Operating Instructions for the

RST Rheometer

BROOKFIELD ENGINEERING LABORATORIES, INC.
11 Commerce Boulevard, Middleboro, MA 02346 USA
TEL 508-946-6200 or **800-628-8139** (USA excluding MA)
FAX 508-946-6262 INTERNET http://www.brookfieldengineering.com

Table of Contents

I Introduction 4
I.1 Measuring Principle 4
I.2 System Configuration 5
I.2.1 RST-CC Rheometer 6
I.2.2 RST-SST Rheometer 7
I.2.3 Measuring Elements and Accessories for RST-CC and RST-SST 7
I.2.4 RST-CPS Rheometer 8
I.2.5 Elements for RST-CPS 9
I.2.6 Computer System 10

II Getting Started 11
II.1 Transportation and Unpacking 11
II.2 Safety 11
II.2.1 General Safety Notes 11
II.2.2 Assembly of KE Cooling Device 13
II.3 Operating Environment and General Handling 14
II.4 Setup for RST-CC and RST-SST 14
II.4.1 Height Adjustment RST-CC 14
II.4.2 Height Adjustment RST-SST 14
II.4.3 Mounting the Workplate RST-SST 15
II.4.4 Electrical Connections RST-CC and RST-SST 15
II.4.5 RST-CC and RST-SST Assembly for Additional Devices 15
II.4.5.1 Assembly of FTK Temperature Control Device (Water Jacket) 16
II.4.5.2 Assembly of Cone/Plate Measuring System 18
II.4.6 Assembly of KE Cooling Device 19
II.5 Setup for RST-CPS 20
II.5.1 Removing Safeguard RST-CPS 20
II.5.2 Electrical Connections RST-CPS 21
II.5.3 Temperature Sensor RST-CPS 21
II.5.4 AC Adapter RST-CPS 21
II.6 Printer Connection 22
II.7 Computer Connection 22
II.8 Cleaning 23
II.9 Maintenance 23

III Making Measurements in Standalone Mode 24
III.1 Quick Start: Run Single 24
III.2 Languages 29
III.3 Touchscreen 30
III.4 The Menu System of the RST Rheometer 30
III.5 Edit 32
III.5.1 Units 32
III.5.2 Measuring Systems 33
III.5.3 User Authorization and Management 36
III.6 Edit Program 37
III.6.1 Quality Control 41
III.6.2 Math 41
III.6.3 Report 41
III.7 Explorer 42

III.8 Options 42
III.8.1 Time 43
III.8.2 Counter 43
III.8.3 Zeroing 43
III.8.4 RS232 43
III.8.5 Memory 43
III.8.6 Export Options 44
III.8.7 Service 44
III.8.8 USB Port and RS232 Port 44
III.8.9 Language 44
III.8.10 Barcode 45
III.8.11 Temperature 45
III.8.12 ABOUT 45
III.9 Run Programm 1 to 11 45

IV General Procedures for Operation of Rheometer and Measuring Systems 47
IV.1 Measurement Systems for RST-CC and RST-SST 48
IV.1.1 Measurement Directly in the Sample 49
IV.1.2 Measurement with Sample in the Measuring System 49
IV.1.3 Measurement with Temperature Control Device 50
IV.1.4 Measurement Using Cone/Plate and Plate/Plate Measuring System Accessory 50
IV.1.5 Measurement Using Special Measuring Bobs 51
IV.2 Measurements Using RST-CPS 51
IV.2.1 Measurement with Manual Gap Adjustment (MGA) 52
IV.2.2 Measurement with Manual Gap Adjustment (MGA) 52

APPENDIX A: Technical Data 53
APPENDIX B: RST-CPS Rheometer Gap Setting Procedure for Cone and Plate Spindles 54
APPENDIX C: Calibration Check 56
APPENDIX D: Symbols for Test Parameters and Units of Measurement 58
APPENDIX E: Data Sheets for Standard Measuring Systems 59
APPENDIX F: RST-SST for Measuring in Brabender Units (BU) 63
APPENDIX G: Instrument Dimensions 64
APPENDIX H: Online Help and Additional Resources 68
APPENDIX I: Warranty Repair and Service 69

I Introduction

I.1 Measuring Principle

The RST Rheometer is a rotational, controlled-stress rheometer. The measuring drive developed for this instrument utilizes a high-precision dynamic drive system with optical encoder for absolute position measurement of spindle geometry.

There are two basic measurement methods:

- rotational measurement under controlled shear rate (CSR)
- rotational measurement under controlled shear stress (CSS)

The RST Rheometer performs rotational tests with pre-set speed (shear rate) and measures the torque imposed on the measuring element or in shear stress a pre-set shear stress to measure the shear deformation of the measured substance by angular deflection of the measuring element. The RST Rheometer can be used for shear stress tests that allow precise measurement of the yield point without shearing the measured substance, as well as creep behavior and recovery after shearing.

Both CSR and CSS measurements can be carried out manually (without PC support) or with a computer system and the Rheo3000 application software.

The RST Rheometer is used in quality control, product development and research.

I.2 System Configuration

RST-CC and RST-SST Rheometer:

The basic configuration for the RST Rheometer includes:

- rheometer with touch screen, electronic unit and measuring drive
- power unit (AC adapter)

Available accessories:

- printer
- coaxial cylinder measuring systems
- temperature sensor Pt100
- measuring device ME3-CP/PP for cone/plate and plate/plate measuring systems
- special measuring systems, e.g. vane spindles
- temperature control device FTK-RST for cylinder measuring systems
- KE cooling unit
- fluid circulation thermostat
- holding device for measuring bob and temperature control device
- computer system
- Rheo3000 software

The RST has the following features of performance:

- digital speed and torque control
- automatic adjustment of control parameters during testing
- direct display of measured and calculated values for speed, torque, shear rate, shear stress, viscosity, temperature, time etc.
- internal storage of measured values
- optional output of measured values to an USB printer
- operator support through dialog control via touch screen direct on the measuring instrument
- built-in system interface with serial standard port (RS232 C) and USB 2.0 for direct connection of a computer
- output of measuring results in the form of a table or graph in real time
- saving of measuring results to USB-2.0-compatible instruments, e.g. USB stick

The RST Rheometer can be operated manually via touch screen or under computer control. DC power supply to the RST Rheometer is through an AC adapter.

I.2.1 RST-CC Rheometer

Figure I-1

Components:

1 Rheometer with touchscreen
2 Measuring bob coupling
3 Seat flange for sample cup
4 Stand base plate
5 Barcode reader
6 Clamp handle
7 Stand
8 Leveling screw

I.2.2 RST-SST Rheometer

The RST-SST Rheometer has the following additional components as shown in the figure.

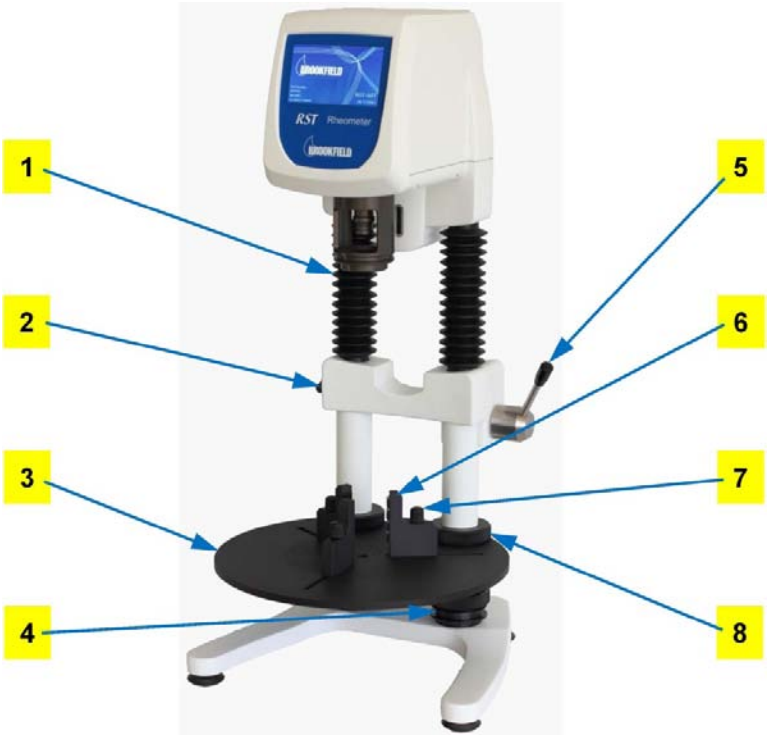


Figure I-2

Components:

1 Extension bellows
2 Clamp handle
3 Work plate
4 Lower seat of work plate
5 Operating handle
6 Fastening claw
7 Thumb wheel
8 Upper seat of work plate

I.2.3 Measuring Elements and Accessories for RST-CC and RST-SST

Measuring devices are not part of the standard delivery of the RST Rheometer and must be ordered according to your measuring requirements.

Optional measuring devices available:

- coaxial standard measuring systems for RST with or without built-in temperature sensor Pt100
- temperature control device FTKY3 fur use of cylinder measuring systems in the temperature range of -10°C … +90°C
- KE cooling device for use of cylinder measuring systems in the temperature range of -20°C … +180°C
- measuring device ME3-CP/PP for use of cone/plate or plate/plate measuring systems in the temperature range of -10°C … +90°C (… +180°C with cooling device)
- special measuring bobs such as vane spindles in the temperature range of -10°C … +90°C (… +180°C with cooling device)
-

I.2.4 RST-CPS Rheometer

The RST-CPS Rheometer system consists of:

- Rheometer head with touch screen containing electronic unit and measuring drive integrated in one housing
- Basic instrument with measuring bottom plate and temperature sensor Pt100
- AC Adapter

Available Accessories:

- **Measuring cones and measuring plates**
- **Bath/Circulator* for RST-CPS-F**
- Computer system
- Rheo3000 software

*The accessories in **bold print** are necessary for a minimal configuration.

Available Accessories:

- Start-up Assistance
- Instrument Training
- Rheo3000 Software Training

Instrument features include:

- Digital control of rotational speed and torque
- Automatic adjustment of control parameters during measurement
- Direct indication of measured and calculated values of speed/shear rate, torque/shear stress, viscosity, temperature and time.
- Internal or external storage of datas (measured values)
- Data output of measured values to a printer
- User support by dialog mode at touch screen display
- Built-in system interface with serial standard interface (RS232-C) for connection to a computer
- USB port for connection of RST-CPS to printer, computer or USB flash drive

The RST-CPS Rheometer can either be operated manually using the touch screen display or it can be operated under computer control. The RST-CPS Rheometer is supplied with direct drive current by the AC Adapter.

Figure I-3

Components:

1 Measuring Head
2 Barcode Reader
3 Spindle (Cone or Plate)
4 Bubble Level
5 Hose Connectors (RST-CPS-F)
6 Touch Screen Display
7 Measuring Spindle Coupling
8 Lever
9 Measuring Bottom Plate
10 Levelling Screw

I.2.5 Elements for RST-CPS

Measuring devices are not part of the standard delivery of the RST-CPS Rheometer and must be ordered according to your measuring requirements. The following types of measuring systems are suited for use with the RST-CPS Rheometer:

a) cone/plate measuring systems
b) plate/plate measuring systems
c) Please select a suitable measuring system in the measuring range required for your measurements (see Appendix E).

When measuring cones are used the shear rate is the same across the whole measuring gap. The most common cone angles are =1° and α=2°. The cone is truncated 50µm (0.05 mm) in order to avoid contact and friction with the bottom measuring plate.

Measuring plates are used when larger filling particles occur in the measured substance. Gaps between 0.1 to 3.0 mm may be used. In this case, the shear rate in the measuring gap is a function of the radius.

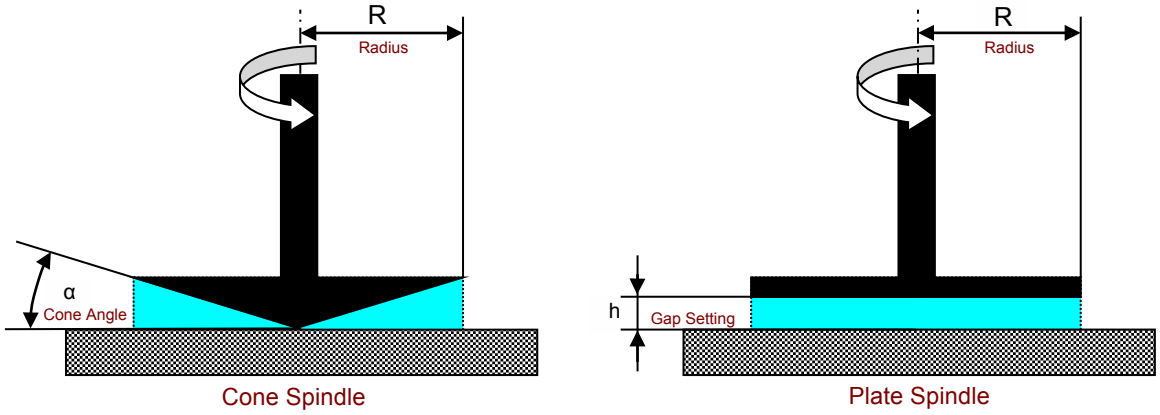


Figure I-4

I.2.6 Computer System

The computer system and the Rheo3000 software are optional and allow for the graphic representation of measuring results in real time, report print-out, analysis of existing measured data and the automation of measuring procedures. Several RST Rheometers can be controlled through several thermostats from different manufacturers.

The computer system consists of a PC with the following minimum system requirements:

- CPU with at least 1.5 GHz clock frequency
- 1 GB RAM (primary storage)
- 2.5 GB free fixed-disk capacity
- operating system Microsoft (32bit or 64bit) Windows XP, Vista, 7 or 8
- mouse and keyboard
- VGA graphic adapter with 1024 x 768 resolution and monitor
- 2 USB ports for rheometer and temperature accessory control
- application software package Rheo3000

The application software for the RST Rheometer (Rheo3000 software package) is available separately and not absolutely necessary for the operation of the measuring instrument. In the following cases, however, it is highly recommended:

- extensive rheological analyses
- graphic evaluation
- evaluation using mathematical models
- automated measurements
- specific requirements (e.g. FDA Title 21 CFR Part 11)
- research and development
- continuous use

II Getting Started

II.1 Transportation and Unpacking

	Transportation
Caution!	Transport the RST Rheometer always in its original carton. Protect the original carton against bumps, shocks and falling down. Observe the notes on ambient conditions.

Should you detect any transport damage when unpacking the instrument, please inform the carrier, draw up damage records with him and contact Brookfield or your Brookfield Dealer.

	Transport damage
Danger!	Check the measuring instrument for transport damage after unpacking. Do not take the measuring instrument into service with transport damage in evidence.

	Moving the measuring instrument
Caution!	To assemble or move the RST-CPS Rheometer, hold it nowhere but by the stand. Never hold the measuring instrument by the Measuring Head to carry it.

