LAMY RHEOLOGY INSTRUMENTS

USING MANUAL

FIRST PRO PLUS

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1. INTRODUCTION

The FIRST PRO PLUS is a device able to measure the viscosity, which is the 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 viscometer 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 viscometer is constituted with a continuous current motor and an optical encoder, in order to warranty a great accuracy of rotational speed, on all torque range.

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

The Viscometer FIRST PRO PLUS can be used with different measuring system. You will find below a list of compatible measuring system with this viscometer.

- **MS ASTM:** Measuring spindles according to ASTM / ISO 2555 (316L stainless steel).These systems are ideally suited for simple viscosity measurement at controlled rotational speed in all areas of activity. The standard recommends use of 600ml beaker for measurement.

- **MS BV:** Measuring spindle for 150ml beaker (316L stainless steel).These spindles are ideally suited for simple viscosity measurement at a rotating speed in control in all areas of activity. They are appreciated for their ease of use and the low volume of product needed compared to the MS ASTM spindles.

- **MS VANE:** Measuring spindles with blades (316L stainless steel). These systems are ideal for viscosity measurement (value or curve) in control or development of all types of products even of very high viscosity with or without particles (size <5mm). They can be used for direct measurement in user's containers or in tubes of MS-DIN systems.

- **MS KREBS**: Krebs type measuring spindles compatible with ASTM D562 standard (316L stainless steel). These systems are ideal for viscosity measurement in Krebs units in control of all types of products. They can be used for direct measurement in user containers or in 600 or 150ml beakers.

- **MS DIN**: Coaxial cylinders measuring systems according to DIN / ISO 3219 (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 the control or development of homogeneous products with liquid aspect and with or without particles (size <200µm).

- **MS SV:** Measuring systems for low volumes (316L stainless steel). These systems, unlike the MS-ASTM and MS-DIN systems, make it possible to measure products in small quantities by applying a shear rate up to temperatures of 200 ° C (according to models, see table). With RT1, these systems are compatible with ASTM D3236.

- **MS CP:** 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 behavior, 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. Usable only with temperature unit CP-1 PLUS.

1.1. COMPONENTS

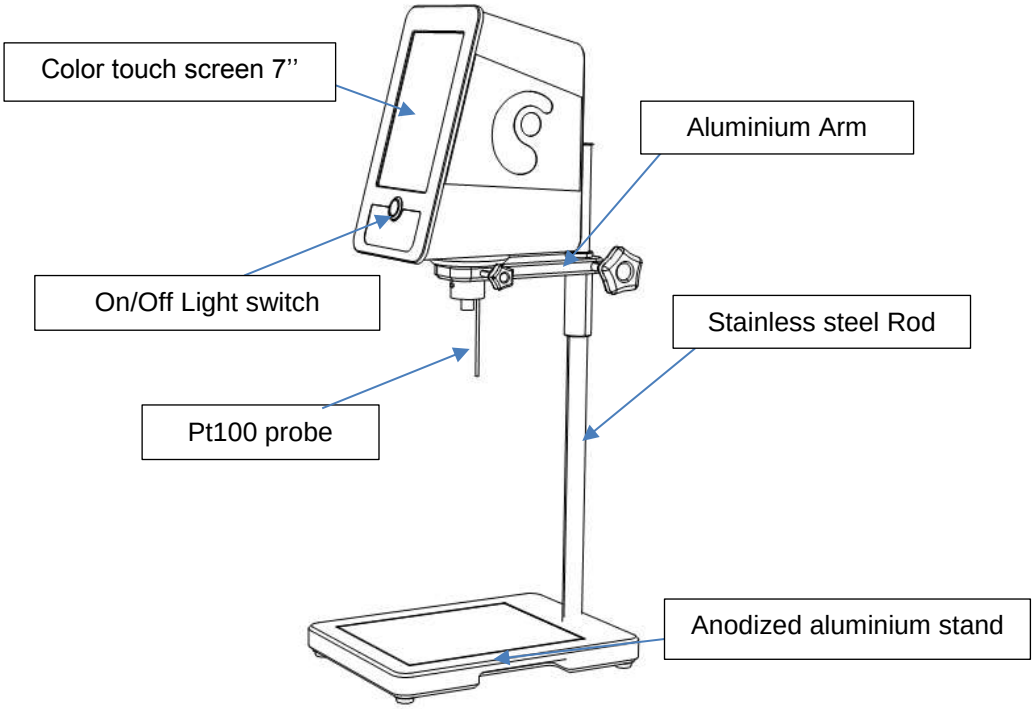
Viscometer is delivered inside a foam protection to avoid any problem during transport. According to your order this foam can be inside a box or a carrying case and can contain measuring system.

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

The stop ring is delivered with FIRST PRO PLUS only then MS ASTM or MS KREBS are ordered.

1.2. GENERAL VIEW OF YOUR DEVICE

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

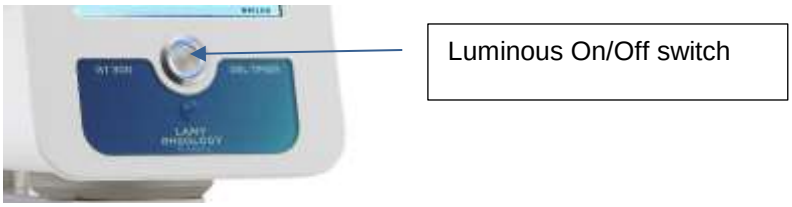


- **TOUCH Screen**

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.

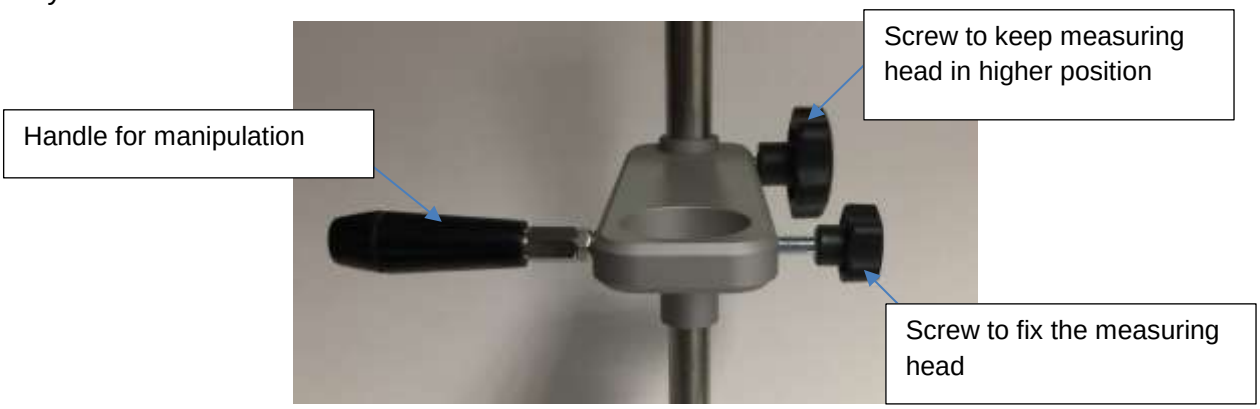
- **On / Off Switch**

Always with the aim of improving your experience, LAMY RHEOLOGY has decided to equip all of its PLUS range with a luminous and design switch. It has been placed in the centre of the device for greater intuitiveness.



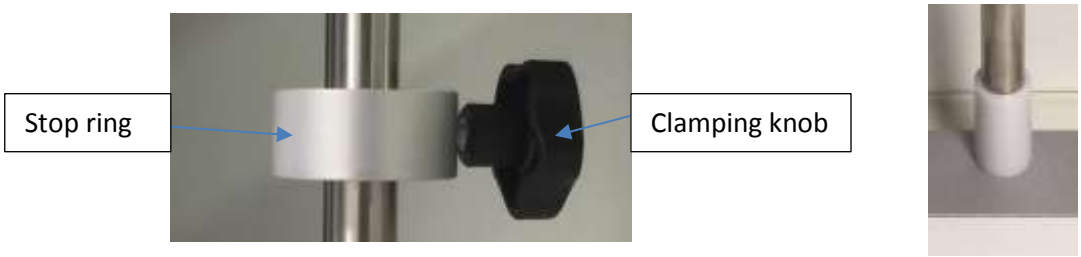
- **Aluminium arm**

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. It is equipped with a ring with a clamping button that is used as a stop for a repeatable positioning during the measurement. The stop ring is delivered with FIRST PRO PLUS only then MS ASTM or MS KREBS are ordered.



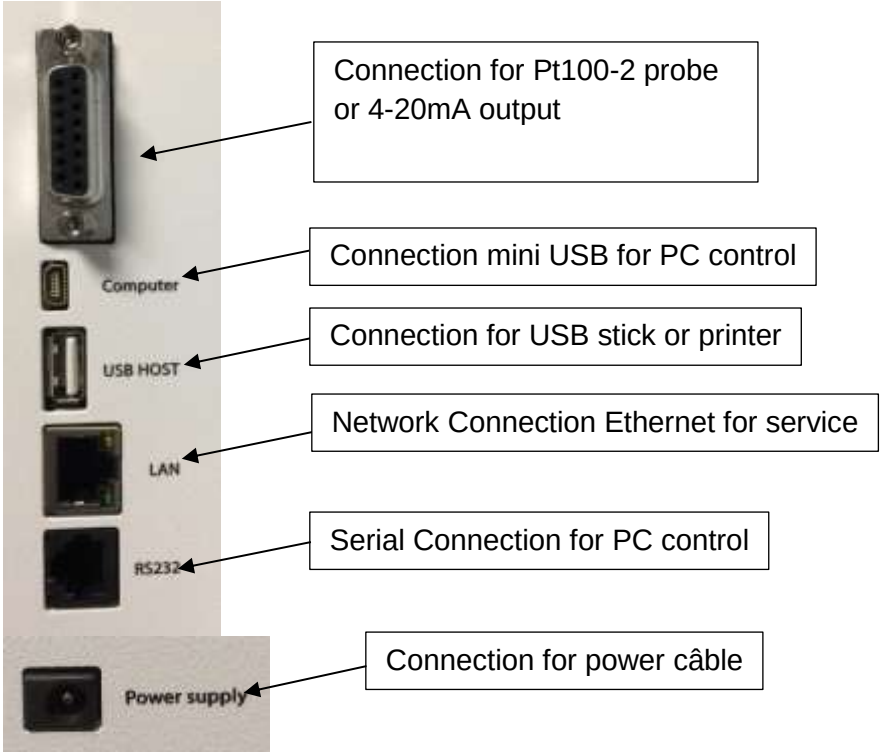
The rod is equipped with a white Delrin ring acting as a stop, thus avoiding the arm being in a position that is too low.

- **Anodized aluminium support**

The stand is entirely made of anodized aluminum. It gives our instruments a very good stability (the maximum permissible temperature on the white part is 50 ° C).

1.3. CONNEXIONS

According to your order, rear panel of device get this available connexions.



1.4. SPECIFICATIONS

Type of instrument: Rotating springless viscometer with 7'' Touch screen
Rotation speeds: Unlimited number of speeds between 0.3 and 250 rpm
Torque range: Standard Version: 0.05 to 13 mNm.
Temperature: The FIRST PRO PLUS has a PT100 sensor which indicates temperatures between -50 °C to + 300 °C
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 – Shear rate
Language: French/English/Russian/Spanish
Compatible measuring system: MS DIN, MS ASTM, MS BV, MS VANE, MS R, MS ULV, MS SV, MS CP
Compatible temperature control: EVA DIN, EVA MS-R, EVA LR-BV, RT1, CP1
Supply voltage: 90-240 VAC 50/60 Hz
Analog output: 4 - 20 mA
PC connections: RS232 Port and USB
Printer connexion: USB Host Port – Compatible PCL/5
Options: Carry case (PN 100500), Rack stand (PN P008000), Software.
Dimensions and weight: Head: L180 x W135 x H250 mm, Hardened steel stand: L280 x W200 x H30 mm, Stainless steel rod: Length 500 mm, Weight: 6.7 kg

1.5. INSTALLATION

Your viscometer should be installed in a clean, vibration-free environment. Even if no level is necessary, choose a stable and flat table.

