Measure what you see.

byko-visc basic / basic EX
Rotational Viscometer

Manual

A member of ALTANA

BYK
Additives & Instruments

byko-visc basic / basic EX
Rotational Viscometer

Manual

Software Version: 1.0

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- Technical & Application Support
- Application and Technical Seminars
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Your BYK-Gardner Team

Table of Contents

1. Introduction

Thank you for acquiring the byko-visc basic or basic EX viscometer model from BYK-Gardner.

The byko-visc basic and basic EX are rotational viscometers, based on the measurement of the torque of a rotating spindle in a sample at a specified velocity. Three different models (for both the basic and basic EX), as well as various accessories, allow it to cover a wide range of viscosity measurement.

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.
- BYK-Gardner guarantees the satisfactory operation of the viscometers and its accessories only 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 warnings and instructions of this manual to ensure the safe and proper operation of the instrument.
- Do not use the instrument for any other purpose that is not described in this manual.
- Do not use any accessory that is not supplied and approved by BYK-Gardner.
- Do not use the viscometer or its accessories if there is any suspicion of malfunction. Do not use the instrument in situations or conditions that can cause personal injury or material damage.

This viscometer is **not** an explosion-proof 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: those who do not follow them may cause serious harm or personal injuries.

To avoid an electric shock:
Never defeat the ground conductor or operate the instrument in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.

3. Symbols used in this manual

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 instrument.

This arrow indicates additional information that should be used by the user.

This symbol warns us of an operational, practical, or similar procedure that, if it is not carried out correctly, may irreparably damage the instrument. Do not proceed further unless the indicated conditions are fulfilled and have been perfectly understood.

4. Conditions for use

- Indoor use
- Maximum altitude 2000 m.
- Surrounding temperature range: from +5 to 40ºC or 41 to 104ºF.
- 80% maximum relative humidity for up to 31ºC or 81ºF and going as low as 50% of relative humidity for up to 40ºC or 104ºF.
- The power source fluctuations should not surpass ±10% of the nominal voltage

5. Maintenance

- Always clean all parts after each use. Clean the spindles and the spindle protector well and then immediately dry them. Make sure that there is not any sample remaining especially in the delicate zones like the spindle connector.
- Detergents or solvents to clean the spindles and the protector:
  - For food samples, use lukewarm water and if necessary, use soft detergents (like those which are used at home)
  - Other solvents that generally give good results are acetone, mineral spirits and alcohol based solvents
  - If you use any other solvent, make sure that it does not corrode the spindles or the protector. The spindles are made of AISI 316.

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

- Regularly check the spindle's thread and the viscometer shaft.
- During the working life of the viscometer, the instrument will require certain check- ups. In this case, please contact your local BYK-Gardner representative.
- Regular maintenance is important. We recommend an annual check-up by the technical service of your local BYK-Gardner.

6. Instrument presentation

When the instrument package is received, verify and confirm the delivery note. If some discrepancy or problem is found, immediately notify your local BYK-Gardner representative.

- Check that the model corresponds to the instrument that was ordered.
- Carefully read the instructions.
- All modifications, eliminations, or lack of maintenance of any of the instrument's mechanisms, defy directive 89/655/CEE and BYK-Gardner is not responsible for any damages that may result.

In the attached photograph (Figure 1) you see the position of each piece inside the instrument's carrying case.

Please, keep the carrying case in a safe location. In the case of needing to transport the instrument or store it for a long period of time, always use the carrying case by placing each part as shown in the photo. In the case of incorrect packing, where any of the parts could suffer some damage, this damage will not be covered by BYK-Gardner's warranty. BYK-Gardner recommends using the carrying case provided with the instrument for any kind of shipment.

Parts included with the instrument for standard delivery:

- Viscometer head with serial number
- Foot or base, 3 height adjustable knobs for the base
- Nut
- Indented rod
- Standard spindles
- Spindle protector
- Spindle support
- Power cable
- Calibration Certification
- byko-visc quick guide

EX only:

- Temperature probe
- USB memory stick
- byko-visc software

Standard spindles
Model L: L1, L2, L3, L4
Models R and H: R2, R3, R4, R5, R6, R7

Fig 1. The viscometer in its carrying case

7. Instrument Description

1. Screen
2. Keyboard
3. Nut
4. Spindle Protector
5. Fastening rod
6. Temperature probe
7. Spindle
8. Sample container (not included)
9. Base (viscometer support)
10. Height adjustable knob

Fig. 2 Frontal view of the instrument

1. Warning Label
2. Power Switch
3. Serial Number Label
4. Power Input
5. Bubble Level

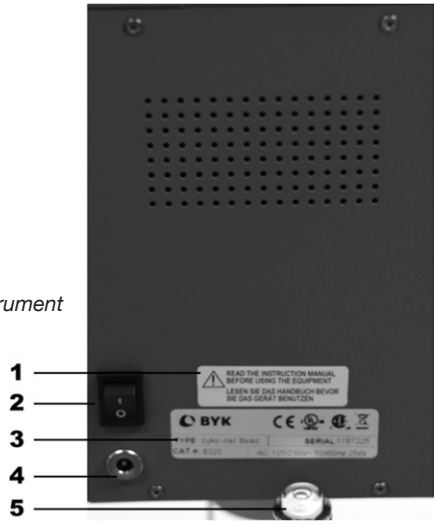


Fig.3 Back view of the instrument

1. Viscometer model
2. Viscometer catalog no.
3. Serial number
4. Electrical Specifications
5. Safety Symbols
   (ex: do not throw in trash)

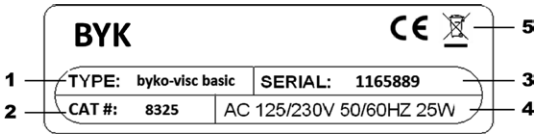


Fig.4 Instrument identification label

7.1 Instrument set-up

- Remove all of the parts from the carry-case or the standard package. Note the figure below (fig 5).
- Correctly screw the three height adjustable knobs (B) into 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. 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 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).

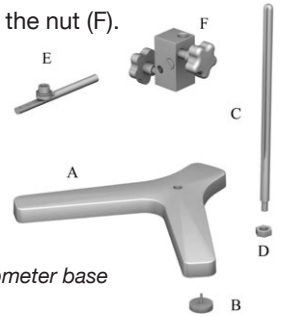


Fig. 5 Set-up for the viscometer base

- The viscometer should be placed on a stable laboratory table or on a stable surface free of vibrations (i.e. caused by other instruments 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 has been designed to work indoors!
- Turn the height adjustment knobs (B) until the bubble is centered in the bubble level (located on rod E behind the viscometer).
- Plug the power cable into its correct slot located on the back of the instrument (Fig. 3 position 4) and plug it into the power source.