	Location
Danger!	Place the measuring instrument upright on a stable, level table (stand base at the bottom). Pay attention to the ambient conditions. Do not place the instrument near the edge of a table.

II.2 Safety

This operating manual uses the following safety notes:

“Danger” indicates a situation of immediate danger which may result in death or irreversible, severe injuries and damage to property if ignored:

	Type or souce
Danger!	Measure(s)

”Caution!” indicates a situation of immediate danger which may result in reversible, slight injuries and damage to property if ignored:

	Type or source
Caution!	Measure(s)

II.2.1 General Safety Notes

Read the operating manual through carefully. It provides important information on unpacking, assembly, start-up and operation of this measuring instrument. If you have any further questions please contact our service department (see Appendix I).

Follow all instructions given in this operating manual. This is the only way to ensure the proper use of this measuring instrument.

More particularly, observe all safety notes.

Danger!	**Personnel and operation** Make sure that the measuring instrument is operated by ONE instructed specialist personnel only.

Danger!	**Operation** Never operate and run the measuring instrument when the instrument or power supply components (e.g. mains cable) are damaged.

Danger!	**Power supply** Switch the measuring instrument off and pull the mains plug for: • service or repair • moving the measuring instrument • removal or attachment of components or accessories • in case of danger.

Danger!	**Service and repair** Service and repair work must only be performed by trained and authorized specialist personnel

Danger!	**Technical modifications** Do not make any technical modifications on the instrument! Any modification will result in the extinguishment of implied and express warranty on the measuring instrument!

Danger!	**Emergency** In case of emergency, turn off the instrument and then disconnect the electrical cord from the wall outlet.

Danger!	**Protection** If this instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.

Danger!	**Protective Clothing** It's recommended to wear protective goggles, gloves and snood-type cap.

Caution!	**General** Observe all safety notes contained in this operating manual and read it through carefully.

II.2.2 Assembly of KE Cooling Device

Danger!	**AC Adapter** Connect the AC adapter using a grounded plug to avoid electric shock or damage to the system components!

Caution!	**Handling** Never lift your RST Rheometer by the measuring element or its coupling.

Danger!	**Operating Environment** RST Rheometer is not exposed to the following: • heavy dirt or dust, • direct sun radiation, • objects that emit strong heat (e.g. heating radiators), • objects with a strong electromagnetic field (e.g. loudspeakers, motors etc.), • liquids or corrosive chemicals. The RST Rheometer is not intended for use in a potentially hazardous environment.

Danger!	**Samples** The user should ensure that the substances placed under test do not release poisonous, toxic or flammable gases at the temperatures which they are subjected to during the testing.

Danger!	**Temperature** If you use temperature control system do not touch any components (such as water jacket, hoses, measurement system) under 5°C or over 40°C of your sample. Do not disconnect any hoses in this temperature range.

Danger!	**Indoor** Operation only indoors.

II.3 Operating Environment and General Handling

Find a comfortable, convenient work place for the installation of the RST Rheometer. There should be enough room to place the Rheometer, the measuring systems, the measuring substances and the peripheral devices (e.g. printer, computer and bath/circulator). You need a grounded AC plug to operate the RST Rheometer. You also need an additional plug for the connection of each peripheral device.

Your operating environment and the place where you store the RST Rheometer should not be extremely hot, extremely cold or extremely moist. Places with strong temperature and air humidity fluctuation should also be avoided.

	Ambient conditions for operation and stoppage
Caution!	Make sure that the following ambient conditons are maintained: • temperature: +10 … +40°C • relative air humidity: 20 … 80%

	Environment and ambience
Caution!	Make sure that the RST-CPS Rheometer is not exposed to: • heavy dirt or dust, • direct sun radiation, • objects that emit strong heat (e.g. heating radiators), • objects with a strong electromagnetic field (e.g. loudspeakers, motors etc.), • liquids or corrosive chemicals.

Be careful to protect the RST Rheometer against heavy bumps or falls down. Avoid vibrations and shocks!

	Handling
Caution!	Never lift your RST Rheometer by the measuring element or its coupling. Avoid everything that might impair the rotation of coupling (e.g. shock).

The Rheometer motor will automatically turn off if the maximum torque (100 mNm) is exceeded.

If the measuring torque is exceeded, e.g. by a stop of the measuring drive under full load or by a rise in viscosity caused by hardening processes, the electronic safety devices will be activated and prevent a defect. However, it is inevitable in such cases to abort the measurement or measuring program and to disconnect the measuring bob from the measuring instrument.

II.4 Setup for RST-CC and RST-SST

II.4.1 Height Adjustment RST-CC

To adjust the height of the stand, release the clamp handle and pull the stand to the desired height, holding the rheometer unit by the rear bridge.
When the height is right, fasten the clamp handle finger-tight again.

II.4.2 Height Adjustment RST-SST

The RST-SST Rheometer can perform viscosity measurements in original packing containers with the test material.

The height of the RST-SST is adjusted by loosening the clamp handle and then moving the instrument to the desired position with the operating handle. After height adjustment the clamp handle can be fastened finger-tight again if desired.

II.4.3 Mounting the Workplate RST-SST

This step is required only if you intend to use the workplate of the RST-SST. To mount it, proceed as follows:

- Place the workplate into the upper or lower seat by pushing it in laterally until it stops.
- Screw the work plate to the stand finger-tight using the two spigot nuts.
- Put the sliding blocks with the threaded rods through the slots in the work plate from below. Make sure that the groove of the sliding block fits into the slot.
- Use the thumb wheel to screw the fastening claw down finger-tight.
- For each slot you will need 1 fastening claw, 1 sliding block with threaded rod and 1 thumb wheel.

II.4.4 Electrical Connections RST-CC and RST-SST

Connections for the electrical components of the RST Rheometer are located on the back of the instrument.

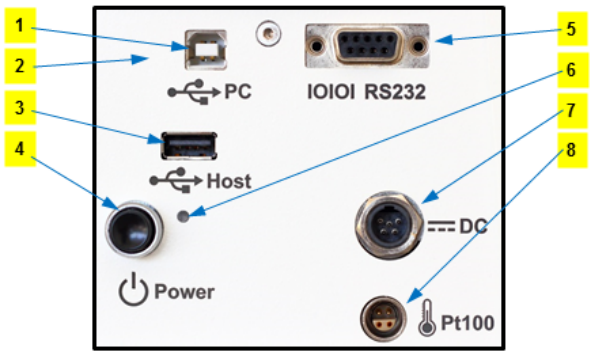


Figure II-1

Connecting elements on the back of the instrument in Figure II-8:

1 PC (USB)
2 LAN (network)
3 USB stick or printer
4 ON / OFF button
5 RS 232 port
6 ON / OFF control light
7 Power unit (AC adapter)
8 Pt100 temperature sensor

	Connecting the measuring instrument
Caution!	Connect or disconnect any cables from and to the RST Rheometer only with the instrument turned off.

II.4.5 RST-CC and RST-SST Assembly for Additional Devices

This section describes assembly and connection of the following measuring systems:

- FTK temperature-control device (water jacket) for use of cylinder measuring systems in the temperature range of -10°C...+90°C (temperature control by liquid thermostat)
- ME3-CP/PP measuring device for cone/plate and plate/plate measuring systems in the temperature range of -10°C...+90°C (temperature control by liquid thermostat)
- KE cooling device in connection with FTK temperature-control device (water jacket) or ME3-CP/PP measuring device for extension of temperature range to -20°C...+180°C

II.4.5.1 Assembly of FTK Temperature Control Device (Water Jacket)

This section describes assembly and connection of the following measuring systems:

Figure II-2

Components:

1	Threaded joint for mounting flange	**4**	Hose conncetion for thermal oil discharge
2	Thermostatting chamber	**5**	Pt100 temperature sensor
3	Threaded joint for sample cup	**6**	Hose connction for thermal oil inflow

Optional temperature control devices available:

- Liquid temperature control device FTK for use in cylinder measuring systems in the temperature range of -10°C ... +90°C (temperature control by liquid thermostat).
- If the optional KE cooling device is used, the temperature control device FTK can be operated in the temperature range of -20°C ... +180°C.

	Temperature control device
Caution!	The temperature control device FTK without KE cooling unit must not be used beyond the temperature range of -10°C ... +90°C!

Figure II-3

FTK temperature control device (water jacket) and measuring systems in Figure II-3:

1 FTK water jacket
2 Sample cup for FTK-RST
3 Immersion type sample cup
4 Measuring bob CC3-8
5 Measuring bob CC3-14
6 Measuring bob CC3-25
7 Measuring bob CC3-40

Assembly:

- Turn the RST Rheometer off with the mains switch on the back of the instrument.
- If the cooling device KE is to be used, mount it first.
- Set the FTK from below on the mounting flange for the sample cup and tighten the thread.
- Fix the hoses for the liquid circulation thermostat (see below).
- Plug the cable “VK-MB” supplied with the FTK into the built-in Pt100 and into the “Pt100” socket on the back panel of the RST Rheometer.

Thermostat connection to the FTK temperature control device:

- Hose connections are required to connect a liquid circulation thermostat when the RST Rheometer is operated with the FTK temperature control device.
- The hoses from the liquid circulation thermostat are connected with the FTK temperature control device (see Figure II-2, page 16) using the quick-fitting couplings.
- For that purpose you push the coupling sleeve slightly back, insert the hose connector and let the coupling go. It will fasten the hose (without screwing or turning) by locking in. Pull lightly to check if the hoses fit tightly.

Danger!	**External thermostat / Cryostatic temperature regulator**
	Set the upper temperature limit at the liquid circulation thermostat to 90°C if using water and to 180°C if using oil (only with KE cooling device!).

Typical thermostatting liquids are:

- -10 °C ... +90 °C deionized water mixed with glycol
- -20 °C ... +180 °C thermostat oil

Suitable thermostatting liquids can be obtained from Rheotec Messtechnik GmbH.

Caution!	**Operation of the FTK**
	When making tests at temperatures below -10°C and above +90°C, do not start the temperature control device FTK before the cooling liquid flows through the KE cooling device in order to avoid overheating of the rheometer.

II.4.5.2 Assembly of Cone/Plate Measuring System

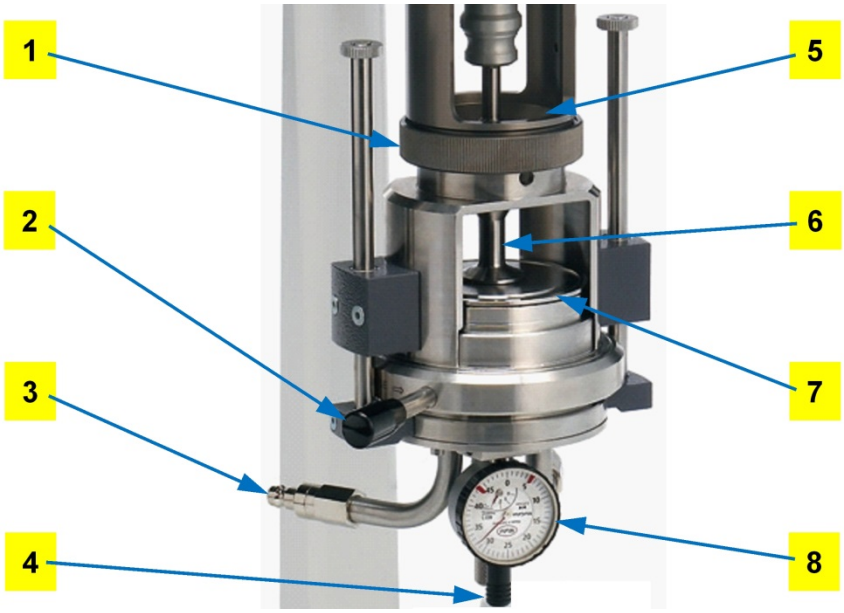


Figure II-4

Components:

1 Threaded joint for mounting flange
2 Quarter-turn fastener
3 Hose connectors for thermostatting medium
4 Adjusting screw
5 Guide pin
6 Measuring bob
7 Measuring table
8 Gauge

The RST Rheometer enables you to determine viscosity using a cone/plate or plate/plate system with the measuring device ME3-CP/PP. To install this optional measuring system, proceed as follows:

- Turn the RST Rheometer off with the mains switch on the back of the instrument
- If the KE cooling unit is to be used, mount it first.
- Set the ME3-CP/PP on the rheometer flange from below and tighten the thread.
- Before tightening the thread, check to see if the guide pin of the measuring plate lies in the groove of the mounting flange of the RST.
- Connect hoses to the liquid circulation thermostat (see below).
- Plug the cable of the built-in Pt100 into the socket “Pt100” on the back panel of the RST Rheometer.

Hose connection from thermostat to measuring device ME3-CP/PP:

- Hose connections are required to connect a liquid circulation thermostat when the RST Rheometer is operated with the cone/plate measuring device ME3-CP/PP.
- The hoses from the liquid circulation thermostat are connected with the cone/plate measuring device ME3-CP/PP using the quick-fitting couplings. For that purpose you push the coupling sleeve slightly back, insert the hose connector and let the coupling go. It will fasten the hose (without screwing or turning) by locking in. Pull lightly to check if the hoses fit tightly.

Caution!	**Measuring device ME3-CP/PP**
	The cone/plate measuring device ME3-CP/PP may only be operated in the temperature range of -10°C ... +90°C.

Caution!	**Cooling device**
	Working in the temperature range of -20°C ... +180°C requires an additional cooling device KE.

Caution!	**Operation of the FTK-RST (water jacket)**
	When making tests at temperatures below -10°C and above +90°C, do not start the temperature control device FTK-RST before the cooling liquid flows through the cooling device KE-FTK-RST in order to avoid overheating of the rheometer!

Danger!	**External thermostat / Cryostatic temperature regulator**
	Set the upper temperature limit at the external liquid circulation thermostat: to +90°C if using water and to +180°C if using oil (with cooling device KE-FTK-RST).

Typical thermostatting liquids are:

- -10 °C ... +90 °C deionized water mixed with glycol
- -20 °C ... +180 °C thermostat oil

Suitable thermostatting liquids can be obtained from Rheotec Messtechnik GmbH.

II.4.6 Assembly of KE Cooling Device

Figure II-5

Components:
1 Cooling device K-MK **2** Hose connections

Using the cooling device KE you can operate the temperature control device FTK-RST or the measuring device KP adapter in the temperature range of -20°C … +180°C.
Flowing through the cooling channel of the cooling device, the cooling liquid prevents heat transmission from the temperature-controlled measuring device to the RST Rheometer.

Assembly:

- Turn the RST Rheometer off with the mains switch on the back of the instrument
- Slide the cooling device KE onto the RST Rheometer from below and tighten the thread.
- Fasten the hoses of the cooling circuit on the cooling device KE using the quick-fitting hose coupling.