This installation notice concern only viscometer without any temperature device. If you have it, please refer to specific notice of temperature unit for installation.

After unpacking all accessories from the box (or case if it is supplied), you must first screw the rod to the base with screw and the key provided.

Then make sure to insert the white Delrin cylinder and set it to the lowest position. Then place the stop ring on the stainless steel rod. Then place arm on rod, respecting the direction as described below. The arm is equipped with two buttons and a handle. You can change them for your convenience if you are left-handed.

You can then put the viscometer on the arm, taking care not to touch the motor shaft or temperature sensor (if your device has one). Align the measuring head correctly and secure it with the screw provided.

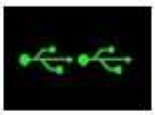
Your viscometer will be used with different measuring system. To know how to mount and use it, please refer section 3.

2. GETTING STARTED

Once power cable has been plugged on rear panel of device (see section 1.3), you can click on button to switch on your device (see section 1.2).

2.1. STATE ICONS

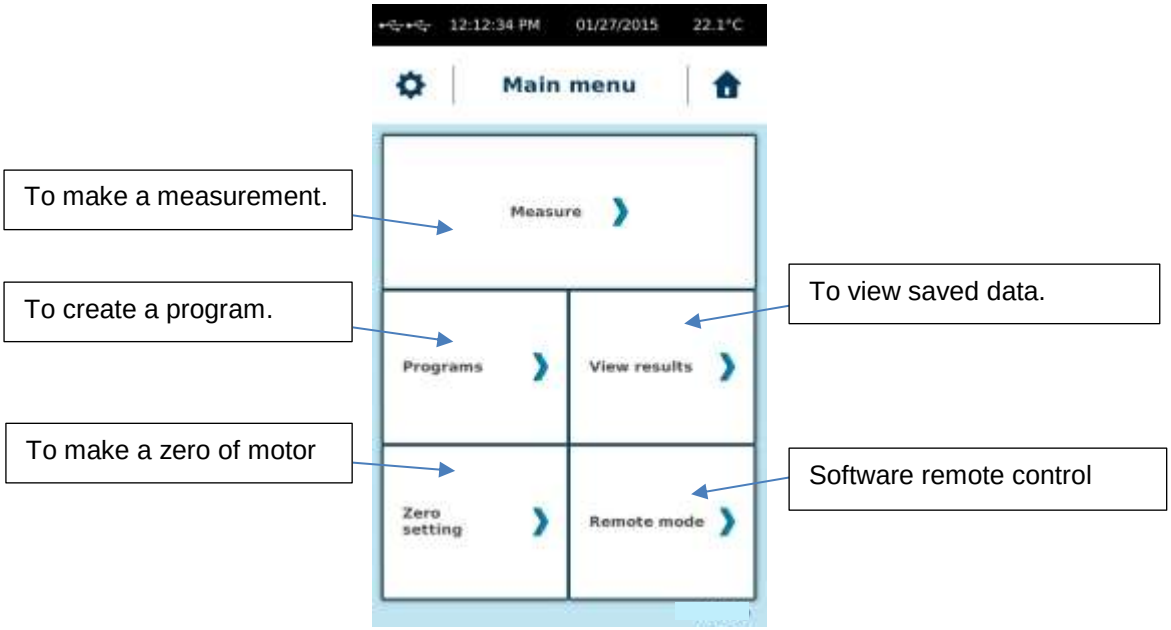
Once your device is switched on, you will see some icons on Touch Screen.

	No Device is connected to the instrument.
	Only one Device is connected to the instrument.
	Two Devices are connected to the instrument.
	Give you the temperature of probe in the sample.
	Enable to go to parameters of instrument.
	Enable to come back to Main Menu.
	Enable to come back to previous menu.

2.2. PRIMARY CONCEPTS

2.2.1. Main Menu

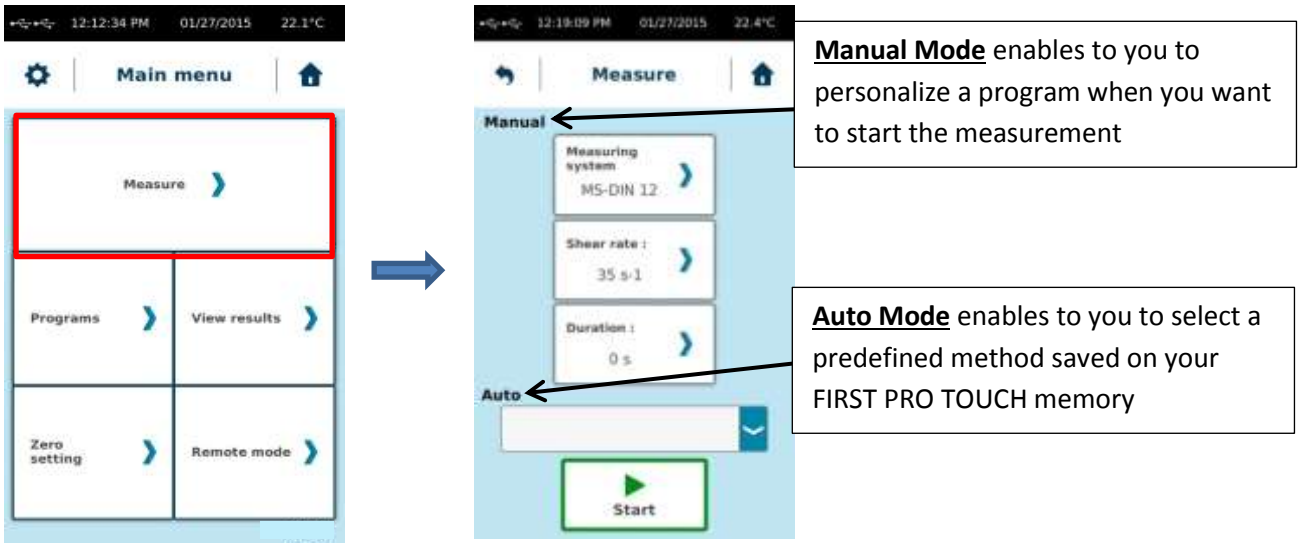
Main menu enable to you to browse between different tabs of your FIRST PRO PLUS. Acces is always available by clickin



2.2.2. Measure

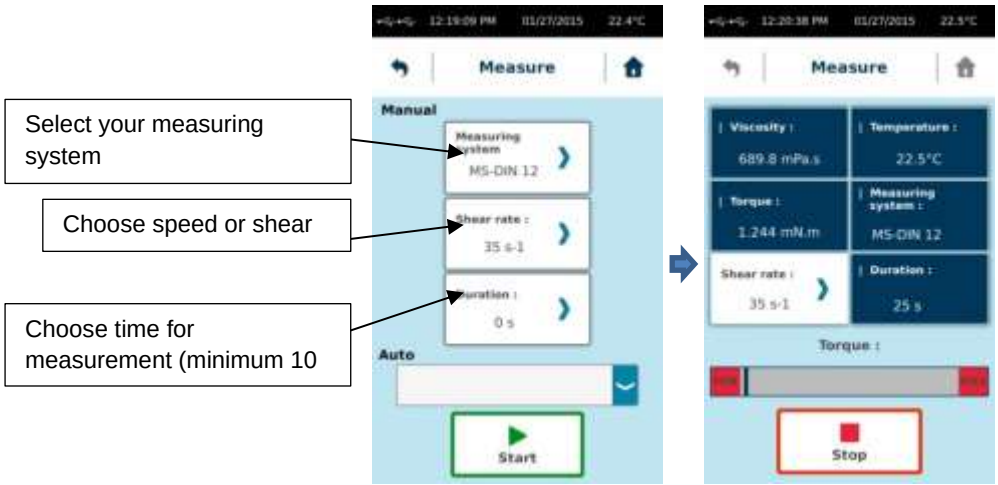
Measure tab is central part of your FIRST PRO PLUS. Before to use it, you should install your measuring system and your sample. Please see section 3.

Then you click on “Measure”, you will see a new window.



Manual Mode enables to choose your measurement parameters like «Measuring System », « Speed or shear rate» then « Time of measurement ».

Click Start to start your measurement. When it is finished, you will see the results of your measurement and can choose to save and / or print your result (if a printer is connected).



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 2.2.7.6.

Choice between “Speed” or “Shear rate” is according to your measuring system. For MS ASTM, MS BV, MS KREBS and MS VANE, you should have only possibility to set the speed. For all other measuring system, you have to use shear rate. 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 2.2.7.6).

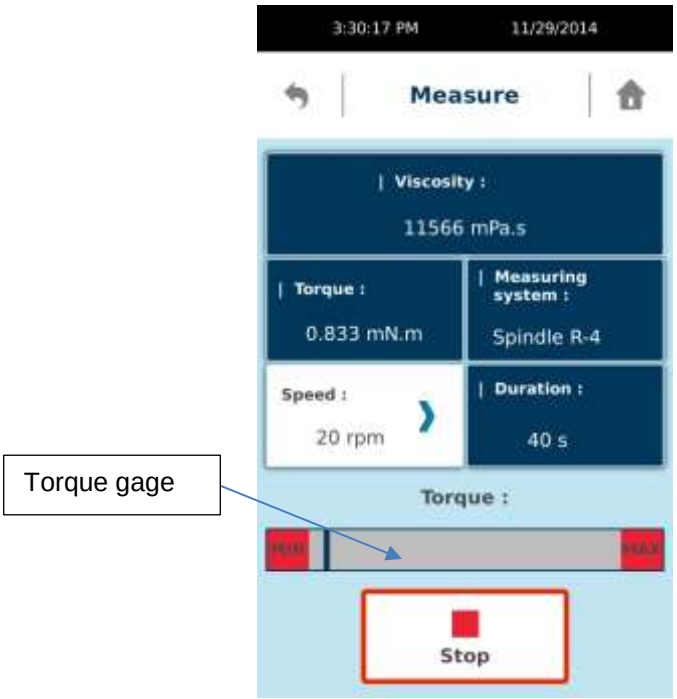
$$\text{SPEED} = \text{SHEAR RATE} / K_D$$

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

Auto mode allows you to select pre-recorded programs. Select the program from the list and click "Start" to start your measurement. The display automatically adjusts to show the current measurement.

Then your settings are ok, you can click “Start” to start your measurement. While your measurement, you will see a torque gage. Please try to not be closed to the upper and lower limit. Please increase speed or take a bigger measuring system if you are close to the lower limit. Please decrease speed or choose smaller measuring system if torque reading is close to the upper limit.

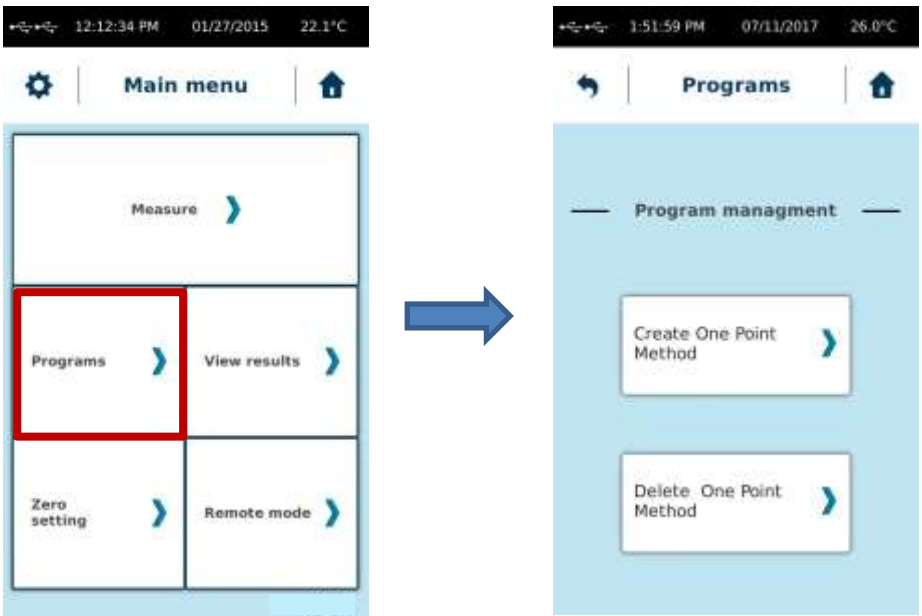
Picture below show how should be the closer position regarding lower limit.



