LAMY RHEOLOGY INSTRUMENTS

USING MANUAL

RM 100 CP2000 PLUS

VERSION N° RM100CP2K-UK06/2025

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1 INTRODUCTION

The instrument is a device able to measure the viscosity, which is capacity of a product to resist to the flow.

The fluid is forced to a shear rate (rotational speed) and the shear stress (motor torque) is measured. The values of shear rate and shear stress then make it possible to calculate the viscosity using the Newton equation and the constants associated with the mobile used.

Equation of Newton is: $\eta = \frac{\tau}{\dot{\gamma}}$

With η for viscosity in Pa.s, τ for shear stress in Pa and $\dot{\gamma}$ for shear rate in s^{-1}.

Shear stress and shear rate are calculated by using constants of each measuring system as:

$\tau = M \times K_{Tau}$ with M for motor torque in mNm and K_{Tau} in Pa/mNm.

$\dot{\gamma} = n \times K_D$ with n for rotational speed in rpm and K_D in s^{-1}/ rpm.

The instrument calculates the viscosity by dividing the shear stress by the shear rate for each measuring point. The K_{Tau} and K_D constants used depend on the measuring system selected for the measurement.

Viscosity depends on the temperature, then it must be essential that all viscosity values are associated to a reading of the sample temperature, in order to compare viscosity for different samples.

There are some products for which the viscosity, to a constant temperature, stay unchanged, even if we change the shear rate. Those samples are named **Newtonian fluids**, i.e. : Oils, Water, Glycerol, etc…However, many substances have a variation of viscosity in function of speed of shearing, and the Flow Behaviour of those samples could be determined with measuring instruments able to set many speeds of rotation.

The instrument is constituted with a continuous current motor with an optical encoder, in order to warranty a great accuracy of the speed of rotation of bob, on all torque range.

The instrument has an easy touch screen display, on which you could read the **speed**, **measuring spindle** reference, temperature, the measured torque and the dynamic **viscosity** in **mPa.s (=cPoises) or Pa.s**.

The instrument can be used with different measuring system. You will find below a list of compatible measuring system with this instrument.

- **MS CP/MS-PP:** Measuring systems cone or plate compatible with DIN 53019 / ISO 3219 / ASTM D4278-D7395 (316L Stainless Steel).These systems make it possible to set the shear rate in order to carry out viscosity measurements or to obtain curves to study flow behaviour, yield stress or thixotropy. They are particularly suitable for measurements on very small quantities for control or development of homogeneous products with or without particles (size <100µm), guaranteeing easy cleaning.

1.1 Components

Viscometer is delivered inside a foam protection to avoid any problem during transport. RM100 CP2000 PLUS is delivered mounted (please note that picture of device below show old design as grey ring below arm is not present anymore, see section 1.2). You will find some cable, measuring system (according to order) and some tools for installation and using.

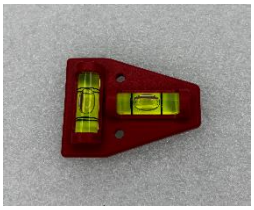
In detail, you will find different part in your box as shown below.

RM100 CP2000 PLUS

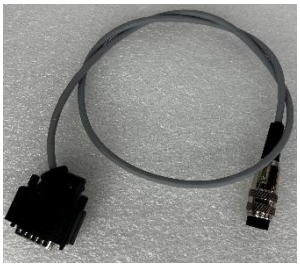
Cable and power supply for measuring head.

Cable for CP2000

Tool for levelling of RM100 CP2000 PLUS



Level indicator



Cable for connexion of measuring head with CP2000 temperature control.

Cable for programmer (only for models N170100, N170300, N170500 and

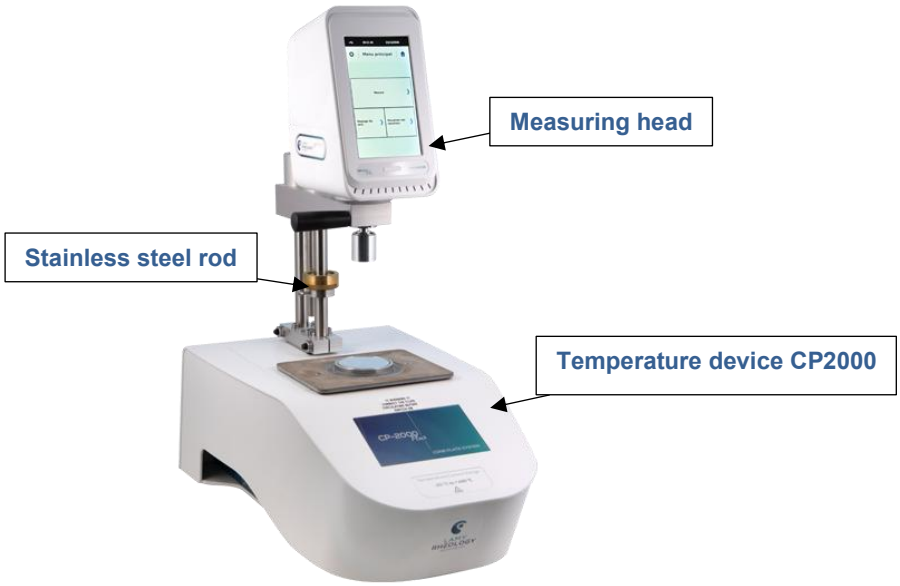
Bottom plate 70mm

Cable for electrical contact between head and CP2000 stand.

Pipe with connector for Liquid Peltier (only models N170200 and N170300).

1.2 General view of your device

Once your device will be mounted and installed, it looks like this;

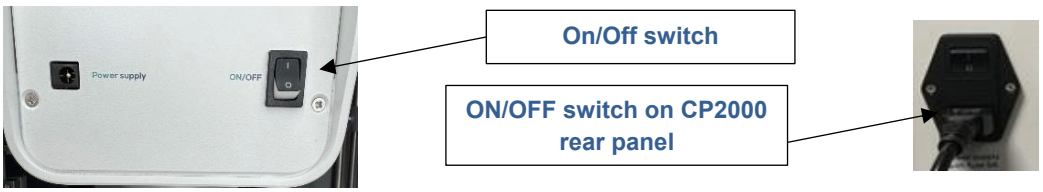


- **TOUCH Screen**

The new PLUS series is equipped with a 7" colour touch screen. It gives you greater working comfort and a clearer view of your data and analysis results.

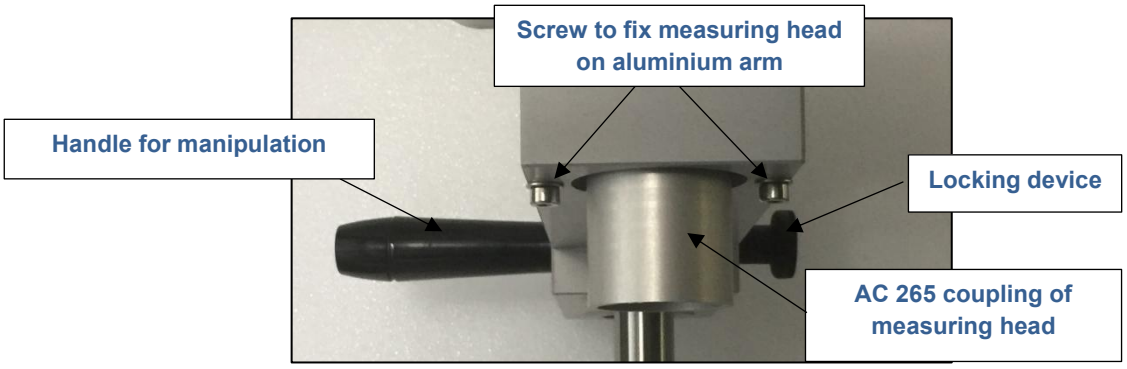
- **On / Off switch**

Always with the aim of improving your experience, LAMY RHEOLOGY has decided to equip its entire range PLUS with an On/Off button. It has been placed on the back of the device for greater intuitiveness. Another switch is located on the back of the CP2000 stand.



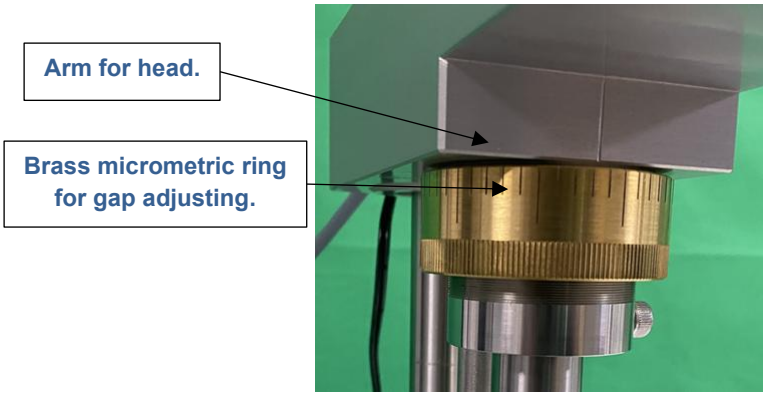
- **Aluminium arm**

The aluminium arm is equipped with the clamping knob allows you to maintain the height of the measuring head and a handle for easy handling. The measuring head is fixed to the arm by one screw.



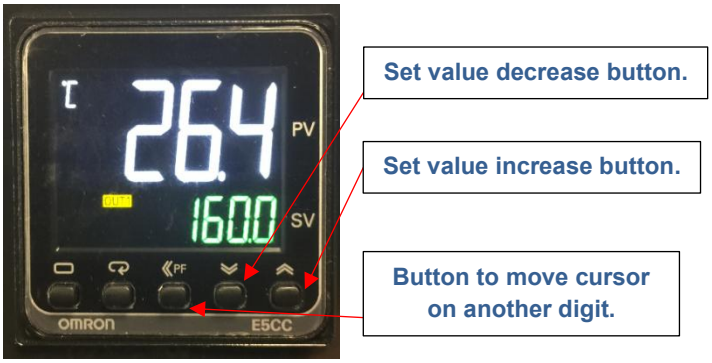
- **Stainless steel rod**

The support rod is made of stainless steel for a solid hold of the measuring head. It has a very long life. One of them is equipped with a micrometric ring for adjusting the gap.



- **Temperature unit CP2000**

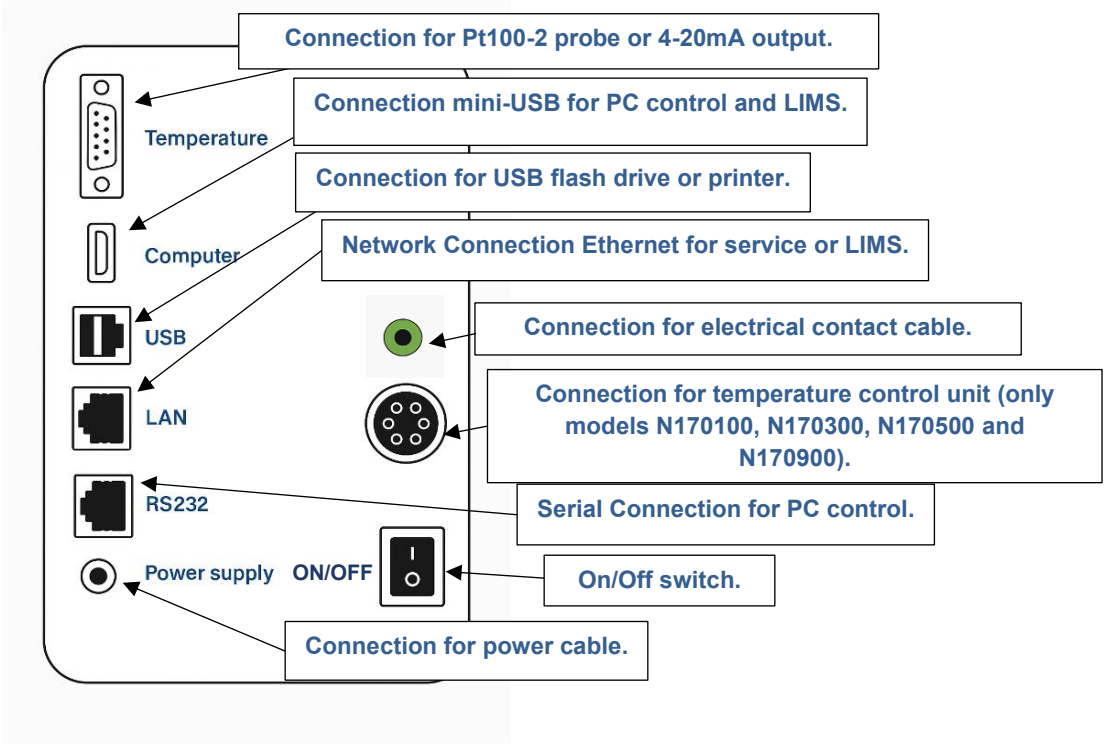
This device regulates the temperature of your sample. Some of them are equipped with a display/regulator OMRON (model N170000, N170200, N170400 and N170800). Some of them doesn't have any regulator and managing of temperature will be done directly on measuring head as explained in section 2.9 (this is the case for models N170100, N170300, N170500 and N170900). It exists in Peltier or electrical heating version.



