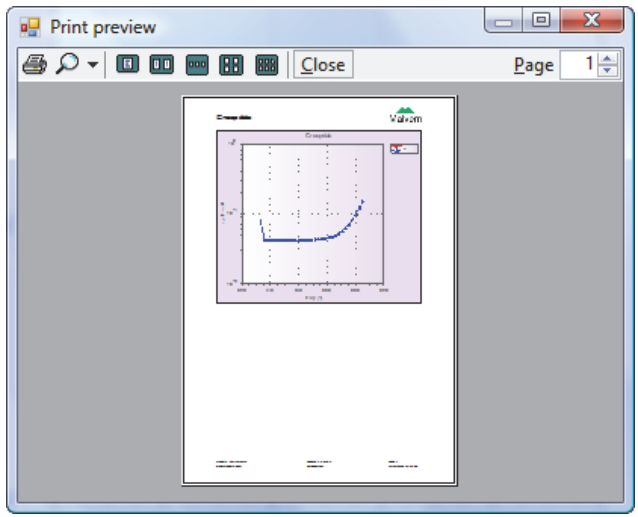
Additionally, when opening more than one results file, the software asks whether you wish to merge the results. Selecting **Yes** merges the results with currently open results file. Selecting **No** replaces them with the new file.

Saving a subset of the data

To save just one part of a sample's results data, for example the **Raw instrument data** item or action, in a separate file, right-click on it in the **Results browser** and select **Save As**.

Printing charts and tables

Charts and tables can be printed for use in reports, etc. To print one, select it and select **File-Print**. To check what the printout will look like, select **File-Print preview** to display a window like this:



Reporting

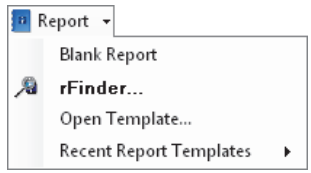
rSpace's reporting feature allows you to create presentable reports that can be generated in the following ways:

- Manually, on an *ad hoc* basis, to present information contained in a previously created data file.
- While running a sequence - so the report is produced automatically by the sequence.

Both methods require that you first create a new report. Once a report has been created and saved it can be then used as a template report.

Creating and saving reports

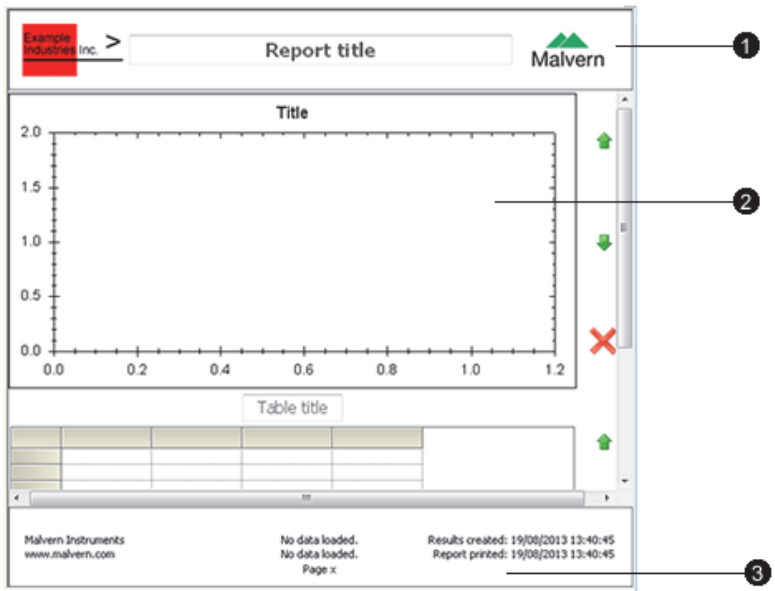
1. To create a new report choose **File-New-Report** or choose one of the options from the **Report** menu:



2. Choose **File - Save (or Save As...)** to save the report, if you wish to use it as a template in the future. By default the file will be saved in the **rSpace/User Templates** folder.

Report layout

- rSpace reports are divided into three zones: the header, body and footer, as shown in this example:



(1) header - contains the title of the report and any logo you wish to attach - this is repeated on each page of the report.

(2) body - the main area of the report where all data in the form of charts and tables is displayed.

(3) footer - this is repeated on each page of the report.

Once charts and tables have been placed within the body area:

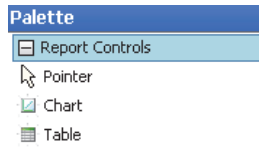
- Click  to move an item up or down in the body area.
- Click  to remove the item .

Setting report title and logo

- Click in the **Report Title** area of the header and enter the required text.
- To add your own logo to the report, click  and then locate the image file you wish to use (120 x 60 pixels maximum).

Adding and configuring report elements

Add charts or tables by first expanding the **Report Controls** tree in the **Palette**.



Then double-click (or drag) elements to add them onto the body area of the report, for example a chart. You can drag as many charts or tables onto the report as required.

If you want to populate the report with data from a previous measurement, the individual elements need to be set up to connect to that data - otherwise, just add all the "empty" report elements as place holders and follow the process detailed under Printing reports from a sequence.