Then your measurement is finished, you will get this windows below. You will find all data you need and get possibility to save them into internal memory or to print it (if a printer is connected). If you choose “Save”, viscometer will ask you to give a name of your measurement. You will have after possibility to read it later (see section 2.2.4.).

2.2.3. Programs

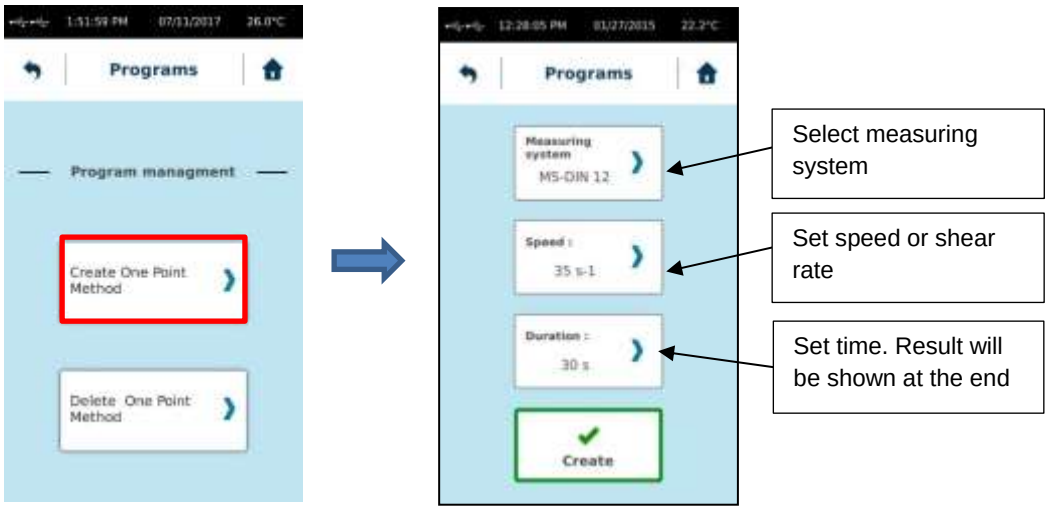
With **Programs** tab, you could define parameters for your standard measuring program and also delete it. We have one kind of program: “One point method”.



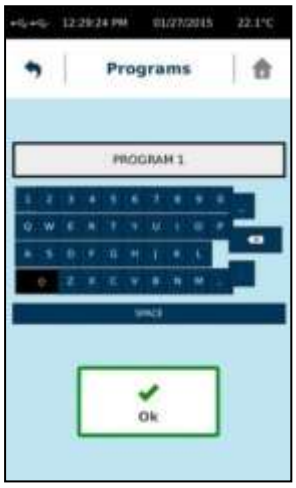
In One point method, you will have one viscosity value at one speed or one Shear rate

When your Program is created, you will find it in **AUTO** list of **Measure** tab.

Click on “Create One Point Method” to start programming



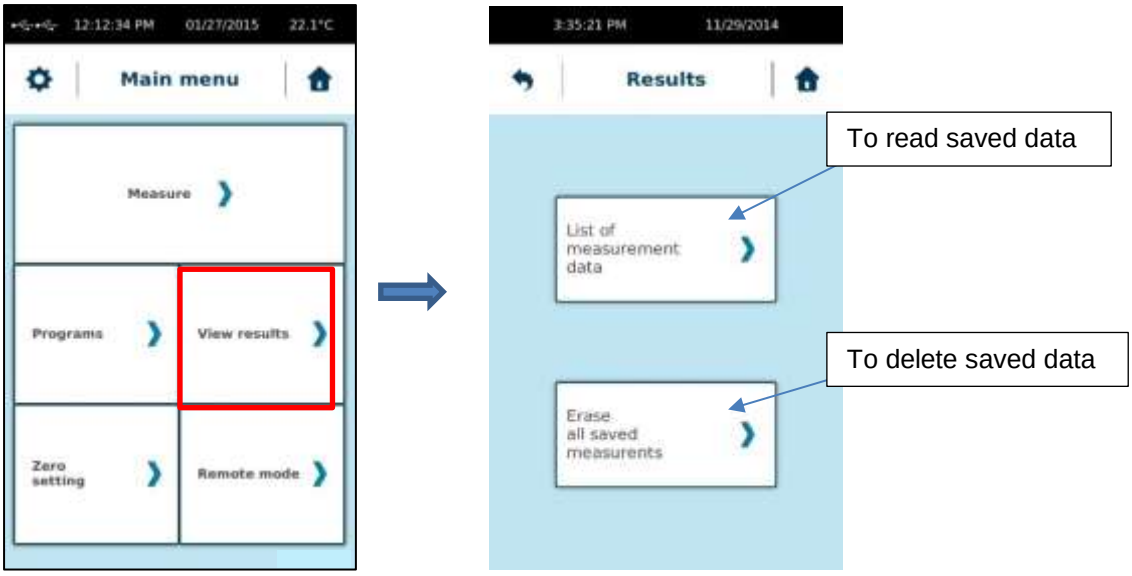
Then you click on create, you will get this screen where name of program need to be given.



To delete “One Point Method”, please do like this

2.2.4. View Result

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



2.2.4.1. Read saved data

By click on tab “List of measurement data” you could see all saved measurement made with your FIRST PRO PLUS. You could select which one you want to read.

Then you selected a measure, you will see result and get possibility to print it if a printer is connected.

By clicking on “Global Export”, you will have possibility to transfer all saved measure on USB stick (if connected).

The format of the data generated and saved by the viscometer is ASCI (* .csv). 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 *. *". Excel will offer you to convert your data by displaying three successive windows. Be careful not to change the options offered except on

the second where it will be necessary to choose the option "semicolon" for the separation of the columns. You can then see your measurement results with the possibility to save a new file in Excel format.

2.2.4.2. Delete saved data

By click on tab you could delete saved measure one by one as you want from your FIRST PRO PLUS memory.

Then you click on “Delete”, saved data will be completely deleted from internal memory without any new confirmation.

2.2.5. Zero setting

The zero setting allows you to calibrate your FIRST PRO PLUS to take account of the engine's empty friction. This operation must be done without measuring system. The rotational speed for zero adjustment is set at the factory. But if you want to change it, you can change it by going to the "Parameters" menu (see section 2.2.7.8). The shifting allows you to give you much more accurate measurements at specific speeds. The best speed for zero setting should be the same as for your measurement.

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

2.2.6. Remote mode

This mode enables to drive FIRST PRO PLUS by external VISCO RM software, supplied on option.

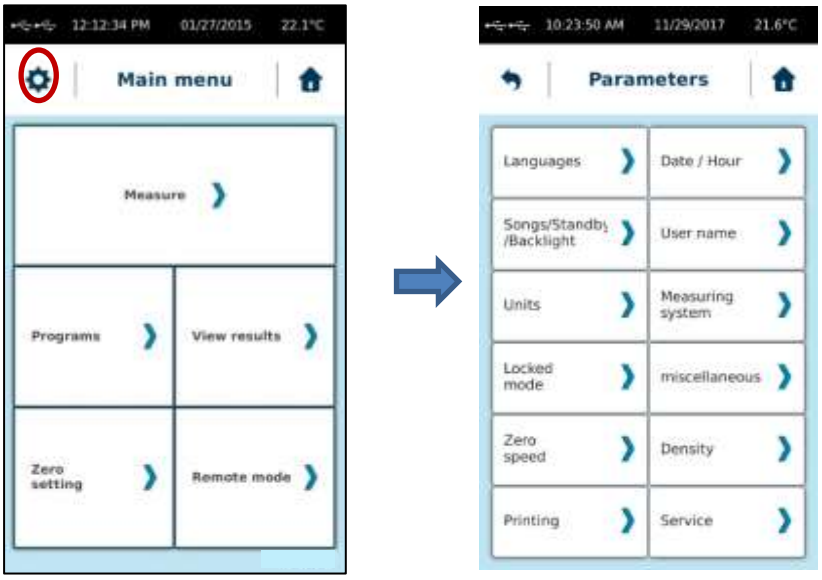
You must select the type of connection: USB or RS232 and connect the appropriate cable (delivered with software) to the computer, open the software, select the right COM port you're using on "SYSTEM" "CONFIGURATION" menu of software and press "Start" to establish connection with external software.

Rq : With mini USB connection, respect strictly the order to start, and if any communication is possible re-connect the USB cable on computer and wait it is recognized before start the communication.

2.2.7. Parameters

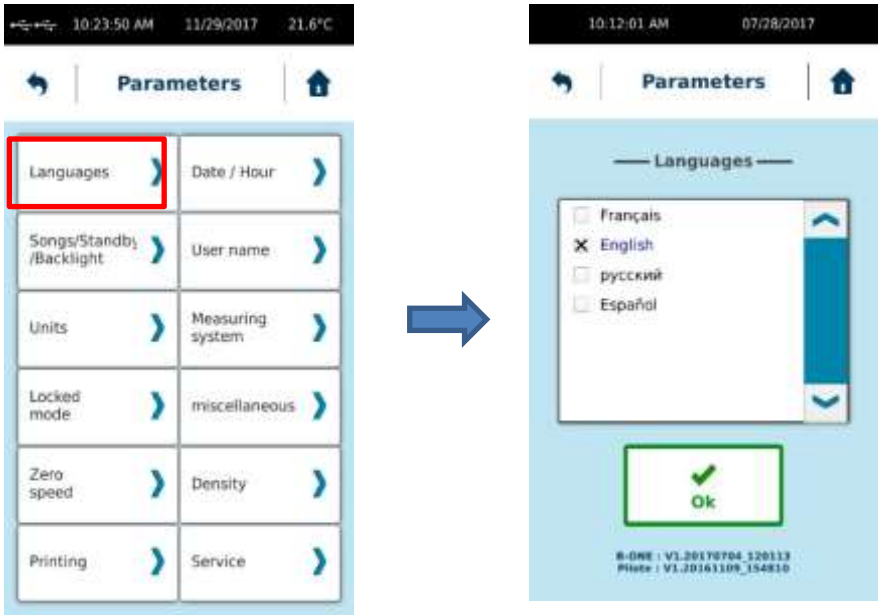
This parameters menu allow you to change settings of your device. It is reachable by clicking on icon "wheel" in upper left corner of touch screen.

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



2.2.7.1. Languages

Enable you to select language of your FIRST PRO PLUS. You have choice between French, English, Russian 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.