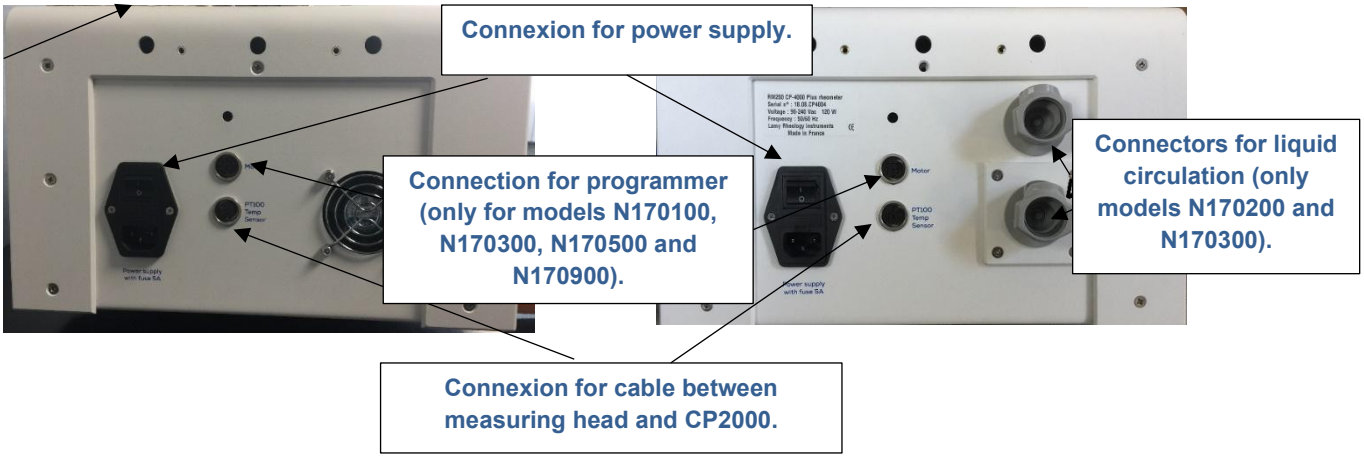
The lower plate is interchangeable to accommodate the diameter of the measuring geometry. By defaut device is delivered with 70mm bottom plate.

1.3 Connections

According to your order, rear panel of device get these available connections.



The rear panel of the CP2000 support has these connections.



1.4 Specifications

Type of instrument: Rotating springless instrument with 7'' Touch screen

Rotation speeds: Unlimited number of speeds between 0.3 and 1500 rpm

Torque range: From 0.05 to 30 mNm.

Accuracy: +/- 1 % of the full scale

Repeatability: +/- 0,2 %

Display: Viscosity – Speed – Torque – Time - Temperature - Choice of viscosity units: cP/Poises or mPa.s / Pa.s

Language: French/English/Russian/Spanish/Turkish/German/Italian/Korean/Portuguese.

Compatible measuring system: MS CP/MS-PP.

Supply voltage: 90-240 VAC 50/60 Hz

Connection: USB, RS232 and ETHERNET.

Options: See brochure

Dimensions and weight: D610 x W340 x H700 mm, Weight: 22 kg.

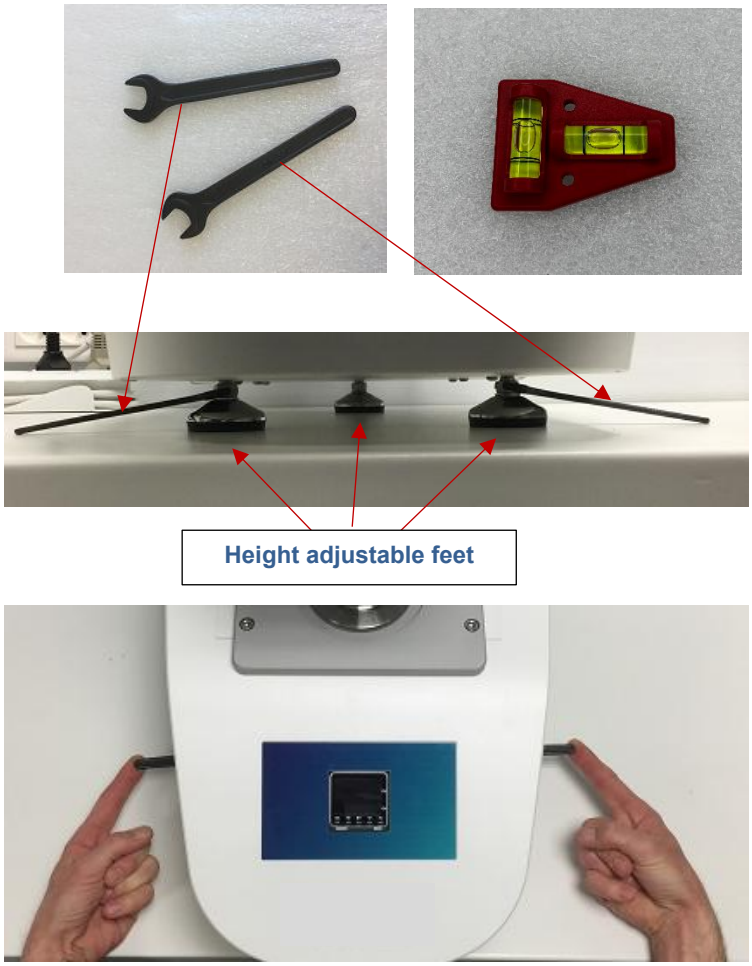
This is the available models.

Part Number Instrument	Designation Instrument
N170000	RM 100 CP2000 PLUS VISCOMETER Peltier air-air (+10 to +70°C)
N170100	RM 100 CP2000 PLUS VISCOMETER Peltier air-air (+10 to +70°C) with programmer
N170200	RM 100 CP2000 PLUS VISCOMETER with liquid Peltier (-20 to +100°C)
N170300	RM 100 CP2000 PLUS VISCOMETER with liquid Peltier (-20 to +100°C) with programmer
N170400	RM 100 CP2000 PLUS H VISCOMETER (Room to +300°C)
N170500	RM 100 CP2000 PLUS H VISCOMETER (Room to +300°C) with programmer
N170800	RM 100 CP2000 PLUS VISCOMETER Peltier air-air (+0 to +150°C)
N170900	RM 100 CP2000 PLUS VISCOMETER Peltier air-air (+0 to +150°C) + programmer

Please note that models N170200 and N170300 requires liquid circulator not included as default shipment. For these devices, ensure that circulating is TURNED ON before any use of RM100 CP2000 PLUS.

1.5 Installation

Install the CP2000 on a solid bench. Place the level on the plane and adjust the level using the 2 keys provided by playing on the three adjustable feet in height.



Connect the temperature reading cord (blue): SUB-D 15 connector on rear of the RM PLUS to the DIN plug on the back of the CP-2000 stand. Connect the cable (black or grey) between the CP2000 (“Motor”) and the head (only for model with programmer). Connect the white electrical contact lead to the back of the measuring head.

Connect the RM100 PLUS and CP2000 power câble. Connect your viscometer by plugging power cable on to rear panel of device. Also cable for software connection when they are provided.

Some models as N170200 and N170300 require liquid circulation. You have to connect provided pipe to circulating bath. Sense of circulation doesn’t matter. Please note to always Switch ON circulating bath before using viscometer.

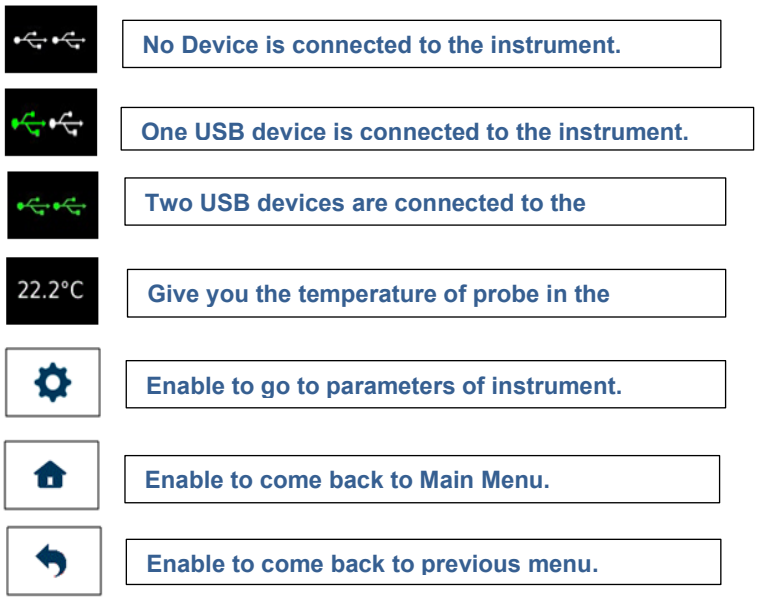
Your instrument will be used with different measuring system. To know how to mount and use it, please see section 3 (see section 1.3).

2 GETTING STARTED

Once power cable has been plugged on rear panel of device, you can click on button On/ Off from behind your device to switch on (see section 1.3).

2.1 State icons

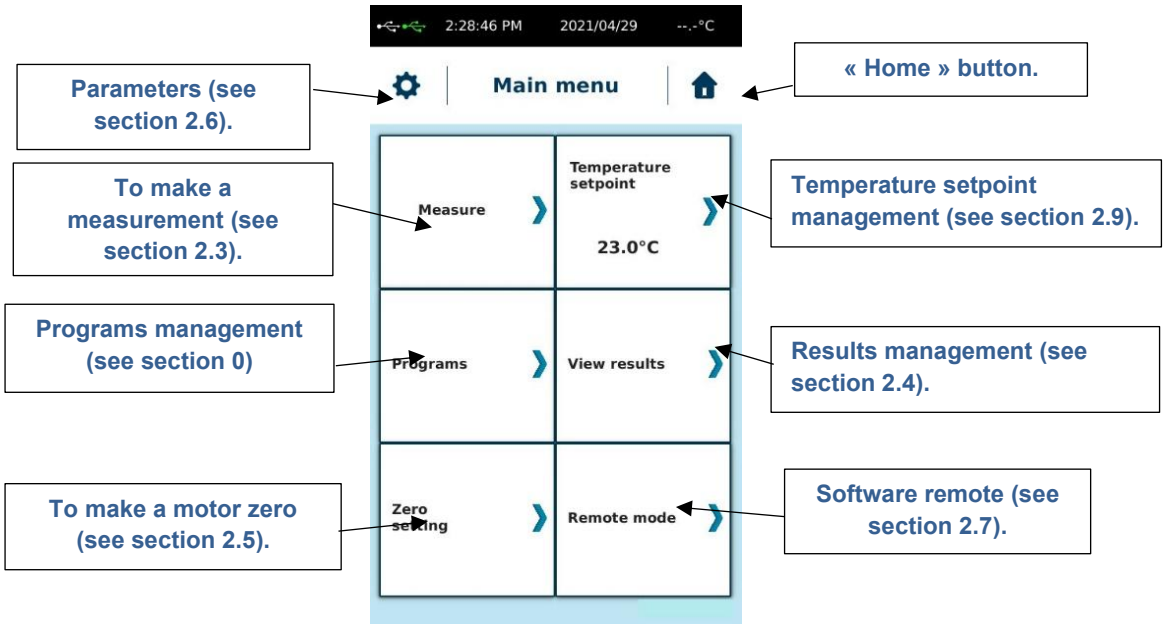
Once your device is switched on, you will see some icons on Touch Screen.



The USB port icon indicates that a USB flash drive has been connected. This is used to update the firmware or to transfer the results.

2.2 Main Menu

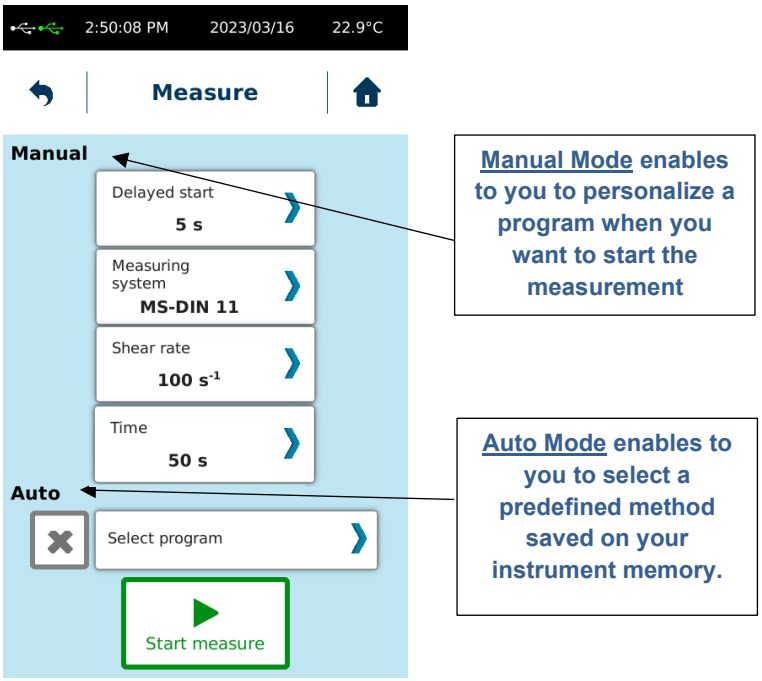
Main menu enable you to browse between different tabs of your instrument. Acces is always available by clicking.



The "Temperature setpoint" button is present only for model N170100, N170300, N170500 and N170900.

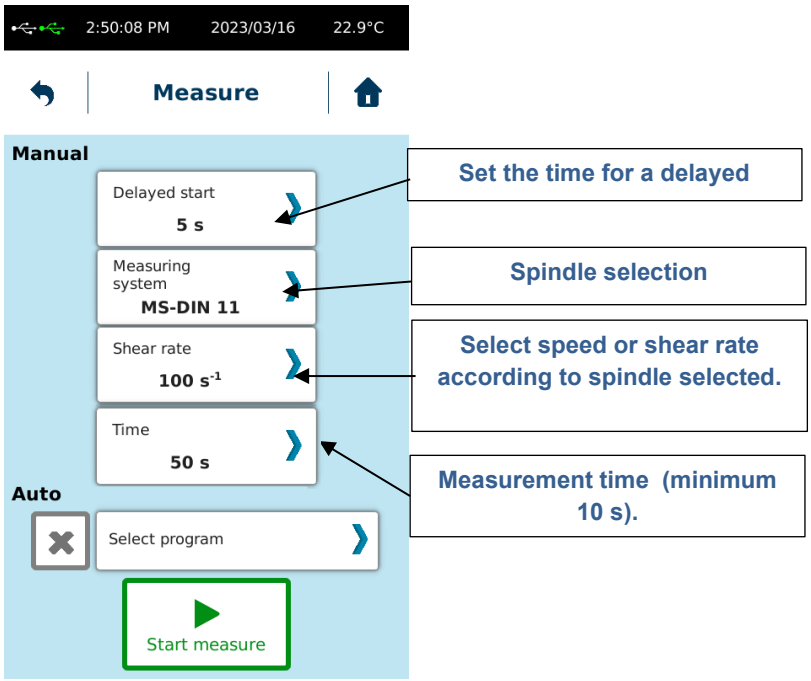
2.3 Measure menu

Measure tab is central part of your instrument. Before to use it, you should install your measuring system and your sample (please see section 3).