WARNING: The socket by which the viscometer will be connected should have a ground. Always use a power cable with a ground connection! Verify that the voltage and the frequency coincide with the specifications for the viscometer (look at the identification label Fig. 4, for more information). Before turning on the instrument, 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 ±10% of the nominal voltage.

7.2 The keyboard and screen

Before starting up the instrument, one should become familiar with the viscometer controls seen in the previous section. The instrument has a 6 key keyboard (Fig. 6) and a 4-lined Alphanumeric Display screen (number 1 Fig. 2) on the front which allows the user to interact with the instrument. The screen always shows the operations that the user is carrying out by showing menus that will be explained later on. The measurements collected by the instrument will also be explained in this manual. The keyboard gives the user mobility throughout all of the menus, the selection of different options and the creation and/or modification of viscosity measurement configurations to suit the user's needs.

The keyboard has the following configuration:

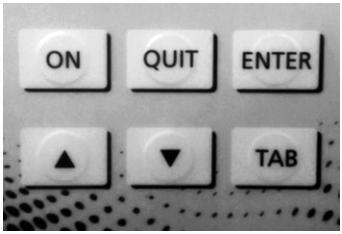


Fig. 6 The keyboard for the byko-visc basic viscometer

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.
TAB	Change the selected field (some menus).
QUIT	Return to previous screen. Stop motor during measurements.
ENTER	Press this key to edit the selected field, or accept an option or value in the field.
ON	Stop/Start the motor during measurements.

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.

7.3 Start-up

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

- Verify that the power cable is connected to the instrument (back part, number 4, Fig. 3) and that the power cable is connected to the power.

The instrument will beep, indicating that it has started and it will show the following screen:

```
BYK-GARDNER
V. 2.0
byko-visc BASIC
English
```

The screen informs the user of the version and the instrument model in addition to the selected language. After a few seconds, the Start-up screen will disappear and the Autotest screen for the viscometer is shown (section 8.1 of this manual).

The instrument initially comes configured with:

- English
- Temperature units in Celsius (ºC)
- Viscosity units in centipoise (cP)

If these are not the desired basic configurations, the instrument 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 'Configuration menu' (section 8.2). Any changes made to the instrument 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 the system will initiate an Autotest.

7.4 Autotest

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

*T*he following message will appear on the screen:

```
AUTOTEST
Remove the
Spindle and
Press <ENTER>
```

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

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

```
Testing
...
```

The dots that appear below the Word ¨Testing¨ will continue to appear and reappear in a progressive manner every half second.

If the Autotest is allowed to finish, two possible messages will appear, depending on the outcome of the diagnostic test.

If the instrument detects an anomaly, it will show the following message on the screen:

```
AUTOTEST ERROR
The system is not
working properly,
press <ENTER>
```

If this message appears, the instrument will let off a whistle and your local BYK-Gardner representative should be contacted. To get BYK-Gardner's contact information, press the <ENTER> key and it will appear in the following format.

```
TECHNICAL SERVICE
BYK-GARDNER
www.byk.com/instruments
```

If there is a system error, the instrument will stay inoperable, meaning the motor will not function. If the instrument is turned off and restarted, the same screen will reappear.

In the case of a successful check the main menu will appear:

```
> Instrument Setup
  Measurement
  Information
  Programming
```

8. Menu system

8.1 The Main Menu

BYK-Gardner viscometers work with a simple 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).

The main menu is the one that appears after the opening screen after the Autotest is completed.

The main menu screen will show:

```
> Instrument Setup
  Measurement
  Information
  Programming
```

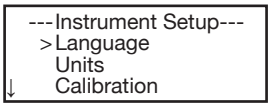
Navigate the menu using the 'Δ' and '∇' keys, then press 'ENTER' once the desired menu option is selected. This will take you to one of the instrument's submenus.

The first time the instrument is used, it is advisable to access the 'Instrument Setup' option as the first step in order to establish the parameters of the viscometer such as language and measurement units.

In the following sections, each of the submenus will be explained.

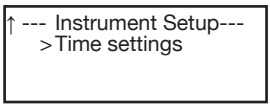
8.2 Instrument Setup menu

The configuration menu contains those functions that are not standardized and that modify the state and/or operations of the instrument (NOTE: some options appear on EX models only). 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.

The "↓" and "↑" symbols indicate there is more to the menu than shown on the screen. Using the "Δ" or "∇" keys to navigate to these additional options, such as the one shown below (EX only):



The main submenu provides the possibility of:

- Changing the working language
- Selecting the measurement units (viscosity and temperature)
- Carrying out calibrations (the machine comes calibrated from the factory, an out of the box calibration is not necessary)
- Adjusting the date and time (EX only).

The language, time and units should be selected by the user before beginning to work with the instrument.

8.2.1 Language (language change submenu)

Once the configuration menu has been accessed, the first option that the cursor '>' points to is 'Language'. To change the language, select this option by hitting the 'ENTER' key.

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

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

English *French* *German* *Italian* *Japanese*
Portuguese *Spanish* *Dutch* *Polish* *Catalan*

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.

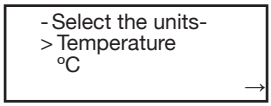
8.2.2 Units. (Unit change submenu)

The byko-visc basic viscometer allows the user to select the units that are used for measuring viscosity (basic and EX) and temperature (EX only)

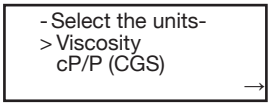
The possible choices for dynamic viscosity are:
- International system of units (Pa·s or mPa·s)
- Centimetre-gram-second system of units (Poise or centipoises)

And the available temperature units are:
- Celsius (ºC)
- Fahrenheit (ºF)

Navigate to the instrument's 'units' submenu and press 'ENTER'. The viscometer will show the following screen:



By using the 'TAB' key you can choose between the viscosity units or return to the temperature units again.



Once the desired field has been selected, the units can be changed by using the 'Δ' and '∇' keys.

After the desired units have been selected, press the 'ENTER' key to save the changes and return to the configuration main menu screen.

8.2.3 Calibration (Calibration submenu)

This submenu contains viscosity calibration options that can be utilized to recalibrate the instrument.