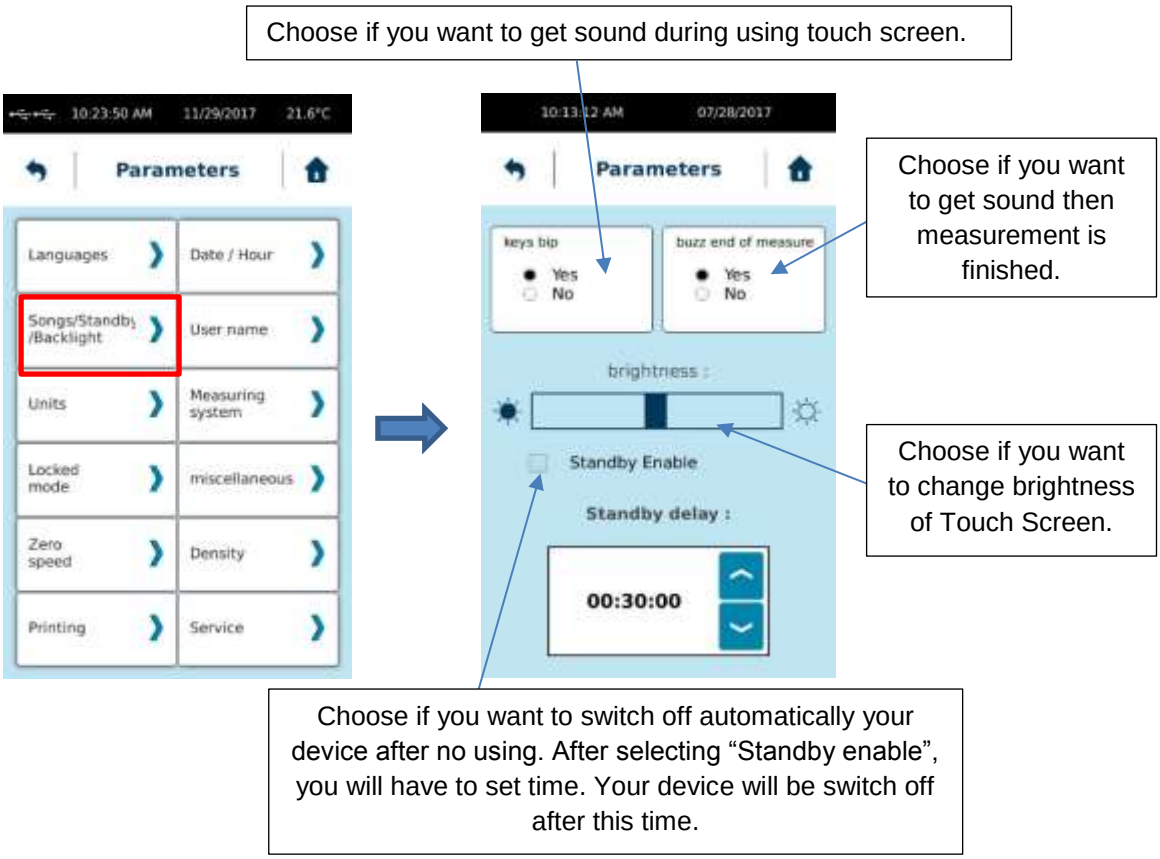


2.2.7.2. Date / Hour

Enable you to adjust hour and date of your FIRST PRO PLUS.

2.2.7.3. Sounds/Standby/Lighting

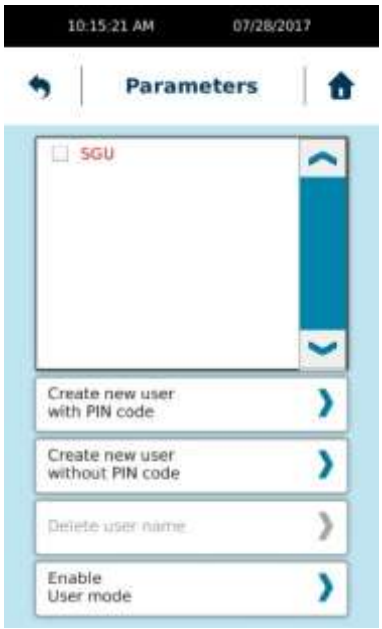
Allow you to modify sounds, lighting and activate or not the Standby mode of your FIRST PRO PLUS.



2.2.7.4. User Name

Operator mode will allow you to create different operators for your FIRST PRO. The use of the operators makes it possible to identify the person making the measurement. 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.

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. 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 FIRST PRO or change operator.

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

2.2.7.5. Units

Enable to you to change unit of viscosity values.

2.2.7.6. Measuring System

Allows you to add or remove a Measuring System.

To create a measurement system, the instrument will ask for both constants and the name. You will find below list of measuring system compatible with your device and corresponding constant. You are not allow to change constant of existing measuring system. If you want to use new constant, you have to create a new measuring system with name as "Copy of…" and enter constant you want to use. Please remember that Constant K_D is use to convert speed in shear rate and K_{Tau} to convert torque in shear stress. As shear rate and shear stress are using to calculate viscosity value, if you use different constant value, you will get different viscosity result.

MS BV

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
BV 1	6,1	1,001	1
BV 10	25,5	0,5	0,7
BV 100	76,5	0,15	0,5
BV 1000	510	0,1	0,5

MS ASTM

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
RV 1	**13,91**	**1**	**1**
RV 2	**55,65**	**1**	**1**
RV 3	**139,1**	**1**	**1**
RV 4	**278,2**	**1**	**1**
RV 5	**556,5**	**1**	**1**
RV 6	**1391**	**1**	**1**
RV 7	**5565**	**1**	**1**
LV 1	**100**	**1**	**1**
LV 2	**500**	**1**	**1**

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
LV 3	**1900**	**1**	**1**
LV 4	**8600**	**1**	**1**
LV 5	**17826**	**1**	**1**

MS VANE

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
VANE 72	157	1	0,5
VANE 72/2	270	1	0,5
VANE 72/4	400	1	0,5
VANE 72 6P	150	1	0,5
VANE 73	785	1	0,5
VANE 74	7850	1	0,5

MS DIN

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
MS-DIN 11	13.2	1.291	0.92
MS-DIN 12	19.4	0.354	0.73
MS-DIN 13	64.4	0.152	0.43
MS-DIN 22	25.8	1.291	0.92
MS-DIN 23	77.9	0.19	0.54
MS-DIN 33	130.1	1.291	0.92
MS-DIN 19	12.56	3.223	0.97

MS SV

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
MS-C/2-D	142.6	1.07	0.9
MS-C/2-3S	142.6	1.07	0.9
MS-D-D	328.6	0.175	0.5
MS-D-3S	328.6	0.175	0.5
MS-C-C	49.7	0.285	0.68
MS-C-D	62	1.07	0.9
MS-C18-C	35.1	0.997	0.9
MS-C19-C	33.1	2.04	0.95

MS CP

SYSTEM	Ktau / 1 mNm in Pa	Kd / 1 RPM in S-1	Ri / Ra
CP 2005	477.5	12	1
CP 2015	477.5	3.8	1
CP 2020	477.5	3	1
CP 2045	477.5	13.3	1
CP 2405	276.3	12	1
CP 2420	276.3	3	1
CP 2445	276.3	13.3	1
CP 2520	244.5	3	1
CP 3020	141.5	3	1
CP 3520	89.1	3	1
CP 4005	59.7	12	1
CP 4015	59.7	3.8	1
CP 4020	59.7	3	1
CP 4040	59.7	1.5	1
CP 4221	51.6	3.8	1
CP 4530	41.9	2	1
CP 5005	30.6	12	1
CP 5010	30.6	6	1
CP 5020	30.6	3	1
CP 6005	17.7	12	1
CP 6010	17.7	6	1
CP 6020	17.7	3	1
PP 25 0.5	326	2.618	1
PP 25 (1mm)	326	1.309	1
PP 25 (2mm)	326	0.654	1
PP 40 (0.5mm)	79.5	4.188	1
PP 40 (1mm)	79.5	2.094	1
PP 40 (2mm)	79.5	1.047	1

2.2.7.7. Locked Mode

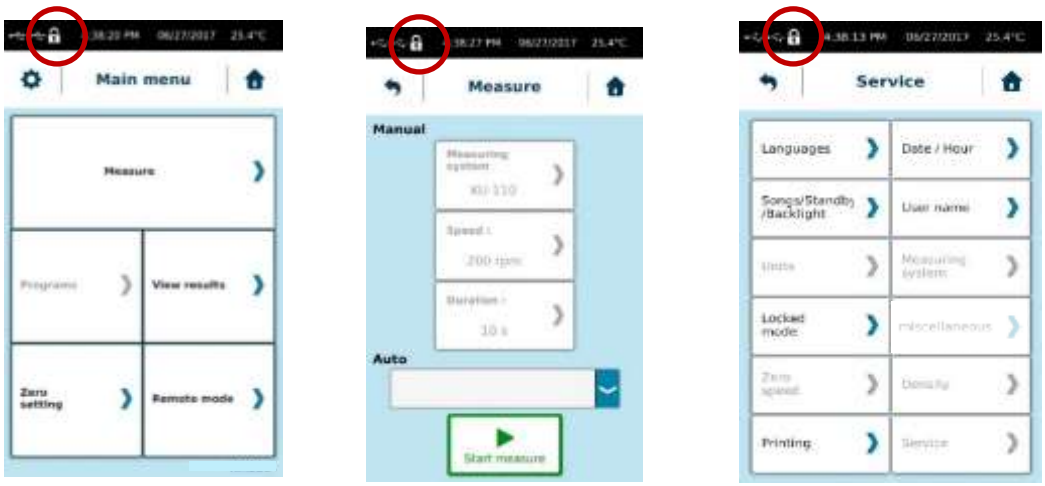
This option allow you to block measuring parameters and settings of your device. It should be set by an administrator or responsible of the device.

This function is not comparable to the “User name” menu (please see section 2.2.7.4). It should be use if you want to protect few settings on your device. All settings will be not locked 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 FIRST PRO 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 FIRST PRO Screen (see picture below). Protected mode protect programs, measuring parameters and some menu as shown on pictures below.



To disable protected mode, you have to go again in service and “Locked mode” and click on disable. You will have to use password.

2.2.7.8. Zero Speed

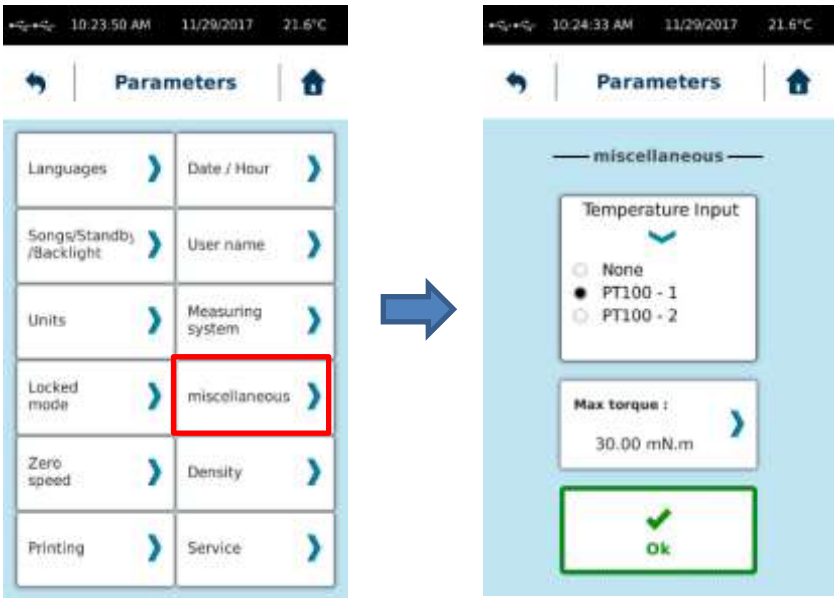
Enable you to adjust the rpm value for the zero adjustment.

You have to use the same speed as for your viscosity measurement. Then zero setting is finished, you have to click “Ok” to validate it.