2.3.1 Manual measure mode

Manual Mode enables to choose your measurement parameters like “Measuring System”, “Speed or shear rate”, “Time of measurement” and “Delayed start”.



Rq : If « Time » = 0, you could modify « speed » during the measurement. This could help you to define the best conditions to work on your sample.

If your measuring system is not in list, you may have to create it. Please refer to section 2.6.6.

Choice between “Speed” or “Shear rate” is according to your measuring system. For measuring system MS-CP/MS-PP, you can use shear rate or speed if you force it to show rpm (see section 2.6.9). If you need to know what is the corresponding speed then you are using shear rate, you have to use constant K_D of your measuring system (information available in section 2.6.6).

SPEED = SHEAR RATE / K_D

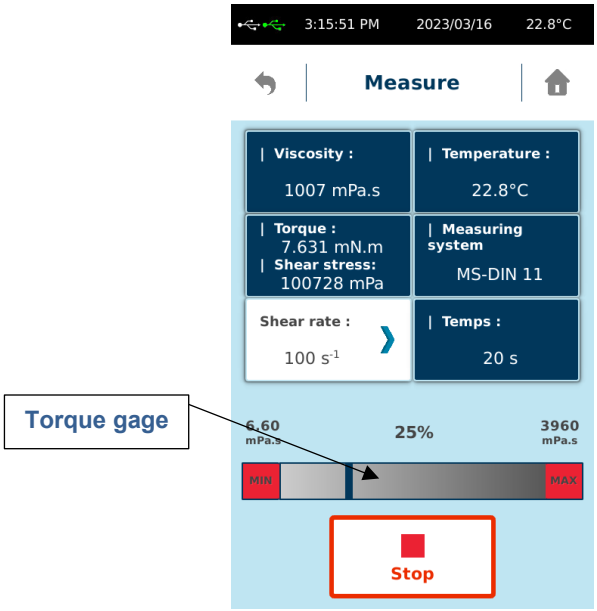
With speed unit in rpm, shear rate in s^{-1} and K_D is rpm/s^{-1}.

When your parameters are entered, make sure that the zero adjustment of the motor has been performed before starting your measurement. Depending on the model of instrument you have, the procedure may be different (see section 2.5).

Make sure that the measuring system you are using has been correctly installed (see section 3).

When all these checks have been carried out, you can click on "Start measure" to start your measurement.

If a delayed start has been requested, the instrument displays a countdown then switches to the next view.

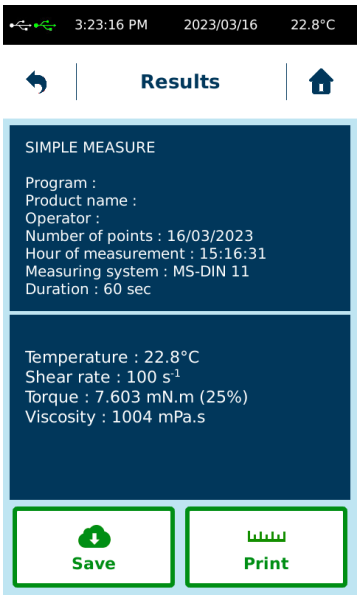


While measurement in manual mode you will see a torque gage (on the bottom side of the display). Boundaries of this gage give you minimum and maximum viscosity you can measure with your selected spindle and set speed/shear rate. You have also value in % corresponding of measured torque vs maximum torque of device. This maximum torque or viewing % can be set on device (see section 2.6.8 and 2.6.9).

You must verify that the measured torque is not too close to the upper or lower limit, because you can get message as “Lower Torque” or “Torque Overload” and measurement will stop automatically. If this is the case, increase speed/shear rate or take a larger measurement system if you are close to the lower limit. Please decrease speed/shear rate or choose a smaller measurement system if the torque reading is close to the upper limit.

You will find several information available on the screen such as torque (mN.m), Shear stress (Pa, can be set on section 2.6.9), temperature (° C), time (s) or viscosity (mPa.s). If the units do not suit you, you can change them in parameters (see section 2.6.5).

Then your measurement is finished, you will get this window below. You will find all data you need and get possibility to save them into internal memory or print it if printer is connected. If you choose “Save”, instrument will ask you to give a name of your measurement. You will have after possibility to read it later (see section 2.4).

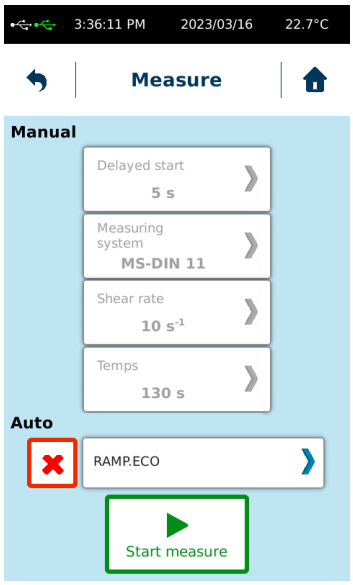


2.3.2 Automatic measure mode

Auto mode allows you to select pre-recorded programs (see section 0). Press “Select program” to see the list of saved method.

The extension shown next to the program name indicates the type of method according to: “*.TXT” for 1-point method, “*.PSS” for step method and “*.

Select the program to use. The instrument displays the measurement view with some information from the selected method.



If you made a mistake in choosing the method, you can use the symbol  to allow you a new selection.

When your parameters are entered, make sure that the zero adjustment of the motor has been performed before starting your measurement. Depending on the model of instrument you have, the procedure may be different (see section 2.5).

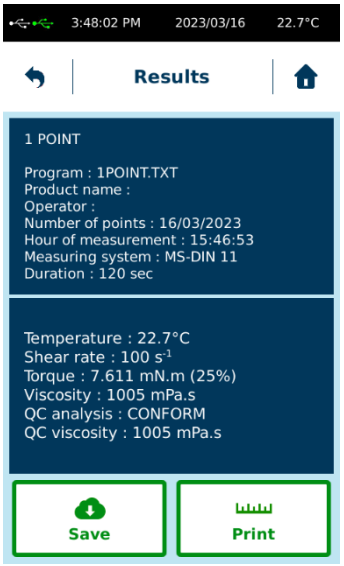
Make sure that the measuring system you are using has been correctly installed (see section 3).

When all these checks have been carried out, you can click on "Start measure" to start your measurement.

2.3.2.1 1 point method measure mode

The results displayed during the measurement is no different from the manual mode with simple measurement (see paragraph 2.3.1).

At the end of measure, instrument show you this new window with important information according to settings of your method.



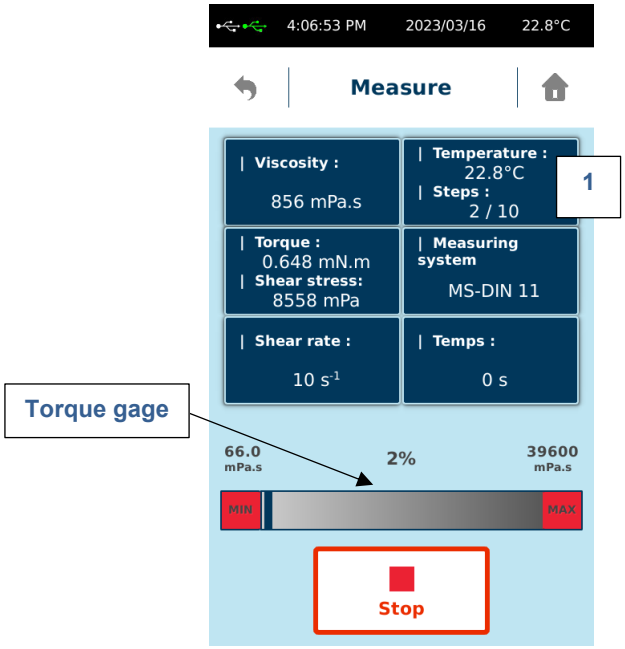
Additionally, to explication on section 2.3.1, you see type of method with name of program on first part of display. On second part of display, you show information about QC analysis if your program had it (see section 2.8.1.1). “QC viscosity” is the measured value used for “QC analysis”.

You will find all data you need and get possibility to save them into internal memory or print it if printer is connected. If you choose “Save”, instrument will ask you to give a name of your measurement. You will have after possibility to read it later (see section 2.4).

2.3.2.2 Step method measure mode

After starting the measurement using a step method, the instrument asks you for a file name to save in its memory.

If a delayed start has been requested, the instrument displays a countdown then switches to the next view.



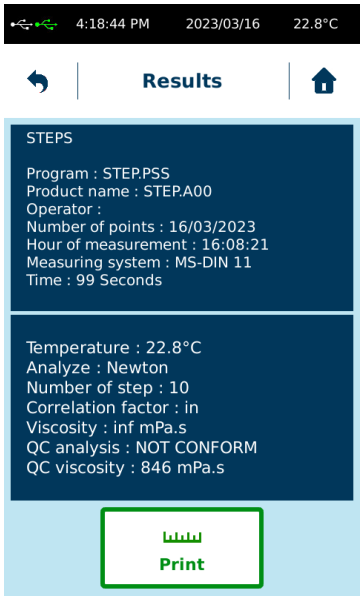
During your measurement, the instrument displays several information. The case marked "1" changes during the measurement. For models N170100, N170300, N170500 and N170900, if you have set a setpoint temperature with a start when the setpoint is reached (see section 2.8.1.2), the instrument displays the current temperature and the elapsed waiting time. When the setpoint condition is reached, case "1" switches to the display of the step in progress. For other models, case “1” directly indicates temperature measured and step in progress. To manage temperature settings with these models, please refer to section 3.2.

The instrument displays a torque gauge with displayed viscosity limits calculated according to measuring spindle used and the speed or shear rate of each step in progress. The percentage value indicates the ratio between the measured torque and the total torque of the instrument. This maximum torque or percentage display can be set on the device (see section 2.6.8 and 2.6.9).

You must check that the measured torque is not near the upper or lower limit, because you may get the message “Torque too low” or “Torque too high” and the measurement will stop automatically. If so, increase the speed or shear rate of your method's steps or use a larger measuring system if you are near the lower limit. Please decrease the speed or shear rate or choose a smaller measurement system if the torque reading is near the upper limit.

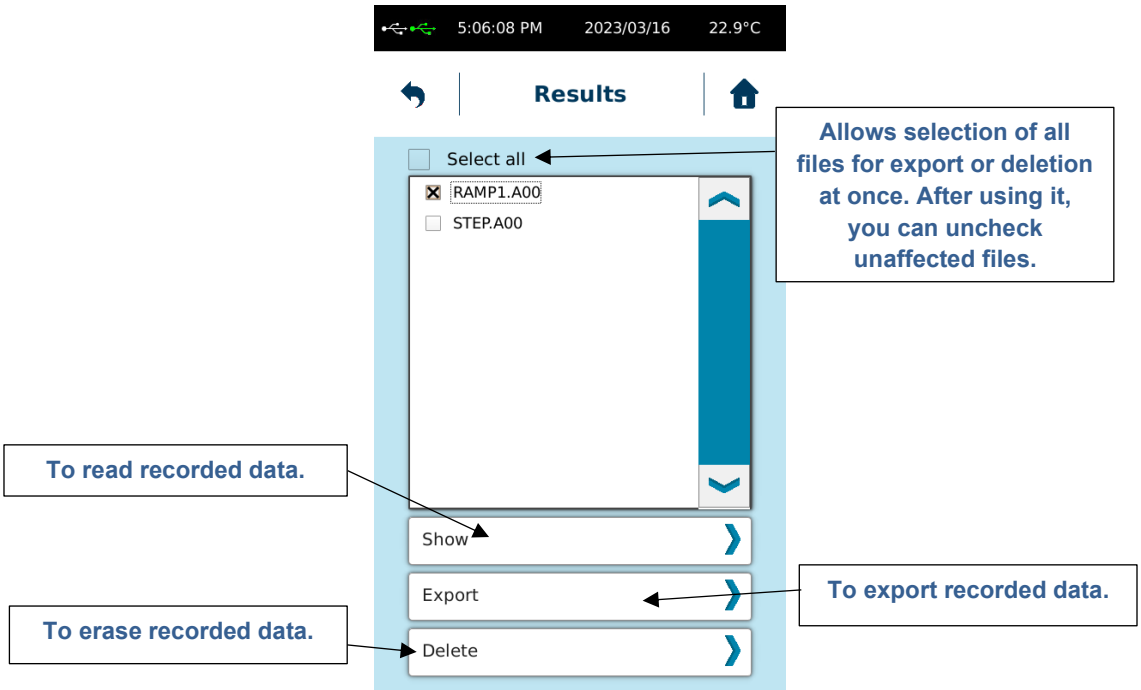
You will find several information available on the screen such as torque (mN.m), stress (Pa) (see section 2.6.9 to display this variable), temperature (°C), time (s) or viscosity (mPa.s). If the units do not suit you, you can change them in the settings (see section 2.6.5).

When your measurement is finished, you will get the window below. You will find all the data you need and will be able to print it if a printer is connected. The instrument displays the results of the rheological analysis and the “QC limits” analysis if your method includes these options (see paragraph 2.8.1.2). Note that the “QC Limits” analysis is performed on the viscosity measured during the last measured step (displayed on the screen after “QC Viscosity”). The data having been automatically saved in memory and you will then be able to read them later (see section 2.4).



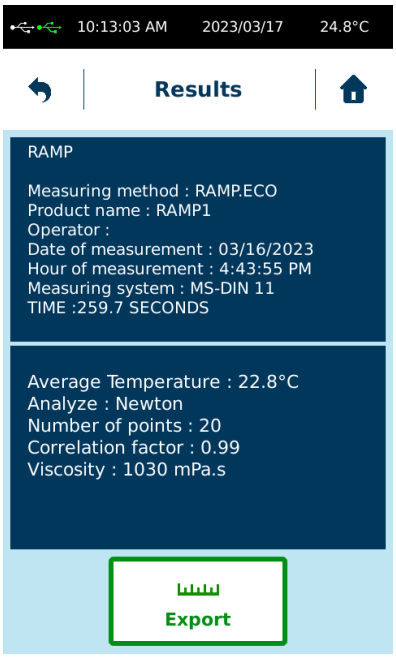
2.4 View results menu

This menu allow you to read, export or delete data from internal memory. Press on « View results » tab in Main menu.