Tables

1. From the palette, drag a **Table** into the body area.
2. Click in the **Table title** area to give the table a title.
3. Select the format for the table by right-clicking it and choosing **Apply Template**, then select:
   - **Blank template** - to leave the table unformatted - or to return a previously selected format back to blank.
   - **Open Template** - to locate the template you wish to apply using the Windows file system- for example *Viscometry - Results data.tbl*
   - **rFinder** - to use rFinder to locate a table template.
   - **Recent Chart Template** - to select a recently opened table template.
4. Apply data to the table:
   - Right-click the table and choose **Properties** - then select the data you want to apply from the **Data** tab. Alternatively, drag data onto the table from the **Results** panel (e.g. live data) - similar to the process of setting up a standalone table.

Charts

1. From the palette, drag a **Chart** onto the body area.
2. Click in the **Title** area and enter a name for the chart.

3. Select the format for the chart by right-clicking it and choosing **Apply Template**, then select:
   - **Blank template** - to leave the chart unformatted - or to return a previously selected format back to blank.
   - **Open Template** - to locate the template you wish to apply using the Windows file system- for example *Creep - Compliance vs Shear stress - Results data.cht*
   - **rFinder** - to use rFinder to locate a chart template.
   - **Recent Chart Template** - to select a recently opened chart template.
4. Apply data to the chart:
   - Right-click the table and choose **Chart Properties** - then select the data you want to apply from the **Data** tab. Alternatively, drag data onto the chart from the **Results** panel (e.g. live data) - similar to the process of setting up a standalone chart.

Setting report element titles

Each table and chart in the report can be given a meaningful title:

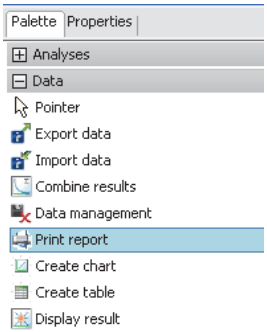
- **Charts** - right click on the chart and choose **Chart Properties**. Then, from the **General** tab, enter the required text in the **Title** field and also ensure that **Show Title** is set to **Yes**. Click **Close** on the Chart Properties window.
- **Tables** - click in the **Table title** text box and enter the required text.

Printing reports from a sequence

This method of printing reports uses live data from the sequence and then adds it straight into a report, which is then automatically sent to a printer.

1. Open the sequence from which you wish to print the report.
2. Choose **Sequence-Add Blank Report** - to create a new report, or just apply a report that has been previously created (to do this right-click and choose **Apply Template** - then select a report).
3. Connect the data to the report - see earlier in this section for more details on how to do this.

From the **Start Sequence** tab drag the **Print report** item from the **Data** category in the palette onto the sequence:



The report needs to be positioned within the final phases of your sequence (after all the data has been gathered).

4. From the **Properties** pane select the options required:

   - **Report** - select the name of the report template.
   - **Printer location** - this list is populated with all your connected printer options - including PDF if installed.
   - **Paper format** - this list is populated with all your connected printers' paper formats.
   - **Report orientation** - -portrait or landscape.
   - **Copies** - the number of copies to print.

7

Loading the sample

Introduction

It is vital that samples are loaded properly. Otherwise accurate measurements and consistency between different samples cannot be guaranteed.

This chapter describes how to load samples for measurement. It covers:

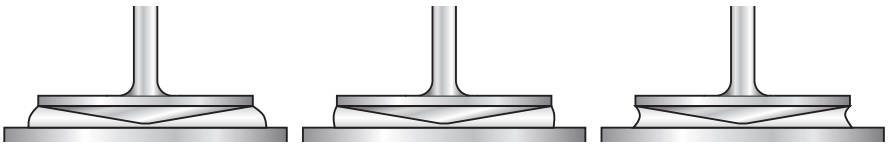
- How to load samples correctly for different geometries.
- Sample types – summarises how to prepare complex fluids, polymers, inorganic compounds and asphalt/fuels/oils.
- Symptoms of poor sample loading – indicates what users may see if samples are not loaded properly.

Loading the sample

The correct amount of sample must be used. Overfilling or underfilling causes data errors.

Cone or plate geometries

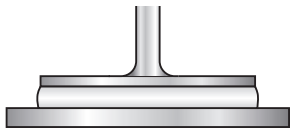
For a plate lower geometry pour or apply approximately the correct volume of sample onto the lower plate. When instructed, overfill slightly initially then trim off any excess sample after the sequence has set the trim gap. **When trimming take care not to scratch the metal surfaces.** For a cone load the sample as shown below:



ill 7747

Overfilled | Correctly filled | Underfilled

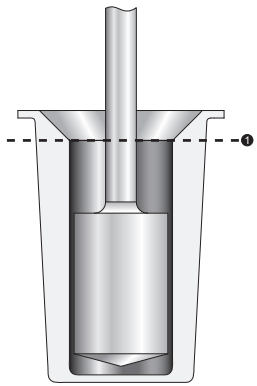
For a parallel plate aim for this situation after trimming:



ill 7748

Cylinder lower geometries

For a cylinder lower geometry fill the cup to the bottom of the leading edge ①, like this:



ill 8220

Other geometries

Double gap

On these fill to the lip of the middle cylinder.