2.2.7.9. Miscellaneous

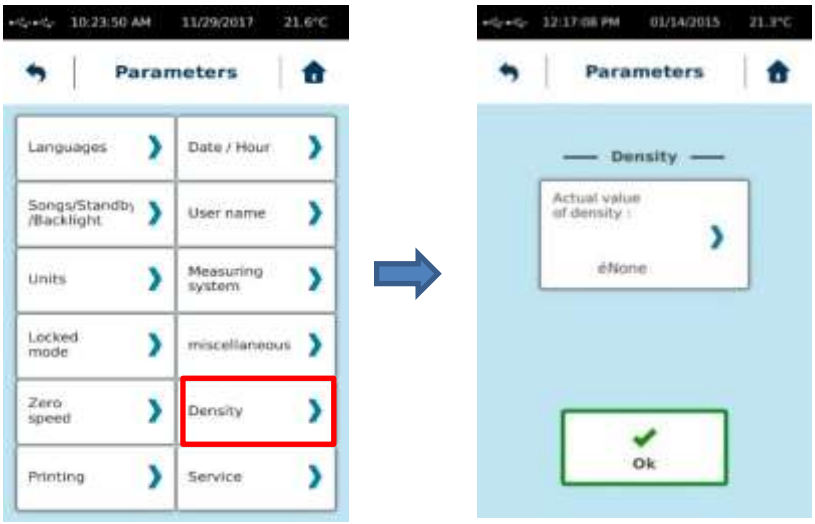
This menu allow you to choose which temperature sensor will be used by the device (Internal of external). By default, PT100-1 is selected and corresponding to PT100 of measuring head. If you want to use external sensor (as for coupling with CP1), you have to select PT100-2.

Allows you to change the maximum torque that will be sent to the analogue recorder that will be connected (oscilloscope or card). This function does not allow to limit the torque of the FIRST PRO PLUS during a measurement.



2.2.7.10. Density

Enable you to enter density value of your product in order to measure his kinematic viscosity.



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

2.2.7.11. Printing

Allows you to connect a printer, print a test page, and choose the print interval time you want during measurement.
The FIRST PRO 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"

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.

2.2.7.12. Service

Reserved to LAMY RHEOLOGY engineers.

3. MEASURING WITH YOUR DEVICE

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

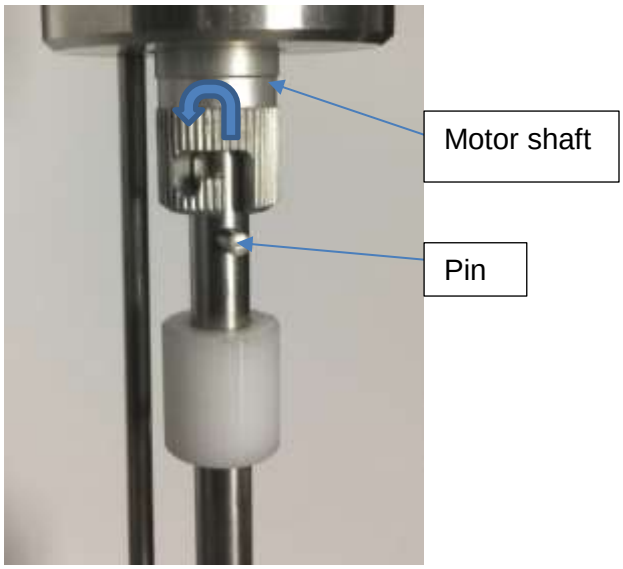
Viscometer need to be installed before next section of this manual (see section 1.5).

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.

As the FIRST PRO PLUS get only one kind of bayonet coupling system, way to install measuring bob on shaft of viscometer is always the same.

Insert the measuring system with the bayonet coupling into the motor shaft by pushing and turning slightly so that the pin is lodged in the space provided.



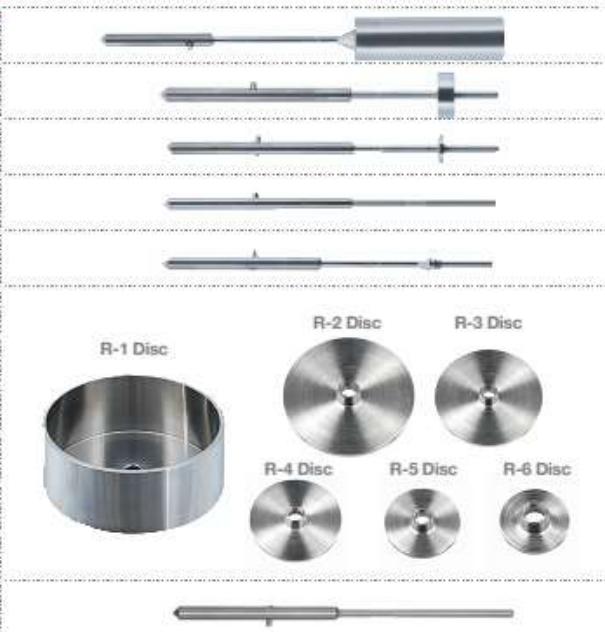
3.2. MS ASTM

Measuring spindles according to ASTM / ISO 2555 (316L stainless steel).

These systems are ideally suited for simple viscosity measurement at controlled rotational speed in all areas of activity. The standard recommends use of 600ml beaker for measurement.

Here below are all available mobiles:

Name	Part number	Dim. (mm)
L-1 spindle	111010	Ø 18.80 - L 65,1
L-2 spindle	111011	Ø 18,72 - L 6,86
L-3 spindle	111012	Ø 12,60 - L 1,78
L-4 spindle	111013	Ø 3,20 - L 31
Axis R 1-6 without disc	111000	Threaded axis
R-1 Disc	111001	Ø 56,26
R-2 Disc	111002	Ø 46,93
R-3 Disc	111003	Ø 34,69
R-4 Disc	111004	Ø 27,30
R-5 Disc	111005	Ø 21,14
R-6 Disc	111006	Ø 14,62
Axis R-7	111007	Ø 3,20



These spindle are composed of two groups. The mobiles L are intended for low viscosity fluids and R mobiles for medium to high viscosities (see tables below):

Designation spindle	Part Number Spindle	Part Number Complete set[b)]		Viscosity range for FIRST/B-ONE (mPa.s)
RV1	111001[a)]		111948	100 to 0.6M
RV2	111002[a)]	111947		200 to 2.4M
RV3	111003[a)]			300 to 6M
RV4	111004[a)]			600 to 12M
RV5	111005[a)]			1.2K to 24M
RV6	111006[a)]			2.8Kto 60M
RV7	111007			12K to 240M
LV1	111010	111014		200 to 4.3M
LV2	111011			1K to 20M
LV3	111012			4k to 82M
LV4	111013			17K to 370M

M for millions, K for thousand

a) Need additional axis (PN111000)

b) Complete set (delivered with axis PN 111000 only for RV spindle)

The spindle L are delivered complete, while the R discs must be screwed on the R1-6 axis (Ref 111000).

When measuring, it is strongly recommended to heat the 600ml beaker. You can use either a thermostatic bath or the EVA LR PLUS temperature control system.

Place the viscometer on its support (see section 1.5). Fill the beaker with 500 ml of product to be tested, taking care not to introduce air bubbles.

Place it in a bath (if you have one) for a sufficient time to reach the desired temperature.

If the product contains volatile or hygroscopic material, cover the beaker for the duration of the operation.

You must choose the measuring spindle according to the viscosity you wish to measure:

- For measurement of a low viscosity product, choose ASTM R-2 and run the unit at a high speed, such as 100 rpm.
- For the measurement of a high viscosity product, choose ASTM R7 and run the machine at low speed, for example 1 rpm.

Place the measuring head in the highest position (use screw on aluminium arm as wrote in section 1.2) and make a zero of your viscometer (see section 2.2.5.).

Insert the measuring system with the bayonet coupling in the motor shaft (see section 3.1).

Use handle to manipulate the device (see section1.2), release screw on aluminium arm and go down to immerge the mobile in the product. Beware of air bubbles under the disk!

Adjust the position of the viscometer in the sample to immerge the mobile to the predefined mark (the lowest for discs # 2 -6, the highest for disc # 1), so as to immerge the Pt100 probe at least 3 mm (only for models equipped with a temperature probe integrated into the measuring head. If an external temperature sensor is used, the liquid level must always be in the mark on the axis mobile). Be careful that the tip of the mobile is 10 mm or more from the bottom of the beaker.

When the measurement height is optimum, use screw on arm to block height of measuring head. After you can use the stop ring on the support rod to memorize the position.

Wait until the temperature of the sample is within the prescribed limits (if you have temperature probe with your device).

Start the measurement at the desired speed and after choose the right measuring system (see section 2.2.2).

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 with screw on aluminium arm as wrote in section 1.2. Remove the measuring spindle to clean it.

3.3. MS BV

Measuring spindle for 150ml beaker (316L stainless steel).

These spindles are ideally suited for simple viscosity measurement at a rotating speed in control in all areas of activity. They are appreciated for their ease of use and the low volume of product needed compared to the MS ASTM spindles.

Here below are all available spindle:

	Name	Part number	Dim. (mm)
	BV 1-100 Axis	117102	-
	BV Disc n°1	117001	Ø 45
	BV Disc n°10	117010	Ø 40
	BV Disc n°100	117100	Ø 20
	BV 1000 Axis	117101	Ø 4
	150-ml glass beaker	117150	Ø 50-52

This spindle allow measurement of huge viscosity range as showing below.

Designation spindle	Part Number Spindle[b)]	Part Number Complete set[c)]	Viscosity range for FIRST/B-ONE (mPa.s)
BV1	117001[a)]	117000	15 to 0.25M
BV10	117010[a)]		100 to 2M
BV100	117100[a)]		1K to 22M
BV1000	117101		10K to 220M

M for millions, K for thousand
Use specific glass Beaker (PN117150 for 10pcs) or specific plastic beaker (PN117155 for 10 pcs).
a) Need additional axis (PN 117102)
b) Need to be used with Centring piece (PN 117202)
c) Complete set delivered with axis (PN117102) and centring tool (PN 117202)

The BV 1000 Axis can be used like this. But for BV Disc 1, 10 and 100, you should screw it on BV 1-100 Axis.

When measuring, it is strongly recommended to heat the 150ml beaker. You can use either a thermostatic bath or the EVA BV PLUS temperature control system.

Place the viscometer on its support (see section 1.5). Fill the beaker with 120 ml of product to be tested, taking care not to introduce air bubbles.

Place it in a bath (if you have one) for a sufficient time to reach the desired temperature.

If the product contains volatile or hygroscopic material, cover the beaker for the duration of the operation.

Place the measuring head in the highest position (use screw on aluminium arm as wrote in section 1.2) and make a zero of your viscometer (see section 2.2.5.).

Insert the measuring system with the bayonet coupling in the motor shaft (see section 3.1).

Use handle to manipulate the device (see section1.2), release screw on aluminium arm and go down to immerge the mobile in the product by tilting the beaker (see picture section 3.2). Beware of air bubbles under the disk!

Adjust the position of the viscometer in the sample to immerge the mobile to the predefined mark. Be careful that the tip of the mobile is 10 mm or more from the bottom of the beaker.

When the measurement height is optimum, you can use the stop ring on the support rod to memorize the position (see picture section 3.2).

Wait until the temperature of the sample is within the prescribed limits.

Start the measurement at the desired speed and after choose the right measuring system (see section 2.2.2).

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 measurement speed.

Then your measurement is finished, raise the measuring head and lock it with screw on aluminium arm as wrote in section 1.2. Remove the measuring spindle to clean it.

3.4. MS VANE

Measuring spindles with blades (316L stainless steel).

These systems are ideal for viscosity measurement (value or curve) in control or development of all types of products even of very high viscosity with or without particles (size <5mm). They can be used for direct measurement in user's containers.

Here below are all available spindle:

Name	Part number	Dim. (mm)	
Vane 72	120017	Ø 21,67 - L 43,38	
Vane 73	111108	Ø 12,67 - L 25,35	
Vane 74	111115	Ø 5,89 - L 11,76	
Vane 72 6 blades	111121	Ø 21,67 - L 43,38	

This spindle allow measurement of huge viscosity range as showing below.

