

# Rotational Viscometer

## Instruction Manual

### *MASTER SERIES EVO EXPERT*



# MASTER SERIES EVO EXPERT Rotational Viscometer

Software Version: 5.0  
Manual Version 1.4

## Instruction Manual

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# 1. Introduction

Thank you for acquiring the Master Evo Expert rotational viscometer model from Fungilab.

The Evo is a rotational viscometer, based on the measurement of the torque of a rotating spindle in a sample at a specified velocity. Three different models, as well as various accessories, allow it to cover a wide range of viscosity measurement.

## 1.1 Machinery identification

Product designation: Digital Viscometer  
Model: MASTER EVO EXPERT  
Manufacturer: FUNGILAB S.A.

Viscolead Series			Master Series				V-series	
One	Advance	PRO	Alpha	Smart	Expert	EVO Expert	V-pad	V-Compact

Table 1 Information table of the Fungilab viscometer models

## 2. Safety Instructions

- It is not the purpose of this manual to outline all of the safety instructions recommended for the use of the rotational viscometer, its accessories and samples. It is the responsibility of the user to establish health and safety practices and to determine the application's limits before use.
- Fungilab guarantees the satisfactory operation of the viscometers and its accessories if there have not been any unauthorized adjustments to the mechanical pieces, the electronic components and the software.
- The operator should follow all of the instructions and warnings and of this manual to ensure the safe and proper operation of the equipment.
- Do not use the equipment for any other purpose than those described in this manual.
- Do not use any accessory that is not supplied or approved by Fungilab.
- Do not use the viscometer or its accessories if there is any suspicion of malfunction. Do not use the equipment in situations or conditions that can cause personal injuries or material damage.

The rotational viscometer is **not flameproof or intrinsically safe (ATEX)** instrument and therefore should not be used in areas where there is an explosion risk.

**Before using the viscometer, carefully read and observe the following precautions:**



Not following the instructions may cause serious harm or personal injuries.

**To avoid an electric shock:**

- The socket by which the viscometer will be connected should have a ground. Verify that the voltage and the frequency match with the specifications for the power supply. Before turning on the machine, let it sit for some time so that it acclimates to the surrounding temperature in order to avoid a short-circuit caused by condensation. The fluctuations of the power source should not surpass  $\pm 10\%$  of the nominal voltage

### 3. Safety Symbols and Precautions

**Safety Symbols:** The following symbols are used in this instruction manual:



This symbol warns us of an operational, practical, or similar procedure that, if it is not carried out properly, may damage the equipment



This symbol indicates hazardous voltages may be present



This symbol indicates additional information that it has to be considered

#### Precautions



If this instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired



This instrument is not intended for use in a potentially hazardous environment



In case of emergency, turn off the instrument and then disconnect the electrical cord from the wall outlet



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

### 4. Utilities

Input Voltage: Universal Power Supply (100-240V)

Input Frequency: 50 / 60 Hz

Power Consumption (Apparent): 15 VA

Power Consumption (Real): 25W



Main supply voltage fluctuations are not to exceed  $\pm 10\%$  of the nominal supply voltage

## 5. Specifications

<b>Speeds:</b>	0.01 – 250 RPM
<b>Temperature Sensing Range:</b>	-40 °C to 300 °C (-40 °F to 572 °F)
<b>USB A Port for use with temperature probe</b>	
<b>Viscosity Accuracy:</b>	±1.0 % of full scale range The use of accessory items will have an effect on the measurement accuracy
<b>Viscosity Repeatability:</b>	±0.2 % of full scale range
<b>Temperature Accuracy:</b>	±0.1 °C   -40 °C to 300 °C (-40 °F to 572 °F)
<b>Operating Environment:</b>	+5 °C to 40 °C temperature range (41 °F to 104 °F) Non condensing humidity
<b>Noise emitted:</b>	Set less than 70 dB (A)
<b>Vibrations emitted:</b>	Less than 2.5 m/s <sup>2</sup>

Conforms to CE Standards:

Machinery directive (2006/42/EC)

Low voltage directive (2014/35/EU):

EN 61010-1:2010      Safety requirements for electrical equipment, for measurement, control and laboratory use

EMC directive (2014/30/EU):

EN 61326-1:2013      Electrical equipment for measurement, control and laboratory use

RoHs directive:

2011/65/EU + 2014/EU a 2014/6/EU +2014/8/EU a 2014/16/EU

WEEE directive (2012/19/EU)

### Notice to customers:



The product is made up of various components and various materials that must be recycled or, failing that, deposited in the corresponding debris removal sites when the product's life has been completed or when otherwise it is necessary to dispose of it. To do this, the end user who acquires the product must know the current regulations of each municipality and / or locality based on the waste electrical and electronic equipment. The user who acquires this product must be aware of and responsible for the potential effects of the components on the environment and human health as a result of the presence of hazardous substances. Never place the product in a conventional container of citizen scope if a previous dismantling and knowledge of the components that incorporates. If you do not know the procedure to follow, consult with the city council for more information.

## 6. Conditions for use

- Indoor use
- Maximum altitude 2000 m.
- Surrounding temperature range: from +5 to 40°C.
- The equipment temperature must be kept above the dew point so moisture doesn't condense on or in it. The power source fluctuations should not surpass  $\pm 10\%$  of the nominal voltage
- Installation category II
- Pollution level II

## 7. Maintenance

- Always clean all of the parts after each use! Clean and dry the spindles and the spindle guard well. Make sure that there is not any sample remaining, especially in the delicate zones such as the spindle connector.
- Use detergents or solvents to clean the spindles and the protector:
  - For cleaning food samples, use lukewarm water and if necessary, use soft household detergents
  - Other solvents that generally provide good results are acetone, gasoline, or any solvent with a high percentage of alcohol
  - For the use of any other solvent, make sure that it does not corrode the spindles or the protector. The spindles are made in AISI 316.

**Warning:** Handle the volatile and flammable solvents with proper cautions. It is the user's responsibility to establish safety conditions at work.



- Regularly check the spindle's thread and the viscometer shaft.
- During the viscometer's lifespan, regular maintenance is important. As the manufacturer, we advise annual check-ups by the technical service of your local distributor.
- The viscometer is powered by a MEAN WELL GST25A12-P6J power supply. Do not open, expose, modify or touch internal circuitry of the power supply.

Fungilab S.A. can check up also the viscometer, working as a technical service, to put in contact with us use the next address.

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## 8. Equipment presentation

- Once the equipment package is received, check and confirm the delivery note. If some discrepancy or problem is found, immediately notify the supplier.
- Verify that the viscometer model corresponds to the one that was ordered.
- Carefully read the instruction manual.
- The manufacturer is not responsible for any damages that may result from modifications or lack of maintenance of any of the machine's mechanisms (directive 89/655/CEE).



Fungilab recommends using the carry-case provided with the equipment for making any kind of delivery. Please, keep the carry-case in a safe location. In case of transporting the equipment or during long storage periods, always use the carry-case by placing each part as shown in the picture. In the attached photograph (Figure 1) the position of each piece inside the equipment's carry-case is presented. In the case of incorrect packing, the pieces of equipment can suffer some damage; this damage will not be covered by Fungilab's guarantee.



Parts included with the equipment standard delivery:

- Viscometer head with serial number
- Foot or base, 3 height adjustable knobs for the base
- Nut
- Fastening rod
- Standard spindles
- Spindle guard
- Spindle support
- Temperature probe
- Calibration Certificate
- Conformity declaration
- Oil certificate document copy
- USB-Memory containing the User Manual (PDF file). The USB-Memory might contain also the company catalogues.
- Power cable
- PT100 probe
- Clip for holding the PT100 probe
- MEAN WELL GS25A12-P6J power supply



**Do not open the power supply due to electrical shock risk and there are not serviceable parts inside. In case of suspecting that the power supply malfunctions please contact FUNGILAB for assistance.**



**It is mandatory to leave enough free space around the equipment ON/OFF switch, needs to be reachable at any time, especially in case of an emergency or malfunction.**



**It is very important to treat the silkscreen printed logos carefully when cleaning the equipment. Please use a soft cloth, with isopropyl alcohol (70%).**

Standard spindles

Model L: L1, L2, L3, L4

Models R and H: R2, R3, R4, R5, R6, R7



Fig 1. Viscometer in its carry-case

## 9. Equipment Description

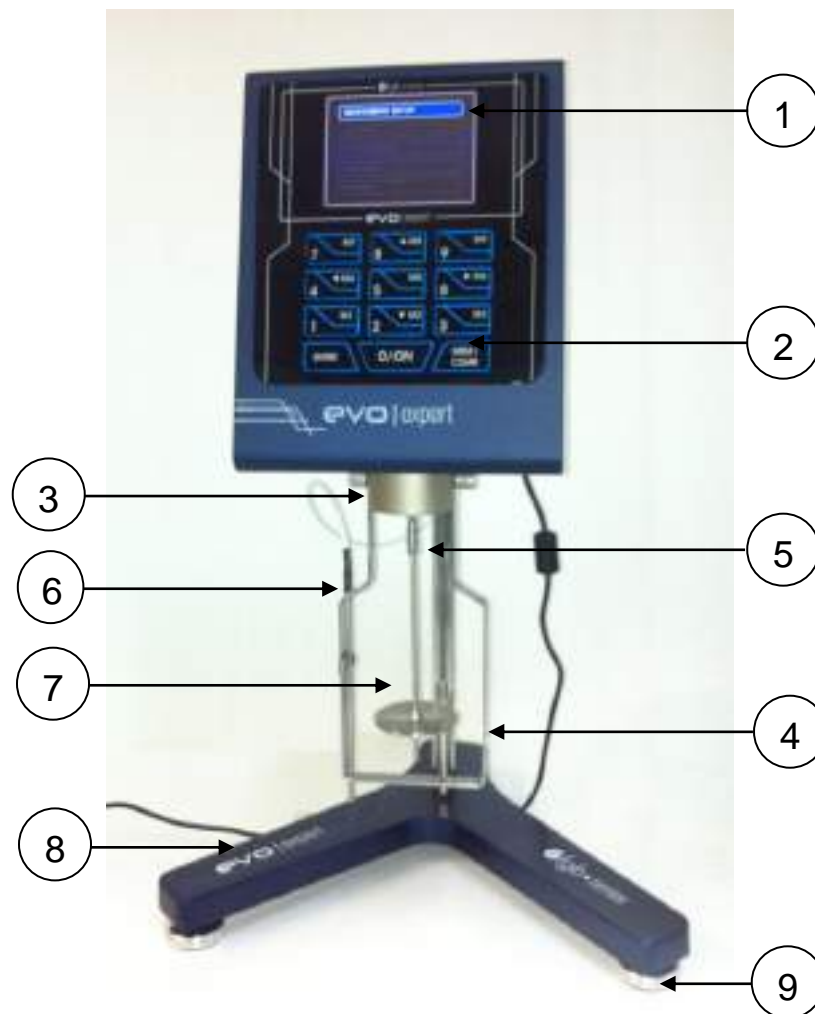


Fig. 2 Frontal view of the equipment

- |                        |                            |
|------------------------|----------------------------|
| 1. Screen              | 6. Temperature probe       |
| 2. Capacitive Keyboard | 7. Spindle                 |
| 3. Nut (back part)     | 8. Base (viscometer stand) |
| 4. Spindle guard       | 9. Height adjustable knob  |
| 5. Fastening rod       |                            |



Fig. 3 Back view of the equipment

- |                        |                                    |
|------------------------|------------------------------------|
| 1. Serial number label | 5. Power cable slot                |
| 2. Warning Label       | 6. USB Temperature probe connector |
| 3. Level               | 7. USB Connector                   |
| 4. Power switch        | 8. Thermosphere connector          |

## 9.1 Equipment Identification



Fig. 4. Equipment identification label

Description of the equipment identification label:

1. Viscometer model
2. Viscometer code
3. Serial number of the equipment
4. Voltage, frequency and power of the equipment
5. Electronic equipment (specifies throw in trash).

## 9.2 Equipment set-up

- Remove all of the parts from the carry-case. Note the figure below (fig 5).
- Correctly place the three height adjustable knobs (B) on the Y-shaped base (A).
- Mount the fastening rod (C) with the holding screw (D) at the base (A).
- Attach the nut (F) to the fastening rod (C). The viscometer should be connected to the nut (F) by means of its rod (E).

**Note:**

*The following process should be done carefully in order to not harm to the shaft of the viscometer. Immediately remove the shaft's plastic protector before beginning to use the viscometer.*



- Insert the horizontal rod of the viscometer (E) into the nut (F).

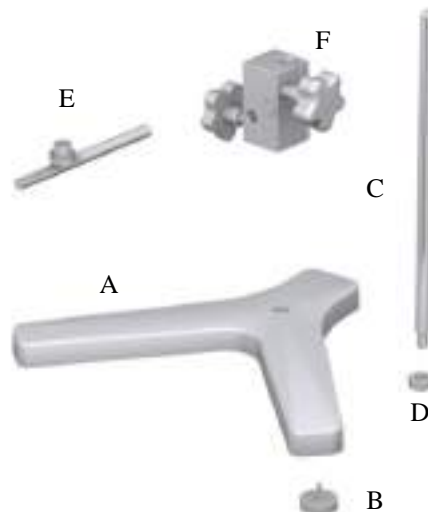


Fig. 5 Set-up for the viscometer base

- The viscometer should be placed on a stable surface free of vibrations (i.e. caused by other machines or equipment). Do not put the viscometer in direct contact with sunlight or in the middle of any air flow (the temperature of the sample can be easily influenced by the surrounding conditions). The viscometer is designed for indoor use.
- Use the height adjustment knobs until the height of the viscometer (located in rod E) is correctly adjusted.
- Plug the power cable into the connector located on the back of the equipment (Fig. 3 position 5) and plug it into the power source.

**WARNING:**

*Verify that the voltage and the frequency coincide with the specifications for the power supply (look at the identification). Before turning on the machine, let it sit for some time so that it acclimates to the surrounding temperature in order to avoid a short-circuit caused by condensation. The fluctuations of the power source should not surpass  $\pm 10\%$  of the nominal voltage.*



## 9.3 The keyboard and screen

Before starting up the machine, it is recommended to become familiar with the viscometer controls seen in the previous section. The instrument has a 12 key capacitive keyboard (number 2 Fig. 2) and a colour TFT screen (number 1 Fig. 2) on the frontal to allow the user to interact with the viscometer. The keyboard gives the user the mobility throughout all of the menus and the selection of different options and configurations. The screen presents informative menus in which the user operates. These menus are detailed later in this manual. The measurements collected by the instrument will also be explained later on.

The keyboard has the following configuration:



Fig. 6 The keyboard for the Evo Expert viscometer

The twelve keys available have many assigned functions depending on the operations that need to be carried out. Some of these functions or operations can be carried out from any screen.

The different numbered keys will always allow you to type in the proper numerical value (if a modifiable field has been selected).

Key	Function
'Δ'	Go to the previous option; increase a value when a field has been selected.
'▽'	Go to the next option; decrease a value when a field has been selected.
'▶'	Change the selected field on some menus.
'◀'	Return to the previous screen.
'ENTER'	Accept an option or value in a field. It also allows editing to fields that can be modified. Access to special functions.
'MEM/CLEAR'	Stop the motor during measurements and returns to the main menu screen. Erase the information present in a field when it is highlighted. Shortcut to a test profile from the main menu screen.
'0'/ON	Start the motor and pause it during measurements. It also allows running the measurement from its configuration screen.

Keys 1M1 to 9M9 are used for recordings and their functions are detailed in section 8.4 of this manual.

In the following sections, the function of each key in the corresponding menus will be explained in full detail, including the exceptions to the general operation.

## 10. Menu system

Fungilab viscometers work with a system of menus that allow the user to go through the instrument in a quick and simple way. The basic actions in the menus are: moving through the options ('Δ' and '∇' keys), selecting an option ('ENTER' key) or returning to the previous menu ('QUIT' key).

### 10.1 Start-up

Turn on the switch on the back of the machine (number 4, Fig. 3). If after doing this, the machine does not turn on:

- Verify that the power cable is connected to both the power and the Power Supply and that the Power Supply is also connected to the equipment (back part, number 5, Fig. 3).

The machine will beep, indicating that it has started and it will show the autotest screen:



The equipment initially comes configured with:

- English
- Temperature units in Celsius (°C)
- Viscosity units in centipoises (cP).

If these are not the desired basic configurations, the equipment can be configured and changed to meet the user's needs. The method of configuring the apparatus by varying these and other parameters is explained in detail in a later section of this manual called 'Instrument setup menu' (section 10.4). Any changes made to the machine will stay configured to the last modification made at the configuration menu and will not return to the factory settings after a restart.

Once the configuration information is given will submit the system to a Autotest.

### 10.2 Autotest

The Autotest process allows you to verify the proper operation of the viscometer, in a way that allows detection of motor malfunctions in a simple and practical way.

**VERY IMPORTANT:** The Autotest should be carried out without a spindle.



Once the Autotest screen is shown on the screen, we should confirm that the spindle is not connected. Afterwards, press 'ENTER' and the auto-check process will begin. While this test is running, the screen will show this message:





The progress bar that appears below the word "AUTOTESTING" displays the status of this process accompanied by a textual representation of the progress in a percent format.

Once the Autotest process finishes, two possible messages will appear, depending on the result of the diagnostic.

If the viscometer detects an anomaly, it will show the following message on the screen while it emits an acoustic warning:

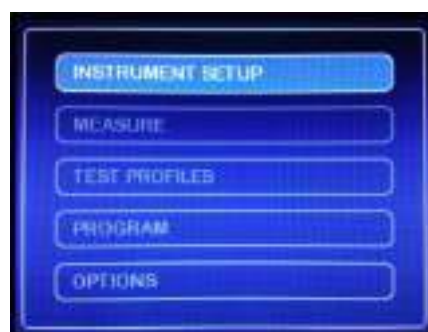


If this message appears, the machine will let off a whistle and a technical service from the supplier or manufacturer should be contacted. To get the manufacturer's contact information, press the <ENTER> key and it will appear in the following format.



If there is a system error, the equipment will stay blocked, meaning the motor is not working properly. If the machine is turned off and restarted, the same screen will reappear.

In the case of a successful check, the main menu will be displayed.





## 10.3 Main Menu

The main menu is the one that appears after the Autotest screen. It is accessed by turning on the machine normally and after a satisfactory result from the test run. The main menu screen will show:



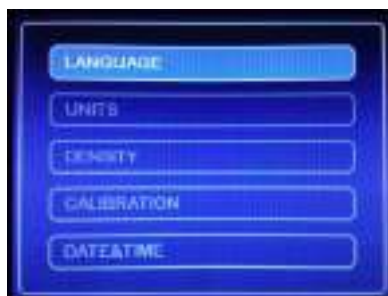
The menu can be navigated with the 'Δ' and '▽' keys. The current selection will be highlighted and by pressing 'ENTER' you will access to the selected submenu (for more information about each function in particular see the corresponding sections).

In the following sections, each of the 5 submenus of the main menu can be seen beginning with the configuration submenu.

The first time the machine is used, it is advisable to access the 'INSTRUMENT SETUP' option as the first step in order to establish the values for certain parameters of the viscometer such as language and measurement units.

## 10.4 Instrument Setup menu

The configuration menu contains those functions that are not standardized and that modify the state and/or operations of the instrument. Once the 'INSTRUMENT SETUP' option is selected by pressing the 'ENTER' key, the following screen will appear:



Move through the options using the 'Δ' and '▽' keys and select a submenu with the 'ENTER' key. By pressing the 'MEM/CLEAR' key, the user can return to the main menu and by pressing the '◀' key, the user can return the previous screen.

The main menu provides the possibility of:

- Changing the working language
- Selecting the measurement units (viscosity and temperature)
- Changing the value of the sample density (by default 1 g/cm<sup>3</sup>)
- Carrying out calibrations (the machine comes calibrated from factory, therefore it is not necessary to do any calibrations when the machine is received)
- Adjusting the date and time.

The language, time and units should be selected by the user before beginning to work with the equipment so that it functions properly.

## 10.4.1 Language

Once the configuration menu has been accessed, the first option that the cursor '>' points to is 'LANGUAGE'. To change the language, this option must be selected by pressing the 'ENTER' key.

When we enter in this submenu, the viscometer will show a screen like the next one:



By using 'Δ' and '▽' the different working languages for this equipment can be seen, which are:

English  
French  
German  
Italian  
Spanish  
Catalan  
Chinese

Once the language has been selected, press 'ENTER' and it will automatically change the language of the menus and return to the configuration main menu screen.

If you want to leave without changing the language, the 'MEM/CLEAR' keys will take him to the main menu or the '◀' key will take you to the configuration menu.