2.4.1 Show results

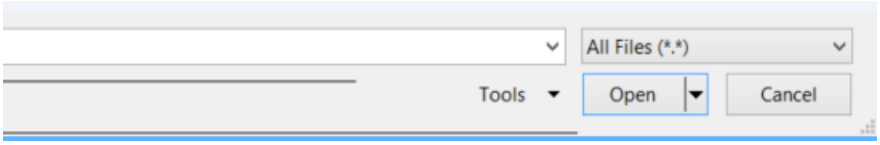
By clicking on this tab, you will be able to view the information concerning the selected measure. The data display format is the same as the one you get at the end of the measurement (see paragraph 2.3.2). You also have the possibility of printing or exporting depending on whether a printer or a USB key is connected to the instrument.



2.4.2 Export results

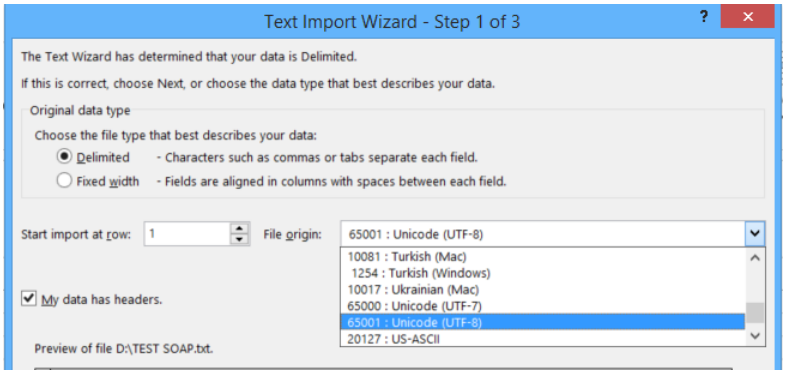
By clicking on "Export" you can transfer the measurements recorded to a USB key if it is connected to the back (see section 1.3). The "Select all" function allows you to export all the measurements at once.

The format of the data generated and saved by the instrument is ASCI (* .txt). Once your data has been copied to the USB drive, you can open the files using the EXCEL spreadsheet. To do this, simply copy the data from the USB key to your computer. Then open Excel, choose "File", "Open", taking care to select "All files *. *".

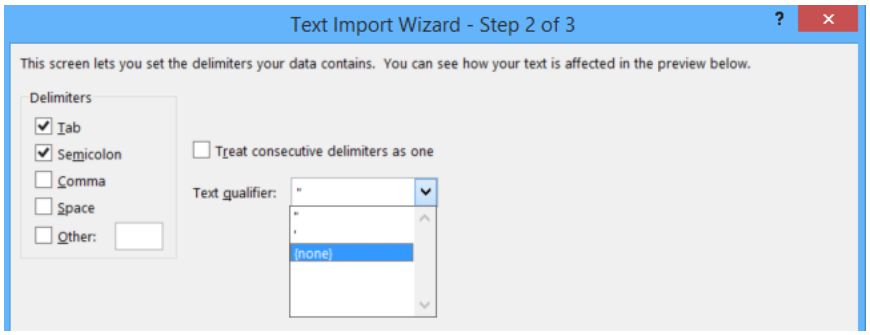


Find your file and click “Open”. Excel will offer you to convert your data by displaying three successive windows.

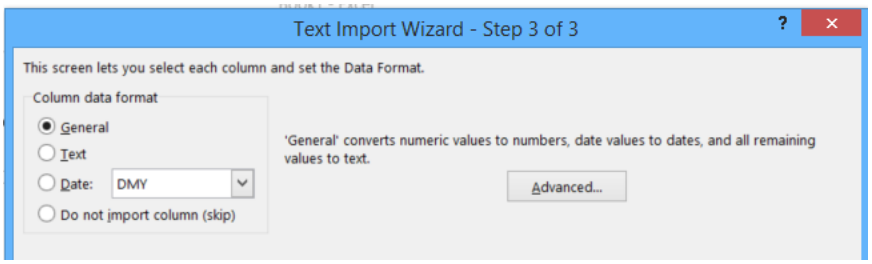
Select “Unicode UTF8” and “My data has Header” (last selection available according Office version) and click “Next”.



On second step, it will be necessary to choose the option “Tab” and "Semicolon" for separation of the columns. For “Text qualifier”, you should set “none”.



On last step, please choose “General” and click “Finish”.

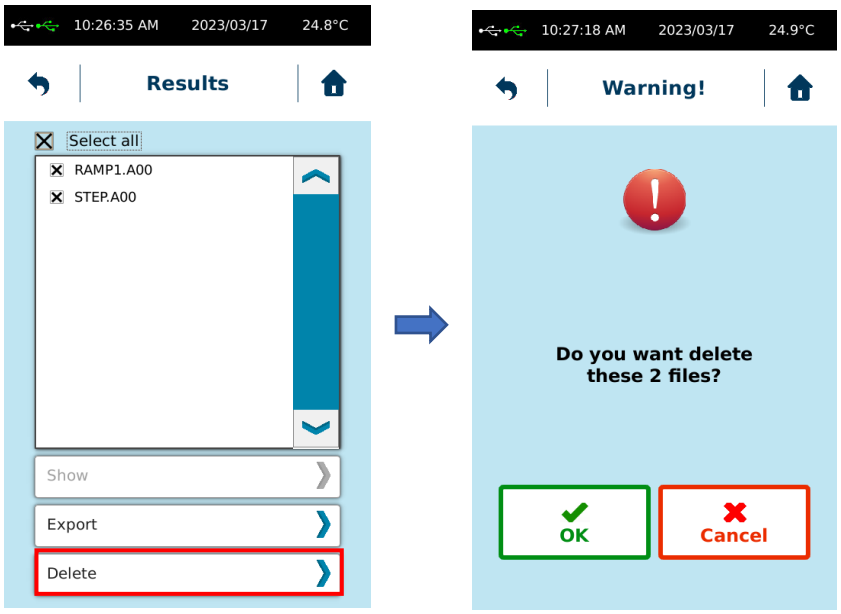


You can then see your measurement results with the possibility to save a new file in Excel format.

2.4.3 Delete results

By clicking on this tab, you can delete all the measurements recorded on your instrument. The "Select all" function allows you to delete all the measurements at once.

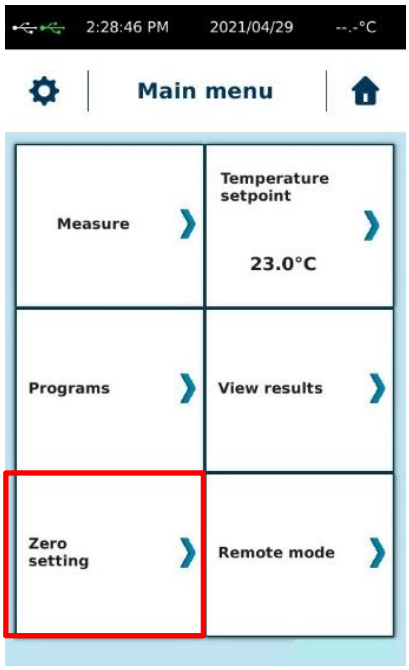
When you click "Delete", the recorded data will be completely deleted from the internal memory after further confirmation from you.



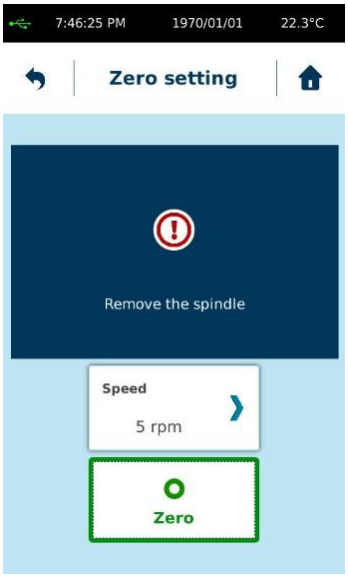
2.5 Zero setting

The zero setting allows you to calibrate your instrument to take account of the engine's empty friction.

Zero setting allows you to calibrate your instrument and take care of motor internal friction.



For standard instruments, this operation must be done without mobile. The rotational speed for zero adjustment is available on the same window. The rotation speed for zero adjustment can be changed to suit your needs, giving you much more accurate measurements at specific speeds near to your measurement parameters.

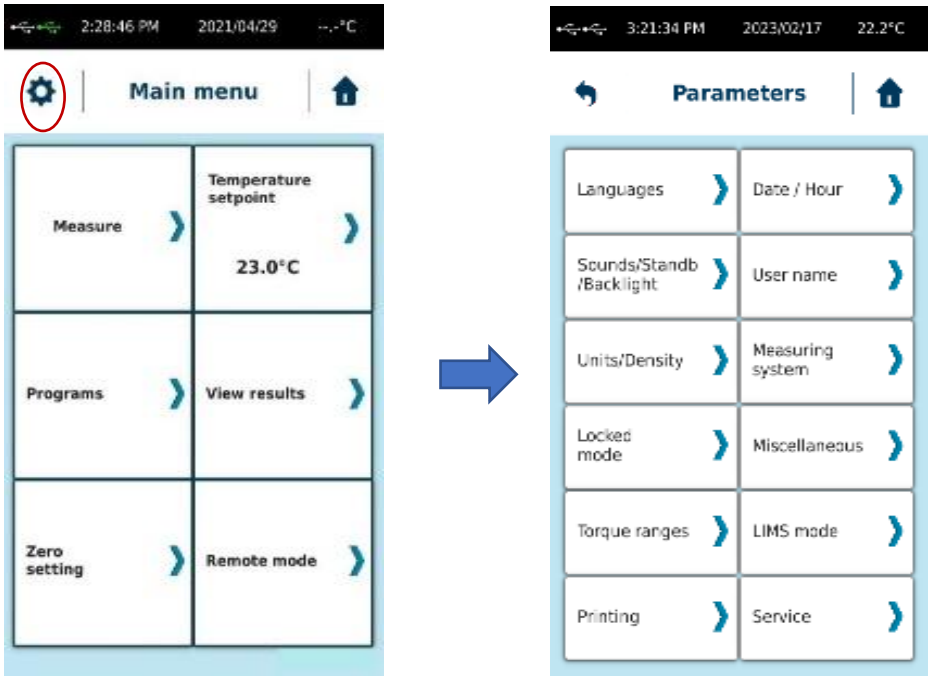


Then zero is finish you can click on OK and internal motor friction will be automatically saved inside memory of instrument. If problem occur during zero setting, please try again. If problem still present, please contact your local distributor or society LAMY RHEOLOGY.

2.6 Parameters menu

This parameters menu allows you to change settings of your device. It is reachable by clicking on icon " ⚙ " in upper left corner of touch screen.

This icon is only available then you are in "Main menu".

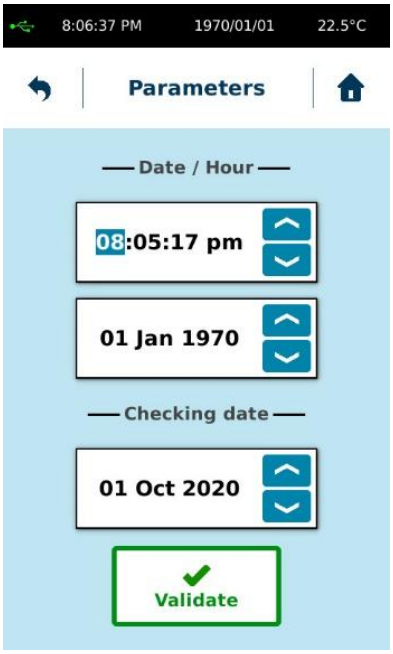


2.6.1 Languages

Enable you to select language of your instruments. You have choice between French, English, Russian, Turkish, Deutsche, Italian, Korean, Portuguese and Spanish. Then you have selected your desired language, you have to click on "Ok" and device will reboot automatically to show new language. In this menu you will be able to see Firmware version of your device.

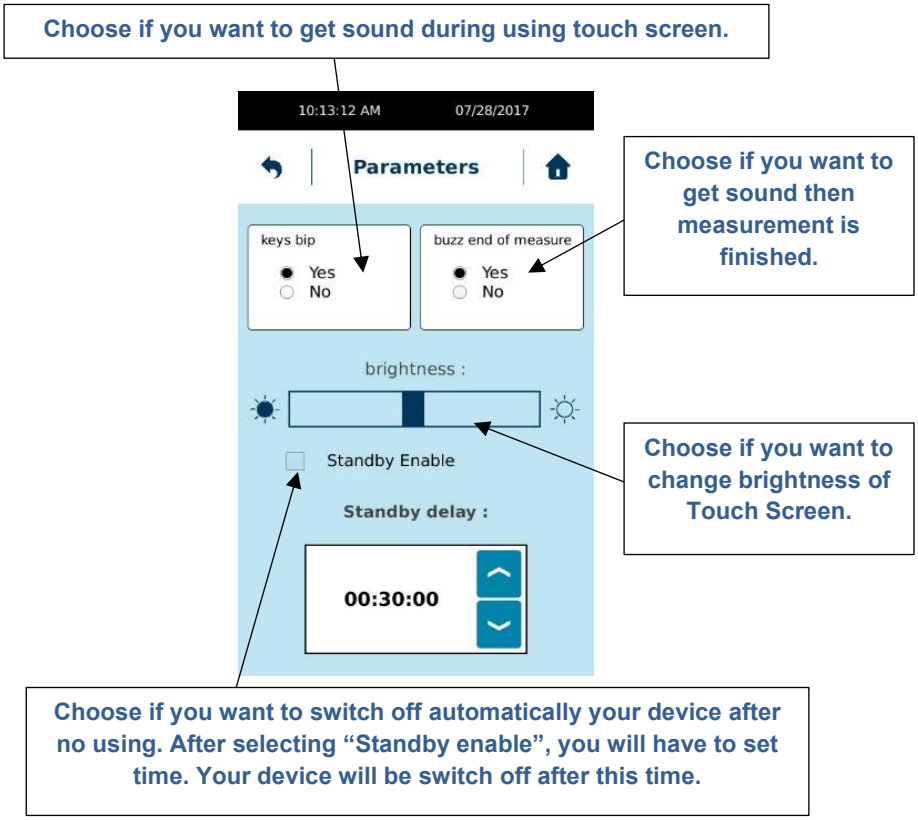
2.6.2 Date / Hour

Enable you to adjust hour and date of your instrument. On this location, you can also set date for next checking of device. Soon this date will be reached, device will show you message as device need to be checked.