Vane tools

Fill these as for the cup and bob shown above.

Sample types

This section summarises how to prepare samples of different types.

Complex fluids

- Complex fluids can be measured using plate, cone, cup and bob or vane configurations, serrated/roughened geometries or the vane tool.
- Use a spoon to load the correct amount of sample. If using a vane tool have the sample pre-dosed into cups.
- Try to make sure that the sample is disturbed as little as possible during loading. Use a pre-set loading sequence for the sample type where possible.
- Use a solvent atmosphere if possible to prevent the sample drying out.
- High viscosity samples can be protected by applying a thin film of a low viscosity oil around the exposed edges of the sample. Only do this for short tests or samples where it is known that the oil will not affect the rheology of the sample.

Polymers

Depending on the polymer type, present the sample to the rheometer as follows:

- **Polymer melts** – as pressed disks, solid strips, granules or fibres.
- **Polymer solutions** – pour it into the cup or onto the plate.
- **Polymer gels** – pour it into the cup or onto the plate (if not already gelled).
- **Gums and resins** – pour it into the cup or onto the plate.

Inorganic compounds

Depending on the compound type, present the sample to the rheometer as follows:

- **Cements, Ceramics** – it depends on the viscosity of the sample. Construction cements can be presented as fluids to cup and vane measuring systems, stiffer pastes should be tested with plate configurations.

  Make sure that the gap between the geometry parts is at least 10 times the largest particle in the sample.

- **Silicones** – this depends on the property being tested and the sample. Solid samples can be tested using solid fixtures, melt rheology can be tested using parallel plates or cone and plate configurations. Silicones can be sensitive to contamination. Make sure the sample area is scrupulously clean.

- **Metals** – solid samples should be as thin as possible to reduce the possibility of measuring in the range of the instrument's compliance (it is made of metal too).

Asphalt, fuels and oils

Depending on its type, present the sample to the rheometer as follows:

- **Bitumen derivatives** – make sure the sample is homogenous before testing. It can be moulded into discs, poured on while above its melting temperature, or applied as a solid strip.

- **High octane fuels** – these are typically low viscosity samples. Use cup and bob geometries. Pour the sample into the cup, ideally away from the rheometer.

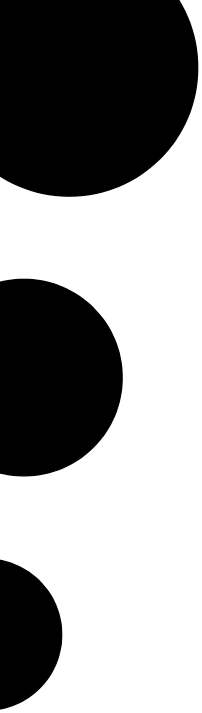
- **Lubricating greases and oils** – some can be low viscosity, in which case, cup and bob is recommended. For high shear viscosity, parallel plates at small gaps are recommended.

Symptoms of poor sample loading

If samples are not loaded properly, this can cause:

- Inconsistency between different loadings of the same sample.
- Structure breakdown in the sample.
- Excessively high or excessively low values.

Part 2 - Supervisor's Guide



8

Advanced features

Introduction

This chapter describes:

- Creating and modifying sequences – editing simple features of a sequence and also changing the sequence structure. We recommend editing existing sequences wherever possible.
- The Parameter dictionary.

Creating and modifying sequences

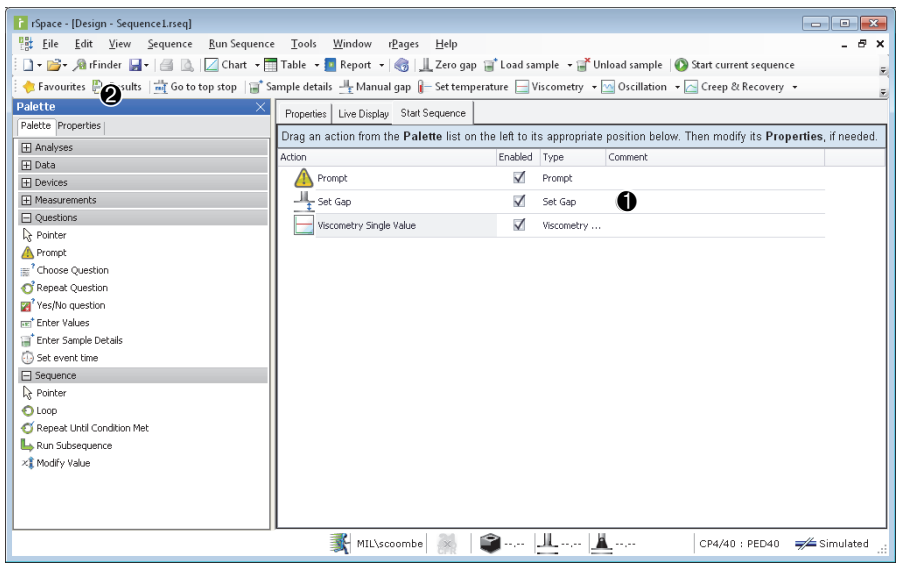
This section shows how to modify sequences. We strongly recommend modifying an existing sequence and saving it with a new name, rather than creating a sequence from scratch. There are two levels of sequence modification:

- **Simple changes** – removing prompts and removing/changing preset values.
- **Structural changes** – changing the order of actions, changing the flow of a sequence and changing the Live display.