## 10.4.2 Units

The Evo viscometer allows the user to select the units that are used for measuring viscosity and temperature.

The possible choices for dynamic viscosity are:

- International system of units (Pa·s or mPa·s)
- Centimetre-gram-second system of units (Poise or centipoises)

And those of temperature units are:

- Celsius (°C)
- Fahrenheit (°F)

When the 'UNITS' submenu is highlighted, it can be accessed by pressing the 'ENTER' key and the viscometer will show the following screen:



By default, the unit for the viscosity is cP and the unit for the temperature is °C. Moreover, the 'VISCOSITY' field appears with light blue background, which means that its value can be changed by using the 'Δ' and '▽' keys. Press 'ENTER' to save the selected viscosity unit and the field 'TEMPERATURE' will appear highlighted with light blue background. The light blue background indicates that the value of the field can be modified by using the 'Δ' and '▽' keys. Press 'ENTER' to save the selected temperature units.

After the desired units have been selected, hit the 'ENTER' key with the 'SAVE' option highlighted in light blue background. The viscometer will save the selected units and it will return to the 'Instrument setup' menu.

If the 'MEM/CLEAR' key is pressed, it will cancel the new selections made for viscosity and temperature, returning back to the previously used settings.

### 10.4.3 Density

The value assigned to the density of the fluid being measured can be changed by means of this submenu. By default we consider the density of water as a reference point, but you can select any other value. The default units will be g/cm<sup>3</sup> of the Centimetre-gram-second system of units (CGS). The field of the whole numbers appears highlighted in light blue background, which means that it can be edited. Use the numerical keyboard to introduce the value desired for the density whole numbers.



Once the digits of the whole numbers are introduced, press 'ENTER' to skip to the next field. Then, the field of the decimal numbers will appear highlighted indicating that this field can be modified. Use the numerical keyboard to introduce the decimal numbers of the density and press 'ENTER' to save these numbers. In order to save the value of the density press 'ENTER' with the 'SAVE' option highlighted in light blue background. The viscometer will return to the 'Instrument setup' menu.

**NOTE:** If you modify the density, the viscometer will give its measurements in cSt (centiStokes), whereas if you conserve the initial density (considered the density by default), the measurements will be in cP (centipoises), P (Poise) or mPa·s, Pa·s.



## 10.4.4 Calibration

This submenu contains the viscosity and temperature calibration options that the user can exploit to recalibrate the viscometer. Moreover, it also contains the 'RESET' option to restore the factory-stage calibration and erase the memory and the programming.

### IMPORTANT:

The viscometer contains a default calibration element, which is installed during the manufacturing process. It is for this reason that it is unnecessary to calibrate the equipment when using it for the first time. Nevertheless, certain norms of quality recommend that the equipment be recalibrated once a year, which is why we offer the user the possibility of realizing this calibration without needing to send the viscometer back to the usual provider, or to FUNGILAB.



FUNGILAB cannot be held responsible for the measurements taken by an independently recalibrated viscometer and it is essential to follow the instructions given by Fungilab carefully when recalibrating.

### Calibration Norms:

- To execute a viscosity calibration, it is necessary to have on hand at least a little standard calibration oil and a thermo-stating system to maintain the sample at a constant temperature. If you do not have this equipment, then you will not be able to guarantee good post-calibration measurements.



Fungilab provides upon request the standard oils necessary for the calibration, as well as the accessories need to thermostate the oils.

- The calibration of any spindle, will only modify the values of that individual spindle. The rest of the equipment's spindles will not be affected by this calibration. If you want to calibrate more than one spindle you will have to be calibrated one by one. The oils used for each spindle will also be different, so for calibration you should have standard silicon oil for each spindle you're calibrating.
- Tables 6, 7 and 8 (page 78) specify the standard oils necessary for each spindle.

This submenu is accessed through the main configuration menu, by choosing the Calibration menu and pressing 'ENTER'. Once at the submenu, the following screen will appear:



Using the 'Δ' and '▽' keys, you can select the different options of this submenu, highlighting each option and pressing 'ENTER' for choosing it. Using the '◀' key, you can return to the previous screen and with the 'MEM/CLEAR' key you will return to the main menu. If you hit 'ENTER', you will select the option indicated by the cursor.

### 10.4.4.1 Reset

This submenu contains the equipment's RESET option.

After resetting, the equipment will recuperate the original viscosity calibration.

Upon entering this submenu, the following screen will appear:



If you want to continue with this process, hit 'ENTER' and you will be brought to the following screen. Otherwise, hit the 'MEM/CLEAR' key, which will bring you back to the main menu. In this submenu, the keys 'Δ' and '∇' have no function.

If you press 'ENTER' here, the factory-stage calibration will be restored (calibration, language), the memory will be erased as well as the programming and you will return to the main configuration screen. If you hit 'MEM/Clear', you will return to the main menu and by hitting '◀', no configuration will be restored and you will also return to the main configuration screen. If you press 'ENTER' with the field 'QUIT' highlighted the system will return to the 'CALIBRATION' menu.

### 10.4.4.2 Viscosity Calibration

From the 'CALIBRATION' menu select the 'USER CALIBRATION' option. The following screen will appear:



Select the 'VISCOSITY' option and you will access to the following screens, depending on the model of your viscometer:

## Model L



## Models R and H



Upon entering this screen, the spindle field is highlighted in light blue background. Using the 'Δ' and '▽' keys you can change the Spindle.

The list of possible spindles to use depends on the model of your viscometer (L, R or H). Thus, in tables 1 through 5 (page 76 and 77) you can see the different spindles available for each model.

Once you've selected your spindle press 'ENTER' and the 'VISCOSITY' field will be highlighted. Press 'ENTER' again and the following screen will appear:



Use the numerical keyboard to introduce the value of the viscosity of the standard oil used for calibration (the standard oils provided by Fungilab provide viscosity tables according to different working temperatures). There is a field for entire numbers and other one for the decimal figures. Once introduced the viscosity value, press 'ENTER' with the 'SAVE' option highlighted to confirm the modification. Next, the following screen will appear:



Once the spindle is in position in the device, press 'ENTER' again and the following screen will appear:



In this screen it is necessary to introduce the time required from the moment you give the command to start the calibration to the moment the device begins the calibration process. This time lapse is frequently used to allow the whole of the sample and spindle to arrive at thermal stability before starting the actual calibration.

On this screen, the field for the hours appears highlighted first. Using the 'Δ' and '∇' keys you can change the number of hours. Once the right value is entered, hit 'ENTER' and the field associated with the number of minutes will stay highlighted and ready to be modified using the 'Δ' and '∇' keys. Following this same procedure, the number of seconds can be modified. When pressing the 'ENTER' key with the 'SAVE' option highlighted it will start a countdown back to zero. The following screen can be an example of this countdown:



The spindle must already be submerged in the liquid once you confirm the start time. When the countdown gets to zero, the viscometer will start the calibrating sequence. While the equipment is calibrating, the following screen will appear (example):



On this screen, the progress bar that appears below the word "CALIBRATING" displays the status of this process accompanied by a textual representation of the progress in a percent format.

The exit key 'MEM/CLEAR' allows us to exit to the main menu but never while calibrating (never while the screen looks like the example just above).

When the calibration process is over, information on the values of the angles and curvatures of the calibration are displayed, as it is shown in the following screen:



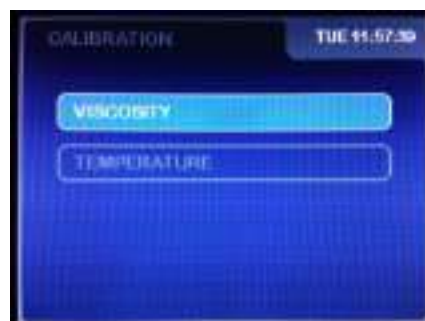
If the curvature is lower to 1.5%, hit 'ENTER' to confirm the calibration and you will be taken to the main menu. The User calibration is now stored in the viscometer's memory.

**NOTE:** Exiting mid-calibration denies the equipment a proper calibration and therefore it cannot guarantee accurate results.



### 10.4.4.3 Temperature calibration

Once selected the Factory Calibration or the User Calibration option from the Calibration submenu, the following screen will appear:



If you select the temperature option (by moving through the menu using the 'Δ' and '▽' keys) and press 'ENTER', you'll be brought to a screen resembling this one:





**VERY IMPORTANT:** The Test-run should be carried out without a spindle.

Once this message is shown on the screen, we should confirm that the spindle is not connected. Afterwards, hit 'ENTER' and you'll be brought to a screen resembling this one:



Connect the temperature simulator, using a type A USB connector, to the back of the viscometer simulating the indicated temperature (in this case 0°C).

The viscometer's screen will show the instructions to follow to achieve the calibration of the probe that measures temperature. You'll have to connect the PT100 simulator generating an impedance equivalent to PT100 at 0 degrees Celsius. Once the gauge is connected hit 'ENTER' and the following screen will appear:



After a few seconds and once the temperature is calibrated to 0 degree Celsius, a second screen of instructions will appear, containing the following information:



Now, you'll have to connect the PT100 simulator generating impedance equivalent to a 100°C PT100. With the gauge connected and hitting the 'ENTER' key, this screen will appear:



After a few seconds, a second screen of instructions will appear, containing the following information:



Now, you'll have to connect the PT100 simulator generating impedance equivalent to a 200°C PT100. With the gauge connected and hitting the 'ENTER' key, this screen will appear:



After the calibrating is done, the equipment will show the following screen:



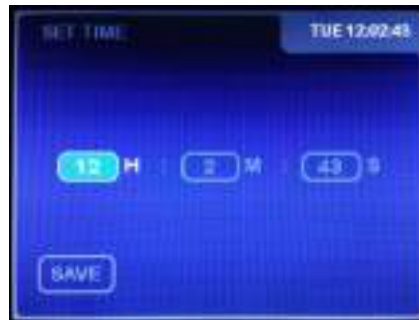
Press 'ENTER' again and the viscometer will show the main menu. The exit keys 'MEM/CLEAR' and '◀' allow us to go back to the main menu or to the previous screen, respectively, though never while calibrating.

**Note:** Exiting in mid-calibration denies the equipment a proper calibration and thus cannot guarantee accurate results.



## 10.4.5 Time Settings

When the 'Date&Time' field is highlighted, press the 'ENTER' key to select this option and the viscometer will display the following page:



At this point, the field associated with the hour will be highlighted, being the background colour of this field light blue. Using the 'Δ' and '▽' keys you can change the hour. Once the right value is entered, hit 'ENTER' and the field associated with the minutes will be highlighted. Following this same procedure, the minutes and seconds can be modified. Press 'ENTER' with the 'SAVE' option highlighted and the time information will be saved. The 'MEM/CLEAR' and '◀' keys fulfil their functions as exit keys, allowing you to return to the main menu without saving the changes or return to the previous screen, respectively.

The date change functions in much the same way as the time change. Once this option is selected, the following screen will appear:



The date can be modified by using the 'Δ' and '▽' keys when the month, day or year field is respectively selected. If you press the 'MEM/CLEAR' key the modification will be cancelled and the previous field value will be restored. By pressing 'MEM/CLEAR' again, you will be brought back to the main menu. The '◀' key allows us to go back to the previous page in which you can switch between modifying the date or the time, but not before pressing 'ENTER' and thus saving the modifications.

## 10.5 Measurement Configuration

The measurement configuration menu allows access to the main function of the device: measuring fluid viscosity. From the main menu screen, with the 'MEASURE' field highlighted, press the 'ENTER' key to choose this option.

After choosing this option, you will see one of these screens, depending on the viscometer model you have:

Model L



Model R and H



Let's first look at what each field represents and how to modify it.

- SPINDLE: the field that indicates which spindle we use for the measurement.
- SPEED: the field indicating the working speed.
- DENSITY: indicates the density of the sample.
- MAX: Maximum viscosity to be determined with the speed and the spindle selected (guideline value).

The 'SPINDLE' field together with the selected 'SPEED' will determine the maximum and minimum viscosity values (from 9 to 23, from page 79 to 93), as well as the existence of a shear stress measurement (if you're using coaxial spindles).

The 'SPINDLE' field appears highlighted first, in light blue background. The viscometer will only show the spindles that are compatible with your model. Use the 'Δ' and '▽' keys to choose the spindle and press 'ENTER' to skip to the next field.

**Note:** The Heldal special spindles, from PA to PF, appears in the 'SPINDLE' field when the 'SPEED' field show a speed value equal or lower than 12 rpm. Otherwise, these spindles do not appear in the 'SPINDLE' field and they cannot be selected.



**IMPORTANT:** Selecting a spindle that doesn't correspond to the ones adapted to your model will cause measurement problems.



The SPEED field appears now highlighted. This field indicates the speed (revolutions per minute) at which the test will be done. The Evo EXPERT series incorporates 56 pre-determined speeds: 0.01, 0.03, 0.05, 0.07, 0.09, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.4, 1.5, 1.8, 2, 2.5, 3, 4, 5, 6, 7.5, 8, 10, 12, 15, 17, 20, 22, 25, 30, 35, 40, 45, 50, 60, 70, 75, 80, 90, 100, 105, 120, 135, 140, 150, 160, 180, 200, 250 RPM.

The viscosity of the liquid and the spindle used determine the speed (refer to tables 9 to 23).

Speed modification: once the corresponding field is selected, showing light blue background, you can move through the pre-established speed using the 'Δ' and '∇' keys. If you want to keep the selected speed, press the 'ENTER' key to skip to the next field.

You have also the option of configuring a stock of personalized speeds to facilitate operations. This option is detailed in section 10.7.2 of the manual.

The field DENSITY is then highlighted. This field indicate the density of the fluid being measured. By default we consider the density of water as a reference point, but you can select any other value. To modify density, press 'ENTER'. The following screen will appear:



The field for the density whole numbers appears highlighted in light blue background, ready to be modified. The desired number can be introduced using the numerical keyboard. Press 'ENTER' to validate the number. Then, the field for the decimals will change its background colour to light blue, indicating that it is ready to be edited. Use the numerical keyboard to introduce the value desired. Press 'ENTER' to validate this value. Press 'ENTER' again with the 'SAVE' option highlighted in order to save the density value. Then, the viscometer will return to the measurement configuration menu.

**NOTE:** If you modify the density, the viscometer will give the measurements in cSt (centiStokes), whereas if you conserve the initial density (considered the density by default), the measurements will be in cP (centipoises), P (Poise) or mPa·s, Pa·s.



If, once the values of all of the fields are confirmed, you press the 'ON' key, you will go on to the measurement screen. If instead you press the 'MEM/CLEAR' key, you'll return to the main menu screen. If you press the '◀' key, you will return to the initial screen.

## 10.5.1 Measurement Screen

You can access this screen by pressing the ON key after the introduction of the measurement parameters. The spindle of the viscometer will start rotating, which means that the equipment is ready to start collecting data. We will now see an example of the data presented on screen at this stage:



As the equipment goes about collecting viscosity data (one data value for each rotation of the spindle), the information on the screen will be updated. On the screen you will see:

- SPINDLE: Current spindle. Selected on the previous screen.
- SPEED: Revolutions per minute. Value selected on previous screen.
- VISCOSITY: Viscosity value expressed in cP or mPa-s, or cSt (in the case that a density different from the default one is introduced).
- TORQUE: Certain percentage of the base scale. Percentage value of the curvature of the spring in relation to the base of the same scale.
- TEMP: Temperature of the sample (°C or °F).

**NOTE:** Depending on the selected speed, it is possible that the speed reading will take a few seconds or minutes to appear. It's important that the viscometer has made at least five rotations (which equals five measurements) before considering the measurements to be valid, as the device needs that time to stabilize. It's also important to only take into account the temperature of a stable sample.



In addition to visualize the obtained measurements of the sample-on-test, the user can perform other actions in parallel from this screen.

The speed field appears by default selected on this screen, highlighted in light blue background. Using the 'Δ' and '▽' keys, you can increase or reduce the speed of the spindle's rotation (RPM). When you press one of these two keys, the rotation speed increases or decreases, respectively, from the previous speed. This way, we can comfortably modify the turning speed without having to leave the measurement screen.

The units in the temperature field (°C and °F) can be modified using the same process but you will have to use the '►' key to select the appropriate field first. The selected field will appear in light blue background.

The instrument allows switching between the viscosity and the Shear Rate and Shear Stress by pressing the 'ENTER' key. This feature is not activated for the spindles that Shear Rate and Shear Stress are not applicable, such as the standard Spindles (L1 to L4 and R1 to R7).

**IMPORTANT:** When the certain percentage of the base scale is lower than 15% or is as high as 95%, the measurement cannot be considered valid and the equipment will emit a warning beep with every rotation made under these circumstances.



If you are using coaxial spindles (TL or TR) or the low-viscosity spindle (LCP/SP) you can access the other measurement information screen.

By pressing 'ENTER' in the main measurement screen, the following screen will appear:



This screen shows the same values of Spindle, Revolutions per Minute, Percentage and Temperature of the sample that were shown on the previous screen. But in addition this screen shows:

- SR: Share Rate.
- SS: Share Stress.

Pressing the ON key during an experiment, the user can stop or start the motor, which allows for momentary pauses in an experiment. When you hit this key, the equipment will show the following message:



If you press the ON key, the equipment will restart the measurements with the same configuration.

## 10.6 Test Profile

FUNGILAB viscometers incorporate a group of programmable logs that allow configurations to be saved in order to speed up use of the machine when carrying out measurements of a certain frequency.

From the main menu screen, select the 'TEST PROFILE' option by using the 'Δ' and '▽' arrows and hit the 'ENTER' key to accept. The viscometer will show the following screen:





The first option will start a measurement with some configurations already recorded in the instrument's log and the second is for saving the measurement options of a new configuration. Select one field or the other by using the 'ENTER' key.

By pressing the 'MEM/CLEAR' and '◀' keys the equipment will return to the main menu screen.

## 10.6.1 Writing Tests Profile (Edit Profile)

To select this option, the 'ENTER' key should be pressed when the 'EDIT PROFILE' option is highlighted. The viscometer will show the following screen:



To choose one of the tests profile, press the corresponding key for the test profile that is desired. The names correspond to the symbols that there are on each of the keys on the apparatus' keyboard (for example hitting the key '6 M6' selects log M6). From there, hit the 'ENTER' key to validate the option.

In the test profile recording there are two option blocks that you must to configure once the desired test profile has been chosen. We will now explain viscometer programming and output specific configuration for the measurement.

### 10.6.1.1 Viscometer programming

Once the log is chosen, the following screen will appear:



For the selection of one of the two options, scroll between the options by using the 'Δ' and '∇' keys and press the 'ENTER' key on the one that is desired. The exit keys, 'MEM/CLEAR' and '◀', continue to fulfil their habitual functions by bringing the user to the main menu screen or the previous screen, respectively. In the case of 'MEM/CLEAR', it will proceed without having saved the changes.

On this screen, these two fields can be configured. Once they are configured, the ON key accesses to the 'MEASURE CONFIGURATION' screen, which should be filled with the main parameters desired for the measurement, such as the spindle, the motor speed and the density of the sample.



## 10.6.1.1.1 TTT and TTS

These abbreviations mean:

- TTT:** Time to Torque. You must set a torque value (%), at which the viscometer will have to stop the measurement. The screen will show the obtained viscosity at this moment in the torque. (see section 10.7.1)
- TTS:** Time to Stop. You must set a time for the experiment and a time for the viscometer to stop. Once the device has arrived at the determined time, the equipment will stop and display the value of the viscosity (see section 10.7.1)

If you choose the option 'TTT and TTS', the following screen appears:



The two fields to activate in this screen are the TTT and TTS. To select a field, use the 'Δ' or '▽' keys to go through the options cyclically. The field that is selected at each moment will change the colour of the text.

TTT and TTS can only be ON or OFF. To change from one to the other you must have the field selected and use the 'ENTER' key to change modes.

If neither mode is chosen, you cannot access the 'Torque' or 'Time' fields. These fields need to be activated ('ON' in the fields TTT and TTS, respectively) in order to access them.

Once the 'Time to Torque' field is activated, the 'TORQUE' field appears highlighted. Press 'ENTER' again to activate the screen that allows the edition of this parameter. This screen is like the following:



The active field can be changed by pressing the '►' key. Once highlighted the appropriate field, it can be selected by pressing the 'ENTER' key. The selected field changes its background colour to light blue, which means that the field can be edited. Using the numerical keys you should enter the desired value and press 'ENTER' again with the 'SAVE' option highlighted to save the changes. This value will remain saved even if the option is deactivated ('OFF').