Designation spindle[a)]	Part Number spindle	Diameter (mm)	Lenght (mm)	Shear rate range for FIRST/B-ONE (s^{-1})	Viscosity range for FIRST/B-ONE (mPa.s)
Vane 72	120017	22	43	0.3 to 250	314 to 6.8M
Vane 72/2	111112	22	20		540 to 11.7M
Vane 72/4	111113	22	10		800 to 17M
Vane 72-6P	111121	22	43		300 to 6.5M
Vane 73	111108	13	26		1.5K to 34M
Vane 74	111115	6	12		15.7K to 340M

M for millions, K for thousand

a) All Vane system get 4 blades (exept PN 111121 6 blades).

All data given in this table are given for information and can be changed according container use for measurement. For example, shear rate range show same data as for speed range of FIRST PRO PLUS. And most of the time, you will be able to use only speed for your viscosity measurement and not the shear rate.

Place the viscometer on its support (see section 1.5).

Place the measuring head in the highest position (use screw on aluminium arm as wrote in section 1.2) and make a zero of your viscometer (see section 2.2.5.).

Insert the measuring system with the bayonet coupling in the motor shaft (see section 3.1).

For the use of these measuring system you can use 600ml or 150 ml beaker or your own container. Fill your beaker or container.

Use handle to manipulate the device (see section 1.2), release screw on aluminium arm and go down to immerge the mobile in the product (see picture section 3.2).

Adjust the position of the viscometer to immerge the measuring system in the sample (only part with blade) and not to close from the bottom of beaker (minimum distance should be 10mm). Be careful that the tip of the mobile is 10 mm or more from the bottom of the beaker.

When the measurement height is optimum, you can use the stop ring on the support rod to memorize the position (see picture section 3.2).

Start the measurement at the desired speed and after choose the right measuring system (see section 2.2.2). If your Vane measuring system is not in the list of device, please refer to section 2.2.7.6 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 measurement speed.

Then your measurement is finished, raise the measuring head and lock it with screw on aluminium arm as wrote in section 1.2. Remove the measuring spindle to clean it.

3.5. MS KREBS

Krebs type measuring spindles compatible with ASTM D562 standard (316L stainless steel). These systems are ideal for viscosity measurement in Krebs units in control of all types of products. They can be used for direct measurement in user containers or in 600 or 150ml beakers.

Here below are all available spindle:

Name	Part number	Dim. (mm)
MK-KU 1-10	111100	l. 53,98
MK-75Y	111103	l. 42,88

For your information, only MK-KU1-10 is conform to the norm ASTMD562.

To get KU unit for your viscosity measurement with your viscometer, you must choose the measuring spindle MK-KU1-10 and speed at 200 rpm. For all other speed and measuring spindle, you will get viscosity value in Pa.s.

Range for these spindle is:

- MK KU1-10: 20-500mPa.s and 40-140KU (at 200 rpm).
- MK-75Y: 100-50000 mPa.s.

Place the viscometer on its support (see section 1.5).

Place the measuring head in the highest position (use screw on aluminium arm as wrote in section 1.2) and make a zero of your viscometer (see section 2.2.5.).

Insert the measuring system with the bayonet coupling in the motor shaft (see section 3.1).

For the use of these measuring system you can use 600ml or 150 ml beaker or your own container. Fill it with the sample.

Use handle to manipulate the device (see section 1.2), release screw on aluminium arm and go down to immerge the mobile in the product (see picture section 3.2).

Adjust the position of the viscometer to immerge the measuring system in the sample (only part with blade) and not to close from the bottom of beaker (minimum distance should be 10mm). Be careful that the tip of the mobile is 10 mm or more from the bottom of the beaker.

When the measurement height is optimum, you can use the stop ring on the support rod to memorize the position (see picture section 3.2).

Start the measurement at the desired speed (200 rpm to get KU unit) and choose the right measuring system (see section 2.2.2).

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 speed.

Then your measurement is finished, raise the measuring head and lock it with screw on aluminium arm as wrote in section 1.2. Remove the measuring spindle to clean it.

3.6. MS DIN

Coaxial cylinders measuring systems according to DIN / ISO 3219 (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 behavior, yield stress or thixotropy.
They are particularly suitable for the control or development of homogeneous products with liquid aspect and with or without particles (size <200µm).

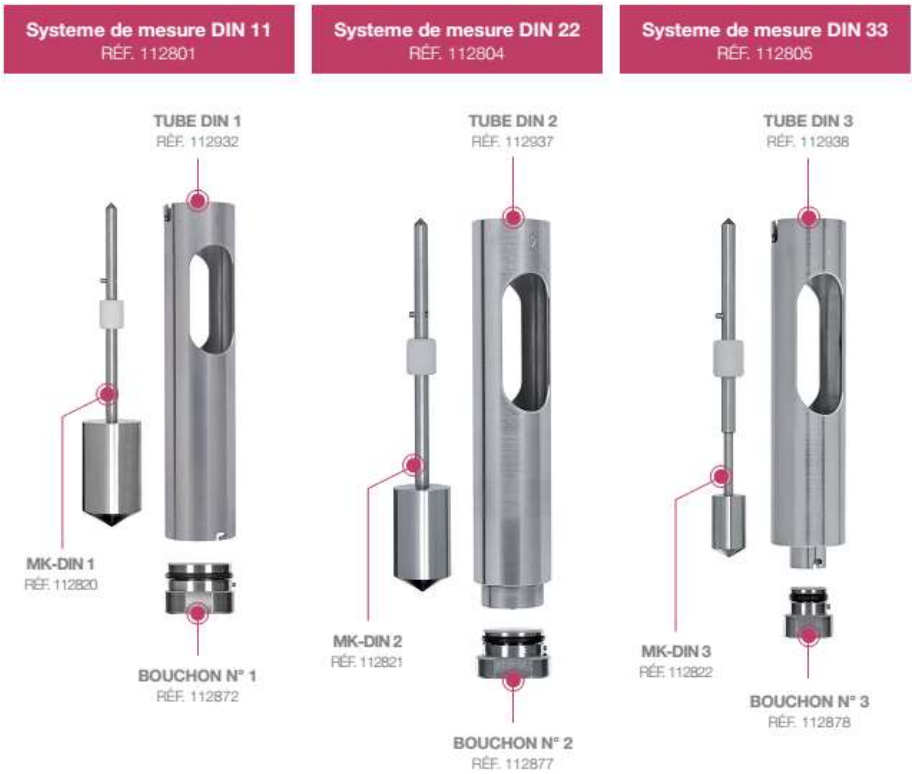
3.6.1. Utilisation of standard tube DIN1, DIN2 and DIN3

This is the measuring systems available:

Name	Part number	
MK - DIN 1	112820	
MK – DIN 2	112821	
MK - DIN 3	112822	
MK – DIN 9	111875	
DIN 1 Tube	112932	
DIN 2 Tube	112937	
DIN 3 Tube	112938	
DIN 1 Cap	112872	
DIN 2 Cap	112877	
DIN 3 Cap	112878	
Mooney Cap	112874	

Each tube is used with the matching cylinder (eg DIN tube 1 with cylinder MK-DIN1). The cylinder MK-DIN 9 is used with the DIN tube 1. The tubes can be closed with their cap assorted or used open for a measurement immersed in a container containing the liquid to be measured. The Mooney plug is used exclusively with the DIN 1 tube and the MK-DIN 1 and MK-DIN 9 cylinders. It reduces the volume of product required for the measurement (see table on the next page).

Examples of complete configurations include a DIN tube, a MK-DIN cylinder and a cap.



In addition to these measuring systems, a DIN X tube with a MK-DIN X + 1 cylinder can be used. Thus, MS DIN 12, MS DIN 13 and MS DIN 23 measuring systems can also be used. The first digit always indicates the number of the tube and the second digit the number of the cylinder MK. There is also a measuring system MS DIN 19 which uses the DIN tube 1 and MK-DIN 9 cylinder.

Here are the measuring ranges of the existing MS DIN measuring systems:

Designation Measuring System	Part Number Measuring system[a)]	Diameter (mm)		Sample volume[b)] (ml)	Shear rate range for FIRST (s^{-1})	Viscosity range for FIRST (mPa.s)
		inner	outer			
MS DIN 11	112801	30	32.5	27	0.4 to 320	25 to 0.44M
MS DIN 12	112802	24	32.5	46	0.1 to 90	110 to 2.3M
MS DIN 13	112803	14	32.5	61	0.1 to 35	920 to 8.3M
MS DIN 19	112806	31.5	32.5	25	1 to 800	8 to 0.17M
MS DIN 22	112804	24	26	22	0.4 to 320	40 to 0.86M
MS DIN 33	112805	14	15	14	0.4 to 320	200 to 4.3M
MS DIN 11 Mooney	112812	30	32.5	23	0.4 to 320	21 to 0.44M
MS DIN 19 Mooney	112811	31.5	32.5	18.5	1 to 800	8 to 0.17M
MS DIN 23	112816	14	26	36	0.1 to 48	810 to 17M

M for millions, K for thousand
a) Complete system (bob+cup+cap)
b) Volume required for Pt100 immersion

All systems shown above can be used with or without a temperature control unit since the tube attaches to the base of the viscometer (see below). When your viscometer is combined with

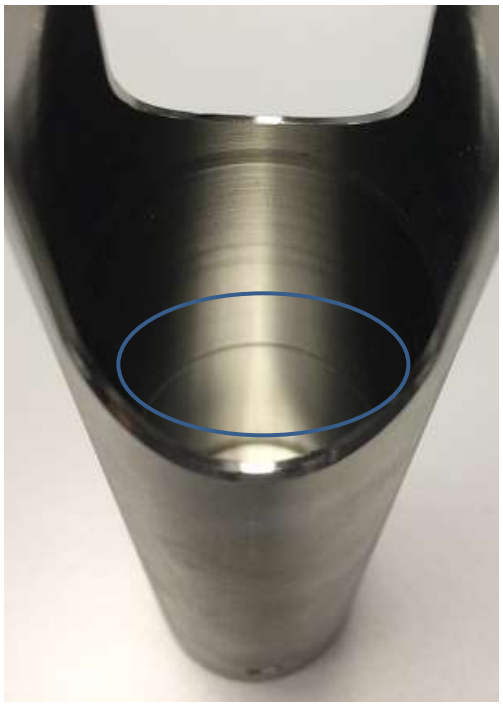
an EVA MS DIN, EVA MS DIN-MSR, EVA 100, RT1 or CT DIN type of temperature setting unit, the positioning of the measuring cylinders and tubes is the same. It will be necessary to introduce the assembly into the temperature chamber.

The installation of the measuring system must be done after the zero adjustment. If this is not done, see section 2.2.5.

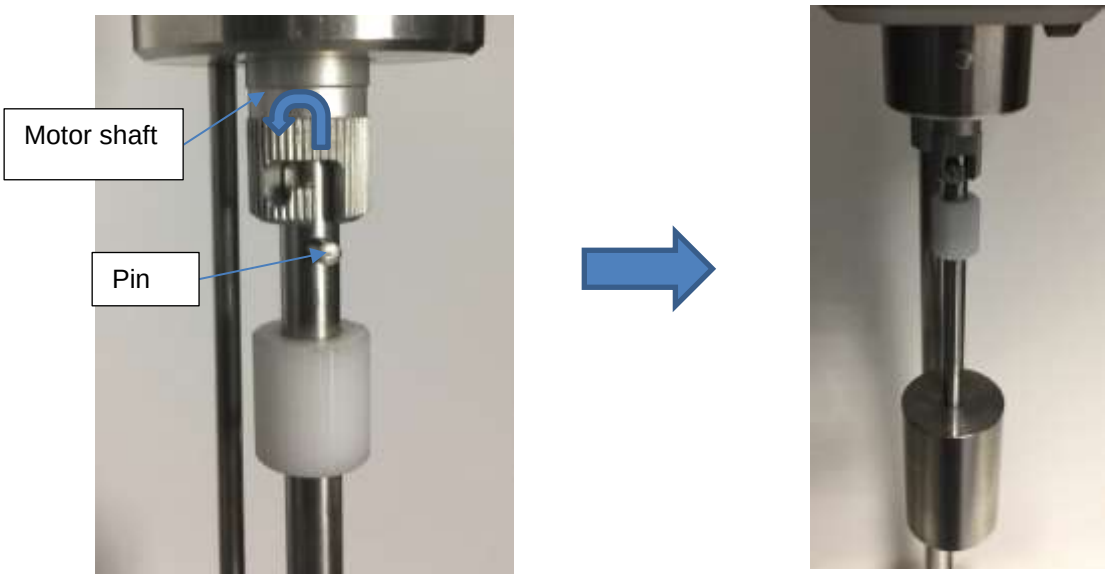
The first step is to install the cap on the tube as shown in the picture below (not necessary if you make a dip measurement directly into a pot). Also check that the gasket is properly installed on the cap.