2.6.3 Sounds/Standby/Lighting

Allow you to modify sounds, lighting and activate or not the Standby mode of your instrument.



2.6.4 User Name

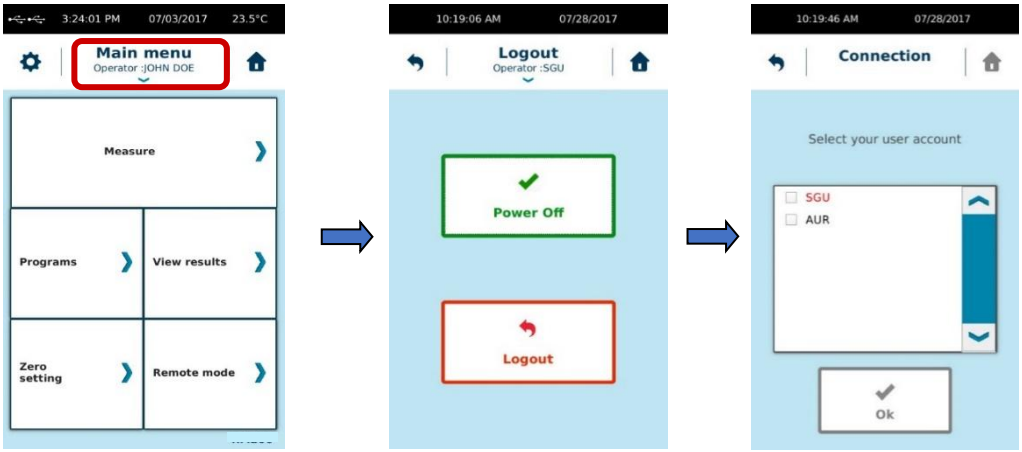
Operator mode will allow you to create different operators for your instrument. The use of the operators makes it possible to identify the person making the measurement (to save name on saved file and see later who made this measurement) or lock some function on device for simple user.

Operator management must always begin with the creation of the first account, which will become the administrator and thus create or delete another operator account. Click on “Create new user with PIN code”. After specifying the name and password, the administrator will be named in red in the list.

You can now create another operator. The account of an operator may or may not be associated with a password (here called PIN code).

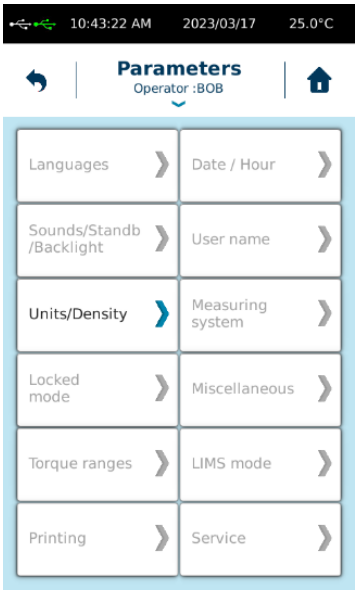
To delete an account, the administrator account must be used. Select the account you want to delete from the list and click on "Delete user name".

To use the operator accounts you must activate the mode by click “Enable User mode”. Device will ask you to select user name you want to use. By returning to the Main Menu, you will see the name of the operator in use. By clicking on the arrow below the name of the operator, you can switch off the instrument or change operator. Click on “Logout” and device will ask you operator account you want to use



If the instrument is switched OFF and ON while operator mode is activated, device will ask you to select the operator you want use.

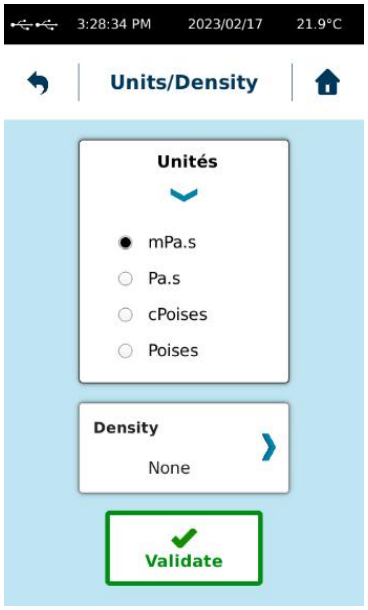
When User mode is enabled, some functions will be not editable for simple user as picture below shows it.

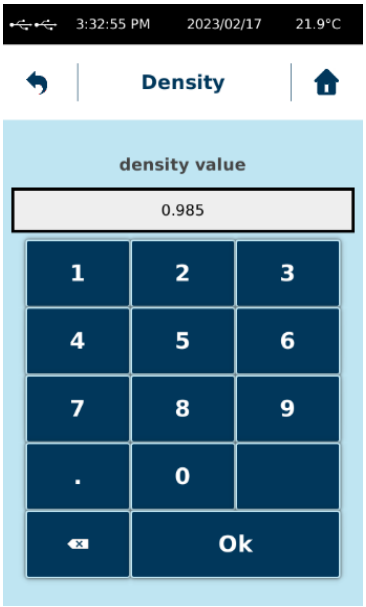


2.6.5 Units/Density

Enable you to change unit of viscosity values and to enter density value of your product to measure in order to calculate its kinematic viscosity.

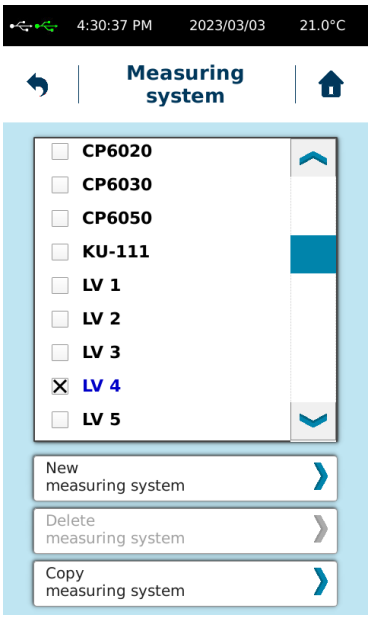
If you set a density value, you will get all the time kinematic viscosity in cStoke. Please remove density information if you want to get back Pa.s or Poise for unit of viscosity.





2.6.6 Measuring System

Allows you to add, copy or delete a Measurement System.



All measurement systems stored by default in memory are not removable. Only those you have created yourself can be removed. To delete a measuring system, select it from the list and choose "Delete Measuring System". If this function remains greyed out when you have selected a system, it is part of the default mobile stored in the instrument's memory.

To add a new measuring system, you can use "New measuring system" or “Copy measuring system” functions. Device will ask you name and constants for this measuring system. In case of copy, device will propose you to keep constant from previous measuring system but you can modify them.

You are not allowed to change the constant of an existing measuring system. If you want to use a new constant for an existing measuring system, you have to copy and modify it. Note that the KD constant is used to convert rotational speed to shear rate and KTau to convert torque to shear stress. Shear rate and shear stress are used to calculate the viscosity value. If you use a different constant value, you will get a different viscosity result.

Here is the list of constants used for measuring systems compatible with the instrument.

MS CP/MS-PP

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
CP1005	3820	12	1
CP1010	3820	6	1
CP1020	3820	3	1
CP1030	3820	2	1
CP06	1380	3.3	1
CP03	552	13.3	1
CP05	552	3.3	1
CP09	552	2	1
CP2005	477.5	12	1
CP2010	477.5	6	1
CP2015	477.5	3.8	1
CP2020	477.5	3	1
CP02	276	13.3	1
CP2404	276	13.3	1
CP2405	276.3	12	1
CP51Z	276	4	1
CP04	276	3	1
CP2420	276.3	3	1
CP52Z	276	2	1
CP01	139	13.3	1
CP10	139	5	1
CP08	139	2	1
CP3510	89	6	1
CP4005	59.7	12	1

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
CP4010	59.7	6	1
CP4015	59.7	3.8	1
CP4020	59.7	3	1
CP4040	59.7	1.5	1
CP07	35	2	1
CP40Z	35	7.5	1
CP42Z	35	4	1
CP41Z	35	2	1
CP5005	30.6	12	1
CP5010	30.6	6	1
CP5020	30.6	3	1
CP6005	17.7	12	1
CP6010	17.7	6	1
CP6020	17.7	3	1
CP6030	18	2	1
CP6050	18	1.2	1
PP20*	636	1.04	1
PP25*	326	1.31	1
PP28*	232	1.47	1
PP35*	119	1.83	1
PP40*	79.5	2.1	1
PP50*	41	2.6	1

* Given values for gap 1mm.

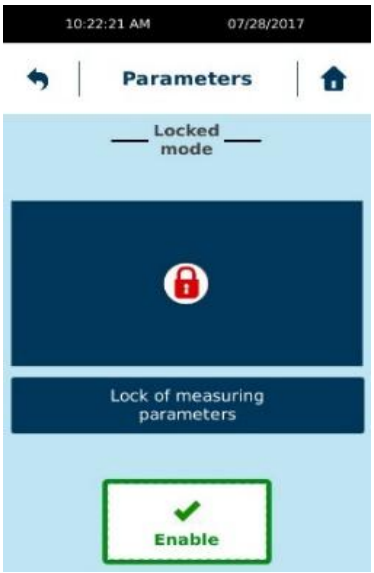
2.6.7 Locked Mode

This option allows you to block measuring parameters. It should be set by an administrator or responsible of the device.

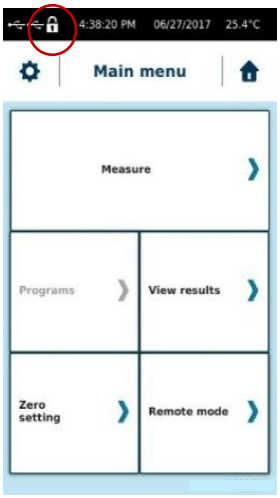
This function is not comparable to the “User name” menu (please see section 2.6.4). It should be use if you want to protect measurement settings on your device. All settings will be not lock by this function. You will see below which settings are concerned.

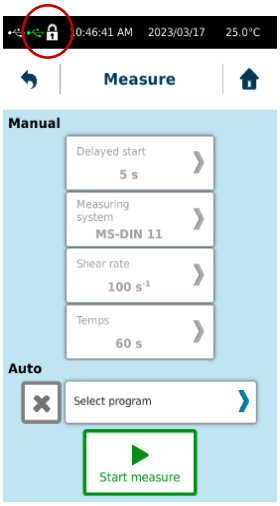
This function will block also parameters for measure. In this way, if you want to use all the time same parameters for measurement, you should enable this locked mode to be sure that nobody will change settings for measurement.

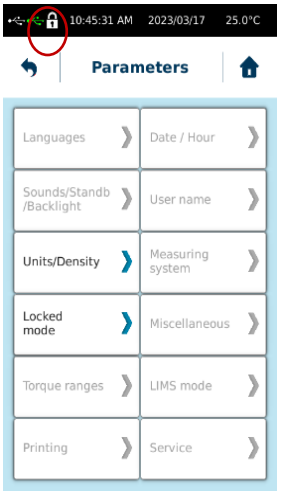
When you click "Enable", the instrument will ask you to save a 4-digit code that will be required to disable this protected mode. Each activation is independent and can be done with a different code. The protected mode is indicated by the presence of a padlock-like icon. **BUT TO DISABLE THIS LOCKED MODE, YOU SHOULD USE 4-digit CODE USED TO ENABLE IT.**



Once protected mode is activated, you will see this icone on instrument's screen (see picture below). Protected mode protect programs, measuring parameters and some menu as shown on pictures below.



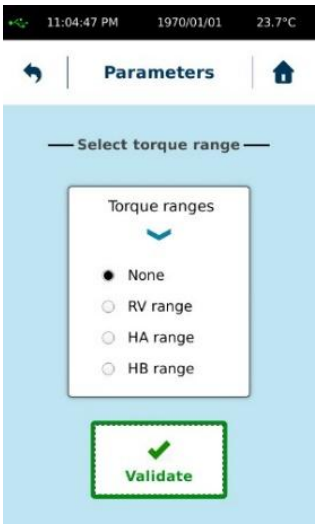




To disable "Locked mode", you must return to service and "Locked mode" and click on "Disable" by entering the 4-digit code.

2.6.8 Torque range

Allows you to adjust the torque range of the device when you want to compare the torque displayed in % with a viscometer equipped with spring technology. If comparison with another spring instrument is not necessary, we advise you to select "None". This setting simply changes the range of torque usable during measurement and the viscosity limits.

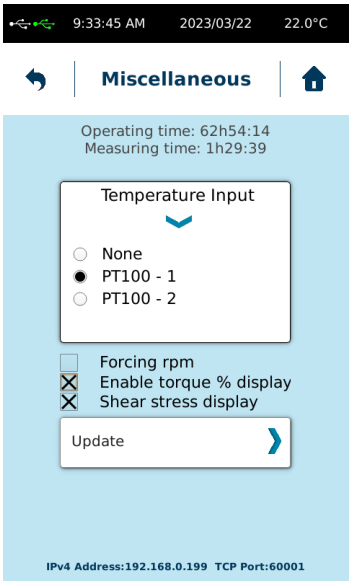


Please see below torque covered by specific range:

- RV Range : From 0.07187 to 0.7187 mNm.
- HA Range : From 0.1437 to 1.4374 mNm.
- HB Range : From 0.5749 to 5.7496 mNm;
- None means no limits. So it will be complete range (see section 1.4).