IMPORTANT: This viscometer contains a default calibration element, which is installed during the manufacturing process making it unnecessary to calibrate the instrument before using it for the first time. Nevertheless, specifications sometimes require that the instrument be recalibrated regularly. For a Certified Calibration the instrument must be sent to BYK-Gardner or an authorized representative. BYK-Gardner cannot be held responsible for measurements taken by an independently recalibrated viscometer. It is essential to follow the instructions given by BYK-Gardner carefully when recalibrating.

Calibration Norms:

- To execute a viscosity calibration it is necessary to have on hand a certified calibration oil and a water bath system to maintain the sample at a constant temperature. These materials are necessary to guarantee good post-calibration measurements. Both the certified oils and water bath can be obtained from your local BYK-Gardner representative
- There are two types of calibration:
  - Calibration of reference spindle: These spindles are coaxial spindles, with which the accessories “small sample adapter” and “low viscosity adapter” must be used. By calibrating these spindles, you’re changing the calibration of all of the viscometer’s spindles. Reference spindles:
    - Model L TL5
    - Model R TR8
    - Model H TR8
  - Calibration of the rest of the spindles: The calibration of any spindle, which is different from the reference spindle, will only modify the values of that individual spindle. The rest of the instrument’s spindles will not be affected by this calibration. If you want to calibrate more than one spindle and you don’t do it with the reference spindle, the spindles will have to be calibrated one by one. The oils used for each spindle will also be different, so for calibration you should have a standard silicon oil for each spindle you’re calibrating.
- Tables 5, 6 and 7 (page 36 and page 37) specify the standard oils necessary for each spindle.

To access the calibration menu, from the main menu select Instrument Setup then Calibration. Once at this submenu, the following screen will appear:

```
    ---Calibration---

  >Reset
↓   Viscosity
```

Using the ‘Δ’ and ‘∇’ keys, you can select the different options of this submenu, placing the ‘>’ cursor over each option and pressing ‘ENTER’ to choose it.

And using the same ‘Δ’ and ‘∇’ keys you can also switch between the original calibration menu screen and the next one (EX only):

```
↑   ---Calibration---
    >Temperature
```

8.2.3.1 Reset

The Calibration submenu contains the instrument's RESET option. After resetting, the instrument will recuperate the original viscosity calibration.

Upon entering this submenu, the following screen will appear:

```
WARNING:
RESET THE EQUIPMENT
<ENTER> <QUIT>
```

If you want to continue with this process, press 'ENTER' and you will be brought to the following screen.

Once the 'ENTER' key is pressed, a second confirmation will be solicited by way of a security measure.
The following screen will appear:

```
Are you sure?

<ENTER> <QUIT>
```

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.

8.2.3.2 Viscosity (Viscosity Calibration)

If you select the viscosity option (moving through the menu with the 'Δ' and '∇' keys and press 'ENTER' you will access the following screens, depending on the model of your viscometer:

Model L

```
Spindle L1
v 100.0 cP
```

Models R and H

```
Spindle R1
v 100.0 cP
```

The proper spindles to use depend on the model of your viscometer (L, R or H). Tables 8 through 17 (beginning on page 37) list the different spindles available for each model.

With the spindle field selected use the 'Δ' and '∇' keys to select the appropriate spindle.

Once the spindle is selected, go to the "Viscosity" field using the 'TAB' key and press 'ENTER'. Use the 'Δ' and '∇' keys to increase or decrease the value of each digit. Then press 'TAB' again to move the cursor to the next digit.

Once the value of the oil is determined, press 'ENTER' to continue with the calibration process

Next, press the ‘ON’ key and the following screen will appear:

Attach the spindle and press <ENTER>

Once the spindle is attached press ‘ENTER’ again and the following screen will appear:

Delay time: 00h 00m 00s

This screen allows you to input a delay time between when the spindle starts spinning and when the calibration process begins, allowing the sample and spindle to come to thermal equilibrium.

NOTE: When the digits of this field are not selected, the whole line will be blinking. When the field is selected using the ‘ENTER’ key, only the place of the digit to be modified will be blinking

To modify the delay time, use the ‘Tab’ key to select the digit to be modified and use the ‘Δ’ and ‘∇’ keys to increase or decrease the value of each digit. Press ‘ENTER’ to confirm the time, then begin the calibration process by pressing ‘ON’.

Pressing the ‘ON’ key will start a countdown back to zero.

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 calibration sequence. While the instrument is calibrating, the following screen will appear (example):

Calibrating 1/11 ....

On this screen, each step of the calibrating process is displayed.

When the process is over, information on the values of the angles and linearity of the calibration are displayed. If the curvature is lower to 2%, press ‘ENTER’ to confirm the calibration and you will be taken back to the main calibration screen.

When the calibration is complete press ‘QUIT’ to exit to the main, but never while calibrating (when while the screen looks like the above example).

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

8.2.3.3 Temperature calibration (EX only)

If you select the temperature option and press ‘ENTER’, you’ll be brought to a screen resembling this one:

Remove the Spindle and press <ENTER>

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

Once this message is shown on the screen, confirm that the spindle is not connected then press ‘ENTER’ and you’ll be brought to a screen resembling this one:

Remove the PT100 probe and connect the 0 °C gauge press <ENTER>

Connect the appropriate temperature simulator (0 °C) to the back of the viscometer and press ‘ENTER’.
The following screen will appear:

Calibrating ...

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:

Replace the 0°C gauge for the 30°C gauge press <ENTER>

Now connect the 30°C temperature simulator and press the ‘ENTER’ key. When the probe is finished calibrating this screen will appear:

Replace the 30 degree Gauge for the 100 gauge press <ENTER>

Connect the 100°C temperature simulator and press the ‘ENTER’ key. When the calibration is finished the screen will return to the calibration menu.

NOTE: Exiting in mid-calibration denies the instrument a proper calibration and thus cannot guarantee accurate results.

8.2.4 Time Settings (EX only)

When the cursor “>” is placed over “Adjust date/time”, press the ‘ENTER’ key to select this option and the viscometer will display the following page:

```
--Time settings--

>Date
 Time
```

At this point you must choose either the date or the time using the ‘Δ’ and ‘∇’ keys to move through the options and ‘ENTER’ to choose the desired field.