Cooling water connection to cooling device KE:

- The hoses of the cooling circuit are connected to the cooling device KE using the quick-fitting couplings.
- For that purpose you push the coupling sleeve slightly back, insert the hose connector and let the coupling go. It will fasten the hose (without screwing or turning) by locking in.
- Pull lightly to check if the hoses fit tightly.

II.5 Setup for RST-CPS

II.5.1 Removing Safeguard RST-CPS

To remove the safeguard:

- Pullout the shipping pin. See Figure II-6, page 20.
- Turn up the lever
- Remove the black foam rubber (shipping protection). See Figure II-7, page 20.

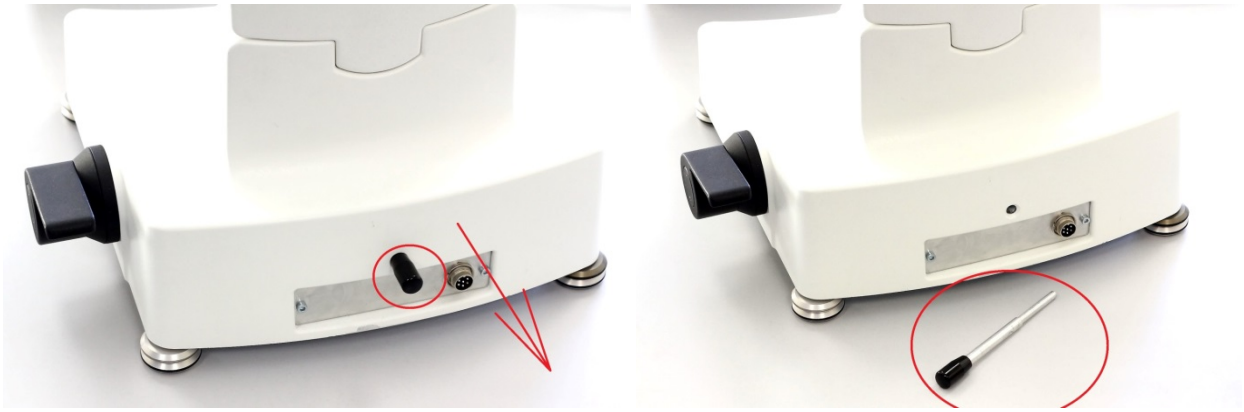


Figure II-6

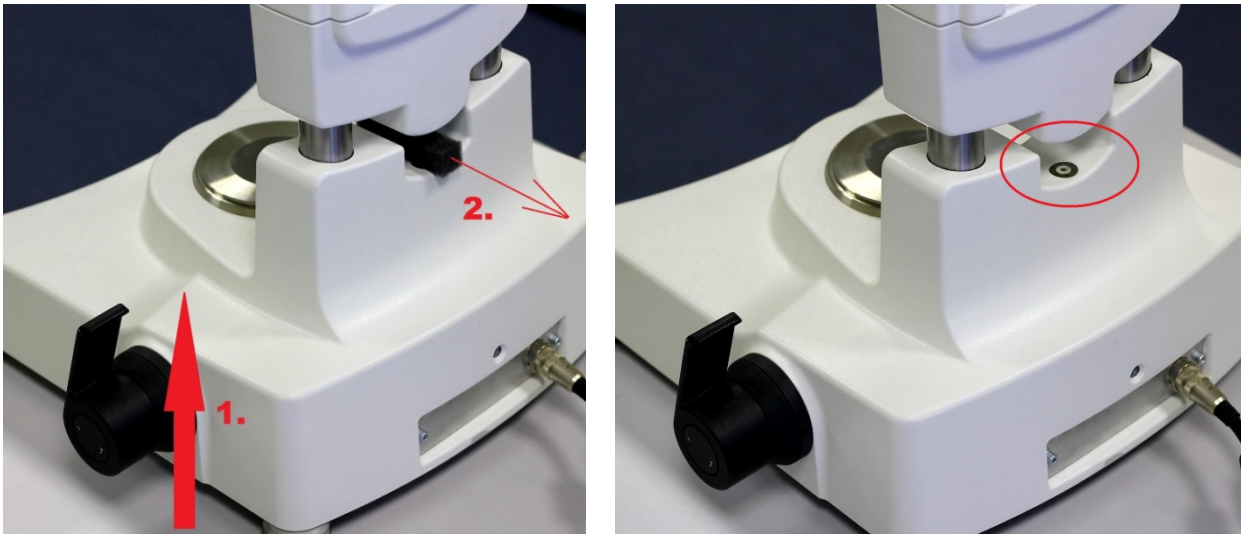


Figure II-7

II.5.2 Electrical Connections RST-CPS

Connections for the electrical components of the RST-CPS Rheometer are located on the back of the instrument.

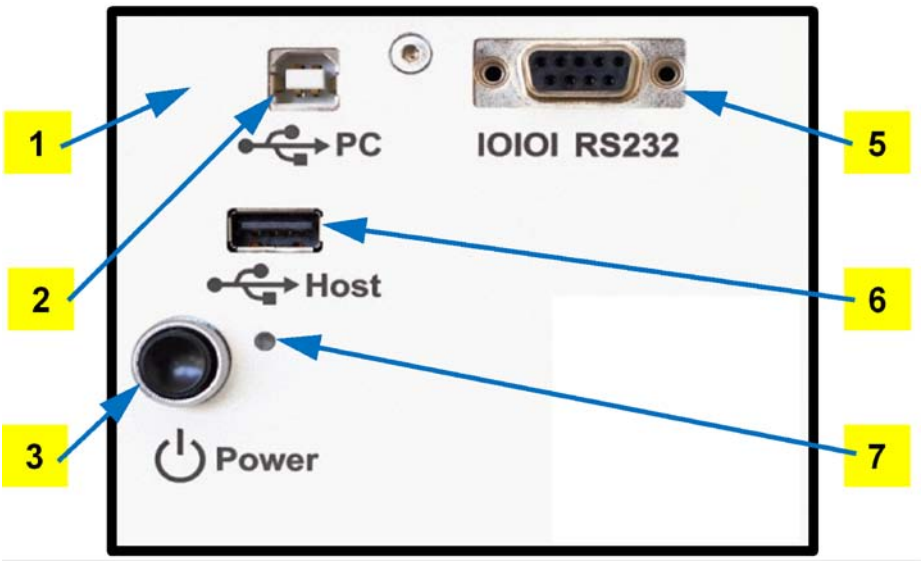


Figure II-8

Connecting elements on the back of the instrument in Figure II-8:

1 LAN (network)
2 PC (USB)
3 ON / OFF button
4 RS 232 port
5 USB stick or printer
6 ON / OFF control light

Caution!	**Connecting the measuring instrument**
	Connect or disconnect any cables from and to the RST-CPS Rheometer only with the instrument turned off.

Be sure that your USB Flash Drive is formatted in FAT32. Otherwise it doesn't work.

II.5.3 Temperature Sensor RST-CPS

The temperature sensor Pt100 is inside the bottom measuring plate. The temperature is measured continuously and is displayed in the Touch Screen Display alternately with the Date.

II.5.4 AC Adapter RST-CPS

The AC adapter is used to power the RST-CPS Rheometer. Do not use any other device to supply the RST-CPS Rheometer with power than the AC adapter of IP class 4/2 delivered by Brookfield.

Danger!	**AC adapter**
	Always connect the AC adapter to a properly grounded socket. To avoid electric shock or damage to system components, always use a properly grounded plug to connect the AC adapter.

Connecting the AC adapter:

- Insert the connecting socket of the power cord into the AC adapter until the plugs locks into place.

- Insert the socket of the DC cable into the “DC” connector on the back panel of the RST-CPS stand and fasten it finger-tight.
- Plug the power cord into a grounded mains socket.
- Turn the RST-CPS Rheometer on again, if necessary.

Figure II-9

	AC adapter
Caution!	The AC adapter should not remain plugged in long when the socket of the DC cable is disconnected from the “DC” connector on the back panel of the instrument.

	AC adapter
Danger!	Be sure to observe the following instructions: • Never reach into the AC adapter or touch its contact pieces! • The AC adapter must lie open and not be covered. • Position cables and AC adapter in a way to ensure that no-one will stumble over them. • The AC adapter and the cables must never get into contact with liquids.

II.6 Printer Connection

For measurements without PC support the printer

- **DYMO LabelWriter®**

This printer can be connected directly to the USB Host port of the RST Rheometer. To print the measured values during measurement you must pre-select “Printer” as output device.

Connecting the printer DYMO LabelWriter®:

- Turn the RST Rheometer off with the mains switch on the back of the rheometer.
- Insert the printer connecting cable into the USB socket on the back panel of the RST Rheometer.
- Turn the RST Rheometer on again.

A standard USB printer connecting cable can be used to connect the printer. The cable is normally delivered with the printer.

The printout of measuring results can only be guaranteed for the printer mentioned above. If you use other printers or need extensive prints (e.g. graphic) or color print you should use the Rheo3000 software.

II.7 Computer Connection

If the RST Rheometer is to be operated in REMOTE mode with PC support (Rheo3000 program package), connect the two devices using a data transmission line delivered by Brookfield with the USB conncetion 2.0 or with the “RS232” socket on the back panel of the RST Rheometer:

- Turn the RST Rheometer off using the mains switch on the back of the instrument.

- Turn your computer system off.
- Insert the data transmission line into the “RS232” or “PC” socket on the back panel of the RST Rheometer.
- Connect the other end of the data transmission line with a free RS232 serial port (e.g. “COM2”) or the USB connector of your computer.
- Turn the RST Rheometer and your computer system on again.

	Data transmission line
Caution!	Use no other than the data transmission line delivered by Brookfield.

For information on the installation of the computer system, please refer to the operating instrutions of the individual devices.

II.8 Cleaning

The paint coat of the RST Rheometer resists most solvents and weak acids. Use a dry, clean, soft and nap-free cloth to clean the housing. Use neutral detergent liquids if necessary.

	Cleaning and Environment
Danger!	Do not use chemical products such as strong solvents or strong acids to clean the housing, especially the Touch Screen Display. Make sure NO liquid penetrates into the housing (e.g. through the instrument connecting sockets) and into the bearings of the measuring drive. This could destroy the instrument and this would result in the destruction of the instrument and in the termination of implied and express warranties!

Use the supplied cleaning cloth to clean the touchscreen and, if necessary, replace the protective foil on the display. It is available from your Brookfield dealer.

II.9 Maintenance

The RST Rheometer system is designed for long-term operation. Should the instrument require repair, contact Brookfield or your authorized Brookfield dealer.

	Service and Repair
Danger!	Only authorized service personnel may work on the control electronics, all accessories, the measuring device, as well as the AC Adapter and all electric circuits and connections!

Measurement accuracy can be checked by the user at any time. We recommend that the measurements be done with Brookfield viscosity standard fluids (mineral oils) as recommended for each individual spindle geometry.

You must:

- Use temperature control
- Select the appropriate measuring system
- Carry out measurements at the following pre-set M (‰ torque) values: 250‰, 500‰ and 750‰
- Read viscosity values from the display on the RST Rheometer

In case of instrument failure (or severe deviation from the mineral oil viscosity value), contact Brookfield or your authorized Brookfield dealer.

III Making Measurements in Standalone Mode

The following chapter summarizes the operation and the menu system of the RST for the performance of manual measurements without PC.

III.1 Quick Start: Run Single

The following steps describe the procedure to run a test in standalone mode:

1. Connect the power supply to the instrument and plug into the main power supply. Turn on the instrument by pushing the POWER button on the back panel. The spindle coupling rotates in one direction, then the opposite direction for a few seconds. The following self-test message appears on the screen during this brief startup procedure:

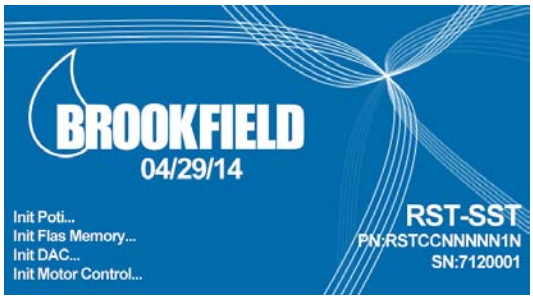


Figure III-1

2. When the self-test completes, the following main screen appears:

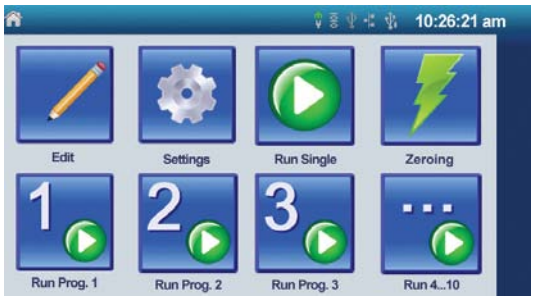


Figure III-2

Attach the spindle. Push the Run Single button. The following screens allow the operator to input test parameters that will execute a single step test.

The data will be reported in the default units for the RST Rheometer;

Viscosity: Pa.s
Shear Stress: Pa
Shear Rate: 1/s
Temperature: °C

Push the OK button to proceed to the next screen. Push the HOME button to return at any time to the main screen.

3. The next screen to appear will be the confirmation for the spindle identity. The bar code on the spindle shaft is identified by the infrared sensor built into the RST Rheometer.

Figure III-3

Push the OK button to proceed to the next screen. Push the BACK ARROW to return to the preceding screen.

4. The next screen confirms the Measuring System Type.

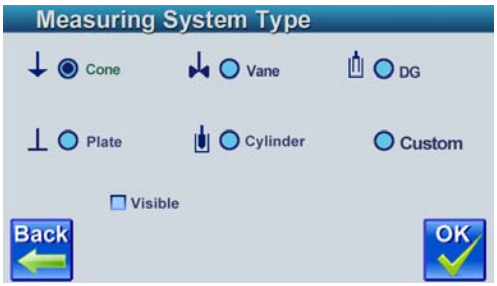


Figure III-4

Choices include: Cone, Cylinder, Vane, Plate, DG (Double Gap) and Custom. Your spindle type will automatically be recognized by your RST Rheometer. The "visible" box will have a check mark. Click this box if you want to remove the check mark, in which case, the spindle identity will not be displayed. Push the OK button to go to the next screen.

5. The following screen appears:

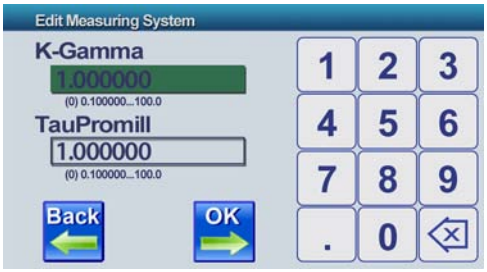


Figure III-5

This screen confirms values for K-Gamma and Tau-Prom; both are automatically recognized on the bar code. Push OK. The following screen appears only when a cone spindle type has been recognized by your RST Rheometer.