The first insertion of the cap can be difficult. You must use some silicone grease to facilitate installation.

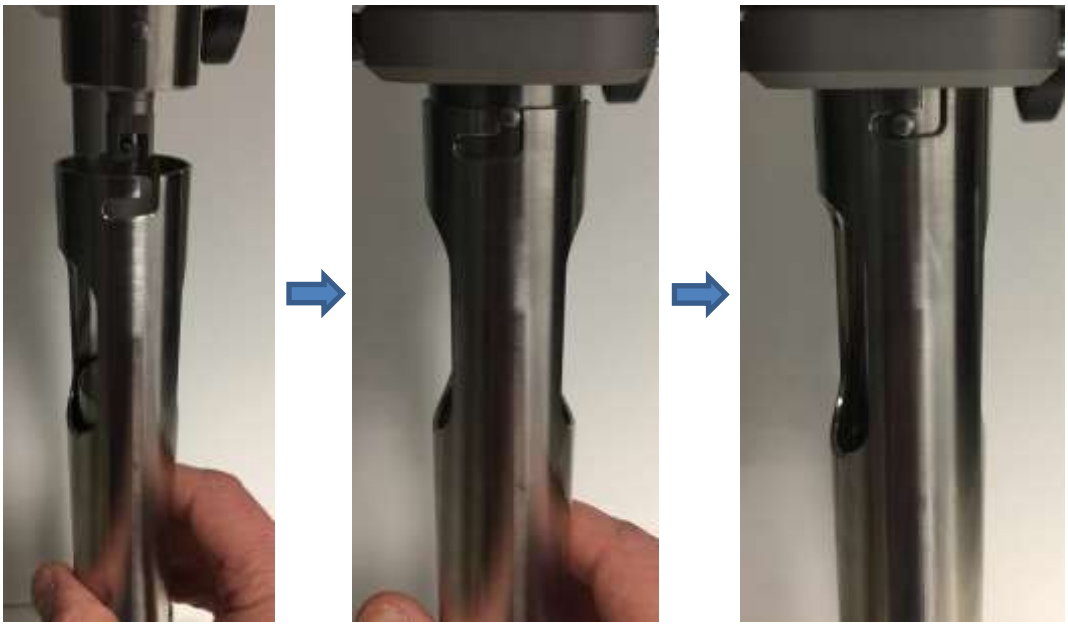
You can then put the product to be measured in the tube. The necessary volume is indicated in the table on the previous page according to the system used. There is a level line in the tube (see picture below).



You must then install the MK-DIN cylinder on the viscometer shaft as shown in the photos below.



You can then introduce the MS DIN tube with the product from the bottom up slowly and making sure to align with the cylinder. Also place the groove on the tube facing you as shown in the picture below). When you are close enough to the viscometer base, you must rotate the tube to place the pin in the groove of the tube.



Once the tube is properly installed, check that the temperature sensor on the viscometer is at least one 3mm deep into the liquid.

When using your viscometer with a temperature control system (EVA MS DIN, EVA MS DIN MSR, EVA 100, CT DIN or RT-1), you must then lower the measuring head in such a way that the tube comes inside the hole provided for this purpose. Check that there is no product on the outer wall of the tube. Use the arm handle and screw (see section 1.2) to gently lower the measuring head. The tube should be easily housed in the chamber. If this is not the case, do not force it and contact your local distributor or LAMY RHEOLOGY. When the measuring head is properly positioned, there is no need to lock the position using the screw on the stem. Also,

be sure to allow sufficient time for stabilization if the measurement temperature is different from the ambient temperature (at least 10 minutes) before making your measurement.

When using MS DIN measuring systems for immersion measurement, the order and method of installation is the same for cylinder and tube. Since there is no cap on the tube, you will need to put the product to be measured in a pot larger than the tube. Then lower the measuring head by using the handle and the screw on the arm (see paragraph 1.2) so that the tube is immersed in the pot and the temperature probe is sufficiently immersed in the liquid (at least 1 cm). Take care that the liquid level never exceeds the level of the white ring present on the cylinder axis MK DIN. You must use the screw on the arm (see section 1.2) to block the measuring position and take care that there is enough space between the tube and the bottom of the pot for the liquid to rise in the tube.

Once the setup is complete, you can do your measurement (see section 2.2.2).

If you have just made a measurement with the tube closed by a cap, rise the measuring head to the highest position by blocking the arm with the screw provided for this purpose (see section 1.2). Carefully remove the cylinder from the viscometer shaft, then remove the tube containing the product and the cylinder, being careful if the temperature is high. You can then remove the

MK DIN cylinder from the DIN tube for cleaning. Remove the DIN tube cap to clean it. Remember to clean the temperature probe (if present).

If you have just made a measurement in immersion (without cap), it is preferable to remove the cylinder from the axis of the motor and after the tube from the base of the viscometer before rise the measuring head. You can then take the tube and cylinder for cleaning. Remember to clean the temperature probe (if present).

3.6.2. Utilisation of tube DIN1 S, DIN2 S and DIN3 S

There are also other DIN x S type tubes that are used with EVA MS DIN, EVA MS DIN-MSR, EVA 100, RT1 or CT DIN temperature units.

Here are the tubes and cylinders available and their accessories:

Name	Part number	
MK - DIN 1	112820	
MK – DIN 2	112821	
MK - DIN 3	112822	
MK – DIN 9	111875	
DIN 1 Cap	112872	
DIN 2 Cap	112877	
DIN 3 Cap	112878	
Mooney Cap	112874	
ST-R centring tool	114436	
DIN 1 S Tube	112933	
DIN 2 S Tube	112948	
DIN 3 S Tube	112944	

DIN xS tubes are used with the same MK-DIN cylinders and caps as standard DIN tubes. The measuring ranges are therefore unchanged (see table section 3.6.1). Their use facilitates cleaning and filling since they are shorter and therefore easier to access. On the other hand, they require the use of an accessory (Ref 114436) which guarantees a perfect centering of the cylinder in the tube.

The first step is to install the cap on the tube as shown in the photo below. Also check that the gasket is properly installed on the cap.

The first insertion of the cap can be difficult. You must use some silicone grease to facilitate installation.

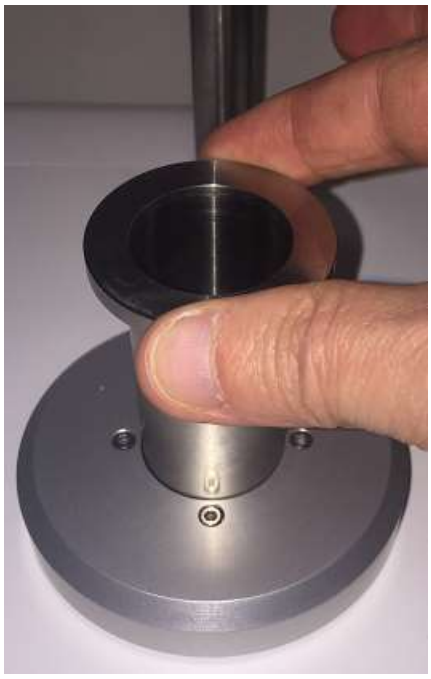
You can then put the product to be measured in the cylinder. The necessary volume is indicated in the table section 3.6.1 according to the system used. There is a level line in the tube (see picture below).

Make sure you have adjusted the viscometer before proceeding to the following steps (see section 2.2.5)

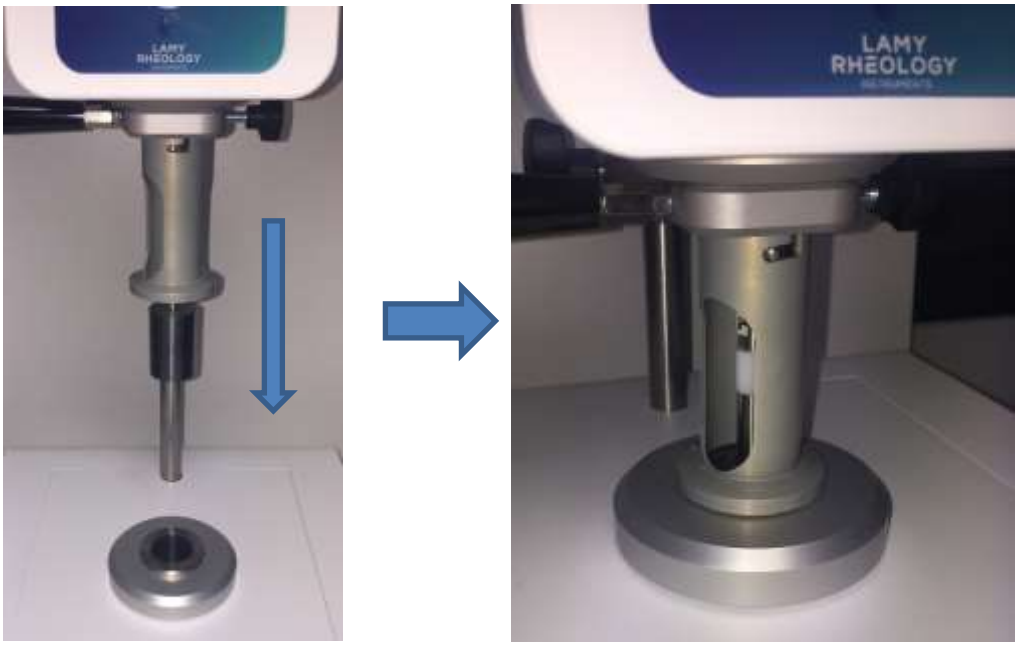
You must then install the centring piece on the base of the viscometer. Also place the groove facing you as shown in the picture below. When you are close enough to the viscometer base, you must rotate the piece to place the pin in the groove.

You must then install the MK-DIN cylinder on the viscometer axis as shown in the photo above.

Put the tube with your product inside the warming unit.



Use the arm handle and screw (see section 1.2) to gently lower the measuring head. The centring piece must completely cover the rim of the tube.



When the measuring head is properly positioned, there is no need to lock the position using the screw on the arm. Also, be sure to allow sufficient time for stabilization if the measurement temperature is different from the ambient temperature (at least 10 minutes) before making your measurement.

Once the setup is complete, you can do your measurement (see section 2.2.2).

When your measurement is complete, it is better to remove the cylinder from the viscometer shaft. That will rest in the tube. Rise the measuring head to the highest position by blocking the arm with the screw provided (see section 1.2). Then remove the tube containing the product and the cylinder, being careful if the temperature is high. You can then remove the MK DIN cylinder from the tube for cleaning. Remove the DIN tube cap to clean it. Don't forget to clean the temperature probe (if available).

3.7. MS SV

Measuring systems for low volumes (316L stainless steel)

These systems, unlike the MS-ASTM and MS-DIN systems, make it possible to measure products in small quantities by applying a shear rate up to temperatures of 200 ° C (according to models, see table).

With RT1, these systems are compatible with ASTM D3236.