If you choose the ‘time’ option, the following screen will appear:

```
Time
            hh:mm:ss
Present:    00:00:00
New:        00:00:00
```

In the second line (Present:) you can see the instrument’s current time, which is presented as information only and cannot be modified. In the third line (New:) you can modify the time. To change the time, hit ‘ENTER’ once and the whole field will be selected. Use the ‘TAB’, ‘Δ’ and ‘∇’ keys to enter the values desired. Once the correct value is entered press ‘ENTER’.

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

```
Date
            dd/mm/yyyy
Present:    00:00:0000
New:        00:00:0000
```

In the second line (Present) you can see the instrument’s current date, which is presented as information only and cannot be modified. In the fourth line (New:) you can modify the date (new date). To change the date, press ‘ENTER’ once and the whole field will be selected. Use the ‘TAB’, ‘Δ’ and ‘∇’ keys to enter the values desired. Once the correct value is entered press ‘ENTER’.

If you press the ‘QUIT’ key the modification will be cancelled and the previous value will be restored.

8.3 Measurement

To perform a viscosity measurement, from the main menu navigate to ‘Measurement’ and press ‘Enter’. You will see one of these screens depending on your viscometer model:

Model L

```
----MeasureConfig.----
SP: L1        RPM:100.0
d:        1.0000 g/cm3
Max:             60.0
```

Models R and H

```
----Measure Config.----
SP: R1        RPM:100.0
d:        1.0000 g/cm3
Max:            100.0
```

Use the ‘TAB’ key to move through the settings and the ‘Δ’ and ‘∇’ keys to change the value. Here’s a rundown of each field:

- SP: select the spindle to be used for the measurement.
- RPM: indicates the working speed of the spindle.
- d: indicates the density of the sample (EX only)
- Max: Maximum viscosity determined by the speed and the spindle selected (informational only, this value can only be changed by changing the SP or RPM fields.)

The SP field together with the selected speed will determine the maximum and minimum viscosity values (tables 8 to 17, from page 38 and on), as well as the existence of a shear stress measurement (if you’re using coaxial spindles). Only the spindles that are compatible with your viscometer model will be selectable.

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

The RPM field (revolutions per minute) indicates the speed at which the test will be done.The basic series incorporates 18 pre-determined speeds:
0.3, 0.5, 0.6, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 10, 12, 20, 30, 50, 60, 100 rpm.
The viscosity of the liquid and the spindle used determine the speed (refer to tables 8 to 17).

Rather than scrolling through the available speeds, you can also ‘Tab’ to the RPM field and press ‘Enter’ to clear the value, then manually enter a speed by using the ‘Tab’ button to select each digit and the ‘Δ’ and ‘∇’ buttons to change the value. Press ‘Enter’ when finished

Once all fields have been correctly set, press the ‘ON’ key to begin measurement. If instead you press the ‘QUIT’ key, you’ll return to the main menu screen, losing all of the data introduced in measurement configuration.

8.3.1 Measurement Screen

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

------Measuring------	
SP: L1	RPM:100.0
v:	30.4 cP
50.1 %	T: 25.1ºC

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

- SP: Current spindle. Selected on the previous screen.
- RPM: Revolutions per minute. Value selected on previous screen.
- V: Viscosity. Value expressed in cP or mPa·s, or cSt (in the case that a density different from the default one is introduced).
- %: Certain percentage of the base scale. Percentage value of the curvature of the spring in relation to the base of the same scale.
- T: Temperature of the sample (EX only)

NOTE: The speed field will be blinking until the motor speed is stable. During this time the Viscometer won't save any value in memory.

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 equal 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.

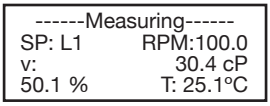
Measurement parameters can also be changed in this screen during measurement.

Use the 'Δ' and '∇' keys to increase or decrease the speed of the spindle's rotation (RPM). When you make a speed change, the field will start blinking again until the motor speed stabilizes.

Viscosity and temperature units can also be changed during measurement, but only if the rotational speed has been stabilized (speed field (RPM) not blinking). Use the 'TAB' key to select the viscosity or temperature field and press 'ENTER', then use the 'Δ' and '∇' keys to vary the units. Press 'ENTER' to save changes. If you do not do this within five seconds the changes will go unsaved.

IMPORTANT: When the viscosity measurement as a percentage of the maximum (based on spindle and RPM's) is lower than 15% or is as high as 100% the measurement cannot be considered valid and the instrument will emit a warning beep with every rotation made under these circumstances.

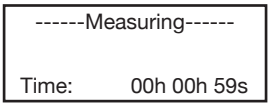
EX only: If you are using coaxial spindles (TL or TR) or the low-viscosity spindle (LVA/SP) you can access an additional measurement information screen. By pressing 'ENTER' in the main measurement screen, the following screen will appear:



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:

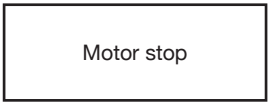
SR: Share Rate. SS: Share Stress.

Using the 'ENTER' key again you can return to the original Measuring screen. You can also, if a Time to Stop is defined (see section 8.4.1.1.1 for more information) press the 'TAB' key to show the countdown as the following screen represents:



On the other hand, if you are not using coaxial spindles (TL or TR) or the low-viscosity spindle (LVA/SP) but there is a Time to Stop programmed, the 'ENTER' key will lead you to the countdown screen.

With the 'ON' key you can start or stop the motor, which allows for momentary pauses in a measurement. When you press this key, the instrument will show the following message:

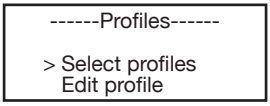


If you press the 'ON' key, the instrument will restart the measurement with the same configuration. If you press the 'QUIT' key at any time during measurement, the viscometer will return to the main menu.

8.4 Test Profiles (EX only)

Some BYK-Gardner viscometers incorporate programmable profiles that allow the user to save measurement configurations. This helps to take measurements more quickly when the same measurement parameters are used frequently.

From the main menu screen scroll to the 'Logs' option and press 'ENTER'. The viscometer will show the following screen:



The first option allows the user to perform a viscosity measurement using a profile that has already been configured. The second option is for programming profile configurations for future use.

8.4.1 Edit Test Profile (EX only)

Select ‘Edit profile’ and the viscometer will show the following screen:

-- Select a Profile --		
M1	M2	M3
M4	M5	M6
M7	M8	M9

Scroll through the profiles using the ‘TAB’ button, then press ‘ENTER’ to edit the selected profile.