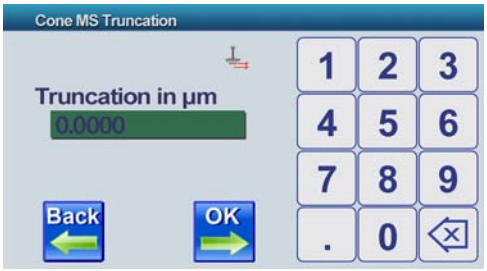


Figure III-6

Enter the value for the cone spindle truncation in mm on this screen. This value is listed on the data sheet that comes with your spindle.

Set the gap for the cone spindle. See Appendix B for the procedure to set the gap.

When the gap has been set, push OK to go to the next screen.

6. If the spindle is not a cone spindle, the following screen appears and provides the sample volume required for a viscosity test with the spindle that has been selected.

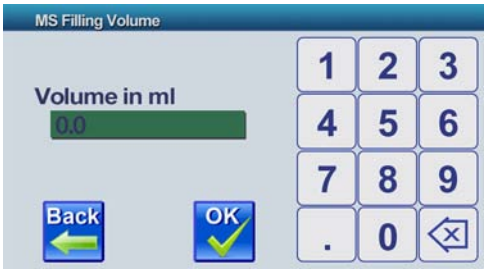


Figure III-7

Push OK to go to the next screen.

7. This screen allows you to choose the type of test that you want to run. Choices include:

Speed
Torque
Shear Stress
Shear Rate

Figure III-8

Push OK to go to the next screen.

8. Enter the START and END values for the test type that you have chosen.

Figure III-9

Push OK to go to the next screen.

9. Enter the number of measuring points and total test time on this screen.

Figure III-10

Push OK to go to the next screen.

10. Check the box “Wait for Temperature” to control the temperature setpoint of the sample material before the viscosity test begins. Push OK to go to the next screen.

Figure III-11

Enter a value for the control temperature on this screen. Push OK to go to the next screen.

11. Input the substance information for the test material if desired. You can use up to 25 alphanumeric characters. This is an optional screen.

Push OK and the viscosity test will automatically start.

12. During the test execution, the following screen shows the parameters that are displayed:

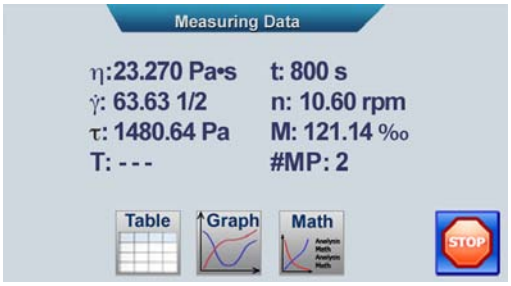


Figure III-12

While the test is running, the following choices are available for data display format:

a) Table format with values for time, viscosity, shear rate or speed, shear stress or torque, and temperature.

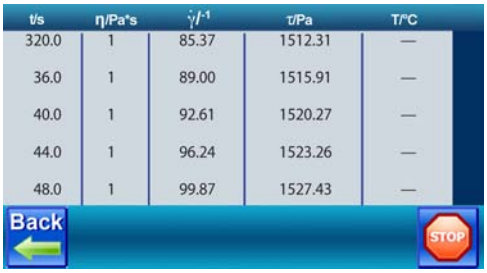


Figure III-13

b) Graph format with time on the x-axis, viscosity on the y-1 axis, and temperature on the y-2 axis.

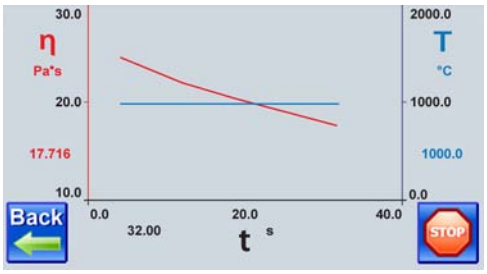


Figure III-14

c) Math format which shows the minimum viscosity value, the maximum viscosity value and the average of all viscosity values. The top half of this table contains data while the bottom half remains empty because there is only one block in this test with multiple steps. See Program Tests to understand how the bottom half of this table is used.

If the STOP button is pushed at any time, the test will stop, and the measuring point data will be saved up to that time.

13. At the end of the test, the operator has the following choices:

a) Repeat the test by pushing the CIRCULAR ARROW. This allows you to repeat the same test by using a single button push.

b) Go to the Data File by pushing the FOLDER BUTTON. This allows you to review data for the test that has just completed. This is discussed in the next Section.

c) Push OK to return to the main screen.

14. Click on the FOLDER icon. The parameters for the completed test are reviewed on the next two screens. The first screen will review the company/user information if the USER MANAGEMENT feature

has been turned on. If you see the following MEAS SYS SN:0 the explanation is that either the spindle with bar code was not recognized or the spindle does not have a bar code.

Push OK to go to the next screen which gives the summary of test parameters.

Push OK to go to the next screen which shows three icons: MATH, QC, REPORT

Push OK to go to the next screen which shows test information for the first measuring point in the completed test. Use the RIGHT ARROW to go forward from the first measuring point to the second measuring point. Continue using the RIGHT ARROW to review all the measuring points in the test file or the LEFT ARROW if you need to go backwards in the test.

The icons at the bottom provide choices for TABLE and GRAPH.

Click on TABLE to review the test measuring points in tabular format. The UP and DOWN arrows allow you to review all of the measuring points in the test.

Click on GRAPH to review the graphical data for the completed test. The Y1-axis is the viscosity data, the Y-2 axis is the temperature data and the X-axis is time. It is not possible to change the identities for each axis.

Click on MATH to review maximum average and minimum viscosity values for the completed test.

III.2 Languages

User screens for the RST Rheometer are available in the following languages; click on SETTINGS on the home screen (main menu), then click on LANGUAGE:

- German
- English
- Chinese

In future versions, the following languages will be implemented:

- Japanese
- French
- Polish
- Portuguese
- Russian
- Spanish

Figure III-15

Figure III-16

III.3 Touchscreen

All user input is done via touchscreen. The touchscreen doubles as both an input and output device. The touchscreen is resistive, i.e. it responds to light pressure. You tap lightly with your finger to select the desired option on the touchscreen. Tap and drag your finger across the touchscreen to perform a drag-and-drop operation. Instead of your finger you may also use the stylus that is provided with your instrument. Replace the protective foil on the display when damage or heavy wear is in evidence.

After turning the RST Rheometer on, you will see the main menu. Since the RST Rheometer cannot show all main menu items at the same time, there is a second menu page to which you go with the icon “Run 4…10“ at the bottom right of the touchscreen.

Tapping at the stylized house you will always get to the first page of the main menu.

Use the arrow keys up or down to turn pages within the active menu.

The Status Bar provides information relating to the time (as configured by the user), the coupling and various connections to the RST-CPS Rheometer:

1 Coupling (green=open; red=closed)
2 RS232 (green=connection to PC)
3 USB Host (green=connection to PC)
4 LAN (green=connected)
5 USB Flash Drive or Printer (green=connected)
6 Time and Temperature (alternating every 3 seconds)

Figure III-17

III.4 The Menu System of the RST Rheometer

This is a schematic representation of the menu sytem of the RST-CPS Rheometer on the touchscreen – start screen / main menu:

→Edit

→Units

→Measuring Systems

→Users

→Edit Program

→Explorer

→**Settings**

→Time

→Counter

→Zeroing

→Barcode

→Memory

→Self Test

→Temperature

→USB

→Language

→German

→English

→Chinese

→Japanese

→Portuguese

→Spanish

→Polish

→French

→Russian

→RS232

→Service

→About

→Activation

→Display

→Export Options

→Run Single

→Zeroing

→Run Program 1

→Run Program 2

→Run Program 3

→Programs 4 to 11

→Run Program 4

→Run Program 5… to 11

III.5 Edit

Press the Edit icon in the main menu.

Figure III-18

In this menu you can change:

- units
- measuring systems
- user management (Users)
- test programs (Edit Prog)
- view and manage measured data in “Explorer”

III.5.1 Units

Press the Units icon in the Edit menu.

Figure III-19

In this menu you can change the units for:

- dynamic viscosity
- temperature

To make a change, press to highlight the radio button in front of the desired unit.

III.5.2 Measuring Systems

Press the Measuring Sys icon.

Figure III-20

In this menu you manage your choice of measuring system (spindle or bob). Measuring systems can be

- changed
- added
- deleted.

An additional feature allows yout to “Hide” measuring systems which you seldom use. Tap the check box in front of the measuring system type you want to hide to remove the check mark.

Press the OK icon to go to a list from which you choose the measuring system to be changed. Bear in mind that the list of measuring systems consists of several pages. Move up or down through the list with the arrows.

Figure III-21

Figure III-22

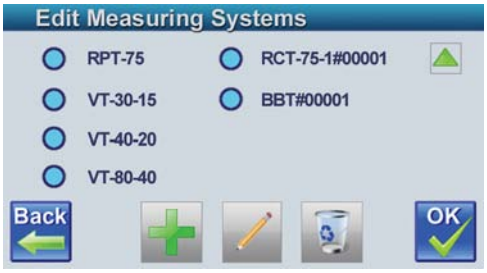


Figure III-23

Using the three icons in the center at the bottom of the screen, you can:

- add (Plus symbol)
- edit (Pencil)
- delete (Waste Paper Basket)

measuring systems.

Press OK to acknowledge this action and to go to the next menu:

Figure III-24

This is where you enter the name of the measuring system using the keyboard to enter up to 25 alpha numeric characters. Push OK to confirm the name and go to the next screen where you select the measuring system type:

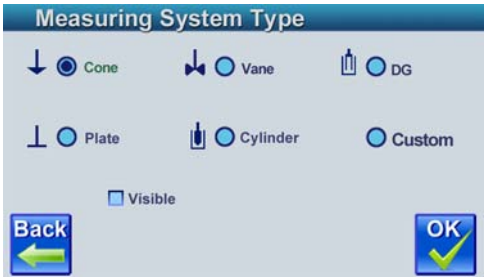


Figure III-25

To select the type of measuring system, press the appropriate radio button:

- Cone
- Plate
- Vane
- Cylinder
- DG
- Custom

By selecting “Visible” you determine whether users selecting a measuring system in the measuring program can see this measuring system.

Press OK to acknowledge your choice. On the next screen you enter the shear rate factor (K•Gamma) and the shear stress factor (Tau Promill) using the numeric keyboard and acknowledge your entries with OK:

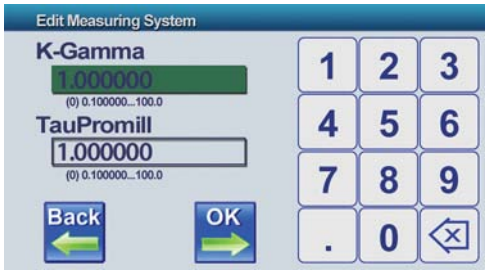


Figure III-26

For cones, truncation must be entered in µm on the next screen:

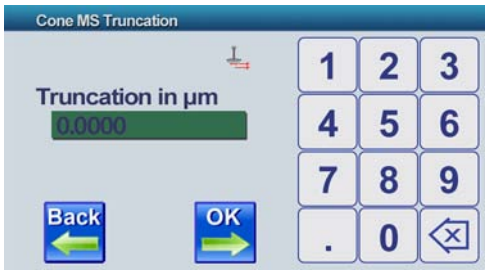


Figure III-27

Acknowledge your entry with OK. Then enter the sample volume required for the measurement in milliliters (mL) in the next mask and acknowledge with OK.

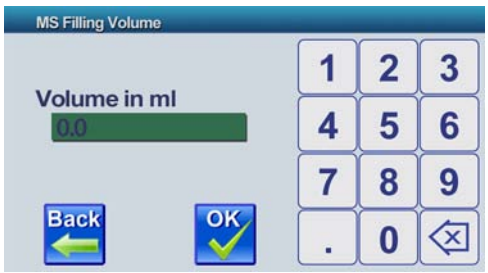


Figure III-28

Now your new or changed measuring system is durably stored in your RST-CPS Rheometer.

To correct input errors or check your entries you can always return to the previous input mask using “Back”.

III.5.3 User Authorization and Management

When using this feature, operators are authorized to perform specific tests by a System Administrator. For example, this feature provides the support capability to comply with the requirements of 21CFR Part 11 for the pharmaceutical industry which addfresses the controls for user access to the RST Rheometer.

Press the “Users” icon. Switch on “User Management” by putting a check mark in the box and press OK.

Figure III-29

The next screen is called “Edit User”. This is the screen used by the Administrator to add authorized users with specific rights to perform tests.

Figure III-30

Use the three iconds at the bottom to add (Plus symbol), edit (Pencil) and delete (Waste Basket) users.

Click on the Plus symbol to add a user. The next screen allows you to enter the User’s name with up to 11 alphanumeric characters. Click OK to go to the next two screens which provide choices for user rights which you wish to assign:

Figure III-31

The first option is “Program” which provides access to test program management. By checking the “View” box, the user is authorized to run test programs. If the box is not checked, then the user will not be able to run any test program. Authorization to “Create”, “Edit” and “Delete” test programs is assigned by checking the corresponding boxes.

The same approach is used for “Measuring Systems and Users”.

Figure III-32

Additional rights are shown on the above screen. Check the box to assign the user rights in each case.

Push the OK button, and the next screen allows you to assign a password with up to 10 alphanumeric characters:

Figure III-33

This password is necessary for the user to gain access to the assigned features when using the instrument.

Once users have been set up by the Administrator, turn off the RST Rheometer. The next time the instrument is turned on, the first screen to appear is User Names. This occurs because the User Management feature is active. Use the Down Arrow to see the menu of users who have been assigned to this instrument. Choose the appropriate user name, enter the password and then push OK to go to the main screen. The name for the current user will appear on the menu bar at the left top of the main screen.

III.6 Edit Program

This allows the user to create a multiple step test for a detailed and comprehensive evaluation of a sample material. For example, it is possible to perform a controlled stress ramp to determine the yield stress, then a flow curve to characterize viscosity vs. shear rate, and finally, a creep/recovery test to measure residual flow and relaxation after the shearing action stops.

There are analysis functions that permit the use of QC limits for viscosity values during the rtest and math models which show the minimum, maximum and average viscosity values. There is a “Reports” function that tells how the data is to be stored after the test.

Click the “Edit” button on the main screen. Then click the “Edit Program” button on the next screen:

Figure III-34

PROG1 through PROG6 are displayed on the screen. Use the down arrow to access PROG7 through PROG11. Each individual PROG is accessed by pressing the radio button and then pressing the OK button.