'Time' is modified in a similar way. You should have the 'TTS' option activated (hitting the 'ENTER' key to change the mode to 'ON'). Once it is selected, hit 'ENTER' and the following screen will be shown:



Change the active field with the '►' key and introduce the desired value in each field using the 'Δ' and '▽' arrows. Hit the 'ENTER' key to accept the value. Hitting 'ENTER' again with the 'SAVE' option highlighted saves the changes and these will be saved until the next modification by the same procedure. If we deactivate the 'TTS' option, the value will remain saved in the memory.

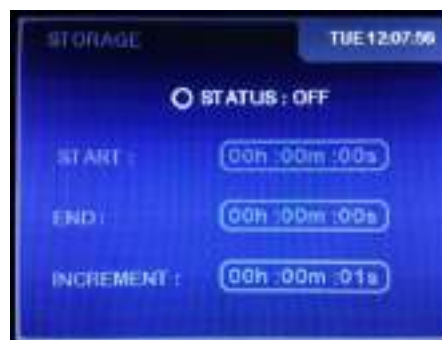
The exit keys 'MEM/CLEAR' and the '◀' key continue to fulfil their traditional functions, bring us to the main menu screens or the previous screen, respectively. With the 'MEM/CLEAR' key, the changes will go unsaved. Moreover, the key 'ON' brings us to 'MEASURE CONFIGURATION' screen.

**NOTE:** It is impossible to select both the TTT and TTS functions at the same time.



### 10.6.1.1.2 Storage

If you choose the Storage option, you will be activating experiment recording or recording measurements in the memory test profile. For this, you will be led to the following screen:



The default mode is 'OFF'. To activate this option, use the 'ENTER' key to turn it 'ON' and vice versa.

While the option is disabled ('OFF'), we cannot select the time fields that regulate this function.

- START: Defines the lapse of time before starting the recording.
- END: Defines the time in which the recording ends.
- INCREMENT: Defines the time interval between recorded samples.

Once the field is active, you can select different fields, jumping for one to another using the 'Δ' and '▽' arrows. To modify each field, press 'ENTER'. A screen such as the following will appear:



The selected field will highlight its background on the screen while it is modified, using the 'Δ' and '▽' arrows and introducing the desired values in the digital places this way. Upon digit entry the viscometer will jump to the next digit place by pressing the 'ENTER' key. To save the changes press 'ENTER' again with the 'SAVE' option highlighted, which will unselected the fields and save the values entered.

The exit keys 'MEM/CLEAR' and the '◀' key continue to fulfil their traditional functions, bringing us to the main menu screens or the previous screen, respectively. With the 'MEM/CLEAR' key, the changes will go unsaved.

## 10.6.1.2 Measurement Configurations

When you are in the 'TTT&TTS/SPEED SETTINGS/STORAGE' screen in the 'EDIT PROFILE' option (as we will now see), the configuration of the measurement or experiment can be started. The 'ON' key will bring you to a screen resembling this one:



The modification on this screen has already been explained in detail in section 8.3 Measurement configuration menu.

**Note:** The profile under edition can be configured with any of the 56 predetermined (standard) speeds. Therefore, all the standard speeds are available when the 'SPEED' field is selected even if the viscometer has activated a preconfigured set of personalized (custom) speeds. More information about the custom speeds will be shown in Section 8.5.2 (Speed Settings).



Once the measurement parameters are configured, press the 'ON' key to save it to the memory test profile. The equipment will move on to the following screen and the recording process will be finalized.



## 10.6.2 Select Profiles

If the user wants to use some of the machine's logs, the 'ENTER' key should be hit once the field of this option is highlighted and the following screen will appear:



To choose one of the test profile options, hit the log key corresponding to the desired log setting (for example 1 M1, would select log M1). The names correspond to symbols on each key on the viscometer's keyboard. After that, hit the 'ENTER' key to validate the option.

Once the test profile is chosen the following information screen will appear:



The disabled options appear in the 'OFF' status. The activated ones appear with some configuration information ('TTT' and 'TTS' options) or with the 'ON' indication ('STORAGE' option). The information shown will not be able to be modified under any condition; it is only shown to inform the user. Once on this screen, the key '◀' takes the user to the log selection screen and the 'MEM/CLEAR' key would take the user back to the main menu of the machine. Press the 'ON' key to directly start the measurement. Press the 'ENTER' key to hide this screen and the instrument will bring the measurement configuration information on the screen (example):



Once on the measurement configuration screen, its details can be seen but not modified. Now if the 'ON' key is hit, the measurement can begin. If the '◀' key is pressed, it goes to the log selection screen and the 'MEM/CLEAR' key would take the user back to the main menu of the instrument.

If by error a test profile is selected that has not been recorded on previously (the viscometer comes from the factory with empty tests profile) and if the 'ENTER' key is hit, a 'MEMORY EMPTY' message will appear:



By pressing the 'ENTER' key again, the test profile selection screen will reappear to be able to select another test profile. The 'MEM/CLEAR' and '◀' keys continue fulfilling their habitual functions by carrying the user to the main menu screen or the previous screen, respectively.

**NOTE:** There exists a way to select the log through fast access. When the user is on the main screen of the viscometer, the 'MEM/CLEAR' key can be hit and a letter M will appear on the lower part of the screen giving this view:



When this M is on the screen the keyboard function has been activated, the user can directly select one of the nine "test profile". Press one of the nine keys with a keyboard test profile symbols (for example 3 M3). It takes the user directly to the test profile information screen and the user can proceed as was explained before. In the same way, if an empty test profile is selected (without having been recorded on), it will show the empty slot screen.

## 10.7 Programming

The Programming menu contains the functions that allow some optional applications to be programmed for the measurements. The TTT (Time to Torque), TTS (Time to Stop) and the Speed Configuration are applications that are complementary to the normal measurements. Contrarily, the options 'Ramp' and 'Multistep' are applications, which function independently of the ordinary measurements. These run through the normal programming of the viscometer.

From the main menu screen you must highlight the option "Program", as seen in the following diagram:



By pressing “ENTER”, you will see the following screen:



The exit keys ‘MEM/CLEAR’ and ‘◀’ will continue to perform their normal functions, bringing you to the viscometer’s main menu screen.

### 10.7.1 TTT (Time to Torque) and TTS (Time to Stop)

Select this function, pressing the ‘ENTER’ key when the ‘TTT and TTS’ option is highlighted and the viscometer will show you the following screen:



This screen will allow us to activate and configure the ‘TIME TO TORQUE’ (TTT) and ‘TIME TO STOP’ (TTS) options that we will currently explain:

- Time To Torque (TTT): the TTT experiment measures viscosity until torque arrives to the prefixed value. To start the experiment is needed to obtain five consecutive measures with a difference in the torque minor than 2%, after that, the device it will measure viscosity until cross the prefixed value of torque (rising or falling). When the viscometer stops, the last viscosity measurement is displayed on the screen.
- Time to Stop (TTS): the ‘Time to Stop’ field is where you program the amount of time you want the measurement or experiment to last. Programming this field with a time limit will define the maximum duration of the viscometer’s measurement. When the viscometer stops because the program is finished, the last viscosity measurement will be displayed on the screen.

To select the field that we want to activate (TTT or TTS) we use the 'Δ' or '▽' keys to jump from field to field cyclically. Then press the 'ENTER' key to activate the selected option. The options for the two fields TTT and TTS can only either be 'ON' or 'OFF'.

If the 'Time to Torque' or 'Time to Stop' fields are not activated (shows the 'OFF' status) the 'Time' and 'Torque' fields cannot be accessed.

Press 'ENTER' to activate the 'Time to Torque' field ('ON' position) and the 'Torque' field will be highlighted. Press 'ENTER' again to proceed to the modifications. The following screen will appear:



Press enter again to select the entire number field. The background of the selected field will change to light blue, indicating that the field can be edited. By using the numerical keys we can introduce the desired torque value, between 15.0 and 95.0. By pressing the 'ENTER' key again the decimals can be introduced. Press 'ENTER' again when the 'SAVE' option is highlighted in order to save the torque value. This number will remain saved, unchanged, even if the 'Time to Torque' option is deactivated (by changing the field option to 'OFF').

The 'Time' field works in a similar way. We need to first activate the 'Time to Stop' option (on 'ON' position) and select it using the 'ENTER' key. The field 'TIME' will appear highlighted. Press 'ENTER' again and the following screen will be on:



The field for the hours appears highlighted in light blue background, so it ready to be edited. Use the 'Δ' and '▽' arrows to introduce the desired number and press 'ENTER' to activate the next field. The same procedure is followed for the minutes and second fields. Pressing the 'ENTER' key when the 'SAVE' indication is highlighted saves the changes, and these will remain unchanged until a new amount is entered in the same way. If we deactivate the 'Time to Stop' option (in 'OFF' position), the value will be saved.

The 'MEM/CLEAR' and '◀' exit keys will continue serving their normal functions, bring us to the main menu screen or the previous screen, respectively. If you use 'MEM/CLEAR', changes will not be saved. Moreover, the key 'ON' brings us to 'MEASURE CONFIGURATION' screen.

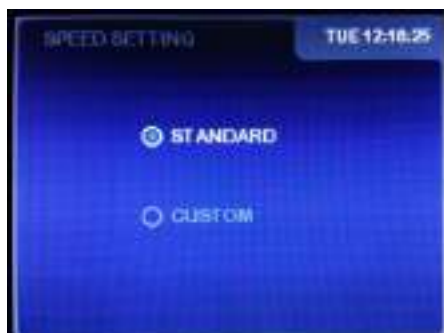
**NOTE:** The TTT and TTS are mutually exclusive, so both functions cannot work at the same time.





## 10.7.2 Speed settings

If we select the 'SPEED SETTING' option, pressing the 'ENTER' key when this option is highlighted, the following screen should appear:



This is the 'SPEED SETTING' submenu screen. The Evo EXPERT series viscometer has a pre-set speed with a total of 56 RPMs (revolutions per minute) as well as speeds in which the RPMs can be set manually. In some cases, when the work speeds are repetitive, the user can personalize these speeds configuring a profile for the measurement.

This way, there are two methods of working with different speeds: selecting speeds directly out of the pre-set group (STANDARD option) or creating a personalized profile which includes the speeds most frequently used (CUSTOM option). This 'CUSTOM' profile will allow you to select up to 18 speeds.

The viscometer provides a default range of speeds, through the 'STANDARD' option. You must use the 'Δ' and '▽' keys to select this option and press 'ENTER' to choose it.

Using the same 'Δ' and '▽' keys, you can change the method to 'Custom' and press 'ENTER' to confirm. You can have only one personalized profile, so if you aren't programmed yet, you will see the following screen:



If you already had a personalized profile programmed, you would see a screen with the speeds that you could add to your programmed ones (with a maximum of 18).

In both cases the 'MEM/CLEAR' and '◀' exit keys will continue to serve their normal functions, bringing you to the main menu or previous screens, respectively.

The personalized profile can have up to 18 speeds. At the end of the profile editing, all of the programmed speeds will be displayed on the screen.

By selecting the 'ADD' field and by pressing 'ENTER' you will start the creation of a new profile adding the first of the custom speeds. When you start the creation of a new personalized profile, the viscometer will display the following screen:





When this screen appears, the speed field will be highlighted. Press the 'ENTER' key to modify this value. You can use the 'Δ' and '∇' keys to change the speed, moving from velocities between 0.01 rpm and 250 rpm (2600 possible combinations).

To confirm the speed, you must press 'ENTER' and the field 'SAVE' will be selected. Press 'ENTER' once again to save that velocity.

The viscometer's screen will now show the list of custom speeds with the first velocity programmed, with the step number and the speed value, as it is shown in the following screen:



On this screen, the 'Δ' and '∇' keys can be used to scroll through the different options, which can be chosen by pressing the 'ENTER' key. The option 'SAVE' saves the list of custom speeds and returns to the 'Speed Setting' menu. The 'CLEAR' option erases the list of custom speeds and returns to the 'Custom Speed' submenu. Finally, a new velocity can be added by highlighting the 'ADD' option (with the 'Δ' and '∇' keys) and then pressing the 'ENTER' key. A new screen will appear:



The second custom speed will be introduced following the same procedure that was used to include the first one. Note that the default velocity that will appear in the speed field is always higher than the previous custom speed. By repeating that procedure, a number of custom speeds can be included. The list of custom speeds can be seen in the following screen:



The custom speeds can be edited individually. The field of a custom speed can be highlighted by using the 'Δ' and '▽' keys. Press the 'ENTER' key to edit the selected custom speed. The speed can be modified, saved or deleted and the list of custom speeds will appear consequently updated. Moreover, the 'CLEAR' option erases all the custom speeds and returns to the 'Custom Speed' submenu.

Once all the desired custom speeds are introduced, highlight the 'SAVE' option with 'Δ' and '▽' keys and press 'ENTER'. This save the custom speeds and return the instrument to the 'Speed Settings' menu.

**NOTE:** The speeds that can be programmed in the personalized profile must follow a positive progression, meaning that any value can be equal or greater than the previous speed but never less.



The 'MEM/CLEAR' and '◀' exit keys bring you to the previous screen, the 'SPEED SETTING' submenu. With the 'MEM/CLEAR' key, changes will not be saved.

### 10.7.3 Multistep

The Multistep application is one of the multiple options offered in the Fungilab Evo EXPERT viscometer-programming menu. This application allows you to increase the viscometer's spindle turn speed non-linearly at a determined time and at a progression that doesn't have to be either constant or positive.

This option can be accessed from the 'PROGRAM' menu, using the 'Δ' and '▽' keys to highlight the 'MULTIESTEP' field and then pressing the 'ENTER' key. The following configuration screen will be shown:

For L models:



For R and H models:



The 'SPINDLE' field appears highlighted in light blue, which means that it is ready to be modified. Use the 'Δ' and '▽' keys to choose the appropriate spindle. Press 'ENTER' again to confirm the spindle. Then, the 'DENSITY' field will appear highlighted. Press 'ENTER' and you will access the following screen:



The field for the density whole numbers appears highlighted in light blue background, ready to be modified. The desired number can be introduced using the numerical keyboard. Press 'ENTER' to validate the whole number. Then, the field for the decimals will change its background colour to light blue, indicating that it is ready to be edited. Use the numerical keyboard to introduce the value desired. Press 'ENTER' to validate this value. Press 'ENTER' again with the 'SAVE' option highlighted in order to save the density value. Then, the viscometer will return to the MULTISTEP configuration screen.

Select the 'STEPS' field using the 'Δ' and '▽' keys and press 'ENTER' to access MULTISTEP programming (details further on).

If the Multistep program has already been programmed, the set will show on the following screen (for example):



This screen shows the set's MULTISTEP program configuration. In this case, it shows that the R1 spindle is being used and that 5 steps are configured in the program. The 'SPINDLE' field appears highlighted by default. Use the 'Δ' and '▽' keys to choose the spindle and then press 'ENTER'.

Use the 'Δ' and '▽' keys to highlight the 'STEPS' field and press 'ENTER' to access the screen where the different configured steps are listed (example screen):



MULTISTEP programmed speeds will be displayed. It can be added new steps with the 'ADD' option and the list of steps can be deleted with the 'CLEAR' option. The list of steps can be also saved with the 'SAVE' option. Use the 'Δ' and '▽' keys to scroll through these options and press 'ENTER' to select one of them. Moreover, the steps listed can be edited or deleted individually. Use the 'Δ' and '▽' keys to highlight one of the steps and press 'ENTER' to edit its parameters. The following screen will appear:



Choose the 'SAVE' option to save the modified parameters or 'DEL' to delete the step under edition. The viscometer will return to the screen with the list of the configured steps. The list will appear updated if the step under edition has been deleted.

The following information is obtained on this MULTISTEP example screen:

- Position 1. Speed 150.0 rpm, experiment time 15 seconds.
- Position 2. Speed 200.0 rpm, experiment time 15 seconds.
- Position 3. Speed 100.0 rpm, experiment time 30 seconds.
- Position 4. Speed 150.0 rpm, experiment time 15 seconds.
- Position 5. Speed 200.0 rpm, experiment time 30 seconds.

This means that the viscometer will have a first measuring at 150.0 rpm for 15 seconds, then for another 15 seconds will take another measurement at 200.0 rpm, drop to 100.0 rpm and 30 second measuring at this speed, then take another 15 second measurement at 150.0 rpm, to return to 200.0 where it will measure for another 30 seconds.

The Multistep program will have as many steps as shown in the Multistep configuration information screen, with a maximum of 10 steps.

Once all the steps are configured, use the 'Δ' and '▽' keys to select the option 'SAVE' and press 'ENTER' to save the programming. Then you will see the following screen:

For L models:



For R and H models:



Here you can reconfigure all of the measurement parameters. The spindle to be used and the density of the sample can be changed in this screen as it is explained above. The steps can also be edited selecting the 'STEP' field with the 'Δ' and '▽' keys and pressing 'ENTER', as it is already explained. Moreover, the execution of the experiment according to the programmed steps can be started from this screen by pressing the 'ON' key.

**NOTE:** The 'Multistep' speeds do not have to be linear, or even follow a positive graduation. The user can program any progression type (growing, decreasing, rising and declining, etc.).



Using the '◀' key you will return to the initial screen of 'MULTISTEP' programming. The 'MEM/CLEAR' key will bring you to the main menu without saving the changes.

It also can be started the execution of the measurement according to the MULTISTEP program from the configuration screen, with the list of configured steps such as the listed in the following example:

MULTISTEP CONF. WED 09:01:25

STEP	SPEED	DURATION
1	100	00H:00M:10S
2	200	00H:00M:15S
3	100	00H:00M:00S
4	100	00H:00M:15S
5	200	00H:00M:00S

ADD CLEAR SAVE

By pressing the 'ON' key, you start the measurements according to the programmed steps. If you press the 'ON' key without having validated a step with the 'ENTER' key, the viscometer will not keep it in memory and will proceed to measure without the non-confirmed step.

Here is a model of the following screen:



As it can be seen, a box with some information appears on the bottom area of the screen. On the left side the 'MULTISTEP' text is shown. Moreover, the central area of the box shows and counts down the remaining time of the step under execution. Furthermore, on the right side it is shown the step under execution from the total of the steps.

When the application is finished, the following screen will appear (example):



The countdown is replaced by the 'END PROGRAM' text.

By pressing the 'MEM/CLEAR' key you'll be brought to the viscometer's main menu screen.

## 10.7.4 Ramp

The RAMP application is one of the many options offered in the 'PROGRAM' menu of the Fungilab Evo EXPERT viscometers. This application allows us to program the viscometer to increase linearly the spindle turn speed in a determined time and with a positive speed graduation.

We select this option by pressing the 'ENTER' key with the 'RAMP' option highlighted on the programming screen. The equipment will then show on the screen:

For the L models:



For the R and H models:



Upon entering this option the SPINDLE field will be selected by default and it will be highlighted in light blue background. You can change the Spindle using the 'Δ' and '▽' keys. Press 'ENTER' again to confirm this selection. The system will skip to the next field.

Using the 'Δ' and '▽' keys you can change the selected field. Once you've introduced the modifications in the spindle field, the next field to modify is the Density. To modify the density, you must press 'ENTER' and you will enter a mode in which the field is numerically alterable. The highlighted field can be modified by pressing the 'ENTER' key. The field to be modified changes its background colour to indicate that the field can be edited. You can modify the number using the digital key on the set, which allow us to introduce the desired numbers, digit by digit. To save the changes, press 'ENTER' when the 'SAVE' field is highlighted.

To select the initial speed (START) you can use the 'Δ' and '▽' keys to highlight this field and by pressing the 'ENTER' key you will allow this field to be edited, changing its background colour to light blue. You can change the values using the 'Δ' and '▽' keys and by pressing the 'ENTER' key again you will be brought to the final speed field (END) which will be highlighted. Here again, you use the 'ENTER' key to select that field and the 'Δ' and '▽' keys to alter the final speed value. Press 'ENTER' again to save this value and you will be brought to the time field (TIME) which will be highlighted.

**NOTE:** The final speed (END) can never be inferior to the initial speed (START) because the ramp must be positive in its progression.



Press 'ENTER' to select the 'TIME' field. The first field, for hours (H), appears highlighted in light blue background so it is ready to be edited. You can change the values using the 'Δ' and '▽' keys and by pressing the 'ENTER' key again you will be brought to the next field, for minutes (M). Repeat the same procedure for the seconds (S) and press 'ENTER' with the 'SAVE' field highlighted to save the programmed time for the analysis. The viscometer will return to the 'Ramp' configuration screen.

The 'ON' key will key the RAMP program running. The viscometer will show the following screen (example):





In the bottom area of the screen we can see that the countdown indicates to us the time left before the process concludes and the 'RAMP' indication.

The 'MEM/CLEAR' key and the '◀' key interrupt the application and bring you to the main menu screen.