  Adding subsequences is covered separately.

The Sequence Designer window

This section describes the components of the software which are used to build sequences (not described in **Chapter 4**):



The components are:

① Sequence Designer window

This has three tabs:

- **Properties** – use this to write the sequence abstract and to specify keywords which will help users of **rFinder** locate the sequence.
- **Live Display** – shows the mix of charts, tables, etc. which the user will see when a sequence is run. It is completely configurable by the creator of the

sequence at the design stage and normally has multiple pages. New pages can be added.

- **Start Sequence** – shows the actions in the sequence and their order. Drag each required action from the **Palette** to this area to build the sequence.

② Palette/Properties window

Palette tab

When the **Start Sequence** tab is active this shows all available actions. When the **Live display** tab is active it shows Live display elements. It is used to select any of these. Double-click on an item to copy it to the **Start Sequence** tab.

Properties tab

Use this tab to configure actions or Live display items selected in the **Sequence Designer** window. The properties of any item selected there are shown here for editing as required. The  button shows basic parameters, the  button shows any advanced parameters. The online help details every parameter shown here.

Making simple changes to a sequence

Users may want to modify sequences in two ways:

- Change the default input values.
- Remove the need to input the variable every time.

To edit simple features of a sequence:

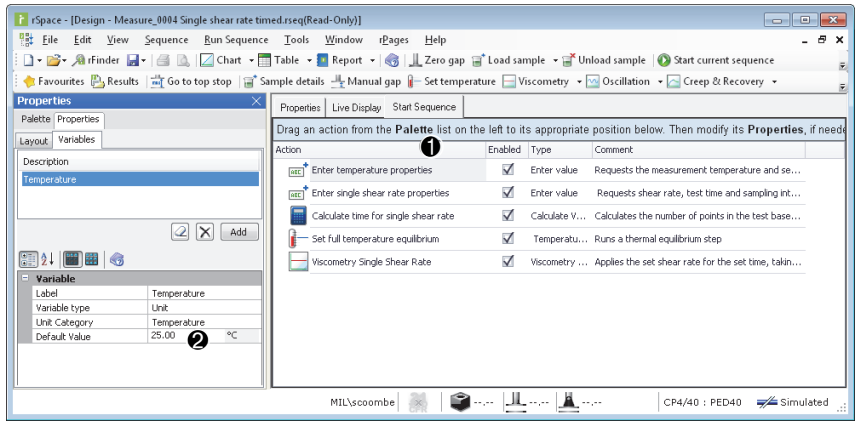
1. Use **File-Open-Sequence** or **File-rFinder** to open the sequence to edit.
2. The sequence is displayed in the **Sequence Designer** window. Select the **Start Sequence** tab to view the actions that make up the sequence.
3. Click on the action whose properties need changing. The following examples show how this can be done.

Example 1: changing the default input values

In this sequence the first action, an **Enter value** action, prompts the user to specify a temperature. The default value it shows is 25°C. Suppose that the user now always tests at 35°C and wants to change the default value to this. They would:

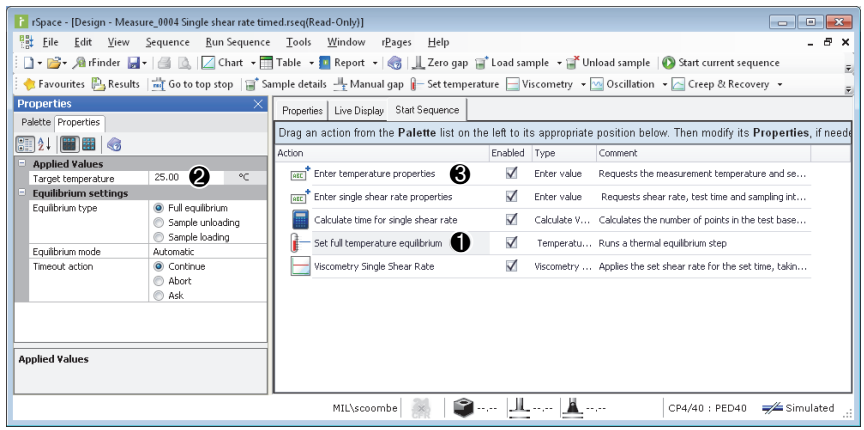
1. Select the first **Enter value** action ① on the **Start Sequence** tab.
2. Look at the **Properties** window to change the settings for this action. The **Default value** parameter ② can be seen, set to 25.
3. Change the **Default value** parameter value from 25 to 35.

This is shown in the following screen shots.