2.6.9 Miscellaneous

This menu allows you to select the temperature sensor used by the instrument. The instrument allows the use of an external probe (Pt100-2) which must be connected to the back of the instrument (see section 1.3). This setting is not available by default on instrument if this device is delivered without external temperature probe. If you buy it later and want to activate this function, please contact your local agent or LAMY RHEOLOGY.



“Update” function is used when updating the machine software is necessary. Do not go in this menu without being invited by the company LAMY RHEOLOGY. The update is done via a USB key connected to the "USB" port. You can then click on "Update" to update your instrument. At the end, your device will turn off and you will have to turn it on again.

“Operating time” and “Measuring time” settings indicate time while device has been switched ON and time while it was used for measurement.

“Forcing rpm” allow you to force device setting only speed in rpm instead shear rate (s-1) when you are using measuring system compliant with DIN 53019 norm (as MS-CP/MS-PP).

“Enable torque % display” allow device to show torque in % above torque gage while measurement.

“Shear stress display” function will provide you shear stress value while measuring.

On bottom part of this view, you see information about network identification of this instrument. It helps you to identify instrument when you want to use LIMS function (see section 2.6.10). These parameters can be changed in menu Service (check with your local contact or Lamy Rheology to provide you access).

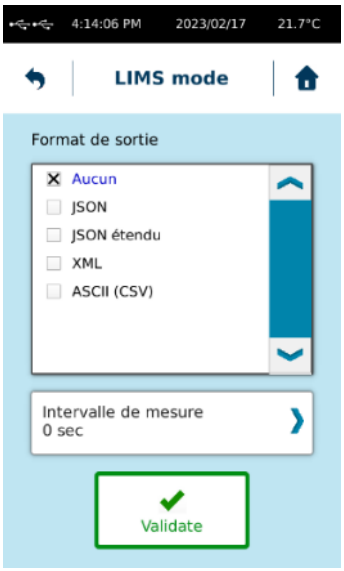
2.6.10 LIMS mode

This menu allows you to select the data format for the LIMS function. To activate this function, a data format must be selected and a “measurement interval” must be entered. Then the instrument will send data at regular intervals to a client (Server). The destination of the data will be configured via the LIMS software used. The connection used will be Ethernet (LAN) on the rear panel of the instrument. The IP address of the instrument for the LAN connection is visible in the “Miscellaneous” menu (see section 2.6.9). The IP address of the instrument can be changed in the service menu. To do this, please contact LAMY RHEOLOGY or your local contact to provide you with an access password.

The “Measurement interval” function allows you to set the time interval used by the device to send data.

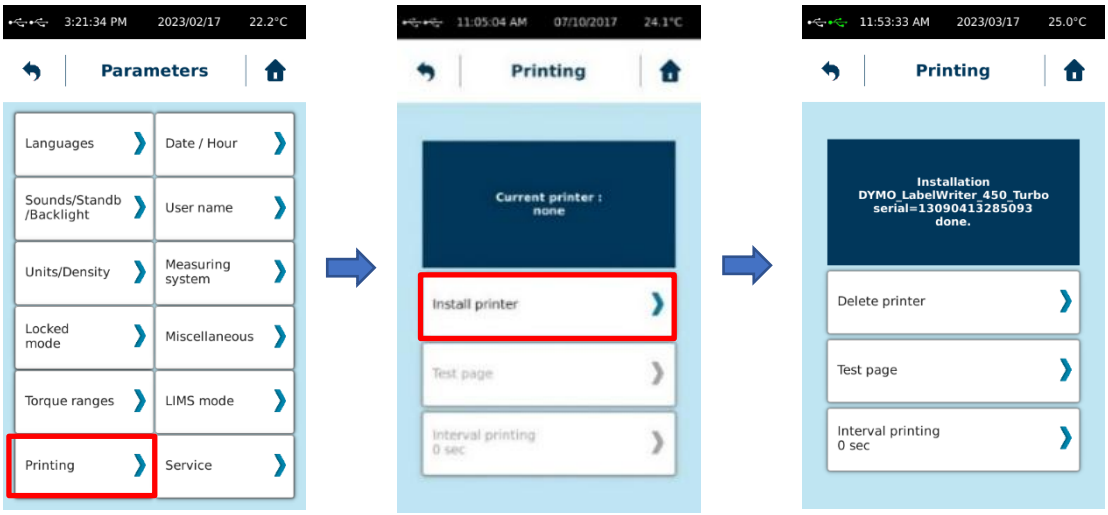
The “Measurement interval” function allows you to set the time interval used by the device to send data.

When a data format is selected, it is no longer possible to use the other connections (USB/RS232) for using the RheoTex software.



2.6.11 Printing

This menu allows you to connect a printer, print a test page, and choose the print interval time you want during measurement.
The instrument can be connected to all printers with a PCL5 print protocol. This includes many A4 printers. The connection is made to the "USB host" port on the back of the instrument.



Once the printer is connected, simply click on "Install Printer".

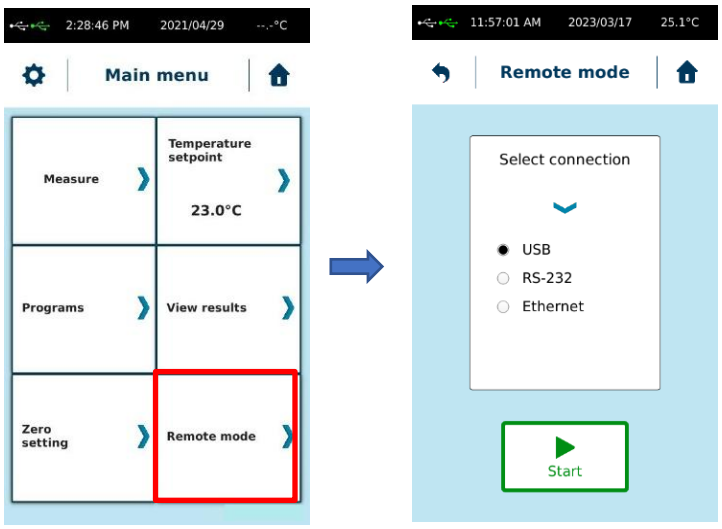
You can also print page for test or set time interval for automatic printing. Then you print data at the end of measure or a saved file, you will have only information shown on device screen as final result. If you want to have more data printed, you have to select “Interval printing” time to get data printed between start and end of your measurement.

2.6.12 Service

Reserved to LAMY RHEOLOGY or local partner engineers.

2.7 Remote mode menu

Remote mode allows you to control your instrument with RheoTex software. If all the connection choices are greyed out and the Ethernet port selected by default, LIMS mode has been activated (see paragraph 2.6.10).



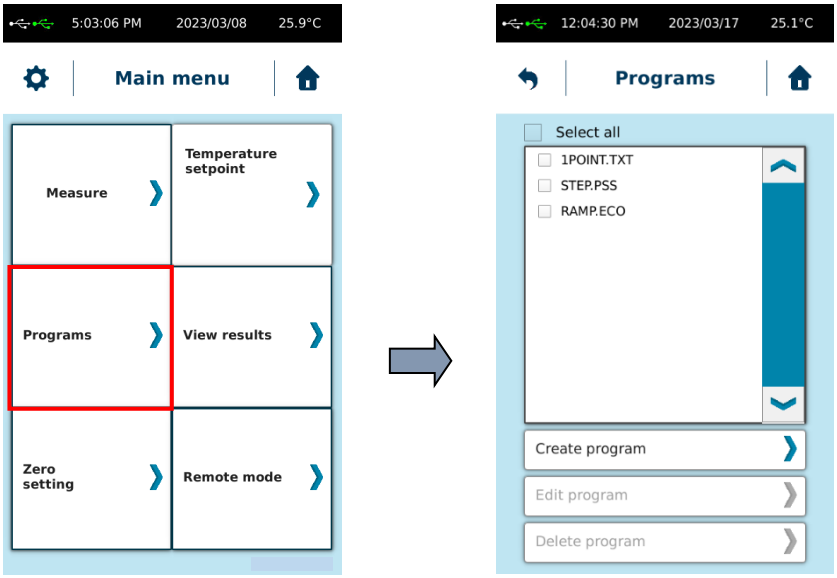
Once the device is connected to the PC, you must select the type of port (USB - RS232 for) and click on "Start" to launch the communication. As long as communication is not established, a "Waiting Connection ..." message appears on the screen. Then launch the software and check that the screen switches to the display below. If this is not the case, check the connections and make sure that the COM port number set in the default settings of the RheoTex software is correct and identical to that recognized by WINDOWS in "Control Panel", then "System and "Device Management" (see the operating instructions for the RheoTex software).

2.8 Programs menu

In the programs tab you will be able to configure, modify or delete your measurement methods. The saved programs can be found in the "Auto" tab of the "Measure" menu (see section 2.3.2).

When you select the "Programs" function, you get a new window where you can see your recorded methods and functions as "Create program", "Edit Program" or "Delete a program". The "Select all" function can only be used for the deletion of methods.

The extension after the program name indicated the type of method according to: " *.TXT" for 1 point method, "*.PSS" for step method.



2.8.1 Create new program

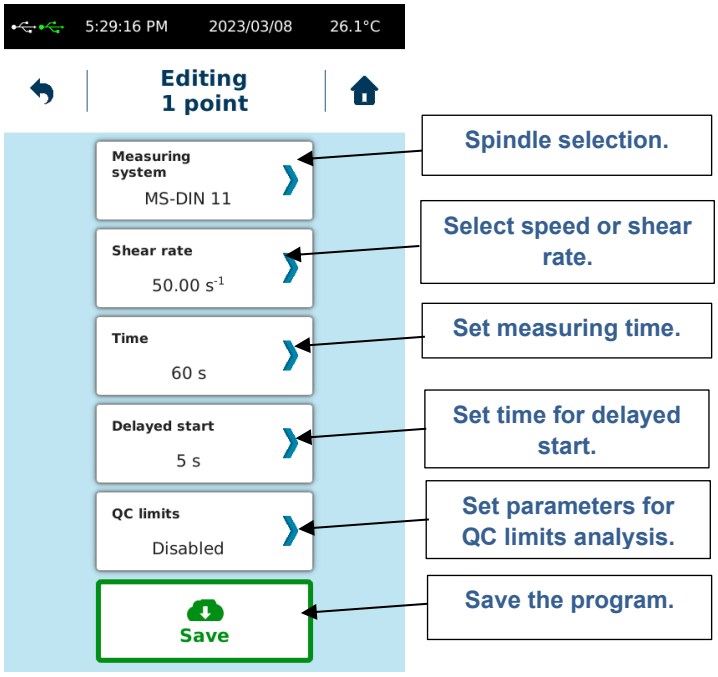
By selecting "Create program", the instrument displays the following view.

The “1 point method” makes it possible to measure your product viscosity at constant rotation speed or constant shear rate during a defined time. The instrument will display measured viscosity at the end of this measurement time.

The “Step method” allows you to fix measurement intervals at different rotation speed or shear rate in order to obtain viscosity values under different shear conditions. It also makes it possible to obtain a flow curve by fixing interval by interval the shear rate and time.

2.8.1.1 1 point method

When you choose 1 point method, the instrument displays the following view.

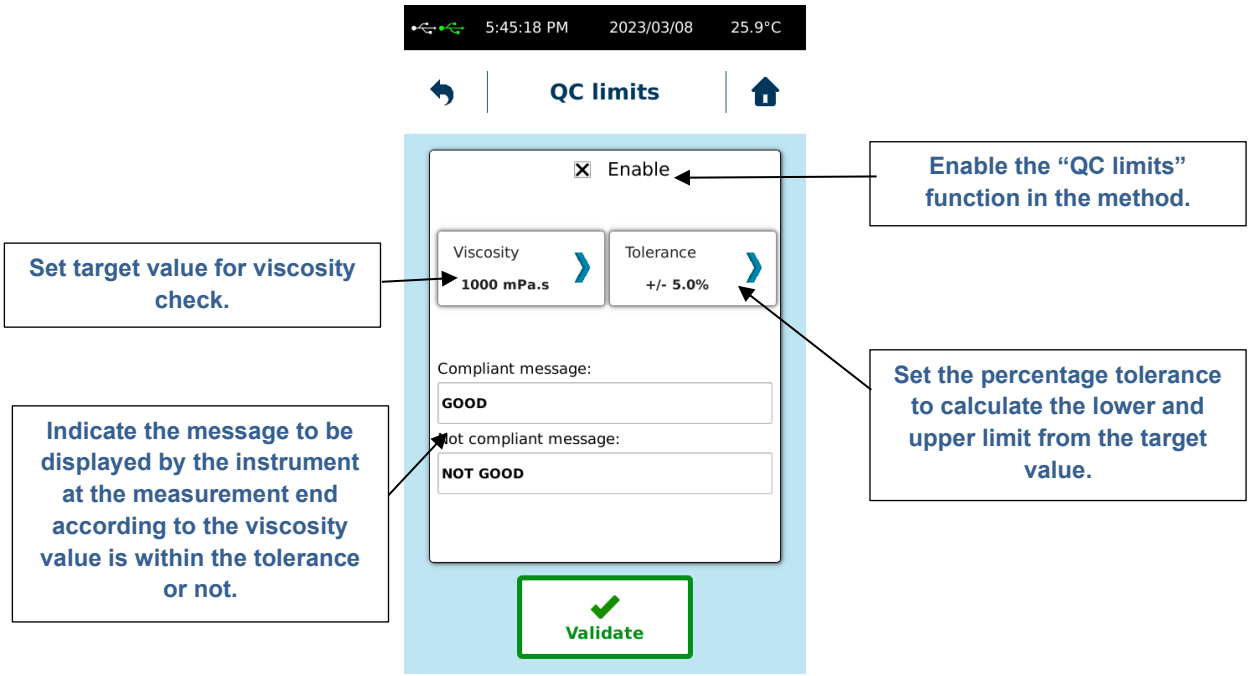


When creating a new method, the next buttons is activated after your validations progresses.

According to the selected mobile, the instrument will offer you to fix the shear rate (s^{-1}) instead speed (rpm) as that is the case for MS DIN or MS SV measuring systems. To force rotation speed in rpm, please read section 2.6.9 of this user manual.