**NOTE:** During a 'RAMP' test, the motor cannot be stopped.

## 10.8 Options

The Options menu contains the information and output options that can be set in the Fungilab Viscometers. When the 'Options' field of the main menu is highlighted, you must select it by pressing 'ENTER'. The viscometer will show the following screen:

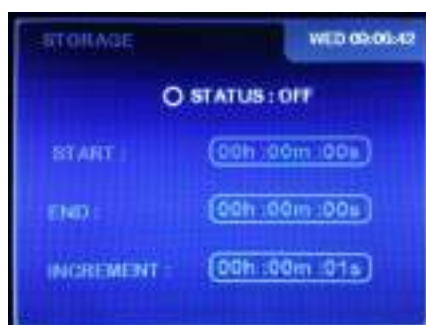


Using the 'Δ' and '▽' keys we can highlight the options in a cyclical way. Press 'ENTER' to choose one of them.

The 'MEM/CLEAR' key and the '◀' key will continue to fulfil their traditional functions, both bringing you to the main menu screen.

### 10.8.1 Storage

The storage submenu allows you to enable the recording system of the viscometer. This selection is mandatory in order to store such information in a file in a USB memory Stick and/or uploading the file into a FTP server. The Output menu presents the following screen:





By default, the 'Status' field is inactive (in the OFF position). You can press the 'ENTER' key to switch the field between active/inactive states (ON/OFF).

While the 'State' field is deactivated (in the OFF position) you will be unable to select the time fields that regulate this function.

Once the 'Status' field is activated (in the ON position), you will be able to select the different fields using the 'Δ' and '∇' keys. The current selected field will remain highlighted on the screen. To edit each field, you must press 'ENTER' on the selected field and then introduce the values using the 'Δ' and '∇' keys. To save the changes, press 'ENTER', whereupon the field will be unselected and the changes saved.

Screen Information:

- START: Defines the lapse of time before starting the recording.
- END: Defines the time in which the recording ends.
- INCREMENT: Defines the time interval between recorded samples.

The 'MEM/CLEAR' key and the '◀' key will continue to fulfil their traditional functions, bringing you to the main menu screen and the previous screen, respectively. Without saving the changes in the case of 'MEM/CLEAR'.

It is also possible to perform a non-stop recording leaving both 'INIT' and 'END' time set to zero and changing the 'STATUS' field to active (ON position). The viscometer will save in its memory one recording every second, with a maximum of approximately 36000 samples. The recording will start with the execution of a new experiment and it will end when the data memory becomes full.

## 10.8.2 Communications

This option allows downloading the data saved in the Viscometer's memory to an external USB-memory, and computer. Additionally, it also enables the remote communications of the viscometer with the Fungilab DATABOSS software (FDB) and with Bluetooth to an android device using the 'FGB EvoExpert' application. When this option is selected, the following menu appears:



The option by default is 'DISABLED', which disable the downloading channels of the instrument. Press 'ENTER' to disable any external communication made by the viscometer. The activation of the 'USB' and Bluetooth downloading channels can be done selecting the appropriate option with the 'Δ' and '∇' keys and then pressing the 'ENTER' key.

## 10.8.2.1 Fungilab DataBoss

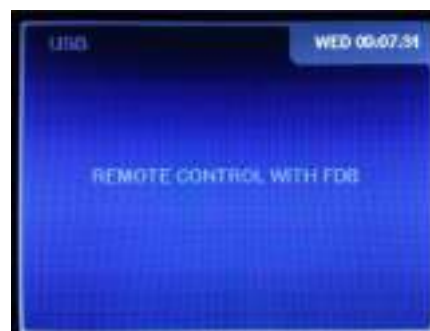
If the 'USB' option is chosen, the following menu will be shown:



The option 'FDB' enables the remote interaction with the Fungilab DATABOSS application. Prior to this selection, the computer has to be connected to the viscometer using a USB to USB cable. Otherwise, the device will be brought to the main menu as soon as the selection is made and it will return to the 'DISABLE' state.



At that point, select the 'FDB' option and press 'ENTER'. The following screen will appear:



If the FDB is running on the computer, this screen will be on for a few seconds until the FDB takes the control of the viscometer. When using the FDB, the indication 'REMOTE' appears on the right bottom area of the measurement screen, as it is shown in the following screen:



More information about the remote handling of the viscometer using the FDB can be found the Appendix B 'Fungilab Data Boss' of this User Manual.

## 10.8.2.2 Memory Stick

The option 'USB PEN' allows the data download to an external USB memory in the data USB port of the instrument. Be sure that the USB memory is connected to the USB connector intended for communication purposes (the upper right one). This connection is shown in the following picture using a USB memory as storage device:



Use the 'Δ' and '▽' keys to highlight the 'USB' option and press 'ENTER' to start the download.



If there is no USB memory the viscometer will not change its screen, waiting for the connection to a USB memory. If the viscometer detects the USB stick connected to the suitable USB connector the download will start, showing this text on the screen:



Once completed the download, the viscometer will return to the main menu.

**NOTE:** To download an experiment, a previous process must have been followed: to realize an experiment and activate the output option ('ON' key).

If there is no data in the USB, the image shown by screen is the following one:



If a USB-memory has been used to download the data, the viscometer will create a folder named 'FUNGILAB' in its root directory. The file or files resulting from the download will be stored in this folder. The first file is named 'FDL0' and the following ones are 'FDL1', 'FDL2' and so on. The files are saved in a CSV (Comma-Separated Values) format, so they can be opened using a plain text editor or a spreadsheet. An example of a file generated by this feature can be seen in the following screenshot:

Fungilab Datalogger						
Viscometer:	EEXR00000					
Date:	10/01/2015					
Measure type:	Normal					
Spindle type:	R1					
Start time:	02:10:11					
Stop time:	02:10:35					
Density:	1.000 g/cm <sup>3</sup>					
Visc. Unit:	cP					
Temp. Unit:	°C					
S.R. Units:	s <sup>-1</sup>					
S.S. Units:	g/(cm·s <sup>2</sup> )					
Time	Speed	Viscosity	Torque	Shear Rate	Shear Stress	Temperature
2:10:14	40.00	0.00	0.00	0.00	0.00	25.00
2:10:15	40.00	0.00	0.00	0.00	0.00	25.00
2:10:16	40.00	0.00	0.00	0.00	0.00	25.00
2:10:17	40.00	0.00	0.00	0.00	0.00	25.00
2:10:18	40.00	0.00	0.00	0.00	0.00	25.00
2:10:19	40.00	254.44	70.78	0.00	0.00	25.00
2:10:20	40.00	240.78	96.45	0.00	0.00	25.00
2:10:21	40.00	240.78	96.45	0.00	0.00	25.00
2:10:22	40.00	239.95	96.36	0.00	0.00	25.00
2:10:23	40.00	237.39	95.25	0.00	0.00	25.00
2:10:24	40.00	237.39	95.25	0.00	0.00	25.00
2:10:25	40.00	235.44	94.56	0.00	0.00	25.00
2:10:26	40.00	217.68	87.38	0.00	0.00	25.00
2:10:27	40.00	217.68	87.38	0.00	0.00	25.00
2:10:28	40.00	213.23	85.62	0.00	0.00	25.00
2:10:29	40.00	198.20	79.58	0.00	0.00	25.00
2:10:30	40.00	190.94	76.66	0.00	0.00	25.00
2:10:31	40.00	190.94	76.66	0.00	0.00	25.00
2:10:32	40.00	184.40	74.03	0.00	0.00	25.00
2:10:33	40.00	185.12	74.32	0.00	0.00	25.00
2:10:34	40.00	185.12	74.33	0.00	0.00	25.00
2:10:35	40.00	178.07	71.49	0.00	0.00	25.00
22 measurements in total						

### 10.8.2.3 Bluetooth

In order to perform the download of the data contained in the Viscometer's memory to the android device using the BLUETOOTH connection of the instrument, use the 'Δ' and '▽' keys to highlight the 'BLUETOOTH' option from the 'COMUNICATIONS' menu and press 'ENTER' to connect to the android device. The following screen will appear:



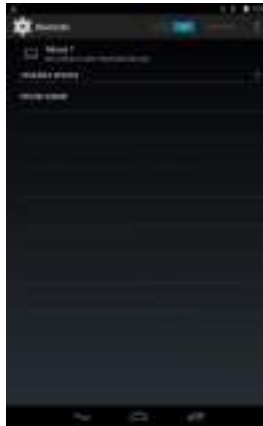
Install the 'FGB EvoExpert' application from Google play.



Open the 'FGB EvoExpert' program in an android. The following screen will appear:



In order to connect to an android device is needed that the devices will be paired. Press the '+' button. The following screen will appear:



Find the serial number of the Evo Expert device and click in the android device, then insert the password 1234 and press 'OK', as in the following screen.



Go back to the main screen of the Evo Expert android application. If the devices are paired correctly will appear the following screen:



In this screen will be appear the devices paired, click in the number of the selected Evo Expert device. The following screen will appear in the android device:



The Evo Expert display will show that the Bluetooth is connected:

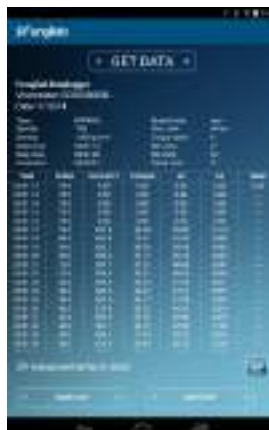


Press the “Get Data” button in the android device and the data will start to be sent. The following screen will appear in to the Evo Expert device:



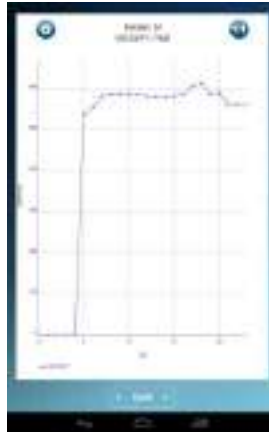
**NOTE:** Previous to get the data, an experiment needs to be realized and the output must be in ‘ON’.




When the previous screen disappears the data will be sent and following screen will appear in the android device:





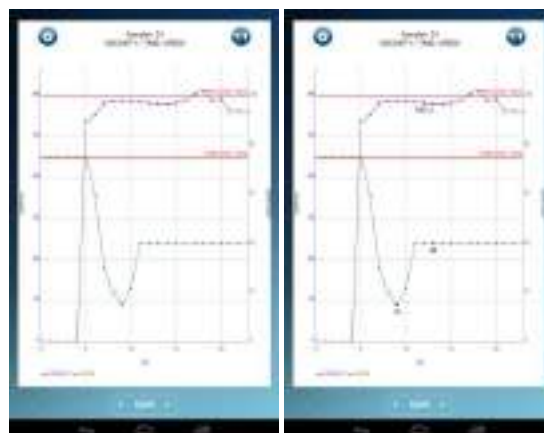
Then this data can be plotted by clicking the  button. Then the following screen appears:



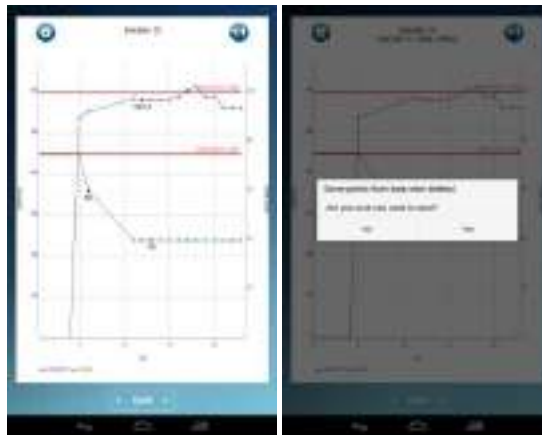
The graphical can be re-scaled using the  button, the plot can be configured by clicking the  button, as can be seen the following image the axis X, Y1 and Y2 can be set as Time, Speed, Viscosity, Torque, Shear Stress, Shear rate and Temperature independently, Also can be set a quality control upper and lower limit to the viscosity, Torque or Shear Stress by clicking the  button. The 'SAVE' button is used to save the plot in to the android device and then can be exported in PDF format.



After press the 'OK' button the plot will be re-plotted with the new configuration. The point of a sample can be marked by clicking on the screen of the android device.



The sample can be also deleted by holding down in the localization on the sample, the change do not will be stored until the 'Save' button is pressed, as can be seen in the following image:



The samples can be export in CSV format to ~/Fungilab/EEXRxxxxxx/FDLxxx.csv by clicking the “MAKE CSV” button.

Time	Viscosity	Speed
0.000	0.000	0.000
0.001	0.000	0.000
0.002	0.000	0.000
0.003	0.000	0.000
0.004	0.000	0.000
0.005	0.000	0.000
0.006	0.000	0.000
0.007	0.000	0.000
0.008	0.000	0.000
0.009	0.000	0.000
0.010	0.000	0.000
0.011	0.000	0.000
0.012	0.000	0.000
0.013	0.000	0.000
0.014	0.000	0.000
0.015	0.000	0.000
0.016	0.000	0.000
0.017	0.000	0.000
0.018	0.000	0.000
0.019	0.000	0.000
0.020	0.000	0.000
0.021	0.000	0.000
0.022	0.000	0.000
0.023	0.000	0.000
0.024	0.000	0.000
0.025	0.000	0.000
0.026	0.000	0.000
0.027	0.000	0.000
0.028	0.000	0.000
0.029	0.000	0.000
0.030	0.000	0.000
0.031	0.000	0.000
0.032	0.000	0.000
0.033	0.000	0.000
0.034	0.000	0.000
0.035	0.000	0.000
0.036	0.000	0.000
0.037	0.000	0.000
0.038	0.000	0.000
0.039	0.000	0.000
0.040	0.000	0.000
0.041	0.000	0.000
0.042	0.000	0.000
0.043	0.000	0.000
0.044	0.000	0.000
0.045	0.000	0.000
0.046	0.000	0.000
0.047	0.000	0.000
0.048	0.000	0.000
0.049	0.000	0.000
0.050	0.000	0.000
0.051	0.000	0.000
0.052	0.000	0.000
0.053	0.000	0.000
0.054	0.000	0.000
0.055	0.000	0.000
0.056	0.000	0.000
0.057	0.000	0.000
0.058	0.000	0.000
0.059	0.000	0.000
0.060	0.000	0.000
0.061	0.000	0.000
0.062	0.000	0.000
0.063	0.000	0.000
0.064	0.000	0.000
0.065	0.000	0.000
0.066	0.000	0.000
0.067	0.000	0.000
0.068	0.000	0.000
0.069	0.000	0.000
0.070	0.000	0.000
0.071	0.000	0.000
0.072	0.000	0.000
0.073	0.000	0.000
0.074	0.000	0.000
0.075	0.000	0.000
0.076	0.000	0.000
0.077	0.000	0.000
0.078	0.000	0.000
0.079	0.000	0.000
0.080	0.000	0.000
0.081	0.000	0.000
0.082	0.000	0.000
0.083	0.000	0.000
0.084	0.000	0.000
0.085	0.000	0.000
0.086	0.000	0.000
0.087	0.000	0.000
0.088	0.000	0.000
0.089	0.000	0.000
0.090	0.000	0.000
0.091	0.000	0.000
0.092	0.000	0.000
0.093	0.000	0.000
0.094	0.000	0.000
0.095	0.000	0.000
0.096	0.000	0.000
0.097	0.000	0.000
0.098	0.000	0.000
0.099	0.000	0.000
0.100	0.000	0.000

Other method to export the data is creating a PDF by clicking the “MAKE PDF” button, The PDF file will be created in ~/Fungilab/EEXRxxxxxx/FDLxxx.pdf, in the PDF will be stored the parameters of the EVO Expert experiment, the data of the experiment and also the plot with the selected configuration as can be seen in the following images.

**REPORT**

**Fungilab**

**PROPERTIES**

Fungilab Datalogger

Microcontroller: EEXR000000

Date: 11/12/14

Measure type: RCP000M

Spindle type: T00

Density: 1.000 g/cm<sup>3</sup>

OC Limits

UPPER LIMIT: 400.0

LOWER LIMIT: 450.0

Start time: 00:01:13

Stop time: 00:01:36

Increment: 00:00:01

Speed Units: rpm

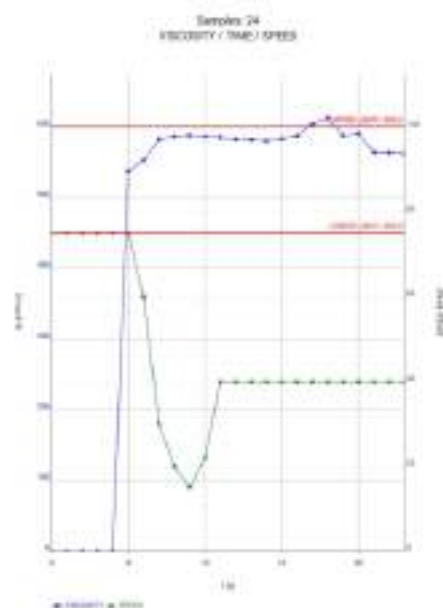
Visc. Units: mPa.s

Torque Units: %

BT Units: m<sup>2</sup>/s

BE Units: Pa

Temp. Unit: °C



TIME	SPEED	VISCOSITY	TORQUE	SR	SS	TEMP
00:01:12	75.0	6.00	0.06	0.06	6.00	0.06
00:01:13	75.0	6.00	0.06	0.06	6.00	---
00:01:14	75.0	6.00	0.06	0.06	6.00	---
00:01:15	75.0	6.00	0.06	0.06	6.00	---
00:01:16	75.0	6.00	0.06	0.06	6.00	---
00:01:17	75.0	527.6	43.89	39.08	3.118	---
00:01:18	60.0	552.8	74.21	62.43	3.436	---
00:01:19	30.0	582.1	96.53	89.45	4.054	---
00:01:20	20.0	586.9	97.12	88.14	4.892	---
00:01:21	15.0	587.7	97.61	88.64	4.897	---
00:01:22	22.0	585.6	96.31	88.53	4.854	---
00:01:23	40.0	584.8	95.39	87.52	4.811	---
00:01:24	40.0	582.3	94.67	87.61	3.877	---
00:01:25	40.0	581.5	94.13	87.28	3.952	---
00:01:26	40.0	579.8	93.21	86.82	3.814	---
00:01:27	40.0	582.6	92.55	85.66	3.879	---
00:01:28	40.0	587.1	90.76	83.56	3.794	---
00:01:29	40.0	604.1	77.83	59.78	3.843	---
00:01:30	40.0	612.3	66.85	50.78	3.148	---
00:01:31	40.0	587.4	51.64	40.48	3.397	---
00:01:32	40.0	590.4	51.30	40.40	3.419	---
00:01:33	40.0	583.7	48.88	37.18	3.117	---
00:01:34	40.0	583.7	45.67	37.18	3.117	---
00:01:35	40.0	582.0	44.94	37.18	3.111	---

## 10.8.3 Information

If you select the 'INFO' option, you will be brought to the following screen:



The geographic area can be chosen here use the 'Δ' and '▽' keys. Press the 'ENTER' key and it will be displayed a screen with the contact information of the manufacturer, resembling this:

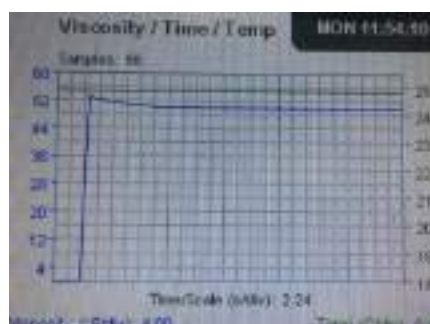


This option is incorporated as a means of security in the case of loss of the present document or the displacement of any reference to the company in technical support or on paper.

## 10.8.4 Graphic Mode

If you select this option, you will be activating the function that creates graphic representation of the values previously saved in the viscometer's memory. The plots and their order of appearance depends on the type of analysis carried out.

For regular measurements (no RAMP/MULTISTEP programming) the viscometer will first display a plot with similar structure to the shown on the following screen:



This plot shows the viscosity and temperature values recorded over the previously programmed storage time (as it is described in 8.6.1 Storage). Moreover, the number of samples of the analysis is displayed on the top of the plot. Furthermore, the represented time scale (in seconds/division) viscosity scale (mPa/division or cP/division) and temperature scale (°C/division or F/division) appears on the bottom area of the plot. In addition, the maximum values recorded for both viscosity and temperature can be shown by pressing the

the '►' key. Press the '►' key again to return to the visualization of the viscosity and temperature scales. It should be noted that when the temperature reaches the full scale value, of 300°C, its plot is shown in solid red line. In most applications, where the temperature of the sample is far below the full scale value, this would indicate there is no temperature probe or it is not properly connected to the instrument.