Click on the PROG1 button. The following screen appears:

Figure III-35

You can change the program name if you wish using the keyboard to input up to 15 alphanumeric characters, including symbols, if desired. Push OK to go to the next screen to choose your measuring system. Use the down arrow to navigate to additional screens with more spindle choices:

Figure III-36

Figure III-37

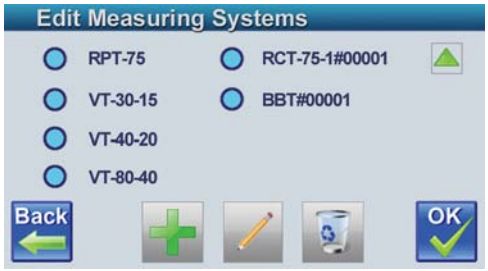


Figure III-38

The spindles are arranged in the following order:
Cone Spindles
Coaxial Cylinder Spindles
Plate Spindles
Vane Spindles

Press the radio button for the spindle that you wish to use in this program.

To enter a spindle that is not in the list, go to the HOME screen, then go to SETTINGS and choose BARCODE. Use this function to enter the parameters for the spindle that you will use.

Push OK to go to the next screen which allows you to choose the instrument units:

Figure III-39

There are choices for viscosity and temperature. Units for viscosity include Pascal•seconds, milliPascal•seconds, Poise and centipoises.

Units for temperature include °C and °F.

Push OK to go to the next screen, “Edit Steps”, where you create a structured test program:

Figure III-40

Use a drag and drop technique to move each program test block that you wish to use. Choices include Constant and Ramp. Constant allows you to maintain a constant value for the test parameter: torque, shear stress, speed, shear rate. Ramp allows you to go from an initial value to a final value for the same test parameters. Place program blocks in sequence to create your test. For example, you can start at a low rotational speed and ramp to a higher speed, then maintain that speed at a constant value, then ramp back down to your start speed.

The first block in your program test will normally be a ramp. If it is a torque or shear stress ramp, the objective could be to determine a yield stress. If it is a speed or shear rate ramp, the objective could be to establish a flow curve.

An alternative technique for moving the test block into the proram is to click on the test block, then click on the empty block in the program sequence. The test block will appear in the empty space.

Click on each program block to enter values for the test parameters. The following screens provide the choices for information that you must enter into the program test block so that you can run the test:

Figure III-41

Figure III-42

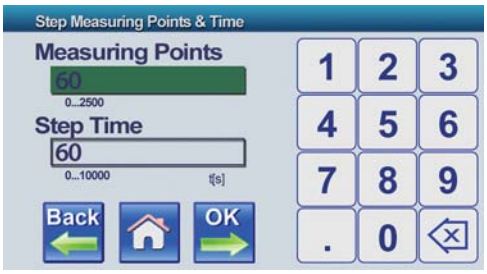


Figure III-43

Figure III-44

Figure III-45

While assembling your test blocks in the order needed to run your program, you may choose additional functions if desired.

III.6.1 Quality Control

Drag the "QC" block to your test program. Double click on the QC block. The screen that appears allows you to enter the target value for viscosity and the tolerance limits in ±% around the target value. For example, if you enter 1000 cP and ±10%, the limits would be 900 cP to 1100 cP. Push OK.

The next screen allows you to control an alarm which is sounded by the RST Rheometer whenever the viscosity is outside the QC limits that you set. The sliding scale allows you to set the amount of time that the larm will beep for each measuring point that is outside the QC limits. The beep time can range from 0.1 seconds to 5 seconds. Your choice for beep time may depend on the time interval between measuring points.

III.6.2 Math

Drag the "Math" block to your test program. Double click on the Math block. The screen that appears allows you to create a summary data report which displays the minimum, maximum and average values for shear rate, shear stress and viscosity. These values can be displayed for each step in the program and/or for the overall test program.

III.6.3 Report

Drag the "Report" block to your test program. Double click on the Report block. A screen called "Default Report Output" shows choices for data output:

- Output Group 1 gives you the choice to send the data to a USB-A memory stock or to a printer.
- Output Group 2 gives you the choice to send the data to a USB-B port or to a local area network, such as Ethernet, or to an RS-232 serial port.

After selecting your data output, push OK to go to the next screen.

Choose the measuring points that you wish to include in your report by clicking the radio button that satisfies your data requirement. If you check the "Math Model Result", the report will include the minimum viscosity value, the maximum viscosity value and the average viscosity value.

Push OK to go to the next screen:

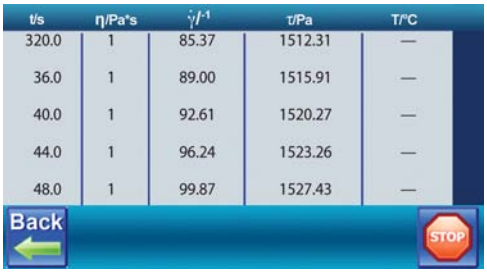


Figure III-46

This shows how the test data will appear whem coming from the printer. If you wish to re-arange the data columns, click on the parameter at the top of each column and use the drop down menu to change the parameter.

Push OK. Enter the "Company Name" on the next screen using up to 25 alphanumeric characters. Push OK. Check the box if you do not want to be asked for the company name again when running the program.

Push OK. Use the "Substance" screen to enter the name of the test material. This completes the creation of your test program. Return to the "Home" screen.

Select the test program that you have created and verify that it executes correctly.

III.7 Explorer

This feature allows you to view and manage test data. Click on the Explorer icon, and go to the next screen. Folder icons are displayed. The first icon is the SD card.

III.8 Options

In this menu you manage and change settings for your RST Rheometer:

Figure III-47

Note that the menu has a second page:

Figure III-48

III.8.1 Time

Set the current date and the current time here and acknowledge with OK:

Figure III-49

III.8.2 Counter

This screen reports the number of tests that have been run by your RST Rheometer.

III.8.3 Zeroing

Zeroing measures the bearing friction and uses this information to adjust measurements during tests.

Figure III-50

High Range Calibration is zeroing for high speeds (1…1300 rpm) and Low Range Calibration is zeroing for low speeds (0.01…1 rpm), and very low range calibration is zeroing for 0.01 rpm. If in doubt, run High Range Calibration for a period of approx. 20 min.

III.8.4 RS232

This screen configures the RS232 port:

Figure III-51

III.8.5 Memory

This screen tells you how much free memory is available in your RST Rheometer. When you open the "Folder" icon, you can review data files stored in memory.

III.8.6 Export Options

The first icon is the SD card. This is for use by Brookfield service personnel.

If a USB memory stick is connected, the next icon is a folder label that will say, “USBSTICK1”. Double click on the folder to view the data files that are stored on the memory stick.

The next icon is a folder that is called, “DATA2”, and contains the test data files from the internal memory of your RST Rheometer. Double click “DATA2” and the data files that have been stored in the RST Rheometer memory will be listed in reverse chronology – from the most recently completed test to the first test. The format for each file will look like one of the following:

- Run Single_63 04/28/14 10:28:25 am
- PROG1_32 04/10/14 15:30:05 pm

Select the test that you are interested in by double clicking on the data file and reviewing the measuring points for that test.

To transfer files from the “DATA2” folder to the USB memory stick, press on the files one time and then on the data transfter icon in the menu bar at the bottom of the screen. The files are automatically transferred to the memory stick.

Choices for file format when exporting data include .csv, .bin, and .txt. Numerical data can be delineated by either a decimal point or comma. Separator designation can either be a tab or a semicolon.

III.8.7 Service

This menu item is relevant only for service work and may be requested by our service technician.

III.8.8 USB Port and RS232 Port

USB Port provides information on use of the port. Host identifides USB memory stick when connected. Device identifies the printer when connected.

RS232 povides sleelctions for band, Data Bits, Stop Bit and Parity.

III.8.9 Language

Select your preferred language for the RST Rheometer from this menu:

Figure III-52

Push the down arrow to see additional languages. Activate the language of choice by pressing the preferred language icon.

III.8.10Barcode

Barcode identification for your measuring system can be checked using this feature:

Figure III-53

III.8.11Temperature

This menu item is relevant for service work only and may be requested by our service technician:

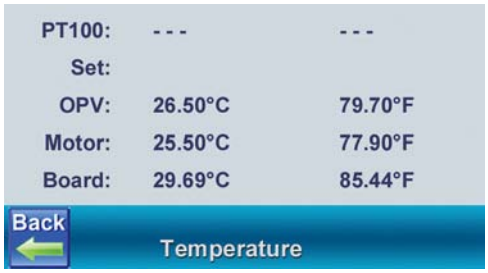


Figure III-54

III.8.12 ABOUT

This screen identifies firmware and hardware information for your RST Rheometer.

III.9 Run Programm 1 to 11

The procedure and functionality of “Run Program 1” is the same as for Programs 2 through 11. Click on the program icon for the test that you have stored in memory using the “Edit Program” feature. The test will start up and execute automatically.

While your program is running, you will see the following measured values on the touchscreen:

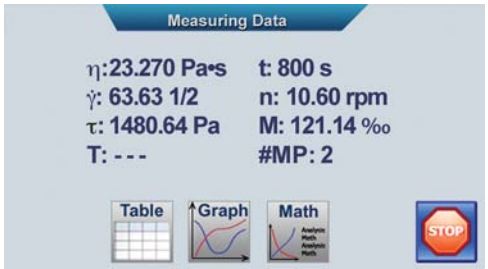


Figure III-55

Click on the “Table” icon (table of measured data in real time) to see the five most recent measuring points.

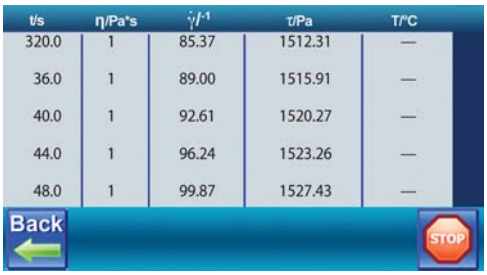


Figure III-56

Click the “Graph” icon (graphic representation of your measured data in real time) to see measured values for viscosity and temperature vs. time.

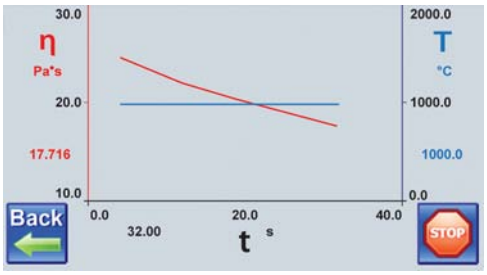


Figure III-57

or the Math icon (mathematic evaluation of your measured data).

IV General Procedures for Operation of Rheometer and Measuring Systems

Caution!	**Assembly / disassembly of measuring devices**
	Make sure during all measurements that no sample or solvent whatsoever penetrates into the measuring bob coupling, the measuring drive, the instrument or the electronic unit.

Caution!	**Power ON**
	During Power ON process the motor encoder needs some rpm for initialization , therefore no spindle may be attached!

This is the procedure to be followed for measurements in manual mode:

Measuring:

- Connect the AC adapter.
- Connect a printer, if required.
- Remove any attached spindle.
- Turn the power button ON and wait until the main menu is shown in the Touchscreen.
- Prepare the sample.
- Attach the measuring system.
- For temperature-controlled measurement, wait until the substance to be measured has reached the desired temperature.
- Start a measuring program.
- After completion of measurement, turn off temperature control, wait until your sample has cooled down.
- Remove and clean the measuring system.

When making measurements in remote mode under PC control, follow this procedure:

- Connect the AC adapter.
- Connect the cable between RST Rheometer and PC.
- Remove any attached spindle.
- Turn the power button ON and wait until the main menu is shown in the Touchscreen.
- Select the menu item Remote.
- Turn on the PC and all peripheral devices.
- Start the Rheo3000 software.
- Load a measuring program into the Rheo3000 software.
- Prepare the sample.
- Attach the measuring system.
- For temperature-controlled measurement, wait until the substance to be measured has reached the desired temperature.
- Start the measuring program in the Rheo3000 software.
- After completion of the measurement, turn off temperature control and wait until your sample has cooled down.
- Remove and clean the measuring system.

IV.1 Measurement Systems for RST-CC and RST-SST

The following types of measuring systems are used with RST-CC and RST-SST:

a) standard coaxial geometry measuring systems for measurement without thermostatic control device FTK, consisting of

- sample cup for (MB3-40...MB3-8 DIN and MB3-DG)
- sample cup buttom
- measuring bob (CCT-40...CCT-8 and CCT-DG)
- thread guard

b) standard coaxial geometry measuring systems for measurement with temperature control device FTK, consisting of:

- sample cup (MB3-40F...MB3-8F and MB3-DGF)
- threaded joint for sample cup
- measuring bob (CCT-40...CCT-8 and CCT-DG)
- optional Pt100 temperature sensor in the sample cup bottom or in the temperature control device

c) disposable measuring systems EWS3-CC40...CC8 DIN/FTK for measurement with temperature control device FTK, consisting of:

- sample cup seat MBA3-CC40...CC8 DIN/FTK
- disposable sample cup (aluminium) EMB-CC40...CC8 DIN/FTK
- sample cup ejector
- measuring bob CCT-40...CCT-8 DIN or disposable measuring bob CCT-25D DIN

d) cone/plate measuring system for measurement with measuring device ME3-CP/PP consisting of:

- measuring cone (RCT-25-1...RCT-50-2) depending on the measuring system

e) plate/plate measuring system for measurement with measuring device ME3-CP/PP consisting of:

- measuring plate (RPT-25 and RPT-50) depending on the measuring system

To carry out measurements, please select a measuring system suited for the desired measuring range and your rheological requirements.

Give due consideration to the following safety notes when carrying out measurements:

	Operation
Danger!	Caution when carrying out temperature-controlled tests: Check temperature before removing the measuring system. Danger of injuries!

	Threaded joint for sample sup
Caution!	Be sure to hold the measuring system with one hand when unscrewing the sample cup. Due to its weight the measuring system will fall down.

	Pt100 temperature sensor
Caution!	Do not immerse the Pt100 temperature sensor into the medium deeper than 2/3 of the length of the metal rod. The cable must remain outside the medium.

IV.1.1 Measurement Directly in the Sample

If necessary, remove the sample cup bottom from the measuring system and attach the thread guard.

Use caution with the Double Gap DG system:

- When using the measuring system MS3-DG, remove the packing ring from between the shell and the inner part of the sample cup. For that purpose you open the measuring system at the bottom and take the inner part out. Be careful not to damage or overstretch the packing ring when you take it out. Place the inner part back inside and and screw down the measuring system.

Slide the coupling sleeve of the measuring bob coupling up (ring visible).
Insert the measuring bob into the coupling with caution. Be careful to insert the shaft of the measuring bob into the coupling without bumping against it.

Slide the coupling sleeve of the measuring bob coupling down (ring hidden).
Fasten the sample cup to the sample cup flange seat using the threaded joint for the sample cup.