The "Delayed start" function allows you to set a waiting time before the measurement. This time will be deducted as soon as you launch the measurement (see section 2.3).

The “QC limits” function makes it possible to verify that the measured viscosity value is between two limits that you have previously set. When choosing this function, the instrument displays the following view.

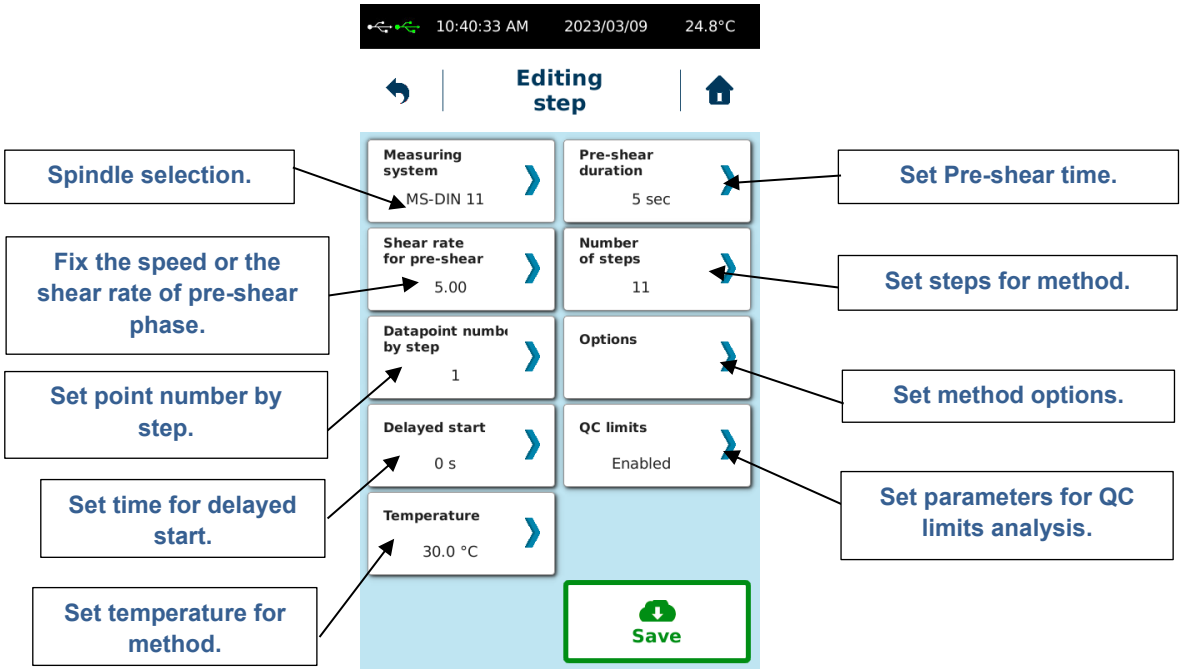


Do not forget to activate the "QC limits" function before validating to exit this window, otherwise the information will not be saved. At the measurement end according to the viscosity value is within the tolerance or not, the instrument will display the message that you have indicated in the "Compliant message" or "Not compliant message" fields.

Once you have finished setting up your method, you can save it by choosing "Save".

2.8.1.2 Step method

When you select step method, you will get the following view.

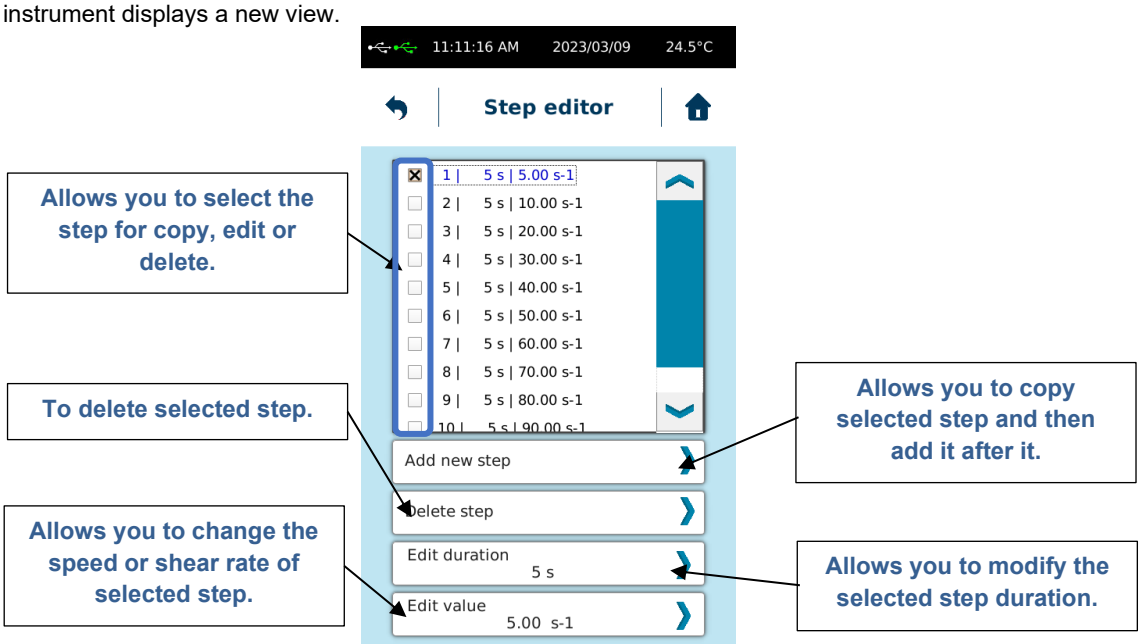


When creating a new method, the next buttons is activated after your validations progresses. According to the selected mobile, the instrument will offer you to fix the shear rate (s^{-1}) instead speed (rpm) as that is the case for MS-CP measuring systems. To force rotation speed in rpm, please read section 2.6.9 of this user manual.

The "Delayed start" function allows you to set a waiting time before the measurement. This time will be deducted as soon as you launch the measurement (see section 2.3).

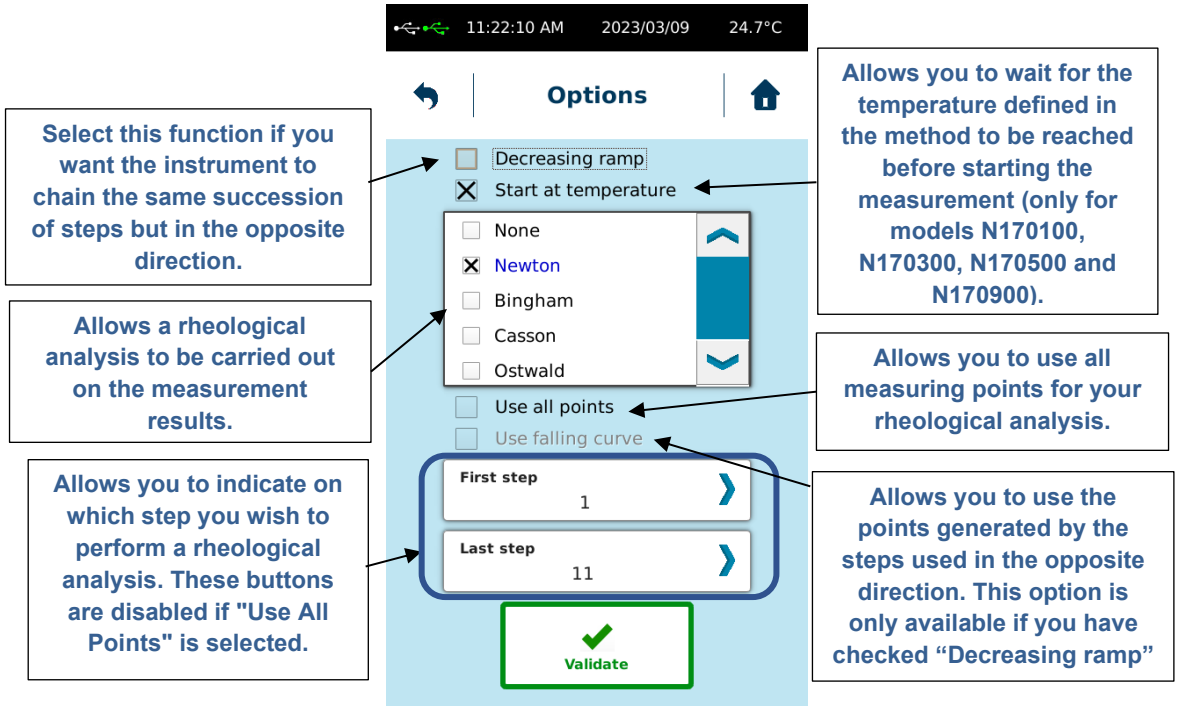
The "Temperature" button is only present if the function has been activated in the instrument as this is the case for model N170100, N170300, N170500 and N170900. This is the case when the instrument has been delivered with a programmable temperature regulation. By default, this function is not accessible.

The “QC limits” function is identical as defined in paragraph 2.8.1.1.When you select the “Number of steps” button, the instrument displays a new view.



Once changes have been done, you can use the button to return to the previous screen. The instrument will display the new number of steps.

The “Options” function allows you to integrate a rheological analysis or a temperature setting condition as described in the following view.



The "Start at temperature" option is only interesting if temperature control is activated on your instrument.

The "Decreasing ramp" option is interesting if you want to use the step method to generate a flow curve. This descending part will be carried out following the first succession of steps. The term "Decreasing" means that the instrument will decrease the speed or the shear rate. It is therefore important that, during the first succession of stages, the speed or the shear rate are increasing.

2.8.2 Edit program

This function allows you to modify an existing method. Select a method by checking the corresponding box. The “Edit program” function becomes active and allows you to navigate through the parameters in the same way as described in paragraph 2.8.1. After modifying the method, you have the option of saving it under another name or overwriting the existing method name.

2.8.3 Delete program

This function allows you to delete a method from the instrument memory. Select the method concerned by checking the corresponding box. You can delete them all at the same time by selecting the "Select all" function.

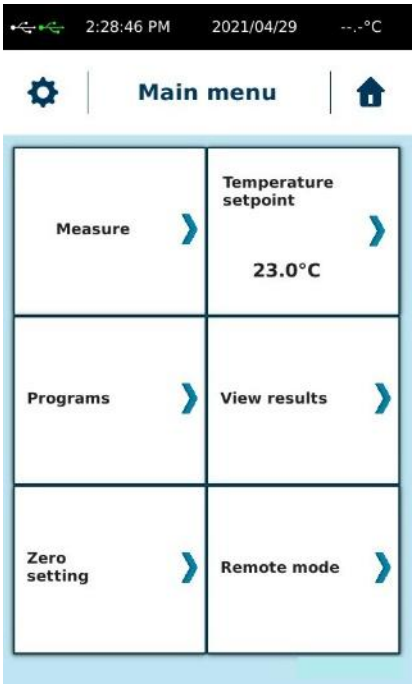
2.9 Temperature setpoint menu

This function is available in the main menu.

As described in paragraph 2.3, this function is only available if your device is delivered with a programmable temperature control (only models N170100, N170300, N170500 and N170900). For other models, please refer to section 3.2 to know how you can manage the temperature.

This mode does not allow temperature ramps to be carried out via the instrument. For this type of method, the use of RheoTex software is required.

Contrary to the use of the setpoint in a measurement method (see section 0), the use of this function is useful for controlling the temperature setting unit without performing a measurement. So, you can precondition your sample to the right temperature before starting the measurement.



3 MEASURING WITH YOUR DEVICE

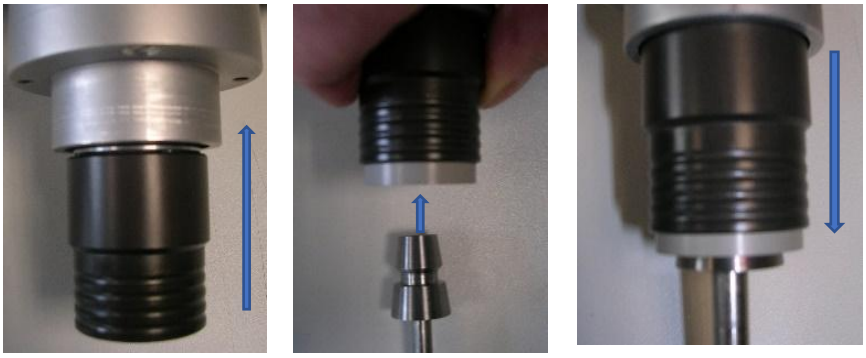
This section will show how use the different measuring system with your device.

Instrument need to be installed before next section of this manual (see section 1.5).

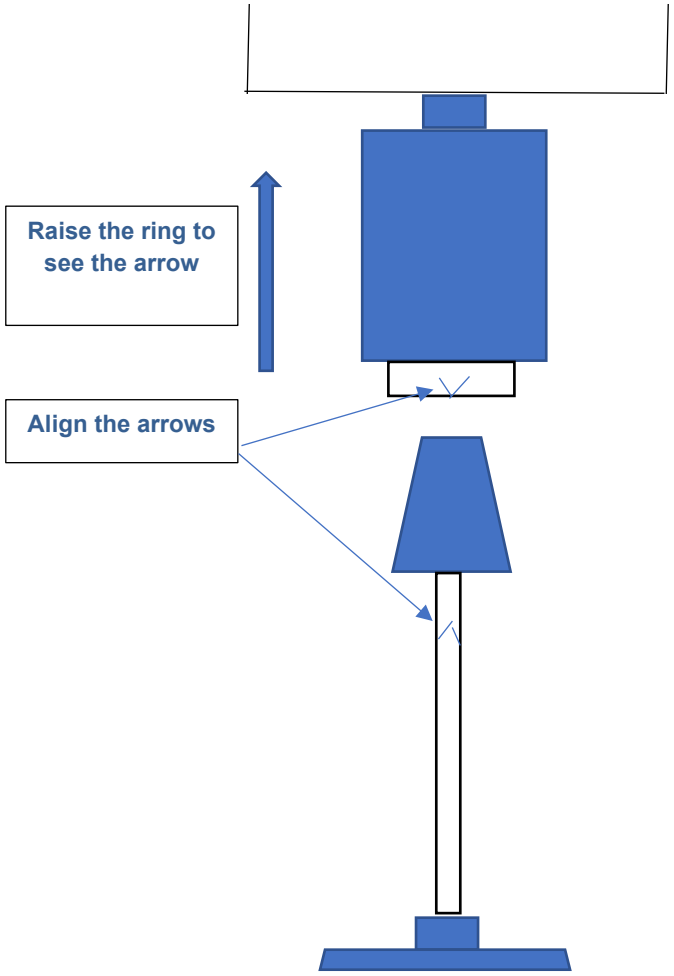
3.1 Installation of measuring system

Read the installation of your measuring system in the following sections before inserting it on your viscometer. Indeed some measuring systems require the installation of accessory before the insertion of the spindle. Don't forget also to make a zero of measuring head before installing of measuring system (see section 2.5).