8.4.1.1 Viscometer programming (EX only)

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

-- TTT & TTS --	
Time to torque:	OFF
Torque:	15.0%
Time to stop:	OFF

8.4.1.1.1 TTT and TTS (EX only)

As stated before, these abbreviations mean:

TTT: Time to Torque. The viscometer will automatically stop measuring when the selected torque percentage is reached, and the screen will display the viscosity measured at that moment. (see section 8.5)

TTS: Time to Stop. The viscometer will run for the selected amount of time then automatically stop measurement and display the viscosity measured at this point (see section 8.5)

Turn these options on or off by using the ‘TAB’ button to scroll to either ‘Time to torque’ or ‘Time to stop’ and pressing the ‘Δ’ or ‘∇’ key to change. Only one of these options can be active at a time. The ‘Torque’ field can only be modified when ‘Time to torque’ is set to ‘ON’, and the ‘Time’ field can only be modified when the “Time to stop’ field is set to ‘ON’.

Modify the ‘Torque’ or ‘Time’ options by using the ‘TAB’ button to scroll to the desired option and pressing ‘ENTER’.

-- TTT & TTS --	
Time:	00h 00h 00s

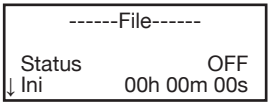
The selected field will be blinking on the screen until it is modified. Save the changes by hitting ‘ENTER’ again.

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

Pressing the ‘ON’ key the viscometer will save the fields activated and take you to the next screen.

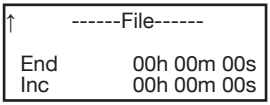
8.4.1.2 Output options (EX only)

This option allows the user to record measurements:



The default mode is 'OFF'. To activate this option, use the 'Δ' or '∇' keys to turn it 'ON'. While the option is deactivated ('OFF'), you cannot select the time fields that regulate this function.

Once the Status is ON the time fields can be selected using the 'TAB' key.

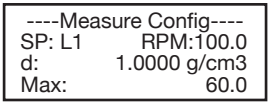


- Ini: After measurement begins the instrument waits this amount of time before it starts recording
- End: The instrument stops recording after this amount of time has elapsed
- Inc: the increments by which samples are taken.

To modify each field, press 'ENTER'. Use the 'TAB' button to scroll through the digits and the 'Δ' or '∇' buttons to change the value. To save the changes press 'ENTER', which will unselect the field and save the values entered.

When you're in the 'options and output configuration' screen (as we will now see), you can begin the configuration of the measurement or experiment.

The 'ON' key will bring you to a screen resembling this one:



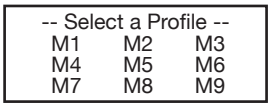
See section 8.3 for a detailed explanation of this screen.

Once the measurement parameters are configured, hit the 'ON' key to save it to the memory. The instrument will move on to the next screen and the recording process will be finalized.

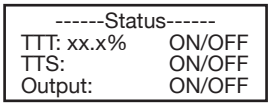
To make sure that the memory has been accurately recorded you can check the process in 'Use Log'

8.4.2 Select Profile (EX only)

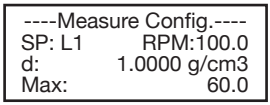
To use an already configured measurement profile, from the Profile screen scroll to 'Select profile' and press 'ENTER'



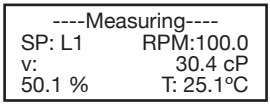
Use the 'TAB' key to select a profile and press 'ENTER' and the following screen will appear showing the profile's configuration (In the sample figure all of the possibilities are shown. Only one of the two words, ON/OFF, will appear depending on which function is active):



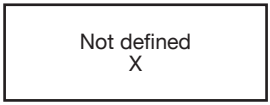
This information cannot be changed at this point. Press the 'ON' key to go see the Measurement Config. Screen (cannot be modified):



Press 'ON' again to begin measurement



If a profile is selected that has not been configured the following screen will appear instead:



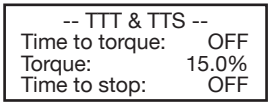
"X" being a profile number from 1 to 9. Pressing 'ENTER' again will take you back to the profile selection screen.

8.5 Programming (EX only)

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.

From the main menu screen you must place the cursor ">" on "Programming", as seen in the following diagram:

By pressing "ENTER", you will see the following screen:



This screen will allow you to activate and configure the ‘Time to Torque’ (TTT) and ‘Time to Stop’ (TTS) options:

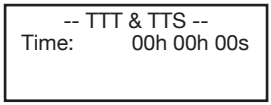
- Time to Torque (TTT): The ‘Time to torque’ field contains the torque value (%) at which the viscometer will stop the measurement. The viscometer gradually changes the speed of the spindle in order to approach the selected torque. When this torque is attained the viscometer stops the measurement and the 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 viscosity measurement will be displayed on the screen.

To select the field that you want to activate (TTT or TTS) you use the ‘TAB’ key and you can jump from field to field cyclically. The selection of fields will start in ‘Time to Torque’. The field that is selected will be intermittently displayed for further information.The options for the two fields TTT and TTS can only either be ‘ON’ or ‘OFF’. To vary this option you need to have the right field selected and use either the ‘Δ’ or ‘∇’ keys to jump from option to option.

If the ‘Time to Torque’ or ‘Time to Stop’ fields are not activated (on the ‘ON’ position), than the ‘Time’ and ‘Torque’ fields cannot be accessed.

Once the ‘Time to Torque’ field is activated (‘ON’ position), you can access the ‘Torque’ field by typing the ‘TAB’ key. The field should begin to blink. You hit ‘ENTER’ to proceed to the modifications. By using the ‘TAB’ key you can introduce the desired torque value (between 15.0 and 95.0) and by hitting the ‘ENTER’ key again, you can keep this amount. This number will remain saved, unchanged, even if the ‘Time to Torque’ option is deactivated (by changing the field option to ‘OFF’).

‘Time’ is modified in a similar way. You should have the ‘TTS’ option activated (hitting the ‘Δ’ or ‘∇’ keys to change the mode to ‘ON’). Once it is selected, use the ‘TAB’ key to change the screen and see:

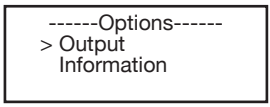


Once the field is selected you need to hit the ‘ENTER’ key and enter the desired numerical amount into the ‘Time’ fields using the ‘Δ’ or ‘∇’ keys. Hitting the ‘ENTER’ key again saves the changes and these will remain unchanged until a new amount is entered in the same way. If you deactivate the ‘Time to Stop’ option (in ‘OFF’ position), the value will be saved.