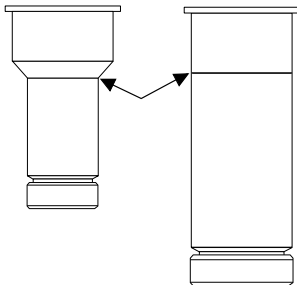


Figure IV-1

Immerse the sample cup in the substance as far as the ring mark or the conical swelling, as the case may be, by lowering the stand.

Make sure that no sample or solvent whatsoever penetrates into the measuring bob coupling, the measuring drive or the electronic unit.

Now the measurement can be carried out.

When the measurement is finished, first open the threaded joint of the sample cup and remove the sample cup, then open the measuring bob coupling and remove the measuring bob.

Clean sample cup and measuring bob carefully without using hard objects. Be sure to avoid scratches.

Store the measuring bob on a soft surface or in its original jar.

IV.1.2 Measurement with Sample in the Measuring System

Fill the sample cup with substance (for filling quantity, see Appendix E “Data Sheets for Standard Measuring Systems”). Avoid trapping air bubbles when filling in the sample, as they would result in non-repruducible or false data.

Insert the measuring bob into the sample cup. Slide the coupling sleeve of the measuring bob coupling up (ring visible). Place the complete measuring system on the sample cup seat flange from below and fasten it with the threaded joint for the sample cup. Be careful to insert the measuring bob shaft into the coupling without bumping against it. Now insert the measuring bob shaft into the measuring bob coupling and slide the coupling sleeve down (ring hidden).

For this type of measurement the sample temperature can be controlled by immersing the measuring system in a suitable thermostat (deliverable as special accessory). In this case it is important to pay attention to the depth of immersion.

	Temperature control
Caution!	Temperature range max.: 0°C ... 90 °C! The cooling device KE is needed for an extended temperature range of -20... 180°C.

For temperature-controlled measurement you need to set the thermostat to the desired temperature and to wait then until the sample has reached the desired temperature (e.g. temperature measurement by Pt100, menu item Devices for Temperature Measurement).

Now the measurement can be carried out.

To remove the measuring system after measurement, open the measuring bob coupling first and then untighten the threaded joint for the sample cup.

Clean sample cup and measuring bob carefully without using hard objects. Be sure to avoid scratches.

Store the measuring bob on a soft surface or in its original jar.

IV.1.3 Measurement with Temperature Control Device

When using a disposable measuring system, place the single-way sample cup into the sample cup seat as far as the widening of the aluminium cup. Due to the widening in its upper part the sample cup is held and clamped tightly. The sample cup ejector serves to remove the sample cup.

Fill the sample cup with substance (for filling quantity, see Appendix E “Data Sheets for Standard Measuring Systems”). Avoid trapping air bubbles when filling in the sample, as they would result in non-repruducible or false measuring values.

Insert the measuring bob into the sample cup. Slide the coupling sleeve of the measuring bob coupling up (ring visible). Place the complete measuring system into the temperature control device from below and fasten it with the threaded joint for the sample cup. Be careful to insert the measuring bob shaft into the coupling without bumping against it. Now insert the measuring bob shaft into the measuring bob coupling and slide the coupling sleeve down (ring hidden).

For temperature-controlled measurement you need to set the thermostat to the desired temperature and to wait then until the sample has reached the desired temperature (e.g. temperature measurement by Pt100, menu item Start & End Temperature).

In this case make sure that cooling liquid flows through the cooling device KE for temperatures outside the range of –10°C...+90°C. Now the measurement can be carried out.

When the measurement is finished, first open the measuring bob coupling and then unscrew the threaded joint for the sample cup.

When using a disposable measuring system, push the single-way sample cup out with the sample cup ejector.

Clean sample cup, sample cup seat and measuring bob carefully without using hard objects. Be sure to avoid scratches.

Store the measuring bob on a soft surface or in its original jar.

IV.1.4 Measurement Using Cone/Plate and Plate/Plate Measuring System Accessory

To insert the measuring bob you need to loosen the quarter-turn fastener (“loose” position) and to pull the measuring table (measuring plate) downwards.

	Assembly / disassembly of measuring device
Caution!	Hold the measuring device with one hand by the lower part while loosening and mounting the quarter-turn fastener, or else the measuring table will fall down.

Unlock the shaft of the measuring bob to be inserted (e.g. RCT-50-1 or RPT-25-2) by loosening the hexagon socket screw, adjust the measuring bob to its shortest length and then fix it again by screwing down moderately.

Slide the coupling sleeve of the measuring bob coupling up (red ring visible). Place the measuring bob into the coupling. Slide the coupling sleeve down (ring hidden) so the measuring bob is firmly seated in the coupling.

Turn the adjusting screw at the measuring table into the lower position. Then move the measuring table back up and secure with the quarter-turn fastener (“fixed” position).

Reduce the current distance between measuring bob and measuring table to about 1 mm by turning the adjusting screw up, moving to a suitable “0” position at the scale of the adjusting screw.

Then set the measuring gauge also to the “0” position and unlock the measuring bob shaft. The measuring bob now lies directly on the measuring table and is fastened in this position.

Lower the measuring table by 0.5mm using the adjusting screw (one turn of the screw) and then move it up again, however to position “5” (50 µm), which is equal to the measuring position of the measuring cone. Other distances, e.g. for use of an RPT-50 measuring plate, are to be adjusted accordingly.

Open the quarter-turn fastener to move the measuring table down and apply the substance to be measured. Lift the measuring table back into working position and close the quarter-turn fastener. Now you can start measurement.

Note: Material emerging at the edge of the cone should be removed using the supplied spatula (error influence!).

For temperature-controlled measurement you need to set the thermostat to the desired temperature and to wait then until the sample has reached the desired temperature (e.g. temperature measurement by Pt100 menu item “Devices for temperature measurement”). Then the actual measurement can begin.

IV.1.5 Measurement Using Special Measuring Bobs

For measurements with special measuring bobs, install the measuring bob (e.g. a vane spindle). Then immerse the measuring bob in the container with the substance to be measured as far as the immersion mark. After measurement, remove the measuring bob by opening the coupling (slide coupling ring up) and pulling the measuring bob downwards.

IV.2 Measurements Using RST-CPS

The cone/plate and plate/plate measuring systems consist of the fixed bottom plate and the upper measuring cone or plate element that is height-adjustable to set the required gap. The setting of the gap depends on your instrument. You can use either Manual Gap Adjustment (MGA) or Automatic Gap Control (AGC). If there is a micrometer ring (Nonius) on the RST-CPS Rheometer you have an instrument with MGA. Otherwise you have to use AGC.

To carry out measurements, please select a measuring system suited for the desired measuring range and your rheological requirements.

Danger!	**Operation**
	Caution when carrying out temperature-controlled tests: Check temperature before removing the measuring system. Danger of injuries!

IV.2.1 Measurement with Manual Gap Adjustment (MGA)

You can carry out measurements after you adjust the gap. Adjust the gap using the procedure in Appendix B.

Set the temperature control (e.g. bath/circulator or peltier temperature control) to the required temperature if measurements are to be taken under controlled temperature. The pre-heating time depends on the sample, on the required temperature and on the measurement system.

Place the sample material on the bottom plate with the instrument head in the upper position (for filling quantity see Appendix E “Data Sheets for Standard Measuring Systems”). Air bubbles in the sample will affect test results and should be avoided.

Attach the spindle. Lower the measuring head using the lever. To avoid interfering side effects, remove excess sample from around the cone or plate with the provided spatula, taking care not to scratch the surface of the bottom plate. Remove excess sample from cone or plate edge. Do not begin the measurement until the temperature in the substance has stabalized at set point.

Now the measurement can begin.

	Temperature Control
Caution!	The measuring cone/plate may only be adjusted, and the hexagon socket screw may only be tightened, when the measuring temperature is set precisely, otherwise the gap distances may be changed by thermal elongation resulting in faulty measurement or in damage to the measuring system.

	Operation
Danger!	Take caution with measurements at high temperature! Always check the temperature before removing the cone or plate to avoid burned fingers!

IV.2.2 Measurement with Manual Gap Adjustment (MGA)

You can carry out measurements after you adjust the gap. Adjust the gap using the following procedure in Appendix B. Follow the sample procedure for making measurements as defined in the preceding section.

Appendix A Technical Data

RST Rheometer	
Viscosity range [1]	$0.1*10^{-3}$ to $5.4*10^{6}$ Pa*s
Torque range **line-powered**	up to 100 mNm
Torque resolution	0.15 µNm
Speed range	0.01 to 1,300 min^{-1}
Angular resolution	1.2 µrad
Temperature range [2]	-20° to +180°C -4° to +356°F
Range of shear rate [1]	0.013 to $7.8*10^{3}$ s^{-1}
Range of shear stress [1]	0.27 to $69*10^{3}$ Pa
Weight (included AC adapter)	11 kg 24 lbs.
Dimensions (Width x Height x Depth)	350 mm x 580 mm x 320 mm 14 in. x 23 in. x 13 in.
Ambience conditions **Temperature** in operation	 +10° to +40°C +50° to +104°F
Relative humidity (not condensing) in operation	 20% to 80%

[1] The range depends on the used measuring system and the sample. Contact your Brookfield dealer for further information.

[2] The range depends on the temperature control. Higher temperatures are available. Contact your Brookfield dealer for further information.

AC Adapter	
Dimensions	155 mm x 60 mm x 38 mm 6 in. x 2.4 in. x 1.5 in.
Weight	0.5 kg 1 lb
Power supply **operating voltage** **output voltage** **output amperage** **power output**	 80 to 264 V AC 24 V DC 3.54 A 85 W
Frequency	47 to 63 Hz

Appendix B RST-CPS Rheometer Gap Setting Procedure for Cone and Plate Spindles

This procedure is for the RST-CPS Rheometer. Both manual and automatic gap setting are explained.

B.1 Manual Gap Setting
Begin the procedure with the rheometer head in the raised position and no spindle attached.

Set the micrometer dial located behind the plate to the zero position. This will place the head of the rheometer in the initial position to start the gap setting procedure. It may be desirable to rotate the micrometer in a counterclockwise direction at first and then return to the zero position. This will remove hysteresis in the column of the instrument.

Attach the cone or plate spindle to the rheometer. Loosen the set screw on the shaft of the spindle. Lower the rheometer head and bring the spindle into contact with the plate. Tighter the set screw. Lift the rheometer head to the raised position.

Review the data sheet for the cone spindle and note the "truncation" value. It will be a number near the value of 0.050 mm (50 microns). Adjust the micrometer dial to the position that agrees with the truncation value. Accomplish this by rotating the micrometer dial in a counterclockwise direction. Each division line on the micrometer dial equals 0.010 mm (10 microns). When the micrometer dial has been moved to the correct position, the gap is set and testing may begin.

For plate spindles the gap setting procedure is similar. Move the micrometer dial to the setting that provides the correct spacing for the material that is being tested. The correct spacing is normally determined by the largest particle size in the material; best practice is to set the gap 5 to 10 times greater than the largest particle. If the largest particle is 0.010 mm, then the gap should be 0.050 to 0.10 mm (50 to 100 microns). If the material does not have particles, but is highly viscous, experiment with various gap settings to determine what will give the most repeatable viscosity measurements.

B.2 Automatic Gap Setting in Run Single Mode
Go to the Home Screen (Main Screen). Press the Run Single button. The next screen tells you to "Plug in measurement system and close coupling!" Attach your spindle. If the RST-CPS recognizes the spindle, press OK:

Example: Name: RCT-25-1 Serial Number: 00002

If the RST-CPS does not recognize the spindle, the following will appear: "Spindle recognition failed! Please select measurement system". Press OK. Select the correct spindle in the next screen. Choices will include the standard cone and plate spindle geometries that are used with RST-CPS as well as spindles with specific serial numbers that you have already been entered into memory in your instrument. Select the appropriate spindle with serial number:

Example: RCT-50-1 #00005 (this is a spindle that is already in memory)

Spindles with serial numbers that are in memory will have cone truncation information that is necessary for the automatic gap function to work correctly.

Press OK. The next screen will ask: "Do you want to adjust the gap now?" Press "Yes". The next screen will say: "Loosen measuring system hexagon screw. Confirm with 'OK'. After loosening the screw, press OK.

The RST-CPS head moves downward to the hit point. The screen will display a downward motion for the rheometer head and say: "Z-Drive moving! Please wait…" When the spindle makes contact with the plate, the next screen will appear: "Tighten measuring system screw!" When the screw has been tightened, press OK. The next screen will say: "Z-Drive moving! Please wait…." The head will return to the up position.

The next screen will say: “Place substance on plate!” Put the sample material on the plate and choose a rotational speed between 0 and 1rpm using the slide scale on the touch screen. This will allow the spindle to rotate slowly while the spindle moves downward to make contact with the sample. Press OK for the spindle to move down into position. The gap setting value will be displayed on the screen beneath the image of the rheometer. Example: 0.050 mm.

The screens that follow direct you through the normal steps to set up the Run Single test.

After the test is complete and you finish your review of the data, press OK to go to the next screen which asks: “Do you want to change measuring system or sample?” If you click “Yes”, the next screen will tell you to open the spindle coupling before the head begins to move upward. The head moves upward after the coupling is open. This leaves the spindle in contact with the sample while the head moves up. Once the head is in the up position, remove the spindle carefully. Clean the spindle and plate. Proceed with the next test.

If you click “No”, you can run another test with the same sample. You can repeat the same test or set up a different test using Run Single to enter the new test parameters.

B.3 Automatic Gap Setting in Program Mode

The procedure is similar to Run Single. Press the program button that you want to use, such as “Start Prog. 3” The sequence of screens that follows will direct you to attach the spindle. The RST-CPS will automatically set the gap and run the test.

Appendix C Calibration Check

The calibration check procedure is performed in order to verify that your RST Rheometer is making correct viscosity measurements. It can be done in standalone mode or under control of Rheo-3000 software running on a PC. Perform the calibration check with the spindle that is most frequently used with your instrument. You do not need to perform a calibration check with additional spindles unless there is a concern that a specific spindle is not measuring properly.

The calibration check can be performed at regularly scheduled time intervals determined by you (before each shift, weekly, monthly, etc) or at any time when there is concern that the instrument is not measuring correctly.

Before performing the calibration check, it is advisable to perform the Zeroing procedure. This feature is accessed in the Settings menu in standalone mode. At a minimum run both the High Range and Low Range Zeroing procedures. The time required to do both is slightly more than a half hour.

Use the appropriate viscosity standard for the spindle that you want to test. Consult the following table which shows the fluid that is recommended for each type of spindle and the required sample volume to perform the calibration check:

Cone Spindles	Fluid	Sample Volume
RCT-25-1	B41000	0.1mL
RCT-25-2	B73000	0.2mL
RCT-50-1	B10200	1.0mL
RCT-50-2	B21000	2.0mL
RCT-75-1	B4900	2.5mL
RCT-75-2	B10200	5.0mL

Coaxial Spindles	Fluid	Sample Volume
CCT-8	B41000	1.0mL
CCT-14	B10200	3.4mL
CCT-25	16.8mL	16.8mL
CCT-40	B2000	68.5mL
CCT-DG	B200	15.7mL

If you have an RST-SST Rheometer and use vane spindles, Brookfield recommends that you perform a calibration check with any one of the coaxial spindles chamber geometries which will also attach to your instrument.