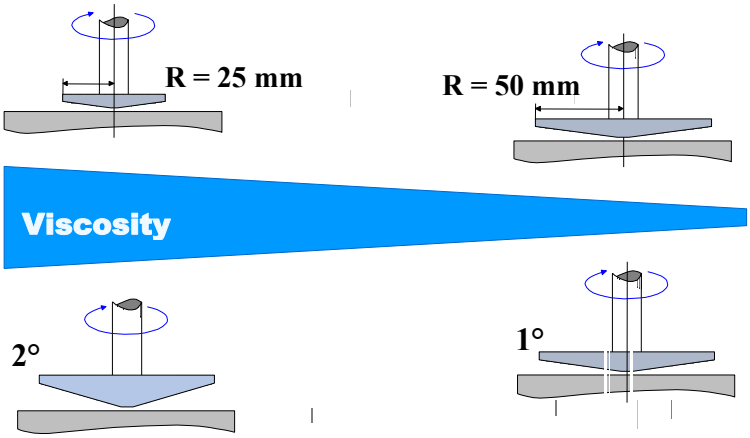
The RM100 CP2000 PLUS version can only be used with cone-plane or plane-to-plane geometries. The coupling of the RM 100 CP2000 PLUS is of type AC 265. It is a system allowing the insertion and the quick fixing of the measuring mobiles. A simple vertical action of the ring upwards (release) or downwards (locking) allows easy manipulation of the measuring tool.



For a good rotation please respect the alignment of arrow on measuring cone and arrow on the coupling.

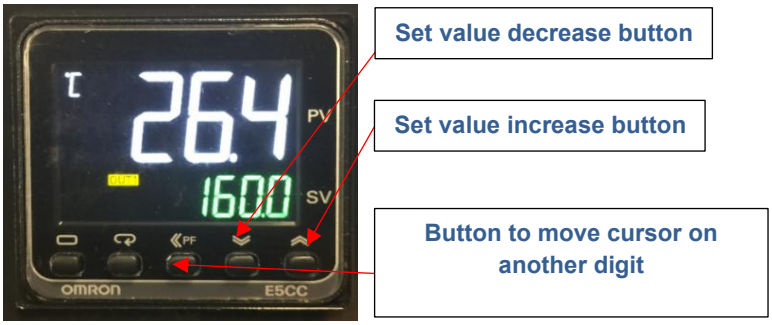


Choice of measuring system must be done according to the product to be measured. Favor wide diameters for low viscosities as shown on diagram below.



3.2 Temperature settings

This section concerns only model N170000, N170200, N170400 and N170800. For other models, please refer to section 2.9.
The value read on this display is the set temperature. The value read on the screen of the RM 100 CP2000 PLUS is the actual value of temperature.
To change the set point, press the arrows to adjust the desired temperature, the new set point will be taken into account after a few seconds without validation. If your device is with Programmer function, you can also set temperature through measuring head (See section 2.9).

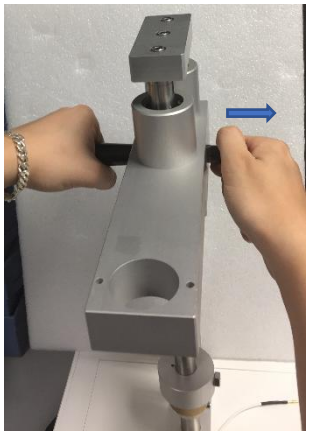


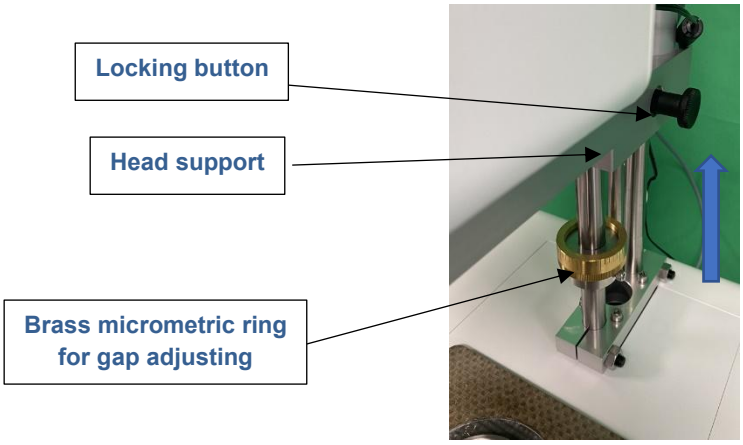
3.3 Gap settings and sample filling

Your RM 100 CP2000 PLUS is equipped with a manual adjustment of the gap. This setting is very important for the measurement position to be as ideal as possible. This adjustment must be made with the mobile but without sample. And it is necessary to do this at the measuring temperature. Lower plate need to be cleaned with solvent (acetone or ethanol) before following information.

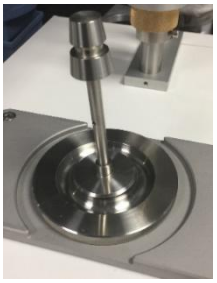
Some cone used with RM100 CP2000 PLUS are truncated. It means that tip of cone is cut at 50 µm. Measuring systems truncated get part number with three first number « 365… ». For these cones, you should use 50 µm metallic spacer that will be place between cone and bottom plate.

Place the measuring head in the highest position. Hold handle, release locking button, rise head and find new hole where button can fit in automatically.





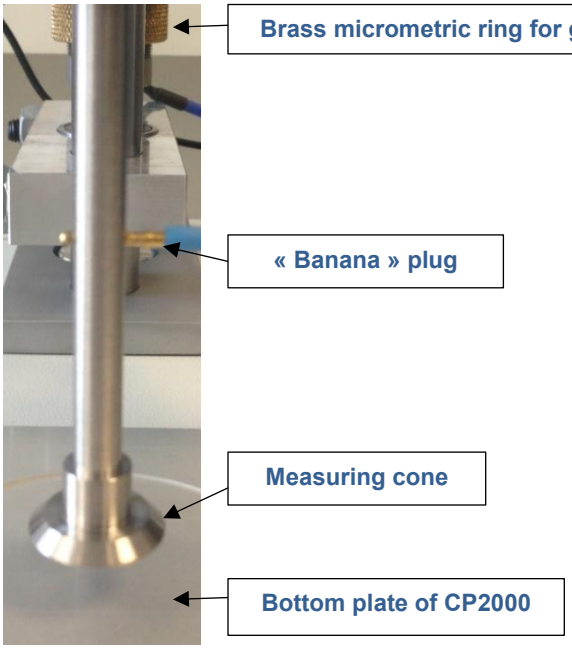
The first step is to heat up your bottom plate (see paragraph 3.2 or 2.9 according to your device model). Also, especially if the test temperature is different from that of the room, place the measuring geometry on the bottom plate to also bring it to temperature.



When the temperature has stabilized, you must leave your geometry in this position for a minimum of 5 minutes.

Make a zero of your viscometer (see section 2.5).

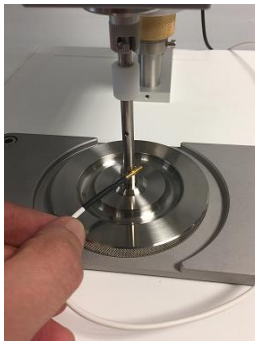
You must then attach the mobile to the viscometer (see paragraph 3.1). Insert the "banana" plug located at the end of the white wire into the hole located on the axis of the measuring cone. This makes it possible to establish an electrical contact between the measuring cone and the lower plane.



Lower the arm of the RM 100 CP2000 PLUS by pulling on the locking device and holding the head with the handle.

Go to its low position in such a way that the arm rests on the brass ring. If a beep sounds and the head cannot be lowered completely because the geometry already touches the plate of the RM 100 CP2000 PLUS before the arm is in contact with brass ring, it is important not force and raise the head completely up to the upper stop. Before descending the head, turn the brass micrometric ring a few turns anticlockwise to raise it. Move the head down again until it stops on brass ring, making sure that the geometry does not touch the plate of the RM 100 CP2000 PLUS. Repeat the operation on the brass ring if it is not.

Gently turn the bronze micrometric ring clockwise to gently lower the arm of the RM 100 CP2000 PLUS until the "beep" is heard; this means that the measuring cone is in contact with the lower plane. Then remove banana plug from axis and keep it in your hand and start a measurement without sample (for example put time at 0 and shear rate at 250 s-1 to get continuous rotation). During rotation, touch axis with banana and earl if a continuous “bip” is present. If this is not the case, use brass ring to get a constant “bip”. Then you get it, stop the test.



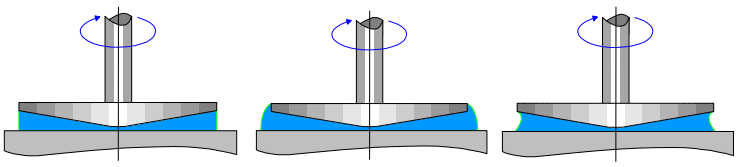
Then you are using a plate-plate measuring system, you have to set in same way the contact position as explained previously. But contact position need to be done by inserting metallic spacer (optional item 100047 as shown on picture above) between MS-PP and 70mm bottom plate. Choice of spacer need to be done according to gap you would like to use with MS-PP measuring system for measurement.

Raise your measurement head. The gap is then adjusted for the cone or plate used.

Do not touch the brass ring again and raise the RM 100 CP1000 PLUS head.

Place sample on 70 mm bottom plate. Move down measuring head to lower position in such a way that the arm will be hold by grey ring.

The amount of sample should be sufficient to completely fill the space between the cone and the bottom. In the case of a liquid sample, you can take the recommended volume for the dimensions of your cone-plane (see table below). For thicker samples, you need to draw enough with a spatula or similar tool.



Sample volume for Plate measuring system depends on gap used. But filling need to be perfect as for cone.

Diameter (mm)	Angle (°)	Sample volume (ml)
10	0.5	0.0023
20	0.5	0.018
20	0.5	0.018
20	1.59	0.058
20	2	0.073
24	0.5	0.031
24	2	0.126
40	0.5	0.146
40	1.59	0.465
40	2	0.585
40	4	1.17
50	0.5	0.285
50	2	1.142
60	0.5	0.5
60	1	1
60	2	2
60	3	3

Start the measurement at the desired speed or shear rate and after choose the right measuring system (see section 2.3). If your measuring system is not in the list, please refer to section 2.6.6 to create it.

The torque measurement is indicated on the instrument screen using a gage. Ensure that the measured torque is always sufficiently far from the lower and upper limits (at least 5% above and below). If this is not the case, you can either change the measuring spindle or change the rotating speed. Then your measurement is finished, raise the measuring head and lock it. Remove the measuring spindle to clean it.

4 VERIFICATION OF YOUR DEVICE

Your device has been calibrated and checked before delivery according to an internal procedure using a cylindrical MS DIN 11 mobile, an oil viscosity 1000 mPa.s and a temperature control system (EVA DIN) at 23 ° C.

We inform you that the cone-plane geometries are never used internally for our checks and calibrations. Indeed, this type of geometry can lead to measurement errors due, for example, to the problems of gap filling, slippage, product ejection or wrong gap distance. You can nevertheless check your RM 100 CP2000 PLUS using your own geometry and a Newtonian standard oil of known and certified viscosity (preferably close to 1000 mPa.s).

When checking your instrument, it is important to calculate the maximum permissible error for the measurement. This error combines the precision of the instrument (1% of full scale for all mobiles and 2% with MS-CP) and the uncertainty in the viscosity value of the verification oil (generally 1% of the nominal value).

The full scale is calculated according to: Full scale viscosity (Pa.s) = (KTAU * M) / (KD * RPM).

Using the maximum torque of the instrument M (or the selected torque range, see section 1.4 or 2.6.8) for each rotation speed RPM and integrates constants KTAU and KD from the measurement geometries (see section 2.6.6).

Example: Mobile MK-CP5010 with a RM100 CP2000 PLUS at 50 rpm. We have: M = 30mNm (maximum torque of the instrument without torque range selection from section 2.6.8); KTAU = 30.6; KD = 6.

The full viscosity scale is therefore: (30.6 * 30) / (6 * 50) = 3.06 Pa.s.

2% of this value corresponds to: 0.061 Pa.s or 61 mPa.s.

For a check on a 1 Pa.s standard oil, the uncertainty on this value is 1% or 10 mPa.s.

The maximum allowed error is therefore: Precision from device + Incertitude from oil.

Here we have: (0.061 + 0.01) /6 = 0.071 Pa.s or 71 mPa.s.

A measurement of this oil between 0.929 Pa.s and 1.071 Pa.s is therefore acceptable.

Here is the procedure to follow for your verification:

1) Perform a motor zero (see section 2.5).

2) Warm up your geometry and the lower plane according to the procedure described in paragraphs 3.2 and 3.3.

3) Install your measuring system (see section 3.1).

4) Set Gap as described in section 3.3.

5) Put standard oil on lower plate and lowering measuring cone in measuring position (see section 3.3 to check good filling of gap).

3) Select a measurement method in manual mode by choosing a measuring time of 120s minimum and a shear of 100 s-1 (see section 2.3).

The result at the end of the measurement must be within the tolerance due to the maximum tolerated error as explained previously. If the measurement is out of range, your instrument may require recalibration.

If the value is out of tolerance, check that all previous steps have been completed correctly. If the problem persists, please contact LAMY RHEOLOGY or your local partner.

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