One more plot can be obtained in regular measurements: the viscosity and speed values recorded over the programmed storage time. Use the 'Δ' and '▽' keys to skip between plots. This plot shows similar to the following screen:



On this plot, the represented time scale (in seconds/division) viscosity scale (mPa/division or cP/division) and speed scale (r.p.m./division) appears on the bottom area of the plot. This second plot also gives the maximum values recorded for both viscosity and velocity, that can be shown by pressing the the '►' key. Press the '►' key again to return to the visualization of the viscosity and speed scales. It should be remarked that the viscosity values obtained when the torque overcomes 100% are plotted in solid red line in this chart.

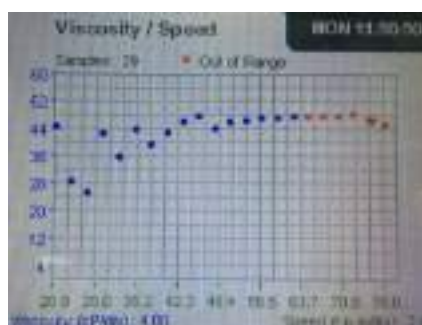
**Note:**

*The time required by the viscometer in order to show the plots depends on the number of samples of the recorded experiment. For relatively long experiments the viscometer can take some seconds to show the plot. During this processing time, the viscometer can not perform any other task and it do not react to any keystroke.*



For the MULTISTEP analysis the viscometer offers the same plots as in the regular measurements but in the reverse order. It first appears the viscosity/speed/time plot and by pressing the 'Δ' key or the '▽' key the viscosity/temperature/time plot is then displayed.

For the RAMP analysis the viscometer provides three graphical representations. The first of them is a plot only available for RAMP analysis. It shows like the following screen:



This plot is the first to appear when conducting RAMP measurements and it shows the viscosity values recorded with the speed values. The viscosity and speed scales are also given in the bottom area of the plot. It should be remarked that the viscosity values obtained when the torque overcomes 100% are plotted in solid red points in this chart.

From this screen, you can use the 'Δ' and '▽' keys to display the other two plots available for the RAMP analysis. Use the 'Δ' key to show the viscosity/speed/time plot and the '▽' key to display the viscosity/temperature/time plot.

The exit keys 'MEM/CLEAR' and the '◀' key continue to fulfil their traditional functions, bring us to the main menu screens or the previous screen, respectively. With the 'MEM/CLEAR' key, the changes will go unsaved.

## 11. Important rheological information

To obtain precise results it is necessary to know the most important rheological properties of the sample.

### **Newtonian fluids**

The viscosity of these fluids does not depend on the shear rate meaning that at any speed the viscosity is the same. Only temperature affects the viscosity; changes of 1°C can provoke a change in the viscosity of up to 10%.

### **Non-Newtonian fluids**

The viscosity of this type of products changes with the speed variable. Due to this inconsistency, the term *Apparent Viscosity* is habitually used.

Within the classification you can find two different groups:

- Time-independent non-Newtonian fluids
- Time-dependent Newtonian fluids

### **Time-independent non-Newtonian fluids**

The viscosity of a time-independent non-Newtonian fluid depends on the temperature and the speed gradient.

#### **Pseudo plastic Fluids:**

The viscosity diminishes when the speed gradient increases.

Practical examples: paints, shampoos, fruit juice concentrate, adhesives, polymers, grease, starch, etc.

#### **Dilatants-Fluids:**

The viscosity increases with the speed gradient.

Practical examples: clay, sweets components, etc.

#### **Plastic Fluids:**

These fluids only start to flow after having been submitted to a certain force (shearing force). They behave like solids in static conditions.

Practical example: Ketchup.

### **Time-dependent non-Newtonian fluids.**

The viscosity of time-dependent non-Newtonian fluids is dependent on the temperature, on the speed gradient and on time.

#### **Tixotropic fluids:**

In these substances the viscosity diminishes with time when the fluid is subjected to a constant speed gradient. These substances tend to return to their previous viscosity once the speed gradient ceases to be applied.

Practical examples: Many products in industrial food production (yogurt, etc.)

#### **Reopectic fluids:**

In these fluids, the viscosity increases with time when the fluid is subjected to a constant speed gradient.

These substances tend to return to their previous viscosity once the speed gradient ceases to be applied.

These fluids are not very common.

**NOTE:** The turbulent behaviour of a fluid can produce falsely high results in viscosity tests. Normally, turbulent behaviour is due to an excessively high rotation speed in relation to the viscosity of the sample (see detailed Warning further on).



## **FACTORS AFFECTING VISCOSITY**

There are many variables that affect the rheological properties of products, so it is very important to take the following factors into account.

### **Temperature**

Temperature is one of the most obvious factors affecting rheological behaviour.

It is essential to consider the effects of temperature on viscosity in the evaluation of materials that are subject to changes in temperature during its use or other processes. Some examples of this are motor oils, greases and adhesives.

### **Shear Rate**

When a fluid is subjected to variations in the speed gradient during its process or use, it is essential to know its viscosity at the projected speed gradients.

Examples of materials, which are subjected to and affected by important variations in speed gradient during its process or use, are: paints, cosmetics, liquid latex, some food products such as ketchup and blood in the human circulatory system.

### **Measurement conditions**

The measurement conditions of a material during its viscosity reading can have a considerable effect on the results of this measurement. Consequently, it is important to be careful and control the environment and conditions of any sample subjected to analysis.

Variables such as the type of viscometer, the speed/spindle combination, the sample's container, the absence or presence of a spindle protector, the temperature of the sample and the sample preparation techniques, etc, can affect not only the precision of the reading but also the real viscosity of the sample.

### **Time**

Ageing under the same speed gradient conditions affects tixotropic and reopectical fluids.

In some fluids the action of time combined with the proportion of the shear is very complex. In these cases, one can observe, with time, a return to the original fluid state.

### **Previous conditions**

The conditions that the sample is subjected to before the viscosity reading can significantly affect the results, especially with heat-sensitive fluids or ageing.

Thus, the storage condition and the sample preparation techniques should be conceived to minimize effects on the viscosity measurements.

### **Composition and additives**

A material's composition is a determining factor in its viscosity. When the composition is altered, whether this is by changing substance proportions that compose it or adding other substances, important changes can be observed in their viscosity.

For example, adding solvent to printing ink reduces the viscosity of the ink and other types of additives are used to control the rheological properties of paints.



## **VISCOSITY MEASURING PROCEDURES**

### **Data history**

We recommend documenting the following information each time you take a viscosity measurement:

- Model or type of viscometer
- Spindle (and accessory)
- Rotation speed
- Sample container
- Sample temperature
- Sample preparation procedure (if existent)
- Spindle protection use

The process is necessary in the event of comparison of results with other organizations, in the interest of being able to guarantee the possibility of reproduction of the results obtained.

### **The spindle and its protection**

Examine each spindle before using it. If it's damaged or eroded in such a way that its dimensions are changed, it will provide false results for your viscosity reading.

The spindle protector (provided with every Fungilab rotational viscometer) protects the spindle and the viscometer axle and it is important for the reading of low viscosities with standard spindles.

The protector should always be used. In the event that it is not used, its absence must be reported in the measurement procedure notes.

The protector isn't used with most of the accessories.

### **Speed selection and spindle**

If there is no described work procedure, the best method for the selection of the spindle for each speed is "trial and error". The objective is a torque reading between 15 and 95%, according to the type of product in question and a percentage higher than 50% is recommendable.

If you know the fluid's approximate viscosity, the quickest spindle/speed selection method is referring to the tables of maximum approximate viscosity.

When you do tests at different speeds, you should select a spindle with which all of the speeds show a torque reading of between 15 and 95%

GENERALLY:

RPM INCREMENT  $\Rightarrow$  READING PRECISION INCREMENT

SPINDLE SIZE-REDUCTION  $\Rightarrow$  READING PRECISION INCREMENT

(Except for the non-Newtonian fluids that change their viscosity value when the rotational speed is modified. In these cases we recommended measuring with a determined speed and using a comparison method.)

### **Size of the sample container**

For measurements using the Fungilab viscometer, we recommend working with containers with an interior diameter of 83 mm or more. The usual container is a 600 ml precipitation vase.

If a smaller container is used, the viscosity values could be greater, especially with low-viscosity fluids.

### **Sample conditions**

The sample should be free of air bubbles.

It should be exposed to a constant and uniform temperature. Before doing the viscosity readings, make sure that the spindle and its protection are the same temperature. Usually, thermostatic baths are used to maintain the sample at the desired temperature.

The sample should have the properties of a homogeneous liquid; this means that it cannot have particles capable of being precipitated, deformed by the shear rate or decomposed into smaller particles.

The measured substances shouldn't be subject to chemical or physical changes during the measurement.

### **Other essential conditions**

Experiments in conditions in which turbulent behaviour can be encountered should be avoided.

The condition should be that of stationary fluid. Accelerations or retarding processes are excluded from the parameters of measurement.

### **Spindle immersion**

The standard spindle should be submerged to the halfway mark in the axle. An erroneous immersion can compromise the result of the viscosity measurement.

With the disc spindles you should avoid the creation of air bubbles, which could remain under the disc. To this end you should insert the spindle laterally and smoothly and bring it over to the centre of the sample. Once it is there, attach it to the viscometer's axle.

### **Precision and Repetition**

FUNGILAB viscometers guarantee a precision of  $\pm 1\%$  from the bottom of the speed/spindle combination scale and a repetition of  $\pm 0.2\%$ .

The precision of temperature measurement is  $\pm 0.2\text{ }^{\circ}\text{C}$ .

### **Getting a viscosity reading**

Before working with the viscometer you should make sure of the following points:

The viscometer is properly fastened to the stick and level.

Both spindle and speed are selected. (read attentively the section about speed and spindle selection).

The spindle is carefully placed and fastened.

The instructions and necessary parameters for obtaining a viscosity reading have been carefully read in the user's manual.

Once the readings have been initiated, allow some time for stabilization, the length of which will be in function of the rotational speed during the measurement.

### **IMPORTANT WARNING**

When you wish to obtain viscosity reading with FUNGILAB rotational viscometers, there are two considerations to take into account:

The obtained viscosity results must be between 15% and 100% of the torque range, for whichever spindle/rotational speed combination.

The viscosity reading must be executed under laminar flow condition, not turbulent flow conditions.

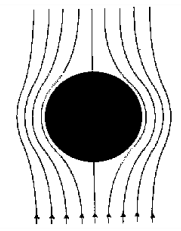
The first consideration is linked to the precision of the instruments. All of the FUNGILAB rotational viscometers guarantee a precision of  $(\pm) 1\%$  from the bottom of any spindle/rotational speed combination scale.

Working with less than 15% of the bottom of the scale is not recommended due to that the potential  $(\pm) 1\%$  error in the viscosity is relatively big compared to the equipment reading.

The second consideration has to do with fluid mechanics. All of the rheological measurements of fluid flow properties must be taken under laminar flow conditions. Laminar flow is when all of the movements of the fluid particles are in sheets, directed by an external applied force.

The flow lines represent speed and fluid flow direction.

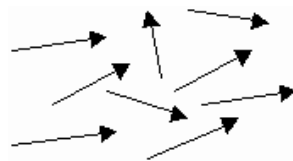
**Laminar flow:** "straight" flow lines. Relatively easy to predict. Generally slow.



**Turbulent flow:** "non-linear" flow lines. Impossible to predict the exact movement of the fluid. Very quick.

For rotational systems, this means that the fluid's movement must be circumferential. When the internal forces of a fluid end up being too great, the fluid can become a turbulent flow, in that the particles that make it up become unpredictable, making it impossible to analyse it with standard mathematical models.

This turbulence creates a false reading which is a lot higher than the real one, without linear growth and totally unpredictable.



For the following geometries, these transition points have been found to be approximate to turbulent flow:

- |                 |                   |
|-----------------|-------------------|
| 1) Spindle L1:  | 15 cP to 60 rpm   |
| 2) Spindle R1:  | 100 cP to 50 rpm  |
| 3) Adaptor LCP: | 0.85 cP to 60 rpm |

Turbulent flow conditions will always exist in these conditions as long as the RPM/cP ratio exceeds the values listed above.

## 12. Accessories

### 12.1. Low viscosity adapters (LCP and LCP/B)

Low viscosity adapters (LCP and LCP/B) do not come with the standard delivery. Any of these two versions (with or without thermo station jacket) must be ordered as an additional accessory. Both LCP and LCP/B accessories are supplied complete with a spindle.

Low viscosity adapters allow more precise measurements than using the standard spindle. The viscometer can measure very low viscosity levels, from 1 cP (when using the L model).

Thanks to its cylindrical geometry shape, it is possible to get Shear Rate determinations and Shear Stress. Only a small quantity of a sample is needed (16 ml.)

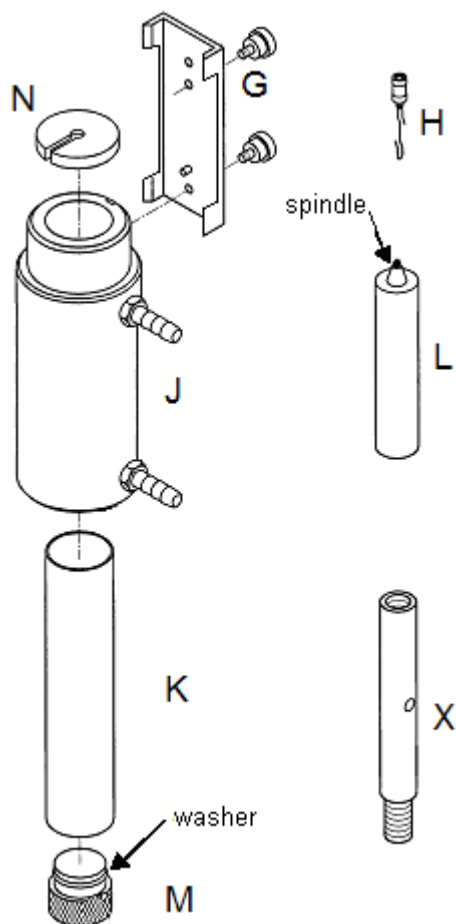


Fig. 7: LCP Spare parts



Fig.8: LCP Adapter assembled in viscometer

## 12.1.1 Mounting

The mounting process is different according to the types of low viscosity accessories (LCP and LCP/B). The difference between them only remains that the LCP has a thermo station jacket (J) and a container (K) and the LCP/B only incorporates a container (K). The LCP screws its thermo station jacket (J) to the connector (G), on the other hand, the LCP/B screws the container directly to the connector (G). Now is detailed the LCP assembling:

- Unplug the viscometer.
- Attach the extension (X) between the base Y shaped (A) and the rib (C). Use a 19 mm adjustable spanner in order to fasten the nut (D).
- Assemble the viscometer again starting with the base. The extension (X) is necessary because of the length of the LCP adapter. Without this extension the assembly of this accessory would be difficult, especially the assembly of the spindle.



Fig. 9: Mounting the LCP adapter extension.

- Close the sample (K) container with the stopper (M).
- Insert the container (K) to the lower part, in the circulation jacket (J) by turning it gently.
- Fasten the circulation jacket (J) to the connector (G).
- Fill the sample container with a 20 ml syringe, or less and fill the 16 ml sample container.
- Connect the hook (H) and the spindle (L)
- Insert the spindle (L) in the circulation jacket (See the note \* below)
- Fasten the connector (G) to the hole in the back of the viscometer's metallic base. **(See the note \*\* below)**
- Screw it with the viscometer axle by turning it clockwise.
- Check the level of the sample. It should be approximately in the middle of the cone, which is connected to the spindle connector (H). Figure 10 shows more information about this.
- Place the upper stopper (N) over the sample container.

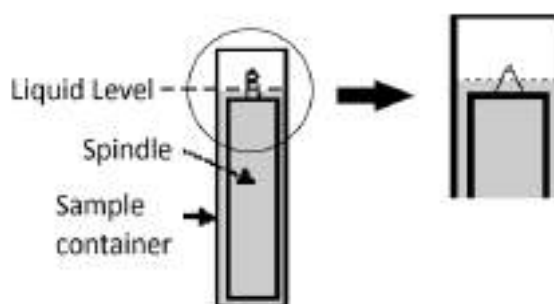


Fig. 10: Full LCP adapter.

### \*Important:

Do this slowly since the spindle must be inserted correctly in the sample. When working with a more viscous sample be careful to avoid pulling the spindle upwards. Hold the spindle connector.

### \*\*Important:

The piece named G has two possible holes for the upper screw.

The top hole is a Universal hole to screw our low viscosity adapter to other viscometers.

The bottom hole is to screw Fungilab pieces.

**NOTE:**

Before starting with the measurements, make sure the viscometer is correctly balanced (check it with the bubble level). The spindle that should be selected is 'LCP/SP'.

## 12.1.2 Dismounting and cleaning

- Unscrew the spindle of the viscometer axis and lower the spindle slowly in the sample container (K).
- Remove Adapter (G) from metallic glass.
- Place the viscometer upright. Remove the upper stopper (N).
- Remove the spindle carefully (L).
- Unscrew the bottom stopper (M) and remove the container (K) from below the thermo station jacket (J).
- Remove the container, wash it or use compressed air. Wash the circulation jacket too if necessary.
- Remove Adapter (G) from the circulation jacket.

**Important:**

Do not use any cleaner or tool that can damage the metallic surface. Make sure you only use liquids that agree with the LCP adapter material!

Solvents that can be used: water, ethanol or high concentrations of alcohol. For other solvents, check the chemistry compatibility table.

## 12.1.3 Technical specification for LCP accessories

**Measurements rank:**

- Sample L: 0.9\*) until 2 000 mPa.s or cP
- Sample R: 3.2\*\*) until 21 333 mPa.s or cP

\*) Limited by turbulences

\*\*) For the measurements that represent 10 % of the base scale

**Sample volume:** 16.0 ml

**Shear rate factor for the LCP spindle:** 1.2236 x RPM \*\*\*)

\*\*\*) Shear rate is calculated based on the features of Newtonian liquids.

**Temperature rank of the circulation jacket & thermo station conditions:**

- Temperature rank allowed: -10 a +100°C (14 a 212 °F)
- Use a thermo station wash with demineralised water or special refrigeration liquid. Change thermostat liquid regularly. Recommended flow: 15 l/min.

**Materials:**

- The metallic parts are made of stainless steel; the leads are made of black delrin plastic. The parts that come into contact with the sample (sample container and spindle) are made of AISI 316 and are suitable for the food industry.
- The lead inferior washer is made with black delrin. It is designed to withstand a maximum temperature of 100°C (212 °F)
- The circulation jacket is made of acetyl and Delrin.
- The O-ring on the plastic stopper (M) of the LCP Adapter is made of delrin. The softening point is 110 °C (230 °F).

## 12. 2. Small sample adapters APM and APM/B

### NOTE:

Small sample adapters (APM and APM/B) do not belong to the standard delivery. Any of these two versions (with or without thermo station jacket) must be ordered as an additional accessory. APM and APM/B accessory are not supplied with a spindle. Special spindles (TL or TR) are used according to the viscometer sample (L, R or H).

Small sample adapters allow more precise measurements than the standard spindles. The measurement rank of a viscometer can get lower viscosity levels.

Thanks to its known cylindrical geometry shape, it is possible to get Shear Rate and Shear Stress determinations. Only a small quantity of the sample is needed.

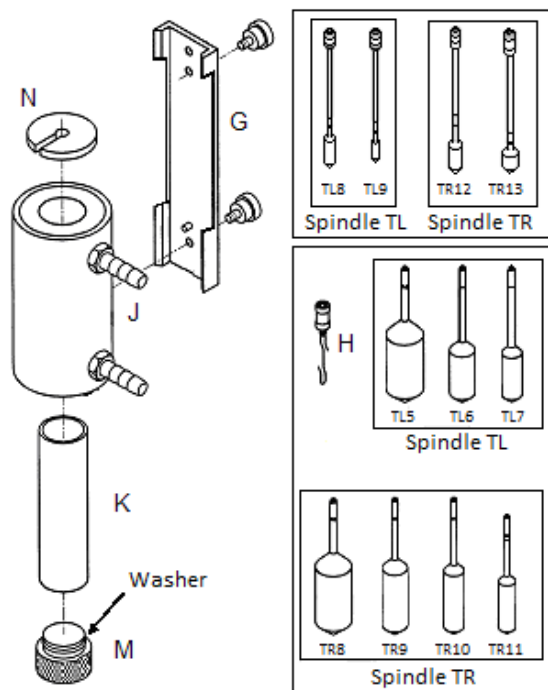


Fig. 11 APM accessory parts



Fig. 12 Set APM

## 12. 2. 1 Assembly

### NOTE:

The mounting process is different according to the types of low viscosity accessories (APM and APM/B). The difference between them only remains that the APM has a thermo station jacket (J) and a container (K) and the APM/B only incorporates a container (K). The APM screw its thermo station jacket (J) to the connector (G), on the other hand, the APM/B screws the container directly to the connector (G). Now is detailed the APM assembling:

- Unplug the viscometer.
- Close the sample (K) container with the stopper (M).
- Insert the container (K) to the lower part, in the circulation jacket (J) by turning it gently.
- Fasten the circulation jacket (J) to the connector (G)
- Fill the sample container with a 20 ml syringe or less and fill the sample container according to the spindle selected (see section 10.2.3).
- Connect the hook (H) and the spindle (L)
- Insert the spindle (L) in the circulation jacket (See the note \* below)
- Fasten the connector (G) to the hole in the back of the viscometer's metallic base (**See the note \*\* below**)
- Screw it with the viscometer axle by turning it clockwise.
- Check the level of the sample. It should be approximately in the middle of the cone, which is connected to the spindle connector (H). Figure 14 shows more information about this.
- Place the upper stopper (N) over the sample container.