Use a circulating temperature bath to condition the viscosity standard to a set temperature, normally 25°C. All Brookfield viscosity standards are calibrated at 25°C. Additional temperature calibrations are available upon request when the fluid is ordered from Brookfield or an authorized dealer. Brookfield also supplies a selection of TC series Temperature Baths for this purpose.

If you have an RST-CPS Rheometer with Peltier Temperature control, you do not require the circulating temperature bath. Temperature control capability is built into the plate on the instrument.

Prepare the proper sample volume for the test and condition to the defined temperature within +/- 0.1°C. Mineral oil is highly temperature sensitive, so it is important to do this correctly. If using the RST-CPS Rheometer, trim the sample around the circumference of the cone spindle.

The calibration check procedure is performed at 3 separate controlled torque values: 125, 250 and 375 per mille. The spindle rotates for at least one minute at each torque value. The viscosity reading at each torque value is recorded. The three viscosity readings must each be within +/- 3% of the actual fluid value for the calibration check to pass.

If the calibration check fails, review each step to make sure that everything was done correctly in accordance with the test procedure. Repeat the test procedure if necessary. Areas for potential error are not having the proper sample volume and not conditioning the sample to the correct temperature. If the instrument fails when you repeat the calibration check, contact Brookfield or your authorized dealer.

Appendix D Symbols for Test Parameters and Units of Measurement

Parameter	Symbol	Unit
Speed	n	[min^{-1}]
Torque	M	[1000 ‰ = 100 mNm]
Temperature	T	[°C,°F]
Time	t	[s]
Shear Rate	D	[s^{-1}]
Shear Stress	τ	[Pa]
Viscosity	η	[Pa•s, mPa•s, cP, P]

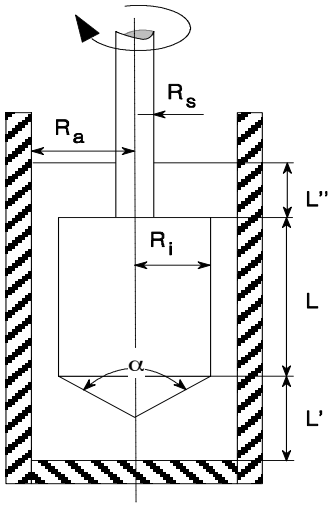
Appendix E Data Sheets for Standard Measuring Systems

Table of Coaxial Cylinder Measuring Systems according to DIN 53018 / 53019 / ISO 3219
(consisting of measuring bob and sample cup)

Three sample cup models are available for the RST-CC and RST-SST Rheometer:

- MB3-40 ... 8 DIN
- MB3-40F ... 8F DIN/FTK
- MBA-40F ... 8F DIN/FTK with EMB-40D ... 8D (disposable)

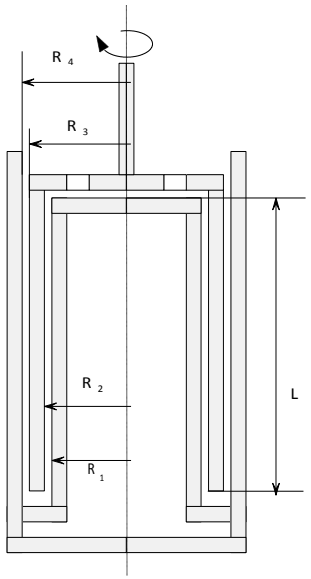
Measuring system	CCT-40	CCT-25	CCT-14	CCT-8
Shear rate range [s^{-1}]	0.0215...2,790	0.013...1,670	0.013...1,680	0.013...1,672
Shear stress range [Pa]	0.89...594	3.43...2,280	19.5...13,000	104...69,600
Viscosity range [Pa*s] 1)	0.0003... 27,600	0.002... 177,000	0.012... 1,000,000	0.065... 5,410,000
Filling quantity [mL]	68.5	16.8	3.4	1
Shear rate factor $K_{\square}$ [s^{-1}/RPM]	2.1480	1.2894	1.2969	1.2865
Shear stress factor $\square_{‰}$ [Pa]	0.2969	1.1419	6.5052	34.8426
Measuring bob radius R_i [mm]	20.0	12.5	7	4
Sample cup radius R_a [mm]	21.0	13.56	7.59	4.34
Shaft radius R_s [mm]	3.5	3.5	2.1	1.2
Angle of measuring bob cone α [°]	120	120	120	120
Distance from lower edge of measuring bob to sample cup bottom L' [mm]	20.5	15.5	13	12
Length of shaft immersed L'' [mm]	20	12.5	7	4
Length of measuring bob L [mm]	60	37.5	21	12
Radius ratio δ = **Error!**	1.050	1.0847	1.0847	1.0847
Coefficient of resistance c_L	1.1	1.1	1.1	1.1



Measuring geometry according to DIN 53019

Table of double gap cylinder measuring system according to DIN 54453
(consisting of measuring bob and sample cup)

Measuring system	CCT-DG
Shear rate range [s^{-1}]	0.043 ... 5,640
Shear stress range [Pa]	0.265 ... 177
Viscosity range [Pa*s] 1)	0.00005 ... 4,070
Filling quantity [mL]	15.7
Shear rate factor $K_{\square}$ [s^{-1}/RPM]	4.3443
Shear stress factor $\square_{‰}$ [Pa]	0.0884
Inside radius of measuring bob R_2 [mm]	19.72
Outside radius of measuring bob R_3 [mm]	20.5
Inside radius of sample cup R_1 [mm]	19.25
Outside radius of sample cup R_4 [mm]	21.0
Measuring length L [mm]	111
Radius ratio δ = **Error!** = **Error!**	1.0244
Coefficient of resistance c_L	1



Measuring geometry according to DIN 54453

Table of cone/plate measuring systems

Measuring System	RCT-25-1	RCT-25-2	RCT-50-1	RCT-50-2	RCT-75-1	RCT-75-2
Shear rate range [s^{-1}]	0.06 … 7,800	0.03 … 3,900	0.06 … 7,800	0.03 … 3,900	0.06 … 7,800	0.03 … 3,900
Shear stress range [Pa]	36.7 … 24,400	36.7 … 24,400	4.58 … 3,050	4.58 … 3,050	1.36 … 905	1.36 … 905
Viscosity range [Pa*s] 1)	0.005 … 407,000	0.01 … 814,000	0.0006 … 50,900	0.0012 … 101,000	0.0002 … 15,000	0.0004 … 30,000
Filling quantity [mL]	0.1	0.2	1	2	2.5	5
Shear rate factor $K_{\square}$ [s^{-1}/RPM]	6.00	3.00	6.00	3.00	6.00	3.00
Schubspannungsfaktor $\square_{‰}$ [Pa]	12.223	12.223	1.5279	1.5279	0.4527	0.4527
Measuring cone radius R [mm]	12.5	12.5	25	25	37.5	37.5
Angle of measuring cone α [°]	1	2	1	2	1	2
Cone truncation [μm]	50	50	50	50	50	50

Table of plate/plate measuring systems
(consisting of measuring plate and measuring device ME3-CP/PP)

The following values pertain to a plate distance of 1 mm. For all other plate distances you can easily calculate $K_{\square}$ using the formula:

- $K_{\square} = (2*\pi / 60) * (R / H)$ R = radius, H = plate distance

Measuring System	RPT-25	RPT-50	RPT-75
Shear rate range [s^{-1}]	0.013 … 1,700	0.027 … 3,400	0.04 5,100
Shear stress range [Pa]	49 … 32,600	6.2 … 4,070	1.8 … 1.200
Viscosity range [Pa*s] 1)	0.03 … 2,490,000	0.002 … 155,000	0,0004 … 30,700
Filling quantity [mL]	0.5	2.0	4.5
Shear rate factor $K_{\square}$ [s^{-1}/RPM]	1.309	2.618	3.927
Shear stress factor $\square_{‰}$ [Pa]	16.297	2.037	0.604
Radius of measuring plate R [mm]	12.5	25.0	37.5

Table of Vanes for the RST-SST Soft Solids Tester

All standard vanes supplied for the Soft Solids Tester have a height (H) to diameter (D) ratio of 2:1. The constants for the standard vanes are as follows:

Vane	Height [mm]	Diameter [mm]	Shear Stress [Pa]
VT-10-5	10	5	330 … 210,000
VT-20-10	20	10	41 … 27,000
VT-20-20	20	20	9 … 5,900
VT-30-15	30	15	12 … 8,000
VT-40-20	40	20	5.2 … 3,400
VT-40-40	40	40	1.2 … 740
VT-50-25	50	25	2.7 … 1,700
VT-60-8	60	8	24 … 15,000
VT-60-15	60	15	7 … 4,300
VT-60-30	60	30	1.6 … 1,000
VT-80-40	80	40	0.7 … 420
VT-80-70	80	70	0.2 … 120

The vanes pre-loaded into the Rheo3000 software assume a ratio of 3:1 (container-to-vane diameter). If you use vane/container combinations that don't match this select an appropriate value from the following table:

Container to Vane Diameter Ratio	Shear Rate Constant K□
1,5 : 1	0,3763
2 : 1	0,2792
3 : 1	0,2355
4 : 1	0,2234
5 : 1	0,2181
∞ : 1	0,2094

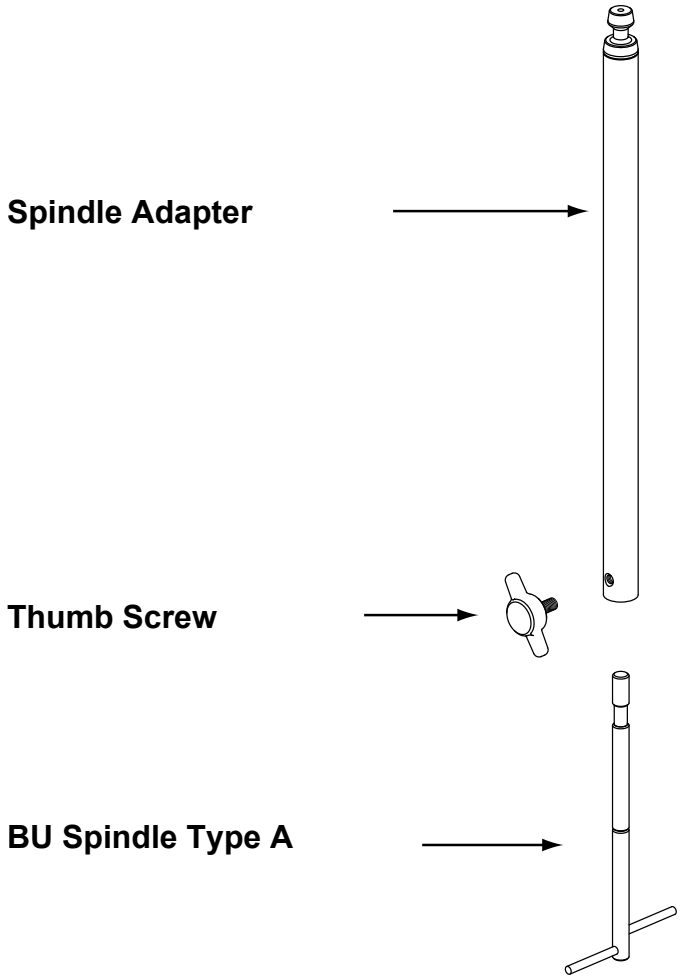
It may be possible to use a vane spindle with the MB measuring chamber. This combination can be used to measure flurries (fluids with suspended particles). Contact Brookfield or your authorized deaer for more information.

Appendix F Measuring in Brabender Units (BU)

RST-SST Rheometers have firmware that will recognize spindle geometry RSS-90Y for testing according to ASTM C474.

The RSS-90Y spindle has three parts:

- Spindle Adapter (which connects to the rheometer)
- BU Spindle Type A
- Thumb Screw (which secures the Spindle in the Spindle Adapter).

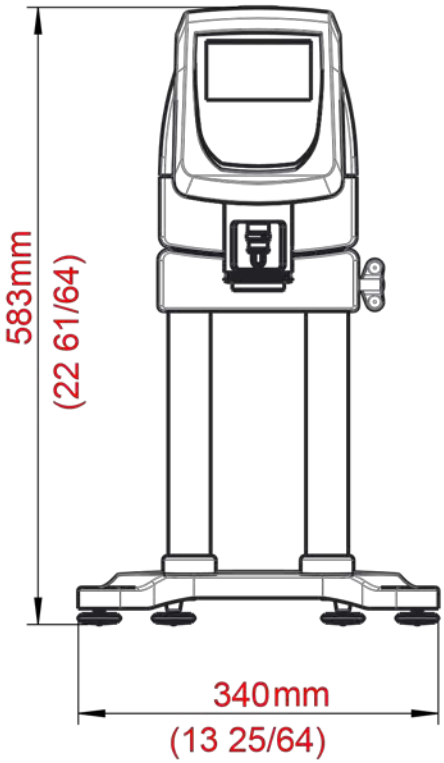


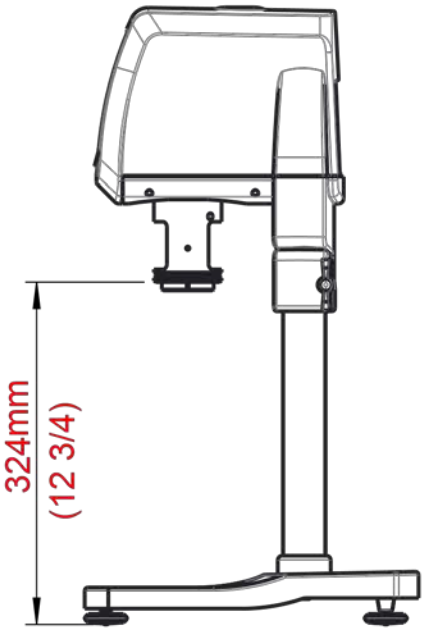
A typical test runs for 60 seconds at 78 RPM. The Brabender Unit value at the end of the time interval is recorded.

The measurement unit is the “BU”, which replaces the shear stress value on the rheometer display. BU is calculated by multiplying the torque by 1. The multiplier, which is called the BU Factor, is the default setting, but may be adjusted if necessary.