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

8.6 Options (EX only)

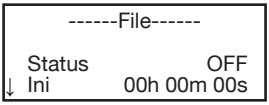
The Options menu contains the information and output options that can be set in the BYK-Gardner Viscometers. When the '>' cursor is on the 'Options' field of the main menu, you must select it by pressing 'ENTER'. The viscometer will show the following screen:



Using the 'Δ' and '∇' keys, you can move our cursor through the options in a cyclical way and to choose one of them, the '>' cursor must be on the field when you press 'ENTER'.

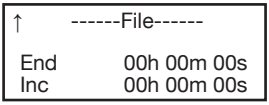
8.6.1 Output

If you choose this option, you will be activating the option of recording an experiment or past measurement saved in the Viscometer's memory. For this you will see the following screen:



By default, the 'Status' field will be inactive (in the OFF position). To activate it you need to use either the 'Δ' or the '∇' keys to switch the status to ON or back to OFF as desired. While the 'Status' field is deactivated (in the OFF position) you cannot select the time fields that regulate this function.

Once the field is active, you can select different fields, jumping for one to another using the 'TAB' key. Pressing 'TAB' in the 'Ini' field, the screen will change to show two more fields:



The selected field will remain blinking on the screen until it is chosen for modifications. To modify each field you must press 'ENTER' once the field is selected and then introduce the values using 'Δ' or '∇' keys or the 'TAB' key to enter a number in each digit place. To save the changes, press 'ENTER', whereupon the field will be unselected and the changes saved.

Screen Information:

- Ini: Begin time of recording.
- End: End time of data recording.
- Inc: By which increments of time a sample is taken.

8.6.2 Information

If you select the 'Information' option, you will be brought to a screen in which the contact information of the manufacturer will be displayed, 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.

9. 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 1ºC 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.

Thixotropic 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.)

Rheopectic 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

Aging under the same speed gradient conditions affects thixotropic and rheopectic 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 BYK-Gardner 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 ==> READING PRECISION INCREMENT

SPINDLE SIZE-REDUCTION ==> 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 BYK-Gardner 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
BYK-Gardner viscometers guarantee a precision of ±1% from the bottom of the speed/spindle combination scale and a repetition of ±0.2%.

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 readings with BYK-Gardner 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.

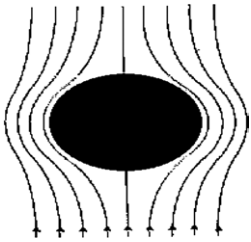
The first consideration is linked to the precision of the instruments. All of the BYK-Gardner rotational viscometers guarantee a precision of (±) 1% from the bottom of any spindle/rotational speed combination scale.

Working within 15% of the bottom of the scale is not recommended due to the potential (±) 1% error in the viscosity being relatively large compared to the instrument reading.

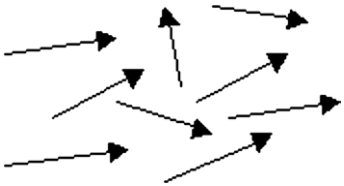
The second consideration has to do with fluid mechanics. All of the rheological measurements of fluid flow properties must be taken under laminar flow conditions. Laminar flow is when all of the movements of the fluid particles are in sheets, directed by an external applied force.

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 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 LVA: 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.

10 Accessories

10.1. Low Viscosity Adapter (LVA) with Water Jacket

The Low Viscosity Adapter does not come standard with the delivery. The Low Viscosity Adapter with Water Jacket is shown in figure 1.

This kit consists of a sample chamber, sample chamber container, mounting channel, two mounting screws, bottom stopper, upper stopper, hook and thread.

This version is suitable for most general purpose applications, but there is another version without the water jacket mounted on the sample chamber container.

The Figure 2 explains how to assemble all the pieces of the kit and attach them to the viscometer. In the picture every item is described, to request information about an item use this as a reference.

Figure 3 shows the spindle that should be used with the Low Viscosity Adapter assembly.

The Mounting Channel has two possible holes for the upper screw:

- The top hole is a universal hole to attach our low viscosity adapter to other brands of viscometers.
- The bottom hole is to attach to byko-visc viscometers.

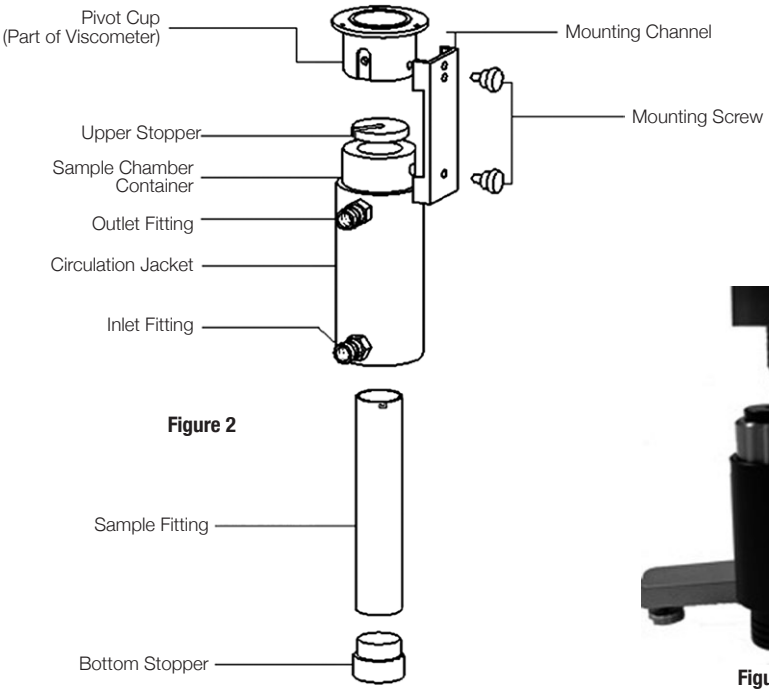


Figure 2

Figure 3

Figure 1

Low Viscosity Adapter without Water Jacket (LVA/B)

The Low Viscosity Adapter without Water Jacket is shown in Figure 4 fully assembled.

The kit consists of a sample chamber container, mounting channel, two mounting screws, bottom stopper, upper stopper, hook and thread.

This version is suitable for most general purpose applications. There is another version with the water jacket mounted on the sample chamber container (see previous page).

The Figure 5 explains how to assemble all the pieces of the kit to the viscometer. In the picture every piece is described, to request information about a piece use this reference.