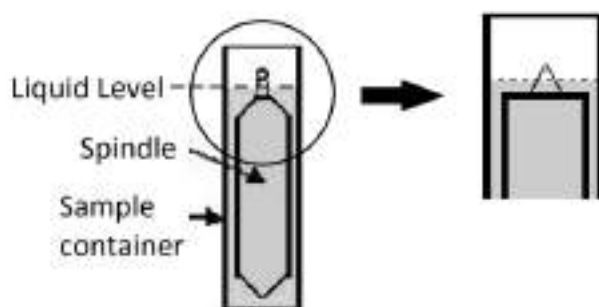


Fig. 14: Full APM adapter.

### \*Important:

Do this slowly since the spindle must be inserted correctly in the sample. When working with a more viscous sample be careful to avoid pulling the spindle upwards. Hold the spindle connector.

### \*\*Important:

The piece named G has two possible holes for the upper screw.  
The top hole is a Universal hole to screw our small sample adapter to other viscometers.  
The bottom hole is to screw Fungilab pieces.

### NOTE:

Before starting with the measurements, make sure the viscometer is correctly balanced (check it with the bubble level). The Spindle you have to select is TL or TR in function of the model of viscosimeter (L. R or H).



## 12. 2. 2 Dismounting and cleaning

- Unscrew the spindle of the viscometer axis and lower the spindle slowly in the sample container (K).



**Caution on removing the spindle, it can be hot due to a previous high temperature experiment.**

- Remove Adapter (G) from metallic glass.
- Place the viscometer upright. Remove the upper stopper (N).
- Remove the spindle carefully (L).
- Unscrew the bottom stopper (M) and remove the container (K) from below the thermostatic flow jacket (J).
- Remove the container, wash it or use compressed air. Wash the circulation jacket too if necessary.
- Remove Adapter (G) from the circulation jacket.

### **Important:**

Do not use any cleaner or tool that can damage the metallic surface. Make sure you only use liquids that agree with the APM adapter material!

Solvents that can be used: water, ethanol or high concentrations of alcohol. For other solvents, check the chemistry compatibility table.

## 12. 2. 3 Technical specifications of APM and APM/B

### **Measurement range:**

- Model L: 1.5\* to 200 000 mPa.s
- Model R: 25\* to 3 300 000 mPa.s
- Model H: 0.2\* to 26 660 Pa.s

\* Measurement representing 10 % of the full scale.

### **Spindles features and APM filling:**

- L Model & TL spindles

Spindle	Shear rate [ s <sup>-1</sup> ] *)	Sample volume [ ml ]	Container
TL5	1.32 x RPM	6.7	STC
TL6	0.34 x RPM	9.0	STC
TL7	0.28 x RPM	9.4	STC
TL8	0.29 x RPM	4.2	TL8C
TL9	0.22 x RPM	16.0	STC

- R Model or H & TR spindles

Spindle	Shear rate [ s <sup>-1</sup> ] *)	Sample volume [ ml ]	Container
TR8	0.93 x RPM	7.1	STC
TR9	0.34 x RPM	10.4	STC
TR10	0.28 x RPM	11.0	STC
TR11	0.25 x RPM	13.5	STC
TR12	0.48 x RPM	3.8	TR12C
TR13	0.40 x RPM	2.1	TR13C

\*) Shear rate is calculated based on the features of Newtonian liquids.

Container	Stopper	D [mm]	L [mm]
TL8C	T8BC	13.03	27.57
TR13C	T13BC	12.7	42.7
TR12C	T12BC	12.7	22.9
STC	STBC	19.05	7

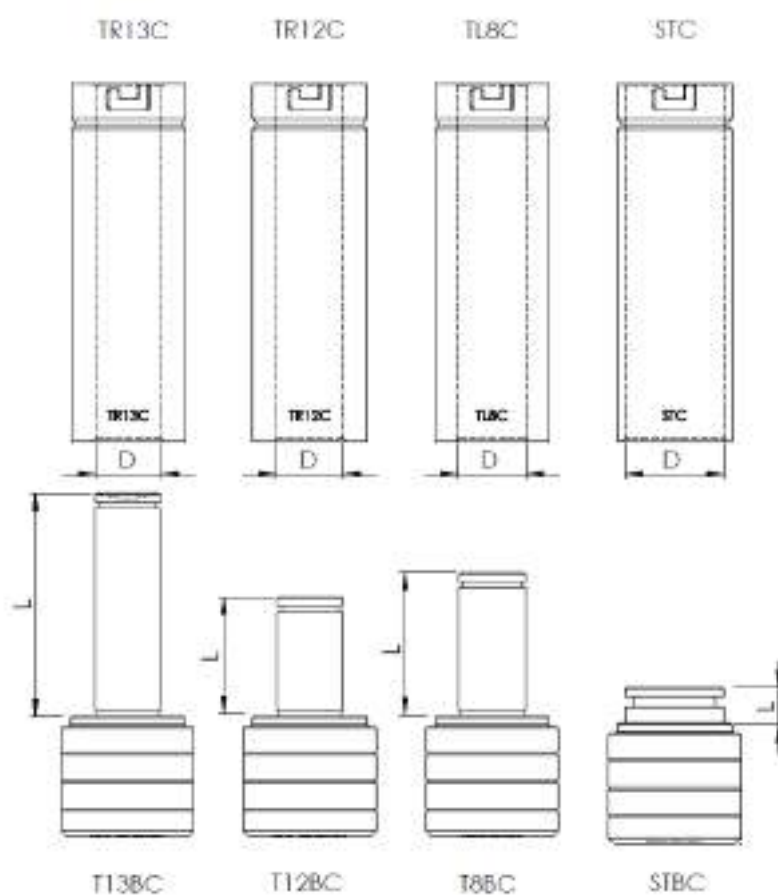


Fig. 15 Container dimensions

#### Temperature range of circulation jacket and thermostatic flow conditions:

- Permitted temperature range: -10 a +100°C (14 a 212 °F)
- Use a thermostatic bath with demineralised water or refrigeration special liquid. Change the liquid form the thermostatic bath regularly. Recommended flow: 15 l/min.

#### Materials:

- The metallic parts are made of stainless steel; the lids are made of plastic in Delrin. The parts in contact with the sample (sample container and spindle) are made of AISI 316 suitable for food industry.
- The lid inferior washer is made in black Delrin. It is designed to get a maximum temperature of 100°C (212 °F)
- The circulation jacket is made of acetal and Delrin.
- The O-ring on the plastic stopper (M) of the APM Adapter is made of Delrin. The softening point is 110 °C (230 °F).

## 12.3 HELDAL UNIT – Helicoidal Movement Unit

#### NOTICE:

The Heldal adapter doesn't come with the standard delivery. It can be ordered as an accessory. The unit is supplied complete with T-shaped spindles, in this case.

The Heldal accessory is used with substances that do not flow by themselves (like ice or pastas). Is engine moves the viscometer slowly in a vertical movement and at the same time the spindle makes the rotation movement. This generates a helicoidal movement that makes that the T-shaped spindle is always in contact with the sample.

The measurements obtained with Heldal do not measure absolute viscosity! They are only comparative measurements with the same geometry as T-shaped spindles.



Fig. 15 Heldal Unit in its case

## 12. 3. 1 Heldal unit Mounting



Fig. 16 Heldal unit set in the viscometer

1. Rib joint	9. Base
2. Lower stop ring	10. Levelling knobs
3. Displacement command	11. Heldal engine unit
4. Viscometer fastening bolt	12. Knobbed fastening rib
5. Upper stopper ring	13. Functioning pilot
6. Heldal fastening group	14. Nut bolt
7. ON/OFF switch	15. Viscometer fastening rib
8. Fastener	

6.1 Spindle connector
6.2 Upper spindle receptor
6.3 Lower spindle receptor
6.4 Counterweight, spindle connector
6.5 Spindle

- Place the fastener (8) facing the short end of the Y-shaped base (9).
- Place the safety shell (1) over the fastening rib (8) on the base of the viscometer (9).

- Place the lower ring in the fastener (8) as explained in the sketch and fasten it with the knobbed fastening rib (12).

**Important:**

Do not fasten the stop rings to the fastening ribs (12) too tightly. They are plastic pieces and they can be damaged. Both stopper rings (upper and lower) look exactly the same and can be changed.

- Place the Heldal engine (11) in the fastener(8) while pressing the displacement command (3).
- Connect the upper stop ring to the fastener (8) and fasten it with the fastening rib (12).
- Insert the viscometer by placing the fastening rib (15) in the Heldel bolt (4) and fasten it with the nut bolt (14).
- Balance the viscometer – Heldal set with the balancing knobs (10).
- Fasten the T-shaped spindle (PA to PF samples) to the viscometer. In order to choose the right one, look at the selection tables (T.3).
  - Screw the counterweight (6.4) in the lower part of the spindle receptor (6.3).
  - Insert the spindle receptor (6.5) between both upper and lower parts of the spindle receptor (6.2 and 6.3). Do not separate these two parts.
  - Fasten the spindle and screw in the lower part of the receptor (6.3) until it is completely fastened.

**Important:**

Do not fasten the spindle tighter than necessary. There should always be a small hole between both parts of the receptor.

- Fasten the spindle receptor and the spindle to the axis of the viscometer, by connecting the thread.
- Place the sample container under the viscometer and insert the spindle into the sample fluid by pressing the displacement button (3).
- The stopper rings limit the vertical movement of the spindle. Therefore, these two rings must be fastened correctly and in their correct positions.

**Important:**

Placement of stopper rings as explained here:

- Upper ring: the spindle should be kept in the same fluid
- Lower stopper ring: The spindle must not touch the edge of the container. If so, the viscometer's axle can be damaged and the results can be wrong.
- Once the rings are fastened, connect the viscometer and the Heldal to the power point. Switch the viscometer on and insert the speed and the spindle, as always.
- Set the Heldal unit on with the ON/OFF switch (7). Check if the pilot is on. If not, check the mains connection.

**OPERATION:**

The Heldal unit (which moves helicoidally) is moved up and down between the two stopper rings. When the engine touches one of them, the unit changes direction.

The Heldal unit will keep moving, until turned with the ON/OFF switch (7).

## 12.4. Thermosphere

The Thermosphere is a heating chamber that is used to work with different samples at high temperatures, it allows to perform different test with a controlled temperature. The thermosphere works in standalone mode, but it can be connected to the viscometer to send the temperature data to the viscometer screen.

The Thermosphere is not included in the standard delivery. It must be ordered as an additional accessory.



Fig. 17 Viscometer with Thermosphere unit

### 12.4.1 Connecting Thermosphere to viscometer

To communicate the Thermosphere with the viscometer it is only needed to connect the USB cable in the USB port dedicated to that function (fig 18.). When you turn on the Thermosphere it will automatically connect with the viscometer. The temperature value it will appear on the measuring screen when the viscometer initiates an experiment.



Fig. 18 Thermosphere connection



Fig. 19 Thermosphere screen

## 13. Model/Spindle correspondence tables

Standard Spindles + R1 (Table 1):

Viscometer model	Spindle
EVO EXPERT L	L1
	L2
	L3
	L4
	L5
	L2C
	L3C
EVO EXPERT R	R1
	R2
	R3
	R4
	R5
	R6
	R7
EVO EXPERT H	R1
	R2
	R3
	R4
	R5
	R6
	R7

SPECIAL SPINDLES FOR APM ADAPTER (Table 2):

Viscometer model	Spindle
EVO EXPERT L	TL5
	TL6
	TL7
	TL8
	TL9
EVO EXPERT R	TR8
	TR9
	TR10
	TR11
	TR12
	TR13
EVO EXPERT H	TR8
	TR9
	TR10
	TR11
	TR12
	TR13

SPECIAL HELDAL SPINDLES (Table 3):

Viscometer model	Spindle
EVO EXPERT L	PA
	PB
	PC
	PD
	PE
	PF
EVO EXPERT R	PA
	PB
	PC
	PD
	PE
	PF
EVO EXPERT H	PA
	PB
	PC
	PD
	PE
	PF

SPECIAL SPINDLES FOR LCP ADAPTER (Table 4):

Viscometer model	Spindle
EVO EXPERT L	LCP/SP
EVO EXPERT R	LCP/SP

SPECIAL VANE SPINDLES (Table 5):

Viscometer model	Spindle
EVO EXPERT L	V71
	V72
	V73
	V74
	V75
EVO EXPERT R	V71
	V72
	V73
	V74
	V75
EVO EXPERT H	V71
	V72
	V73
	V74
	V75



## 14. Model/spindle/oil calibration tables

MODEL L (Table 6):

Spindle	Standard oil
L1	RT50
L2	RT500
L2C	RT500
L3	RT1000
L3C	RT1000
L4	RT5000
L5	RT12500
TL5	RT50
TL6	RT500
TL7	RT500
TL8	RT1000
TL9	RT5000
LCP	RT5

MODEL R (Table 7):

Spindle	Standard oil
R1	RT50
R2	RT500
R3	RT500
R4	RT1000
R5	RT5000
R6	RT5000
R7	RT30000
TR8	RT500
TR9	RT5000
TR10	RT5000
TR11	RT5000
TR12	RT5000
TR13	RT12500
LCP	RT50

MODEL H (Table 8):

Spindle	Standard oil
R1	RT1000
R2	RT5000
R3	RT12500
R4	RT12500
R5	RT30000
R6	RT100000
R7	RT100000
TR8	RT5000
TR9	RT12500
TR10	RT30000
TR11	RT60000
TR12	RT60000
TR13	RT60000

## 15. EVO Expert L standard spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	L1	L2	L3	L4	L5
0.3	20K	100K	400K	2M	4M
0.5	12K	60K	240K	1.2M	2.5M
0.6	10K	50K	200K	1M	2M
1	6K	30K	120K	600K	1.2M
1.5	4K	20K	80K	400K	800K
2	3K	15K	60K	300K	600K
2.5	2.4K	12K	48K	240K	500K
3	2K	10K	40K	200K	400K
4	1.5K	7.5K	30K	150K	300K
5	1.2K	6K	24K	120K	250K
6	1K	5K	20K	100K	200K
10	600	3K	12K	60K	125K
12	500	2.5K	10K	50K	100K
20	300	1.5K	6K	30K	60K
30	200	1K	4K	20K	40K
50	120	600	2.4K	12K	25K
60	100	500	2K	10K	20K
100	60	300	1.2K	6K	12K
200	30	150	600	3K	6K
250	24	120	480	2.4K	4.8K

Table 9.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 16. EVO Expert L Special aerial spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	L2C	L3C
0.3	100K	400K
0.5	60K	250K
0.6	50K	200K
1	30K	125K
1.5	20K	80K
2	15K	60K
2.5	12K	50K
3	10K	40K
4	7.5K	30K
5	6K	25K
6	5K	20K
10	3K	12K
12	2.5K	10K
20	1.5K	6K
30	1K	4K
50	600	2.5K
60	500	2K
100	300	1.2K
200	150	600
250	120	480

Table 10.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 17. EVO Expert L Special spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	TL5	TL6	TL7	TL8	TL9
0.3	10K	100K	200K	400K	1.6M
0.5	6K	60K	120K	240K	1M
0.6	5K	50K	100K	200K	800K
1	3K	30K	60K	100K	500K
1.5	2K	20K	40K	80K	330K
2	1.5K	15K	30K	60K	250K
2.5	1.2K	12K	24K	50K	200K
3	1K	10K	20K	40K	160K
4	750	7.5K	15K	30K	125K
5	600	6K	12K	25K	100K
6	500	5K	10K	20K	80K
10	300	3K	6K	12K	50K
12	250	2.5K	5K	10K	40K
20	150	1.5K	3K	6K	25K
30	100	1K	2K	4K	16K
50	60	600	1.2K	2.5K	10K
60	50	500	1K	2K	8K
100	30	300	600	1.2K	5K
200	15	150	300	600	2.5K
250	13	125	250	480	2K

Table 11.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 18. EVO Expert L LCP Adaptor table

Maximum guideline values in cP (mPa·s)

RPM/SP	LCP
0.3	2K
0.5	1.2K
0.6	1K
1	600
1.5	400
2	300
2.5	240
3	200
4	150
5	120
6	100
10	60
12	50
20	30
30	20
50	12
60	10
100	6.0
200	3.0
250	2.4

Table 12.

### ATTENTION:

K Indicates thousands.

M Indicates millions

Example: 7.8K = 7800

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 19. EVO Expert L special Vane spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	V71	V72	V73	V74	V75
0.3	8.1K	34.6K	167K	1.6M	721K
0.5	4.9K	20.8K	100K	1M	433K
0.6	4K	17.3K	83.5K	848K	360K
1	2.4K	10.4K	50.1K	508K	216K
1.5	1.6K	6.93K	33.4K	339K	144K
2	1.2K	5.2K	25K	254K	108K
2.5	982.2	4.1K	20K	203K	86.6K
3	818.5	3.4K	16.7K	169K	72.1K
4	613.9	2.6K	12.5K	127K	54.1K
5	491.1	2k	10K	101K	43.3K
6	409.2	1.7K	8.3K	84.8K	36K
10	245.5	1K	5K	50.8K	21.6K
12	204.6	867	4.1K	42.4K	18K
20	122.7	520.2	2.5K	25.4K	10.8K
30	81.8	346.8	1.6K	16.9K	7.2K
50	49.1	208	1K	10.1K	4.3K
60	40.9	173.4	835.7	8.4K	3.6K
100	24.5	100	501.4	5K	2.1K
200	12.2	52	250.7	2.5K	1K
250	9.8	41.6	200	2K	800

Table 13.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 20. EVO Expert L special Haldal spindle selection table

Maximum guideline values in cP (mPa·s)

RPM/SP	PA	PB	PC	PD	PE	PF
0.3	62.4K	124.8K	312K	624K	1.5M	3.1M
0.5	37.4K	74.8K	187K	374K	936K	1.8M
0.6	31.2K	62.4K	156K	312K	780K	1M
1	18.72K	37.4K	93.6K	187K	468K	936K
1.5	12.4K	24.9K	62.4K	124K	312K	624K
2	9.36K	18.7K	46.8K	93.6K	234K	468K
2.5	7.4K	14.9K	37.4K	74.8K	187K	374.4K
3	6.2K	12.4K	31.2K	62.4K	156K	312K
4	4.6K	9.3K	23.4K	46.8K	117K	234K
5	3.7K	7.4K	18.7K	37.4K	93.6K	187.2K
6	3.1K	6.2K	15.6K	31.2K	78K	156K
10	1.8K	3.7K	9.3K	18.7K	46.8K	93.6K
12	1.5K	3.12K	7.8K	15.6K	39K	78K

Table 14.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 21. EVO Expert R standard spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	R1	R2	R3	R4	R5	R6	R7
0.3	33.3K	133.3K	333.3K	666.6K	1.3M	3.33M	13.3M
0.5	20K	80K	200K	400K	800K	2M	8M
0.6	16.6K	66.6K	166.6K	333.3K	666.6K	1.6M	6.6M
1	10K	40K	100K	200K	400K	1M	4M
1.5	6.6K	26.6K	66.6K	133.3K	266.6K	666.6K	2.6M
2	5K	20K	50K	100K	200K	500K	2M
2.5	4K	16K	40K	80K	160K	400K	1.6M
3	3.3K	13.3K	33.3K	66.6K	133.3K	333.3K	1.3M
4	2.5K	10K	25K	50K	100K	250K	1M
5	2K	8K	20K	40K	80K	200K	800K
6	1.6K	6.6K	16.6K	33.3K	66.6K	166.6K	666.6K
10	1K	4K	10K	20K	40K	100K	400K
12	833	3.3K	8.3K	16.6K	33.3K	83.3K	333.3K
20	500	2K	5K	10K	20K	50K	200K
30	333	1.3K	3.3K	6.6K	13.3K	33.3K	133.3K
50	200	800	2K	4K	8K	20K	80K
60	166	660	1.6K	3.3K	6.6K	16.6K	66.6K
100	100	400	1K	2K	4K	10K	40K
200	50	200	500	1K	2K	5K	20K
250	40	160	400	800	1.6K	4K	16K

Table 15.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.