Here are the available accessories:

	Name	Part number
	MK-C/2 MK-D MK-C MK-C18 MK-C19	116010 111878 116002 112507 116015
	DIN3S Tube	112944
	C Tube with insert	116001
	MB-D Alu Cup	114319
	MB-C Alu Cup	114306
	D Insert	150500
	C Insert	111934
	ST-R centring tool	114436
	n°3 Cap	112878
	Delrin Cap	116005

All these accessories can be combined to obtain the following measuring systems:

Name of measuring system	Part number of complete measuring system	Measuring cylinder	Measuring cup	Holder for disposable cup	Measuring disposable cup (100)	Centring tool	Cap	Category
MS-C/2-D (disposable)	116020[a)]	116010		150500	114319	114436		A
MS-C/2-3S	116021	116010	112944			114436	112878	B
MS-D-D (disposable)	116022[a)]	111878		150500	114319	114436		A
MS-D-3S	116023	111878	112944			114436	112878	B
MS-C-C	116000[b)]	116002	116001				116005	C
MS-C-C (disposable)	116024[a)]	116002		111934	114306	114436		A
MS-C-D (disposable)	116025[a)]	116002		150500	114319	114436		A
MS-C18-C	116026[b)]	112507	116001				116005	C
MS-C18-C (disposable)	116027[a)]	112507		111934	114306	114436		A
MS-C19-C	116028[b)]	116015	116001				116005	C
MS-C19-C (disposable)	116029[a)]	116015		111934	114306	114436		A

Measuring systems of category A can only be used with EVA DIN, RT1 and CT DIN temperature controllers. They come with disposable cups (a batch of 100) ideal for measuring on aggressive or difficult to clean products.

Measuring systems of Category B can only be used with EVA DIN, RT1 and CT DIN temperature controllers. They come with a reusable stainless steel measuring cup.

The measuring systems in category C can be used alone or with DIN EVA and CT DIN temperature regulations. They come with a measuring cup in stainless steel.

Here is the detailed technical information and measurement ranges:

Designation Complete Measuring System	Part Number Complete measuring system	Diameter (mm)		Sample volume (ml)	Shear rate range for FIRST (s^{-1})	Viscosity range for FIRST (mPa.s)
		inner	outer			
MS-C/2-D(disposable)	116020[a)]	13.6	15	6.81	0.5 to 260	280 to 3.7M
MS-C/2-3S	116021	13.6	15	4.52		
MS-D-D(disposable)	116022[a)]	7.5	15	8.85	0.1 to 43	3.8K to 42M
MS-D-3S	116023	7.5	15	6.56		
MS-C-C	116000[b)]	13.6	20	18.45	0.1 to 71	350 to 6.4M
MS-C-C(disposable)	116024[a)]	13.6	20	22.22		
MS-C-D(disposable)	116025[a)]	13.6	15	3.04	0.5 to 267	116 to 1.6M
MS-C18-C	116026[b)]	18	20	11	0.5 to 250	71 to 0.9M
MS-C18-C(disposable)	116027[a)]	18	20	11		
MS-C19-C	116028[b)]	19	20	9	1 to 510	33 to 0.43M
MS-C19-C(disposable)	116029[a)]	19	20	9		

3.7.1. Use of measuring system of category A

Whatever the measurement system model, the use is the same.

The measuring head must first be installed on the heating unit (see installation instructions supplied with the temperature control).

Check that the motor has been adjusted before proceeding to the next steps (see section 2.2.5).

The first step is to place the screw on the centring piece and then install the latter on the base of the viscometer.

The screw locks the centring piece on the base of the viscometer.

You can then set up the cylinder on the bayonet coupling of the viscometer.

Place the disposable cup holder in the well of the temperature control.

Take a disposable cup, fill it with your product (see table on the previous page for the volume of product to be put into the measurement system). Then place it in the disposable cup holder.

Use handle and screw of arm (see section 1.2) to gently lower the measuring head. The centring piece must completely cover the edge of the disposable cup insert.

When the measuring head is properly positioned, there is no need to lock the position using the screw on the arm. Also, be sure to allow sufficient time for stabilization if the measurement temperature is different from the room temperature (at least 10 minutes) before taking your measurement.

You can do your measurement (see section 2.2.2).

Once the measurement is complete, unhook the mobile from the viscometer axis and rise the measuring head. Remove the mobile to clean it. Remove the disposable cup holder with disposable cup. Also clean the temperature probe and the centring piece. It can stay in place on the basis of the viscometer for a next measurement.

3.7.2. Use of measuring system of category B

Whatever the measurement system model, the use is the same.

The measuring head must first be installed on the heating unit (see installation instructions supplied with the temperature control).

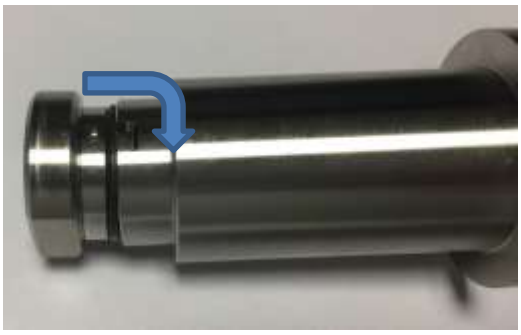
Check that the motor has been adjusted before proceeding to the next steps (see section 2.2.5).

The first step is to place the screw on the centring piece and then install the latter on the base of the viscometer.

The screw locks the centring piece on the base of the viscometer.

You can then set up the cylinder on the bayonet coupling of the viscometer.

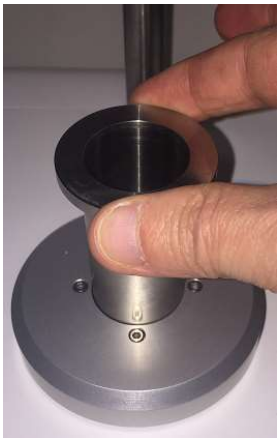
Install the cap on the tube as shown in the photo below. Also check that the gasket is properly installed on the plug.



The first insertion of the cap can be difficult. You must use some silicone grease to facilitate installation.

You can then put the product to be measured in the cup. The required volume is indicated in the table in section 3.7 according to the system used.

Put the tube with your product inside the heat setting unit.



Use handle and screw of arm (see section 1.2) to gently lower the measuring head. The centring piece must completely cover the edge of the disposable cup insert.

When the measuring head is properly positioned, there is no need to lock the position using the screw on the arm. Also, be sure to allow sufficient time for stabilization if the measurement temperature is different from the room temperature (at least 10 minutes) before taking your measurement.

You can do your measurement (see section 2.2.2).

When your measurement is complete, it is recommended to remove the cylinder from the viscometer shaft. It will rest in the tube. Rise the measuring head to the highest position by blocking the arm with the screw provided (see section 1.2). Then remove the tube containing the product and the cylinder, being careful if the temperature is high. You can then remove the cylinder from the cup to clean it. Remove the cap from the tube to clean it. It should be necessary to clean the centring tool.

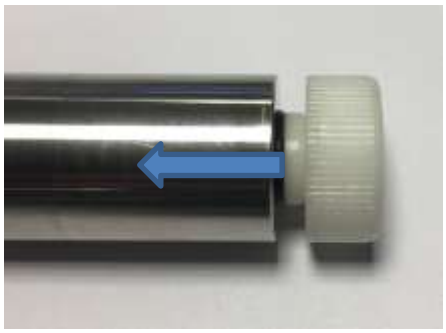
3.7.3. Use of measuring system of category C

These systems can therefore be used with or without a heating unit (DIN EVA and CT DIN). The cup used for these systems is the same (Ref 116001). This is fixed directly to the base of the viscometer.

The measuring head must first be installed on the temperature control unit (see installation instructions supplied with the temperature control) or on the standard support if you not use a heating system (see section 1.5).

Check that the motor has been adjusted before proceeding to the next steps (see section 2.2.5).

The first step is to install the cap on the tube as shown in the photo below. Also check that the gasket is properly installed on the plug.



The first insertion of the cap can be difficult. You must use some silicone grease to facilitate installation.

You can then put the product to be measured in the cup. The necessary volume is indicated in the table in section 3.7 according to the system used.

You can then set up the cylinder on the bayonet coupling of the viscometer.

You can then present the tube with the product from the bottom up slowly and making sure to align with the cylinder. Also place the mark on the tube facing you as shown in the picture below). When you are close enough to the Viscometer base, you must rotate the tube to place the pin in the mark of the tube.

Once the tube is properly installed, check that the temperature sensor on the viscometer is at least one centimetre deep into the liquid.

When using your viscometer with a temperature control system (EVA MS DIN or CT DIN), you must then lower the measuring head so that the tube fits into the chamber provided for this

purpose. Check that there is no product on the outer wall of the tube. Use the handle and screw on arm (see section 1.2) to gently lower the measuring head. The tube should be easily housed in the hole of temperature controller. If this is not the case, do not force it and contact your local distributor or LAMY RHEOLOGY. When the measuring head is properly positioned, there is no need to lock the position using the screw on the stem. Also, be sure to allow sufficient time for stabilization if the measurement temperature is different from the room temperature (at least 10 minutes) before taking your measurement

Once the setup is complete, you can do your measurement (see section 2.2.2).

When your measurement is complete, it is recommended to remove the cylinder from the viscometer shaft. It will rest in the tube. Rise the measuring head to the highest position by blocking the stem with the screw provided (see section 1.2). Then remove the tube containing the product and the cylinder, being careful if the temperature is high. You can then remove the cylinder from the tube to clean it. Remove the cap from the tube to clean it. Clean the temperature sensor.

3.8. MS CP

The use of cone-plane measuring systems is possible with the FIRST PRO PLUS. All information regarding the installation and use of these measuring systems is explained in the operating instructions of the CP-1 PLUS.

4. VERIFICATION OF YOUR DEVICE

Your instrument is calibrated at the factory with an ASTM R2 mobile or MS DIN11 measuring system (see calibration certificate) and a certified oil with a viscosity close to 1000 mPa.s. The verification method differs depending on the measurement system selected. You may decide to perform the verification with your own measurement systems, but it is highly recommended to use one of the two measurement systems mentioned above. In case other systems are used, please contact LAMY RHEOLOGY for the most appropriate verification method.

Viscosity measurement on a 1000 mPa.s standard silicon oil with a ASTM 2555 R2 measuring system.

- See section 3.2 and 3.1 for detail about preparation.

- Adjust the automatic zero in the air at 50rpm, without any spindle, until it stops (see section 2.2.5).

- Fill the 600ml beaker with the standard oil.

- Insert the 600ml beaker in a controlled temperature unit like EVA LR system or thermostatic bath.

- Attach the spindle R2 to the viscometer and immerge the spindle in the oil at the good level (mark on the spindle).

- Wait for 15 minutes until the standard oil rise the good temperature.

- Select on the instrument the measuring system R2, select 50 rpm for the speed, select 60 seconds for the measuring time, and start the measurement (see section 2.2.2).

Viscosity measurement on a 1000 mPa.s standard silicon oil with a defined DIN11 measuring system.

- See section 3.6 and 3.1 for detail about preparation.

- Adjust the automatic zero **in the air**, **without any spindle**, until it stops (see section 2.2.5).

- Fill the measuring tube DIN 1 with the standard oil.

- Attach the spindle MK-DIN 1 to the viscometer and fix the tube to the viscometer (see section 3.6)

- Insert the measuring system in a controlled temperature unit like a EVA DIN system or thermostatic bath.

- Wait for 10 minutes until the standard oil rise the good temperature.

- Select on the instrument the measuring system DIN11, select 50s-1 for the speed, select 30 seconds for the measuring time, and start the measurement (see section 2.2.2).

Result at the end of the measurement must be within +/-5% of the standard viscosity value. If the measure is out, your instrument might need to be recalibrated.

Check if the error does not come from a wrong filling, a wrong zero adjustment, a wrong spindle rotation, or a wrong temperature value.

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