Example 2: permanently setting a value

Here the user wants to fix the temperature in the test, not be prompted for it. They would select the **Set full temperature equilibrium** action ① and change the **Target temperature** property ②:



Finally they would disable or delete the **Enter temperature properties** action ③.

4. When all elements are complete, select **File-Save sequence as** and name the sequence. Save it in the **User sequences** folder.

Changing the order of actions

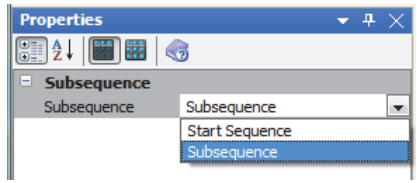
To change the order of actions, simply select an action and drag it up or down on the **Start Sequence** tab.

Adding a new subsequence

In this section the "master sequence" refers to the main sequence. This is the sequence shown on the **Start Sequence** tab.

To add a subsequence:

1. Open the master sequence and select the **Start Sequence** tab.
2. Click **Sequence-Import subsequence** and load in the subsequence. Standard sequences to use for this are held in the folder **rSpace\Design**. The sequence will load as a separate tab in the sequence, named with the subsequence name. Alternatively, add a blank subsequence by choosing **Sequence-Add subsequence**, and then define the settings as with any sequence.
3. Make the main **Start Sequence** tab active and drag a **Run subsequence** action onto it (from the **Sequence** actions group in the Palette). Insert this action at the point that the subsequence should start.
4. Select the **Run subsequence** action and in the **Properties** window, click next to **Subsequence** to display the drop-down list and choose the subsequence name in this list. (The list also displays **Start Sequence**; ignore this.)



5. Cut all of the user input actions (temperature, strain, start and end frequencies) from the subsequence and paste them into the main sequence (start sequence). All of the enter value actions should be grouped together at the beginning of the sequence, before the sample is loaded.

Making structural changes to a sequence

Full information on how to make structural changes to a sequence is included in the rSpace training courses - contact Malvern Instruments for more details. Additionally, further details can be found in the rSpace Help system.

The Parameter dictionary

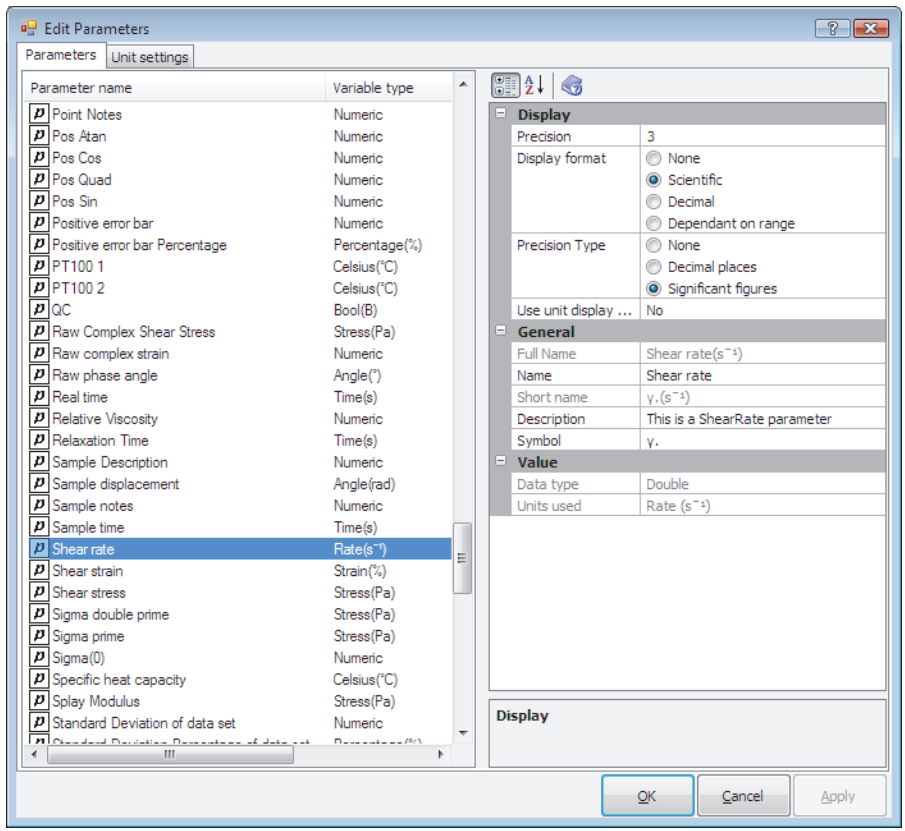
The Parameter dictionary gives information on all parameters used throughout the system and allows values to be set accordingly. This includes:

- Description, display format, name and symbol used.
- Output precision.

- Data type and units used.