## 22. EVO Expert R Special spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	TR8	TR9	TR10	TR11	TR12	TR13
0.3	166.6K	833.3K	1.6M	3.3M	1.6M	4.1M
0.5	100K	500K	1M	2M	1M	2.5M
0.6	83.3K	416.6K	833.3K	1.6M	833.3K	2M
1	50K	250K	500K	1M	500K	1.2M
1.5	33.3K	166.6K	333.3K	666.6K	333.3K	833.3K
2	25K	125K	250K	500K	250K	625K
2.5	20K	100K	200K	400K	200K	500K
3	16.6K	83.3K	166.6K	333.3K	166.6K	416.6K
4	12.5K	62.5K	125K	250K	125K	312.5K
5	10K	50K	100K	200K	100K	250K
6	8.3K	41.6K	83.3K	166.6K	83.3K	208.3K
10	5K	25K	50K	100K	50K	125K
12	4.16K	20.83K	41.6K	83.3K	41.6K	104.1K
20	2.5K	12.5K	25K	50K	25K	62.5K
30	1.6K	8.3K	16.6K	33.3K	16.6K	41.6K
50	1K	5K	10K	20K	10K	25k
60	833.3	4.16K	8.3K	16.6K	8.3K	20.8k
100	500	2.5K	5K	10K	5K	12.5K
200	250	1.25K	2.5K	5K	2.5K	6.2K
250	200	1K	2K	4K	2K	5K

Table 16.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 23. EVO Expert R LCP Adaptor table

Maximum guideline values in cP (mPa·s)

RPM	LCP
0.3	21.3K
0.5	12.8K
0.6	10K
1	6.4K
1.5	4.2K
2	3.2K
2.5	2.5K
3	2.1K
4	1.6K
5	1.2K
6	1K
10	640
12	533
20	320
30	213
50	128
60	106
100	64
200	32
250	27

Table 17.

### ATTENTION:

K Indicates thousands.  
M Indicates millions

Example: 7.8K = 7800  
Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 24. EVO Expert R special Vane spindle selection table

Maximum guideline values in cP (mPa·s)

RPM / SP	V71	V72	V73	V74	V75
0.3	87.3K	370K	1.7M	18.1M	7.6M
0.5	52.3K	222K	1M	10.8M	4.6M
0.6	43.6K	185K	891K	9M	3.8M
1	26.1K	111K	535K	5.4M	2.3M
1.5	17.4K	74K	356K	3.6M	1.5M
2	13K	55.5K	267K	2.7M	1.1M
2.5	10.4K	44.4K	214K	2.1M	924K
3	8.7K	37K	178K	1.8M	770K
4	6.5K	27.7K	133K	1.3M	577K
5	5.2K	22.2K	107K	1M	462K
6	4.3K	18.5K	89.1K	905K	385K
10	2.6K	11.1K	53.5K	543K	231K
12	2.1K	9.2K	44.5K	452K	192K
20	1.3K	5.5K	26.7K	271K	115K
30	873.3	3.7K	17.8K	181K	77K
50	524	2.2K	10.7K	108K	46.2K
60	436.6	1.8K	8.91K	90.5K	38.5K
100	262	1.1K	5.3K	54.3K	23.1K
200	131	555	2.6K	27.1K	11.5K
250	104.8	444	2.1K	21.7K	8.5K

Table 18.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 25. EVO Expert R special Haldal spindle selection table

Maximum guideline values in cP (mPa·s)

RPM/SP	PA	PB	PC	PD	PE	PF
0.3	666.6K	1.3M	3.3M	6.6M	16.6M	33.3M
0.5	400K	800K	2M	4M	10M	20M
0.6	333.3K	666.6K	1.6M	3.3M	8.3M	16.6M
1	200K	400K	1M	2M	5M	10M
1.5	133.3K	266.6K	666.6K	1.3M	3.3M	6.6M
2	100K	200K	500K	1M	2.5M	5M
2.5	80K	160K	400K	800K	2M	4M
3	66.6K	133.3K	333.3K	666.6K	1.6M	3.3M
4	50K	100K	250K	500K	1.25M	2.5M
5	40K	80K	200K	400K	1M	2M
6	33.3K	66.6K	166.6K	333.3K	833.3K	1.6M
10	20K	40K	100K	200K	500K	1M
12	16.6K	33.3K	83.3K	166.6K	416.6K	833.2K

Table 19.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 26. EVO Expert H standard spindle selection table

Maximum guideline values in Poise

RPM/SP	R1	R2	R3	R4	R5	R6	R7
0.3	2.6K	10.6K	26.6K	53.3K	106.6K	266.6K	1M
0.5	1.6K	6.4K	16K	32K	64K	160K	640K
0.6	1.3K	5.3K	13.3K	26.6K	53.3K	133.3K	533.3K
1	800	3.2K	8K	16K	32K	80K	320K
1.5	533.3	2133	5.3K	10.6K	21.3K	53.3K	213.3K
2	400	1.6K	4K	8K	16K	40K	160K
2.5	320	1.28K	3.2K	6.4K	12.8K	32K	128K
3	266.6	1066	2.6K	5.3K	10.6K	26.6K	106.6K
4	200	800	2K	4K	8K	20K	80K
5	160	640	1.6K	3.2K	6.4K	16K	64K
6	133.3	533.3	1.3K	2.6K	5.3K	13.3K	53.3K
10	80	320	800	1.6K	3.2K	8K	32K
12	66.6	266.6	666	1.3K	2.6K	6.6K	26.6K
20	40	160	400	800	1.6K	4K	16K
30	26.6	106.6	266	533	1066	2.6K	10.6K
50	16	64	160	320	640	1.6K	6.4K
60	13.3	53.3	133.3	266.6	533	1.3K	5.3K
100	8	32	80	160	320	800	3.2K
200	4	16	40	80	160	400	1.6k
250	3.2	13	32	64	128	320	1.3K

Table 20.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 27. EVO Expert H Special spindle selection table

Maximum guideline values in Poise

RPM / SP	TR8	TR9	TR10	TR11	TR12	TR13
0.3	13.6K	66.6K	133.3K	266.6K	133.3K	333.3K
0.5	8K	40K	80K	160k	80K	200K
0.6	6.6K	33.3K	66.6K	133.3K	66.6K	166.6K
1	4K	20K	40K	80K	40K	100K
1.5	2.6K	13.3K	26.6K	53.3K	26.6K	66.6K
2	2K	10K	20K	40K	20K	50K
2.5	1.6K	8K	16K	32K	16K	40K
3	1.3K	6.6K	13.3K	26.6K	13.3K	33.3K
4	1K	5K	10K	20K	10K	25K
5	800	4K	8K	16K	8K	20K
6	666	3.30K	6.6K	13.3K	6.6K	16.6K
10	400	2K	4K	8K	4K	10K
12	333	1.6	3.3K	6.6K	3.3K	8.3K
20	200	1K	2K	4K	2K	5K
30	133	666	1.3K	2.6K	1.3K	3.3K
50	80	400	800	1.6K	800	2K
60	66	333	666	1.3K	666	1.6K
100	40	200	400	800	400	1K
200	20	100	200	400	200	500
250	16	80	160	320	160	400

Table 21.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 28. EVO Expert H special Vane spindle selection table

Maximum guideline values in poise

RPM / SP	V71	V72	V73	V74	V75
0.3	6.9K	29.6K	142K	1.4M	615K
0.5	4.1K	17.7K	85.6K	868K	369K
0.6	3.4K	14.8K	71.3K	724K	307K
1	2K	8.8K	42.8K	434K	184K
1.5	1.3K	5.9K	28.5K	289K	123K
2	1K	4.4K	21.4K	217K	92.4K
2.5	838	3.5K	17.1K	173K	73.9K
3	698	2.9K	14.2K	144K	61.6K
4	523	2.2K	10.7K	108K	46.2K
5	419	1.7K	8.5K	86.8K	36.9K
6	349	1.4K	7.1K	72.4K	30.8K
10	209	888	4.2K	43.4K	18.4K
12	174	740	3.5K	36.2K	15.4K
20	104	444	2.1K	21.7K	9.24K
30	69.8	296	1.4K	14.4K	6.1K
50	41.9	177	856	8.6K	3.6K
60	34.9	148	713	7.2K	3K
100	20.9	88.8	428	4.3K	1.8K
200	10.4	44.4	214	2.2K	924
250	8.4	35.5	171	1.7K	680

Table 22.

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.

## 29. EVO Expert H special Haldal spindle selection table

Maximum guideline values in Poise

RPM/SP	PA	PB	PC	PD	PE	PF
0.3	53.3K	106K	266.6K	533.3K	1.3M	2.6M
0.5	32K	64K	160K	320K	800K	1.6M
0.6	26.6K	53.3K	133.3K	266.6K	666.6K	1.3M
1	16K	32K	80K	160K	400K	800K
1.5	10.6K	21.3K	53.3K	106K	266.6K	533.3K
2	8K	16K	40K	80K	200K	400K
2.5	6.4K	12.8K	32K	64K	160K	380K
3	5.3K	10.6K	26.6K	53.3K	133.3K	266.6K
4	4K	8K	20K	40K	100K	200K
5	3.2K	6.4K	16K	32K	80K	160K
6	2.6K	5.3K	13.3K	26.6K	66.6K	133.3K
10	1.6K	3.2K	8K	16K	40K	80K
12	1.3K	2.6K	6.6K	13.3K	33.3K	66.6K

Table 23

### ATTENTION:

K Indicates thousands.

Example: 7.8K = 7800

M Indicates millions

Example: 1.56M = 1560000

**NOTE:** It is not recommended to work with viscosity values of less than 15% of the lower part of the selected scale.



# Appendix A: Fungilab Data Boss Evo

## B.1.- Introduction

### B.1.1.- About Fungilab Data Boss (FDB)

Viscometer Evo Expert can be controlled remotely using the Fungilab Data Boss (FDB) software. This software allows the documentation of each experiment with a name, date, number, user, notes, etc., which is essential for performing follow-up experiments. The possibility of programming the viscometer for simple measurements, ramps and other configurable tests is an important tool for the study of different materials' behaviour.

The Fungilab Data Boss software has three basic functions: it controls the execution of the experiment, the storage of the results obtained and the analysis of the tests carried out.

#### *Experiment execution:*

- Test-run and data base record opening
- Viscometer control; stopping and starting
- Viscosity sample test
- Real-time graphic presentation of results

#### *Data Storage:*

- Store results from experiment
- Verifies obtained results
- Organizes data base with additional information

#### *Data consultation and analysis:*

- Clear presentation of data
- Multiple consulting choices
- 12 different possible graphics
- Different types of listing methods can be acquired from other applications

### B.1.2- System requirements

The following system requirements must be met in order for Fungilab Data Boss Evo software to operate properly.

Operating system	Windows XP, Windows Vista, Windows 7, Windows 8 (supported 32bits and 64bits versions) Windows 10 (supported 32bits and 64bits versions)
RAM (used by the software)	32 MB minimum; at least 64 MB recommended
Hard drive space	10 MB
Mouse	Required
USB Port	Required

### B.1.3- Registering Fungilab Data Boss

The software needs to be registered in order to perform new experiments. In order to register the software, it is needed an authorization code that can be obtained from Fungilab.

Please have the following information available when contacting Fungilab so that they may assist you.

Product model

Product Serial Number

### B.1.4- Contacting Fungilab

You can contact us at <http://www.fungilab.com/>

## B.2.- Getting started

### B.2.1- Software installation

- Insert the Fungilab Data Boss installation disk (CD-ROM) or the USB Pendrive into the appropriate drive of your computer.
- Wait for the setup application to be loaded. If the setup application does not appear, use the windows explorer to locate the *setup.exe* file in the appropriate drive and launch it.
- Once the setup application has started, follow the on-screen prompts to complete the installation.

The Fungilab Data Boss requires some additional software that can be downloaded from the Microsoft website at no extra cost. On one hand, the *Microsoft .NET Framework 3.5 SP1* and the *Windows Installer 3.1* are automatically installed by the Fungilab Data Boss installer if they are not detected in the computer where it is being installed. On the other hand, the *Microsoft Visual C++ 2010 Redistributable Package* has to be installed manually. It can be downloaded from the Microsoft website through the following links.

Microsoft Visual C++ 2010 Redistributable Package for 32-Bit x86 operating systems:

<http://www.microsoft.com/es-es/download/details.aspx?id=5555>

Microsoft Visual C++ 2010 Redistributable Package for x64 Edition operating systems:

<http://www.microsoft.com/en-us/download/details.aspx?id=14632>

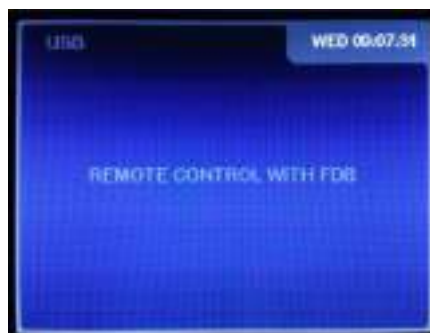
**Note:** *The Microsoft Visual C++ 2010 Redistributable Package must be properly installed in order to run the Fungilab Data Boss application. Otherwise the USB communication between the computer and the viscometer will not work correctly and the Fungilab Data Boss app will not run.*



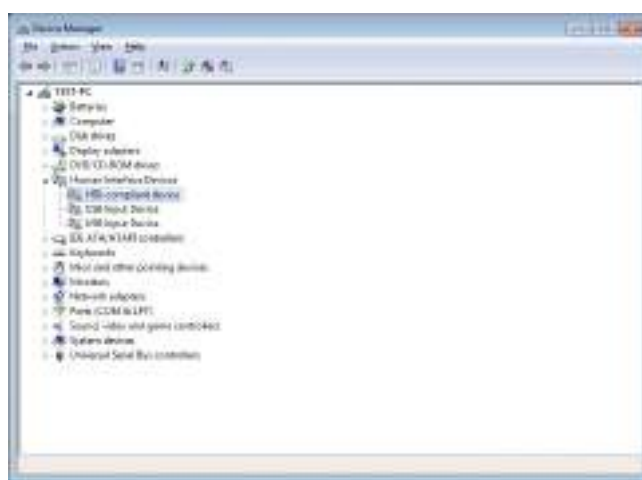
### B.2.2- Viscometer installation

In this simple guide you will find step-by-step the instructions for properly installing the Fungilab measurement device.

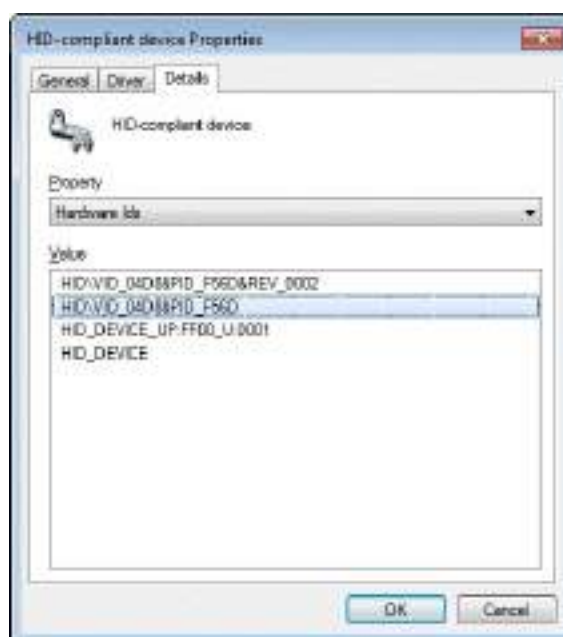
1) Be sure that the viscometer is working in the remote mode. In this case, the text 'REMOTE CONTROL WITH FDB' appears on the screen of the viscometer. More information about the remote mode can be found in Section 10.8.2 (Communications) of this User Manual. Important: PC is not able to connect to Viscometer if is not working in "REMOTE CONTROL WITH FDB" mode.



2) Connect the viscometer to the computer with a USB to USB cable (male A-type to male A-type) such as the one provided with the viscometer. A few seconds later a message on your Desktop will appear. It not necessary to install a specific driver because the viscometer is detected as Human Interface Device (HID). To confirm that the PC is correctly connected to viscometer, you can access to the Device Manager:



Look at HID; note a new device named HID-Compliant Device is showed. If you have some HID-Compliant Devices, you can see the VID and PID of the device. The VID and PID corresponding to EVO series are 04D8 and F56D.



If a problem occurs during the installation process, uninstall the driver from Control Panel, restart the computer and repeat the steps explained in this Appendix.

### B.2.3- Starting Fungilab Data Boss

Locate and select Fungilab Data Boss icon within Fungilab program group. Fungilab Data Boss will be loaded and the Login Window will appear.

Running for first time:

The first time you run the software there is only a user created in the database.

The login details are

username: admin

password: 1234

It is strongly recommended to change the password as soon as possible.

Be sure that the viscometer is working in the remote mode. In this case, the text 'REMOTE CONTROL WITH FDB' appears on the screen of the viscometer. More information about the remote mode can be found in Section 8.6.2 (Communications) of this User Manual.

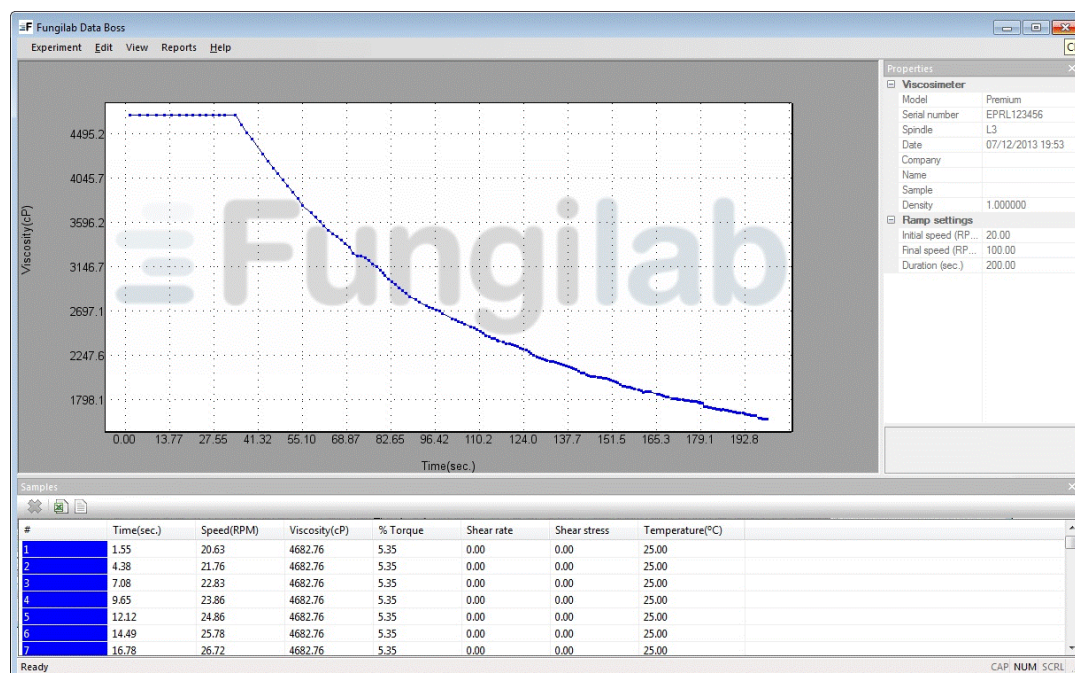
## B.3.- Using Fungilab Data Boss

### B.3.1- Login Window



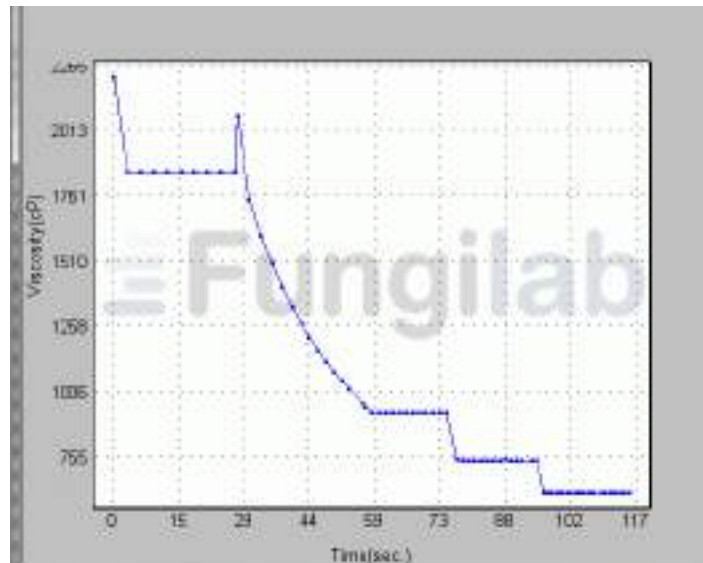
The Login Window is used to authenticate the user that is going to use the software.