Figure 3 (see previous page) shows the spindle that should be used with the Low Viscosity Adapter assembly.

The piece named Mounting Channel has two possible holes for the upper screw:

- The top hole is a universal hole to attach our low viscosity adapter to other brands of viscometers.
- The bottom hole is to attach to byko-visc viscometers.

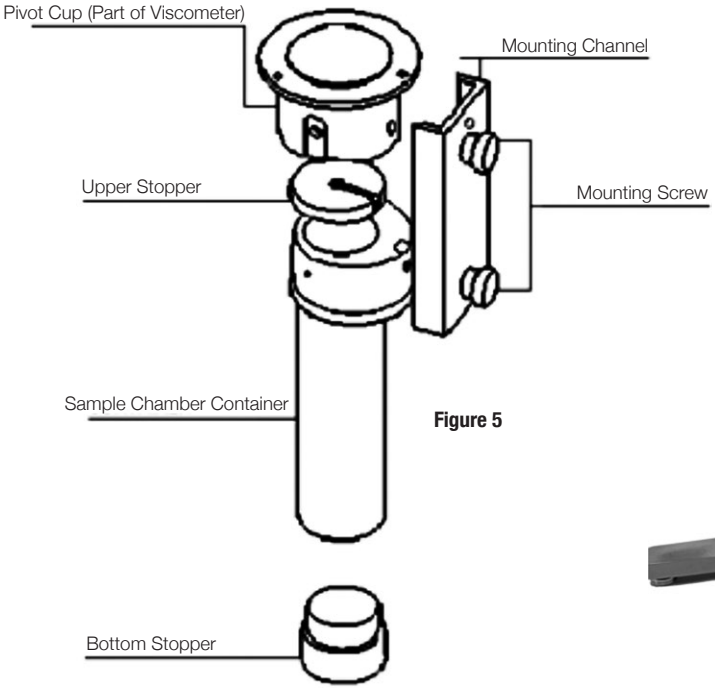


Figure 5

Figure 4

10.1.1 Mounting

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

- Unplug the viscometer.
- Attach the extension (X) between the Y shaped base (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 LVA adapter. Without this extension the assembly of this accessory would be difficult, especially the assembly of the spindle.
- Close the sample container (K) 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 into 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). Fig. 11 shows more information about this.
- Place the upper stopper (N) over the sample container.

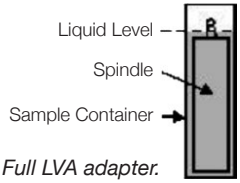


Fig. 11: Full LVA adapter.

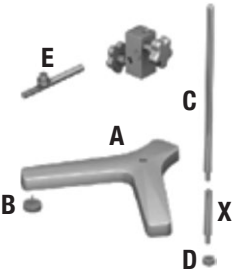


Fig. 10: Mounting the LVA adapter extension.

***Important:** The piece named G has two possible holes for the upper screw. The top hole is a Universal hole to attach our low viscosity adapter to other viscometers. The bottom hole is to attach BYK-Gardner pieces.

****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.

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

10.1.2 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 base.
- 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 LVA adapter material! Solvents that can be used: water, ethanol or high concentrations of alcohol. For other solvents, check the chemistry compatibility table.

10.1.3 Technical specification for LVA 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 LVA 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 stoppers 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 stopper interior washer is made with black delrin. It is designed to withstand a maximum temperature of 100ºC (212 ºF)
- The circulation jacket is made of acetyl and delrin.
- The O-ring on the plastic stopper (M) of the LVA Adapter is made of delrin. The softening point is 110 °C (230 °F).

10.2. Small Sample Adapter (SSA)

NOTE: Small sample adapters do not belong to the standard delivery. Any of these two versions (with or without thermo jacket SSA/B) must be ordered as an additional accessory. The SSA accessory is 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.

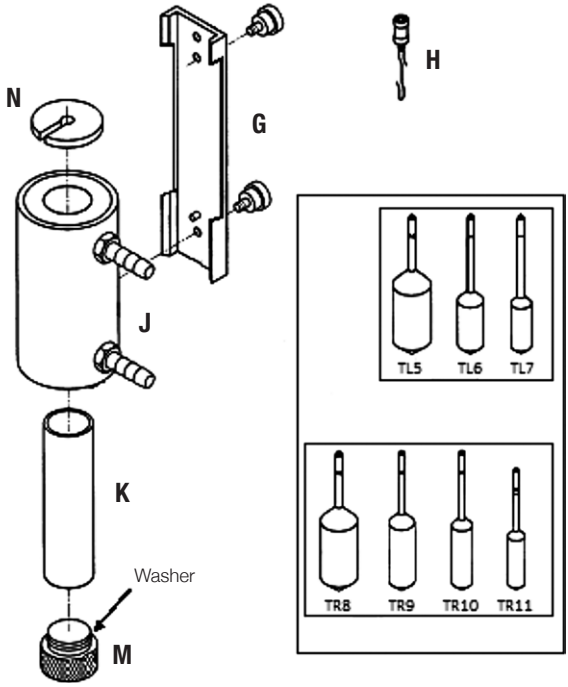


Fig. 12 SSA accessory parts

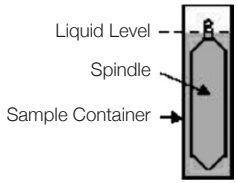
10.2.1 Assembly

NOTE: The mounting process is different according to the types of SSA. The difference between them only remains that the SSA has a thermo station jacket (J) and a container (K) and the SSA/B without water jacket only incorporates a container (K). The SSA screw its thermo station jacket (J) to the connector (G), on the other hand, the SSA/B screws the container directly to the connector (G). Now is detailed the SSA assembling:

• Unplug the viscometer.
• Attach the Y shaped base (A) to the rib (C). Use a 19 mm adjustable spanner in order to fasten the nut (D).
• Close the sample container (K) 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 15 shows more information about this.
• Place the upper stopper (N) over the sample container.

***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 attach our small sample adapter to other viscometers. The bottom hole is to attach BYK-Gardner pieces.

Fig. 15: Full SSA adapter.