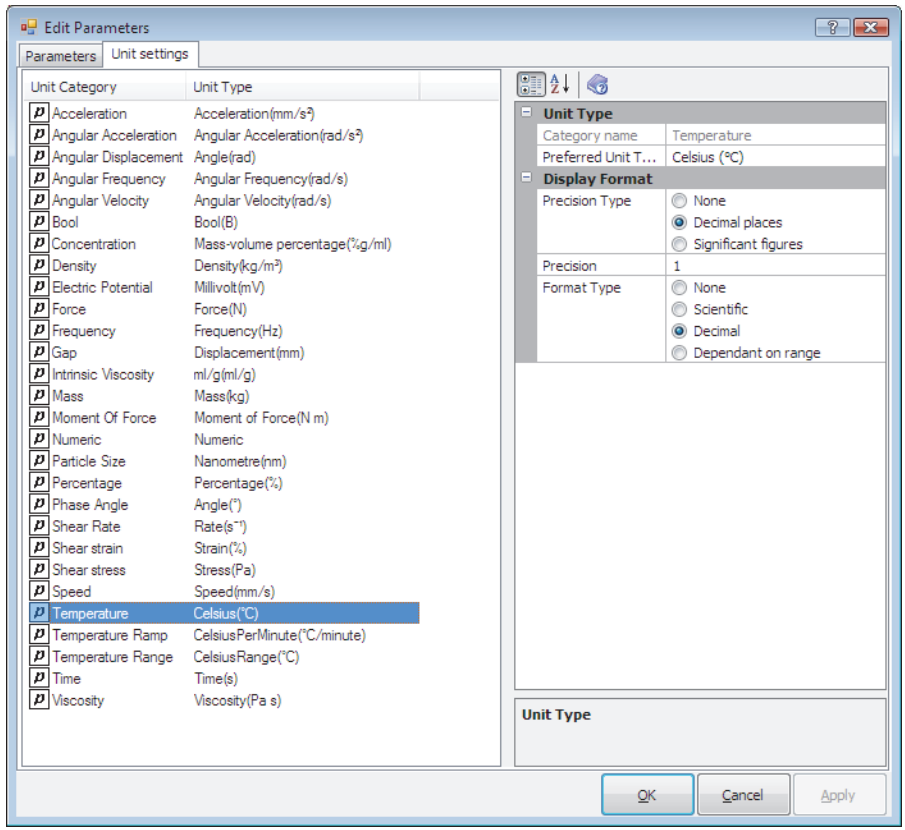
Note:
Changing the details of a variable or unit here will change its characteristics throughout the software; even for measurements that were made and displayed initially using different settings.

Select **Tools-Options-Parameters** to open the window:



The default view shows all the **Parameters** used by the system. Click the **Parameter name** or **Variable type** header to sort the parameters as required.

Click the **Unit settings** tab to display unit information relating to the parameters. Again, click the **Unit Category** or **Unit Type** header to sort the units accordingly.



For either Units or Parameters, select an item from the list to display its characteristics in the right-hand pane.

Then make any amendments to the characteristics as required, and then click **OK** to implement the changes. If more than one alteration is required, click **Apply** instead of **OK** to continue working in the Parameter Dictionary.

9

Using the Materials database

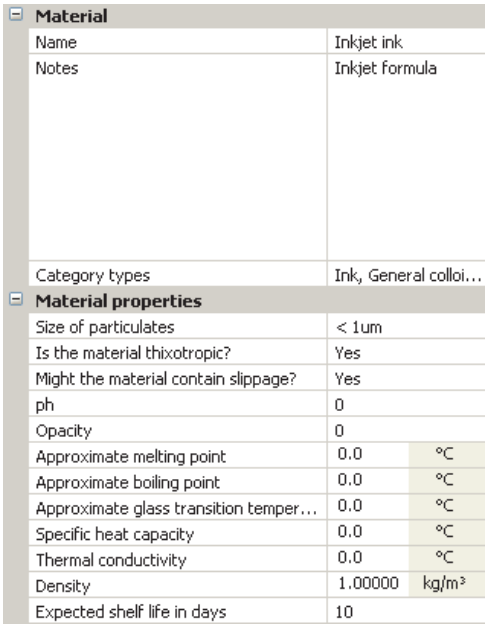
Introduction

This chapter describes the Materials database. It covers:

- About the Materials database.
- How to use the database.
- How to set up the database.

About the Materials database

The Materials database should hold all required information on the types of material to be measured. It is a way to store standard parameters for samples, as follows:



Material		
Name	Inkjet ink	
Notes	Inkjet formula	
Category types	Ink, General colloi...	
Material properties		
Size of particulates	< 1um	
Is the material thixotropic?	Yes	
Might the material contain slippage?	Yes	
ph	0	
Opacity	0	
Approximate melting point	0.0	°C
Approximate boiling point	0.0	°C
Approximate glass transition temper...	0.0	°C
Specific heat capacity	0.0	°C
Thermal conductivity	0.0	°C
Density	1.00000	kg/m³
Expected shelf life in days	10	

This information shows:

- **Material** – name, category types and notes about the material.
- **Material properties** – physical properties of the material type; melting point, pH, etc.
- **Structural properties** – provides structural characterization properties of complex fluids and polymers, for example Deborah number, concentration, Splay modulus etc.
- **Measurement properties** – how the system should measure this type of material. Set the sequence up to use this type of information. Most Solve sequences already do this.
- **Corrections** – properties used in calculations of other variables.