### B.3.2- Main Window



The **Main Window** displays the data of the current experiment.

### B.3.3- Plot Window



The **Plot Window** displays a graphical representation of the gathered data.

Additional information

To select samples:

- Right click on the plot.
- A contextual menu will be loaded. Click on Select mode.
- Click on the plot to drag a selection rectangle.

To zoom:

- Right click on the plot.
- A contextual menu will be loaded. Click on Zoom mode.
- Click on the plot to drag a zoom rectangle.

To view all samples:

- Right click on the plot.
- A contextual menu will be loaded. Click on View all.

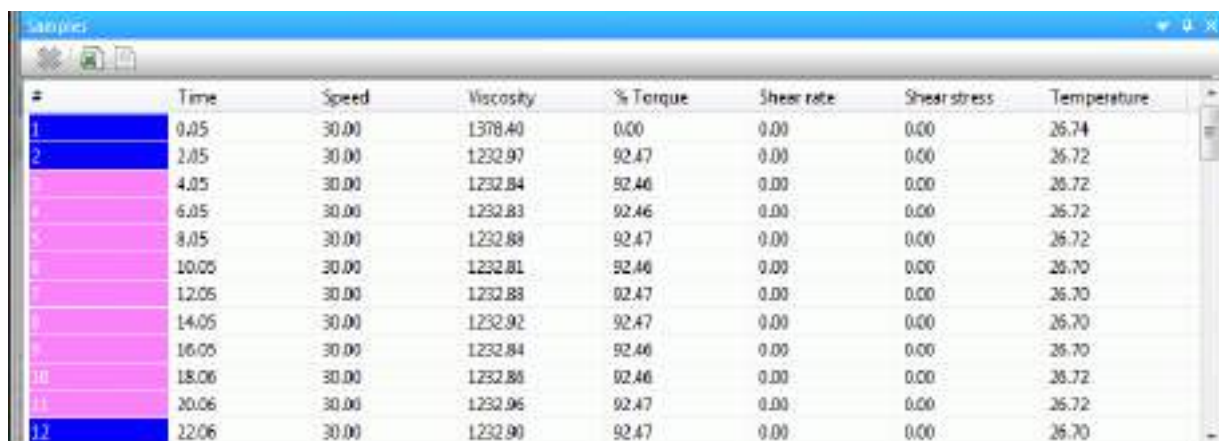
To customize the plot:

- Right click on the plot.
- A contextual menu will be loaded. Click on Plot->Customize....

To customize the samples:

- Select some samples.
- Right click on the plot.
- A contextual menu will be loaded. Click on Samples->Customize....

### B.3.4 Samples Window



The screenshot shows a window titled 'Samples' with a table containing 12 rows of data. The columns are: #, Time, Speed, Viscosity, % Torque, Shear rate, Shear stress, and Temperature. Rows 1 and 2 are highlighted in blue, while rows 3 through 12 are highlighted in pink.

#	Time	Speed	Viscosity	% Torque	Shear rate	Shear stress	Temperature
1	0.05	30.00	1378.40	0.00	0.00	0.00	26.74
2	2.05	30.00	1232.97	92.47	0.00	0.00	26.72
3	4.05	30.00	1232.84	92.46	0.00	0.00	26.72
4	6.05	30.00	1232.83	92.46	0.00	0.00	26.72
5	8.05	30.00	1232.88	92.47	0.00	0.00	26.72
6	10.05	30.00	1232.81	92.46	0.00	0.00	26.70
7	12.05	30.00	1232.88	92.47	0.00	0.00	26.70
8	14.05	30.00	1232.92	92.47	0.00	0.00	26.70
9	16.05	30.00	1232.84	92.46	0.00	0.00	26.70
10	18.06	30.00	1232.88	92.46	0.00	0.00	26.72
11	20.06	30.00	1232.96	92.47	0.00	0.00	26.72
12	22.06	30.00	1232.90	92.47	0.00	0.00	26.70

The Samples Window displays numerical information of each sample of the current experiment.

Additional information

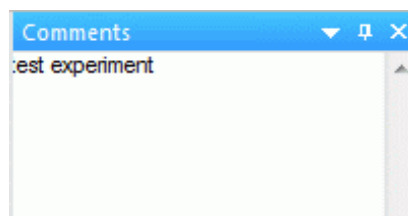
To export some samples to an Excel file (xls) :

- Select some samples (if nothing is selected, all samples are exported by default).
- Click on the Excel icon.
- A standard file save dialog will be loaded. Type the filename and click on Save...

To export some samples to a Text file (txt):

- Select some samples (if nothing is selected, all samples are exported by default).
- Click on the Text icon.
- A standard file save dialog will be loaded. Type the filename and click on Save...

### B.3.5 Comments Window



The Comments Window can be used to enter a brief description of the experiment.

### B.3.6 New Experiment Window

New experiment...

General

☒ Viscosimeter

Model	Premium
Serial number	PRER123456
Spindle	R2
Date	05/19/2011 14:39

Parameters

☒ Experiment

Experiment	Step
------------	------

☒ Step settings

Speed (RPM)	100.00
Duration (sec.)	10

Add to queue

Experiment queue

Summary	Remove
	Move Up
	Move Down
	Load...
	Start...

The New Experiment Window lets to design a new experiment.

Typical usage:

- Select a spindle.
- Select an experiment type.
- Configure the experiment parameters.
- Click Add to queue to add the current parameters to the experiment queue.
- Click Start... to process the experiment queue.

Experiment types

Step:

Parameters

☒ Experiment

Type	Step
------	------

☒ Step settings

Speed	20
Duration	60

A step experiment gathers samples at a constant velocity. In the previous example, the samples are taken with 20 rpm and 60 seconds.

Ramp:

Parameters

☒ Experiment

Type	Ramp
------	------

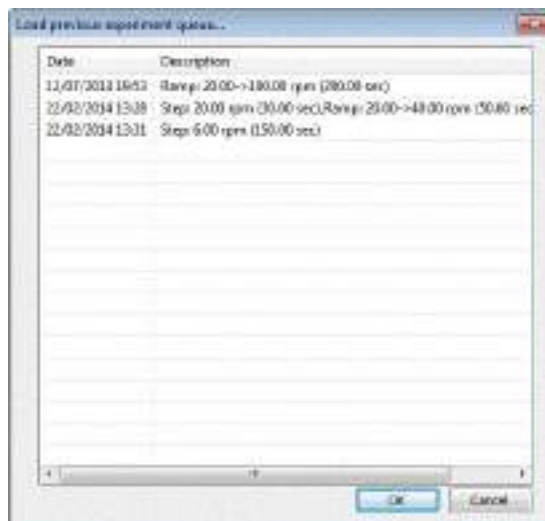
☒ Ramp settings

Initial speed	20
Final speed	40
Duration	60

A ramp experiment gathers samples at a varying velocity.

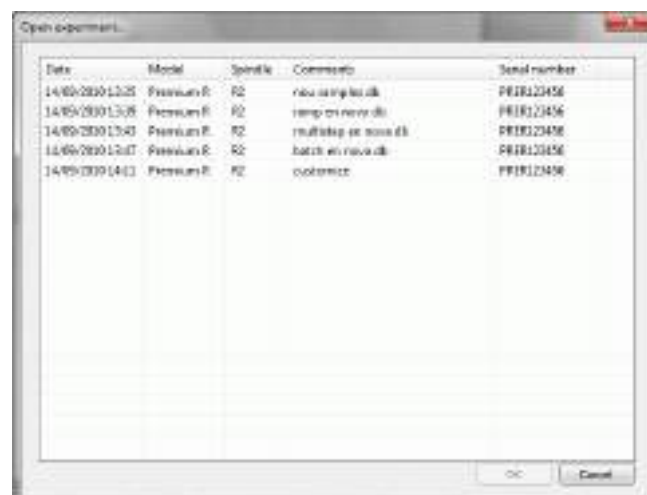
In the previous example, the samples are taken between 20 and 40 rpm along 60 seconds.

### B.3.7 Load Queue Window



The Load Queue Window lets to load a previously saved experiment queue.

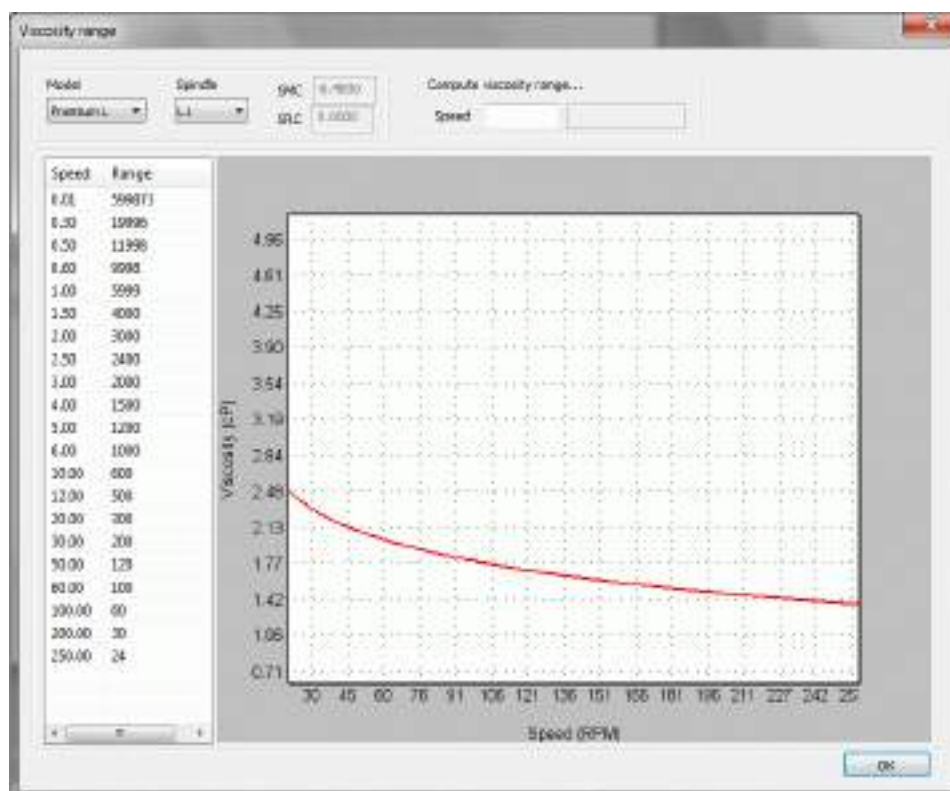
### B.3.8 Open Experiment Window



The Open Experiment Window lets to open a previously saved experiment.



### B.3.9 Spindles Window



The Spindles Window displays a numerical and graphical representation of the measurement range of the selected viscosimeter model and spindle.

### B.3.10 Math Models Window



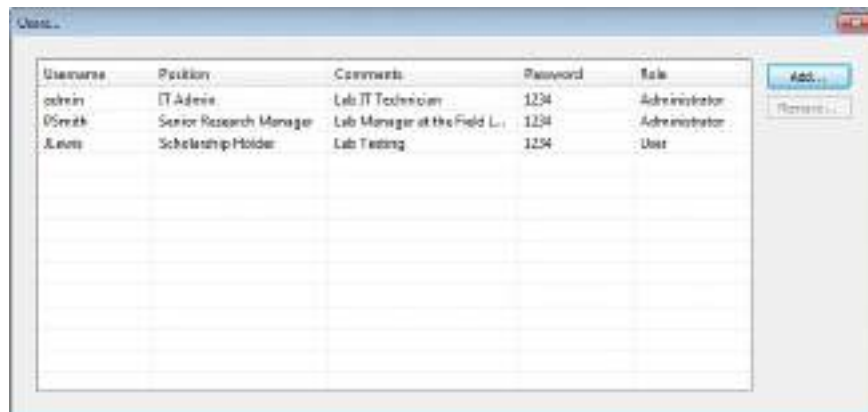
The Math models Window analyzes the current experiment and displays the confidence of fit for several equations. The confidence of fit is a measure of how well the data fits the best fit curve for a particular equation with 0% for the worst fit and 100% for the best fit.

### B.3.11 Password Window



The Password Window lets to change the password of the current user.

### B.3.12 Users Window



The Users Window lets to manage users.

Note: This window is only accessible to users with Administrator role.

Additional information

To create a user:

- Click Add....
- Once clicked the Edit User Window will be loaded.

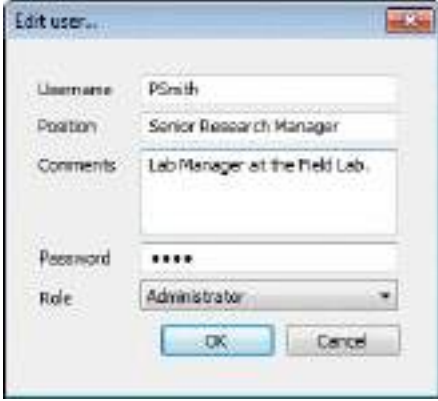
To remove an existing user:

- Select the user in the list.
- Click Remove....

To edit an existing user:

- Double click the user in the list.
- Once double-clicked the Edit User Window will be loaded.

### B.3.13 Edit User Window

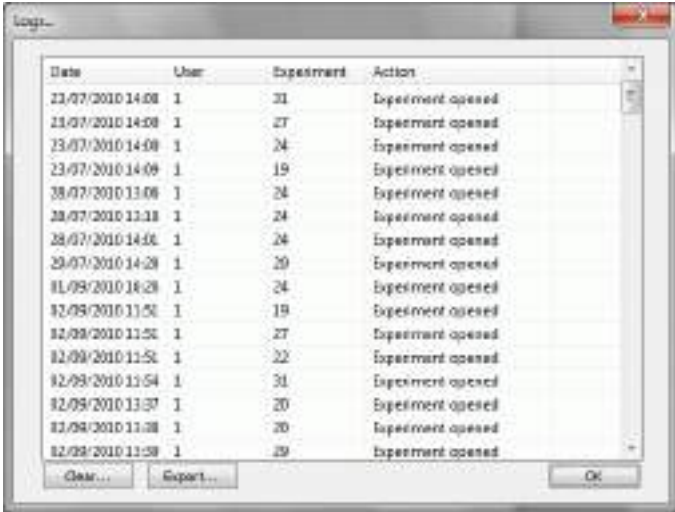


The 'Edit user...' window contains the following fields and controls:

- Username:** Text field containing 'PSmith'.
- Position:** Text field containing 'Senior Research Manager'.
- Comments:** Text area containing 'Lab Manager at the Field Lab'.
- Password:** Password field with four asterisks '\*\*\*\*'.
- Role:** Dropdown menu currently set to 'Administrator'.
- Buttons:** 'OK' and 'Cancel' buttons at the bottom.

The Edit User Window lets to enter the username, password and role of a user.

### B.3.14 Logs Window



The 'Logs...' window displays a table of log entries. The table has four columns: Date, User, Experiment, and Action. Below the table are 'Clear...' and 'Export...' buttons, and an 'OK' button at the bottom right.

Date	User	Experiment	Action
23/07/2010 14:08	1	31	Experiment opened
23/07/2010 14:08	1	27	Experiment opened
23/07/2010 14:08	1	24	Experiment opened
23/07/2010 14:09	1	19	Experiment opened
28/07/2010 13:06	1	24	Experiment opened
28/07/2010 13:18	1	24	Experiment opened
28/07/2010 14:06	1	24	Experiment opened
29/07/2010 14:28	1	20	Experiment opened
01/08/2010 18:28	1	24	Experiment opened
02/08/2010 11:50	1	19	Experiment opened
02/08/2010 11:50	1	27	Experiment opened
02/08/2010 11:50	1	22	Experiment opened
02/08/2010 11:54	1	31	Experiment opened
02/08/2010 13:37	1	20	Experiment opened
02/08/2010 13:38	1	20	Experiment opened
02/08/2010 13:39	1	29	Experiment opened

The Logs Window keeps track of a number of significant occurrences in the software.  
Note: This window is only accessible to users with Administrator role.

#### Additional information

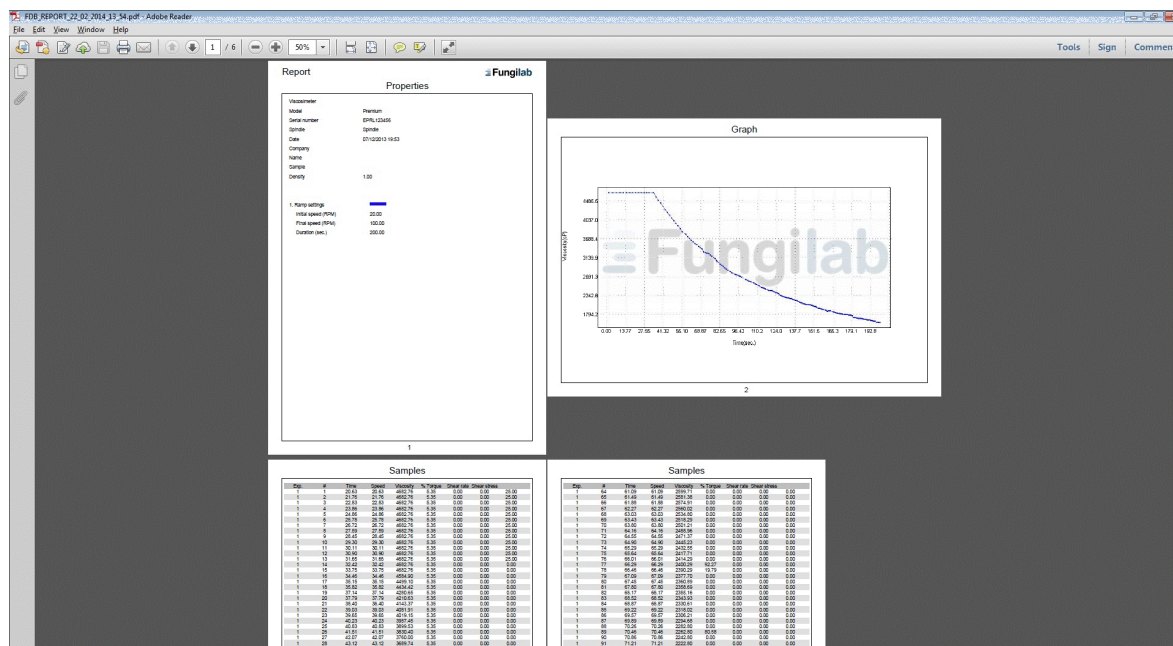
##### Clear...

This option lets to erase all log information.

##### Export...

This option lets to save all the log information to disk.

### B.3.15 Generating PDF Report



You are able to generate a PDF report of the experiments that are showed in Fungilab Data Boss Evo. In the upper menu is showed and option named "Reports" where you can find the "Generate PDF" option. Then, a file explorer is showed to select the folder to create the PDF file and the name of the file. Once generated the PDF report, automatically is opened with the default PDF file reader installed on the system.

### B.4.- Troubleshooting Fungilab Data Boss

#### B.4.1- Logging failure. Authentication failed



The authentication failed error occurs when the software can't find a user with the specified password.

Suggested solution: check your username and password.

#### B.4.2- Connection error



The connection error occurs when the software can't establish a connection with the viscometer.

Suggested solution: check the USB connection cable and/or restart the viscometer.

#### **B.4.3- Database error**



The database error occurs when the software detects a problem with the database.

Suggested solution: restart the application and contact your software provider if the problem persists.



## WARRANTY CERTIFICATE

FUNGILAB S.A. guarantee the perfect functioning of this instrument against defects in material or workmanship, when used under appropriate conditions and in accordance with the operation instructions for a period of **TWO YEARS** from the invoice date of the product.

The following cases cancel the warranty period:

- Misuse of the instruments
- When the equipment have been made damaged by the user
- When the user have not had in mind the Fungilab recommendations and maintenance.
- When the instrument have been repaired or mishandled by anybody not allowed for the Fungilab technical service.
- When the serial number is incorrect or it does not suit with the written in the warranty.

FUNGILAB's sole obligation shall be to repair or to replace any part(s) that prove defective within the warranty period and shall not be liable for consequential damages resulting from the use of its products.