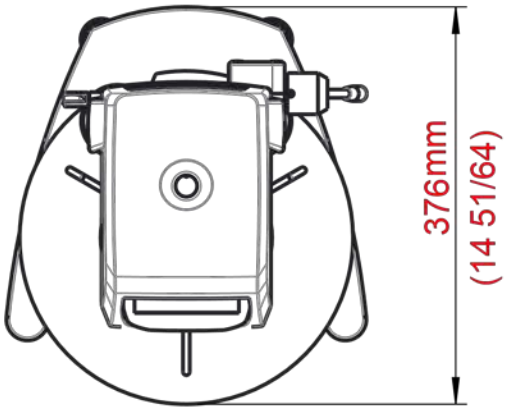
Appendix G Instrument Dimensions

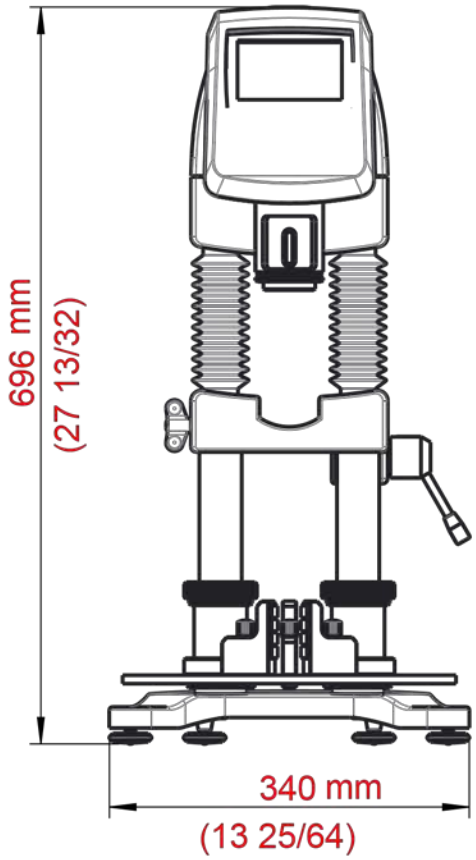
RST-CC:

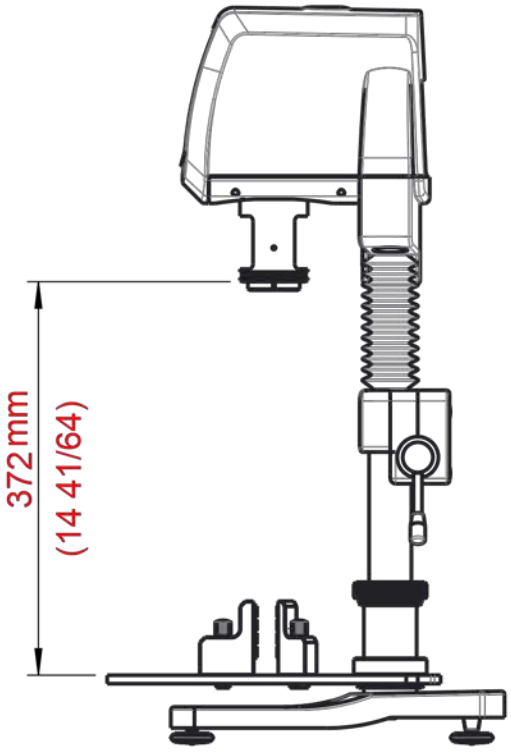




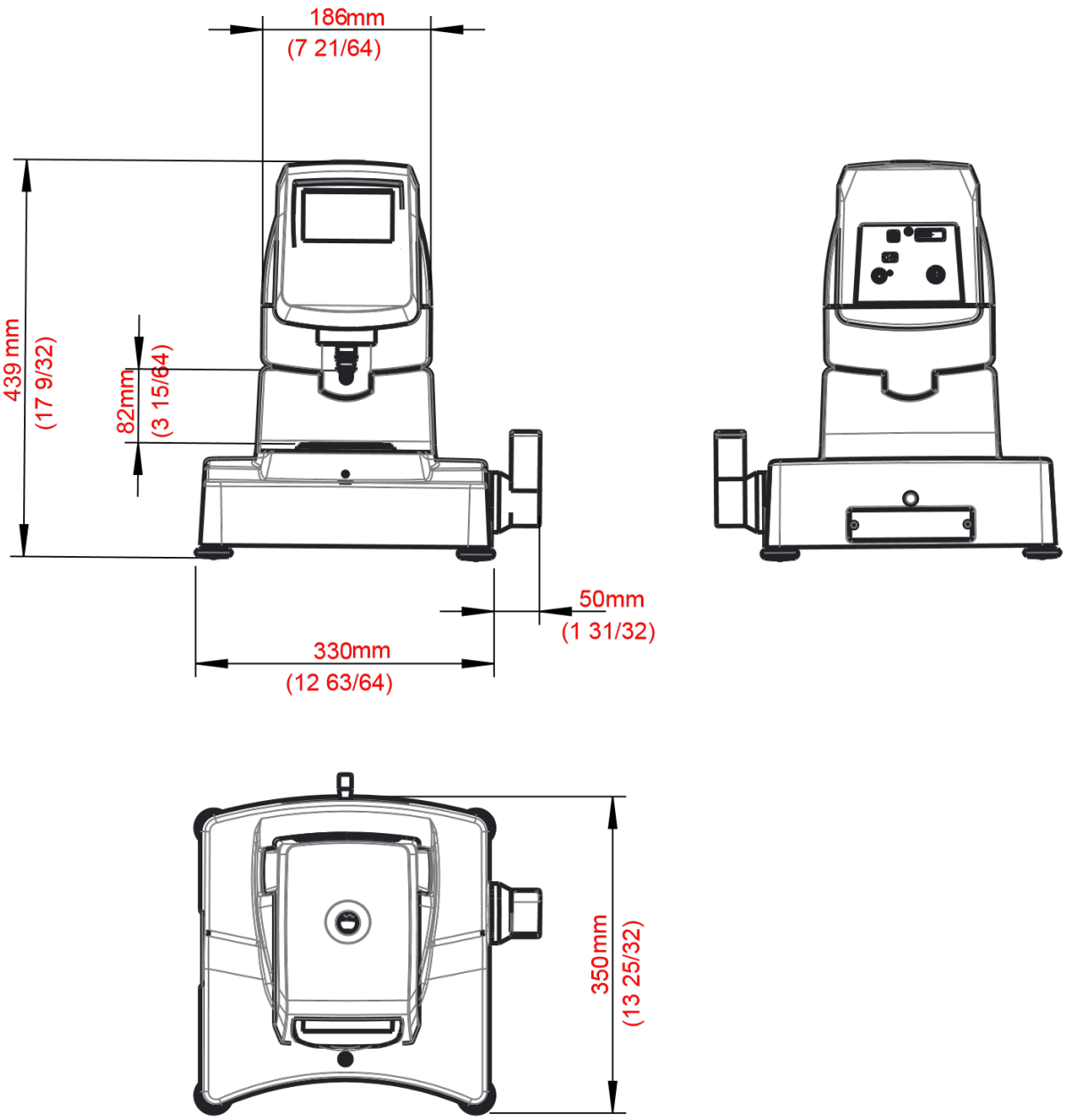
RST-SST:



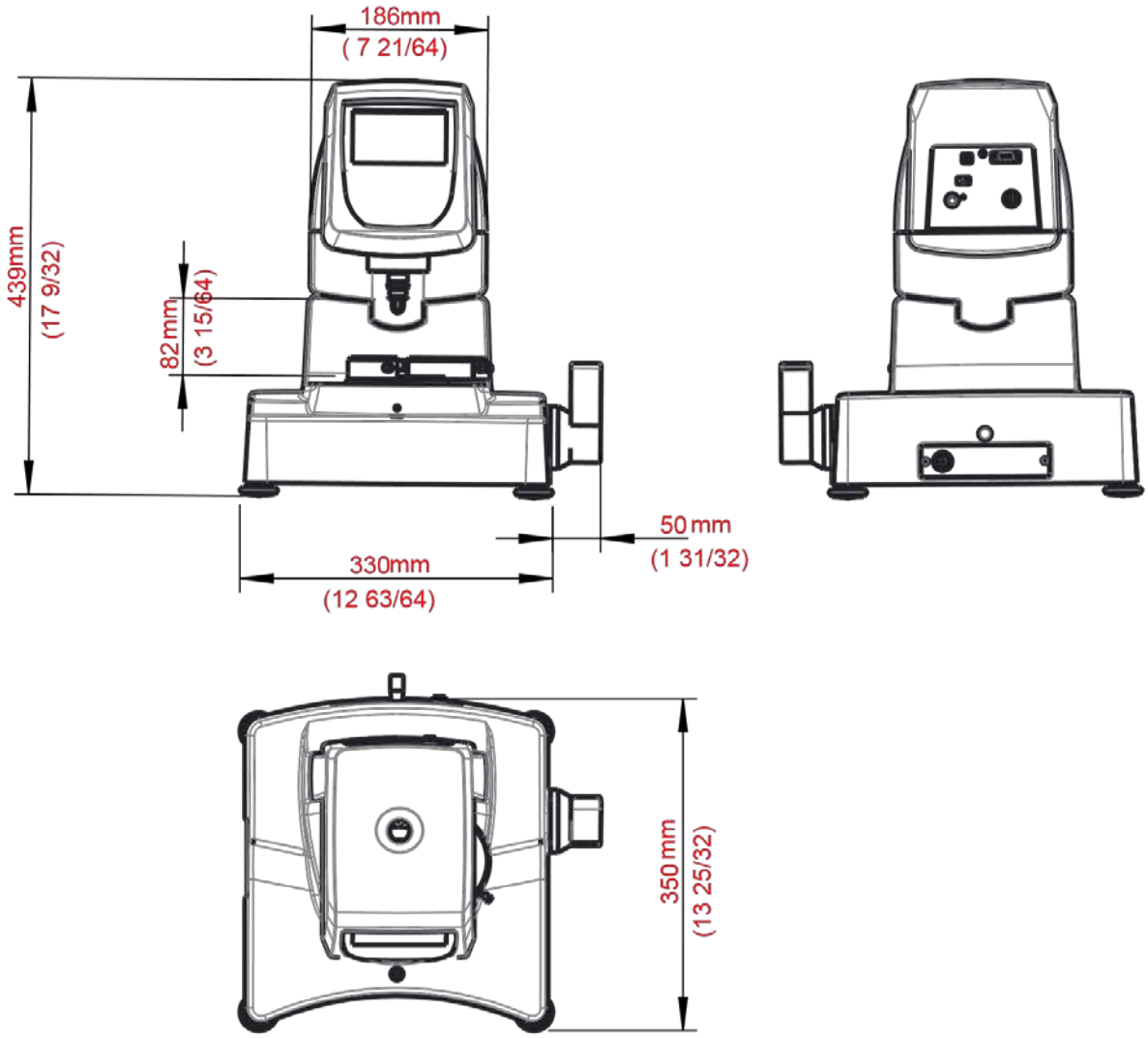




RST-CPS-F:


186mm
(7 21/64)
439 mm
(17 9/32)
82mm
(3 15/64)
50mm
(1 31/32)
330mm
(12 63/64)
350mm
(13 25/32)

RST-CPS-PA / -PO, RST-CPS-EH:



Appendix H Online Help and Additional Resources

www.brookfieldengineering.com**

The Brookfield website is a good resource for additional information and self-help whenever you need it. Our website offers a selection of "how-to" videos, application notes, conversion tables, instructional manuals, material safety data sheets, calibration templates and other technical resources.

http://www.youtube.com/user/BrookfieldEng

Brookfield has its own YouTube channel. Videos posted to our website can be found here as well as other "home-made" videos made by our own technical sales group.

www.ViscosityJournal.com

Brookfield has a satellite website that should be your first stop in viscosity research. This site serves as a library of interviews with experts in the viscosity field as well as Brookfield technical articles and conversion charts. Registration is required, so that you can be notified of upcoming interviews and events, however, this information will not be shared with other vendors, institutions, etc..

Article Reprints

- **Available in Print Only**
- Brookfield has an extensive library of published articles relating to viscosity, texture and powder testing. Due to copyright restrictions, these articles cannot be emailed. Please request your hardcopy of articles by calling our customer service department directly or by emailing: marketing@brookfieldengineering.com.
- **Available Online**
- Brookfield has a growing number of published articles that can be downloaded directly from the Brookfield website. These articles can be found on our main site by following this path: http://www.brookfieldengineering.com/support/documentation/article reprints.

More Solutions to Sticky Problems

Learn more about viscosity and rheology with our most popular publication. This informative booklet will provide you with measurement techniques, advice and much more. It's a must-have for any Brookfield Viscometer or Rheometer operator. More Solutions is available in print and also as a downloadable PDF on the Brookfield website by following this path:
http://www.brookfieldengineering.com/support/documentation.

Training/Courses

Whether it is instrument-specific courses, training to help you better prepare for auditing concerns, or just a better understanding of your methods, who better to learn from than the worldwide leaders of viscosity measuring equipment? Visit our Services section on our website to learn more about training.

** Downloads will require you to register your name, company and email address. We respect your privacy and will not share this information outside of Brookfield.

Appendix I Warranty Repair and Service

Warranty

Brookfield Viscometers/Rheometers are guaranteed for one year from date of purchase against defects in materials and workmanship. They are certified against primary viscosity standards traceable to the National Institute of Standards and Technology (N.I.S.T.). The Rheometer must be returned to **Brookfield Engineering Laboratories, Inc.** or the Brookfield dealer from whom it was purchased for no charge warranty service. Transportation is at the purchaser's expense. The Rheometer should be shipped in its carrying case together with all spindles originally provided with the instrument. If returning to Brookfield please contact us for a return authorization number prior to shipping.

For a copy of the Repair Return Form, go to the Brookfield website,
www.brookfieldengineering.com

For repair or service in the **United States** return to:

Brookfield Engineering Laboratories, Inc.
11 Commerce Boulevard
Middleboro, MA 02346 U.S.A.
Telephone: (508) 946-6200 FAX: (508) 946-6262
www.brookfieldengineering.com

For repair or service outside the United States, consult Brookfield Engineering Laboratories, Inc. or the dealer from whom you purchased the instrument.

For repair or service in the **United Kingdom** return to:

Brookfield Viscometers Limited
Brookfield Technical Centre
Stadium Way
Harlow, Essex CM19 5GX, England
Telephone: (44) 1279/451774 FAX: (44) 1279/451775
www.brookfield.co.uk

For repair or service in **Germany** return to:

Brookfield Engineering Laboratories Vertriebs GmbH
Hauptstrasse 18
D-73547 Lorch, Germany
Telephone: (49) 7172/927100 FAX: (49) 7172/927105
www.brookfield-gmbh.de

For repair or service in **China** return to:

Guangzhou Brookfield Viscometers and Texture Instruments Service Company Ltd.
Suite 905, South Tower, Xindacheng Plaza
193 Guangzhou Da Dao Bei, Yuexiu District
Guangzhou, 510075 P. R. China
Telephone: (86) 20/3760-0548 FAX: (86) 20/3760-0548
www.brookfield.com.cn

On-site service at your facility is also available from Brookfield. Please contact our Service Department in the United States, United Kingdom, Germany or China for details.