The reason for using the Materials database is that a sequence can be set up to use the values in it to make decisions and configure values.

How to use the database

Follow these guidelines:

- Always add a new material type to the database before measuring it.
- For optimum measurements, add all known parameters to the database.

Passing a database between sites

The Materials database is the file **materials.dat**. This can be transferred between systems if necessary. We recommend backing up this file regularly if new materials are frequently added.

Setting up the database

This section describes how to add materials to the database. It is good practice to do this for all materials.

To add materials to the database:

1. Select **Tools-Options-Materials...** to display the **Material Database** dialogue. Initially the database will contain information provided by Malvern.
2. Click the **New** button. This adds an entry to the **Material Name** list with a default name.
3. Click in the **Category types** field to display a  button. Click on this
4. This opens the **Category types** dialogue. Select a category for the material from the pull-down list or type in a new category and click the **Add Item** button. Click **OK** to return to the **Material Database** dialogue. The **Category type** will be that which was just selected.
5. Type in any notes on the material.
6. Enter values in the **Material properties** and **Measurement properties** sections. Where parameters have a drop-down list, select from the options available, otherwise type in values.
7. After entering all data for the material correctly, click **Save**.
8. Either click **New** to add another material or **Close** to return to the main window.

Deleting a material

Obsolete material information can be deleted to tidy up the database, though this is not essential.

To delete a material:

1. Select **Tools-Options-Materials...** to open the **Material Database** dialogue.
2. Select the material in the **Material Name** column and click the **Delete** button.

10

Using the Geometries database

Introduction

This chapter describes the Geometries database and covers the following sections:

- About the Geometries database.
- How to set up the database.

About the Geometries database

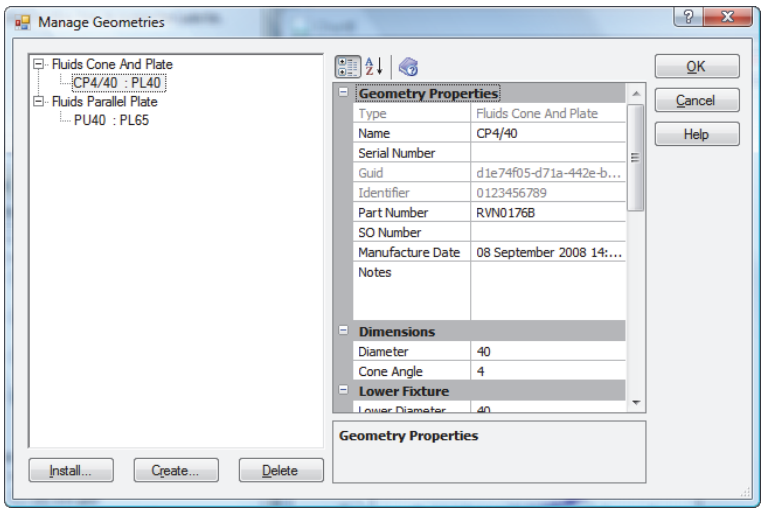
The Geometries database holds all required information on geometries available on the system.

The instrument automatically recognises the upper geometry is inserted by reading a small radio tag built into it. If the geometry is new, the software prompts the user to insert the USB key supplied with it by Malvern. Its details will be added to the database.

The geometries database holds information on the available lower geometries which can be used with the upper geometry. This normally includes multiple lower geometries with one upper geometry instance. Lower geometries are not detected by the instrument.

For example, one instance might include a parallel plate PP20 (upper) and a pedestal PL20 (lower). The same instance might also include a pedestal PL40 (lower). This means that "geometry" really refers to the geometry of the sample.

This illustration shows how parameters appear in the database:



For each geometry the database includes the following:

- **Geometry Properties** – name and manufacture information.
- **Dimensions** – upper geometry diameter, cone angle, etc. These change with geometry type.
- **Lower fixture information** – details on the lower geometry.
- **Material** – density, thermal conductivity, shear modulus, etc.
- **Operation** – the working, trim and loading gaps to use.

- **Corrections** – any calibration data.
- **Shear parameters** – stress and strain constants.

Passing database files between instruments

The database is saved as the file **geometrydata.dat**. It can be copied between instruments as necessary.

Setting up the database

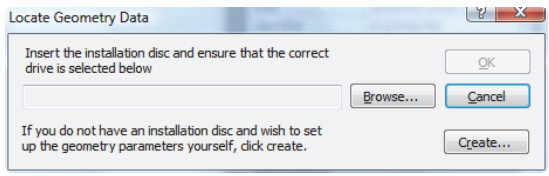
This section describes how to add geometries to the database. If the instrument detects that a new geometry has been inserted in the chuck, it prompts the user for its details. All new geometries have an installation disk/USB key holding their data for easy addition to the database, though the information can be added manually.

To add a new geometry:

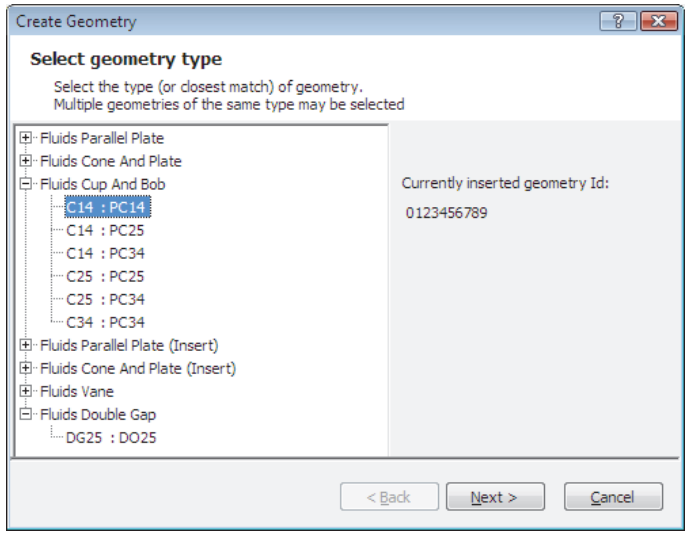
1. Power on the instrument and start the software.
2. Insert the USB key for the geometry.
3. Insert the geometry in the chuck. The system will locate the information on the USB key automatically and add it to the database.
4. The instrument recognises the geometry, loads the data and gets the geometry ready to zero.

To add a geometry to the database manually:

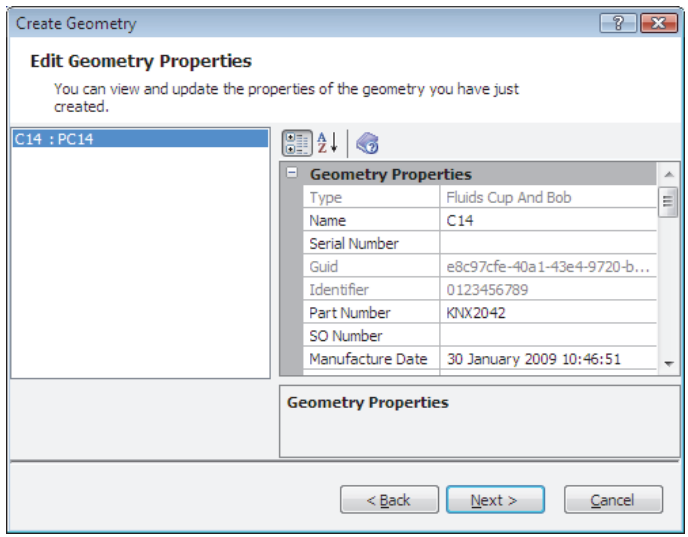
1. Insert the geometry in the chuck. The **Manage Geometries** dialogue is displayed:



2. Click the **Create...** button. This displays the **Create Geometry** dialogue:



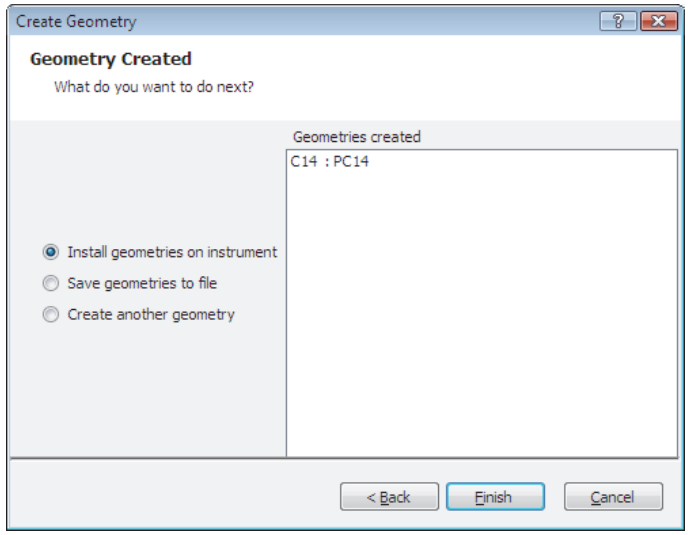
3. Select the geometry type in the list and click **Next**. This displays the **Edit Geometry Properties** dialogue:



4. Enter the serial number for this combination of upper and lower geometries.

5. The other information displayed should be largely suitable. Review this and make any changes required. For more information on any parameter, select it and look at the brief help information shown above the buttons. (The full online help gives more information on some parameters.)

6. Click **Next**. This displays the **Geometry Created** dialogue:



7. Select one of the following three options then click **Finish**.

   - **Install geometries on instrument** – installs the geometry and exits setup.
   - **Save geometries to file** – this saves the complete database as a **.rgde** file.
   - **Create another geometry** – this repeats steps 2 to 5 for a new geometry. This will use the same RFID tag unless the user changes it. Use it to set up multiple lower geometries with one upper geometry.

8. Either click **New** to add another sample or **Close** to return to the main window.

Deleting a geometry

Obsolete geometry information can be deleted to tidy up the database, though this is not really necessary.

To delete a geometry:

1. Select **Tools-Options-Manage Geometries...** to open the **Manage Geometries** dialogue.
2. Select the geometry in the list and click the **Delete** button. When asked, confirm the deletion.

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