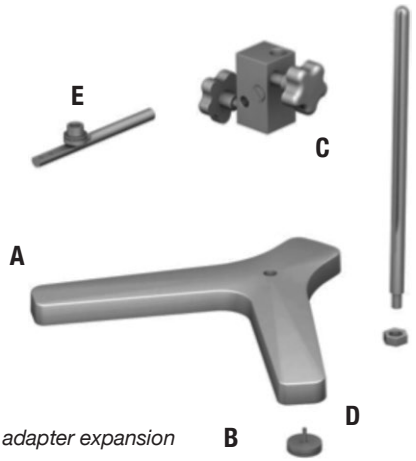


Fig. 14: Mounting the APM adapter expansion

***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 viscometer (L. R or H).

10.2.2 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 base.
- 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 SSA adapter material! Solvents that can be used: water, ethanol or high concentrations of alcohol. For other solvents, check the chemistry compatibility table.

10.2.3 Technical specifications of SSA and SSA/B

Measurement rank:

Sample L: 1.5*) until 200 000 mPa.s
Sample R: 25*) until 3 300 000 mPa.s
Sample H: 0.2*) until 26 660 Pa.s

*) Measurement represents 10 % of the full scale.

Spindles features and SSA filling:

- L Sample & TL spindles

Spindle	Shear rate [s-1] *)	Sample volume [ml]
TL5	1.32 x RPM	6.7
TL6	0.34 x RPM	9.0
TL7	0.28 x RPM	9.4

- R sample or H & TR spindles

Spindle	Shear rate [s-1] *)	Sample volume [ml]
TR8	0.93 x RPM	7.1
TR9	0.34 x RPM	10.4
TR10	0.28 x RPM	11.0
TR11	0.25 x RPM	13.5

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

Temperature rank of circulation jacket and thermo station conditions:
- Permitted temperature rank: -10 a +100°C (14 a 212 °F)
- Use a thermostatic bath with demineralised water or refrigeration special liquid. Change the liquid in the bath regularly. Recommended flow: 15 l/min.

Materials:
- The metallic parts are made of stainless steel, the stoppers are made of plastic in black Delrin. The parts in contact with the sample (sample container and spindle) are made of AISI 316 suitable for food industry.
- The stopper interior washer is made in black Delrin. It is designed to get a maximum temperature of 100ºC (212 ºF)
- The circulation jacket is made of acetyl and Delrin.
- The O-ring on the plastic stopper (M) of the SSA Adapter is made of Delrin. The softening point is 110 °C (230 °F).

10.3 HELIO STAND UNIT

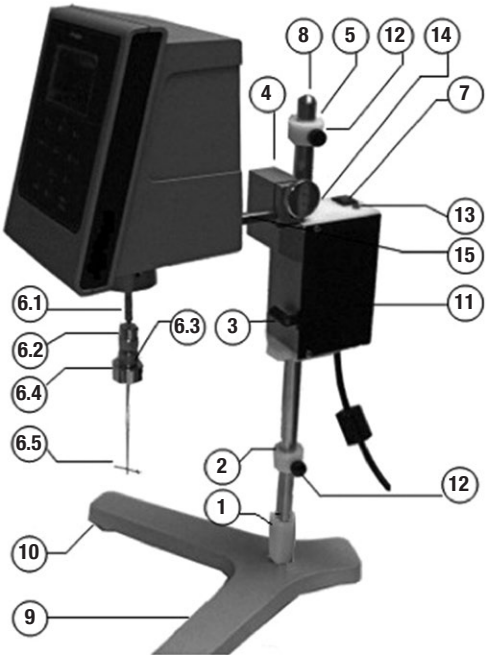
NOTE: The Helio stand does not come with the standard delivery. It can be ordered as an accessory. The unit is supplied complete with T-shaped spindles, in this case.

The Helio stand accessory is used with substances that do not flow by themselves (like ice or pastas). Its motor 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 causes the T-shaped spindle to always be in contact with the sample.

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

Fig. 16 Helio Stand Unit in its case

10.3.1 Helio Stand unit mounting



1. Rib joint	9. Base
2. Lower stop ring	10. Levelling knobs
3. Displacement command	11. Helio motor unit
4. Viscometer fastening bolt	12. Knobbed fastening rib
5. Upper stopper ring	13. Functioning pilot
6. Helio 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

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 Helio Stand motor (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 Helio bolt (4) and fasten it with the nut bolt (14).
- Balance the viscometer – Helio Stand 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 Helio Stand to the power point. Switch the viscometer on and insert the speed and the spindle, as always.
- Set the Helio Stand unit on with the ON/OFF switch (7). Check if the pilot is on. If not, check the main connection.

OPERATION:
The Helio Stand unit (which moves helicoidally) is moved up and down between the two stopper rings.

When the motor housing touches one of them, the unit changes direction.
The Helio Stand unit will keep moving, until turned with the ON/OFF switch (7).

11. Model/Spindle correspondence tables

Standard Spindles + R1 (Table 1):

VISCOMETER					
Model	**Spindle**	**Model**	**Spindle**	**Model**	**Spindle**
BASIC L	L1	BASIC R	R1	BASIC H	R1
	L2		R2		R2
	L3		R3		R3
	L4		R4		R4
			R5		R5
			R6		R6
			R7		R7

SPECIAL SPINDLES (Table 2):

VISCOMETER					
Model	**Spindle**	**Model**	**Spindle**	**Model**	**Spindle**
BASIC L	TL5	BASIC R	TR8	BASIC H	TR8
	TL6		TR9		TR9
	TL7		TR10		TR10
			TR11		TR11

SPECIAL HELIO STAND SPINDLES (Table 3):

VISCOMETER					
Model	**Spindle**	**Model**	**Spindle**	**Model**	**Spindle**
BASIC L		BASIC R	PA	BASIC H	PA
			PB		PB
			PC		PC
			PD		PD
			PE		PE
			PF		PF

SPECIAL SPINDLES (Table 4):

VISCOMETER					
Model	**Spindle**	**Model**	**Spindle**	**Model**	**Spindle**
BASIC L	LVA/SP	BASIC R	LVA/SP	BASIC H	

12. Model/Spindle/Oil calibration tables

MODEL L (Table 5):

SPINDLE	STANDARD OIL
L1	RT50
L2	RT500
L3	RT1000
L4	RT5000
TL5	RT50
TL6	RT500
TL7	RT500
LVA	RT5

MODEL R (Table 6):

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
LVA	RT50

MODEL H (Table 7):

SPINDLE	STANDARD OIL
R1	RT1000
R2	RT5000
R3	RT12500
R4	RT12500
R5	RT30000
R6	RT100000
R7	RT100000
TR8	RT5000
TR9	RT12500
TR10	RT3000
TR11	RT60000

Table 8. Basic L standard spindle selection

Maximum guideline values in cP (mPa·s)

RPM / SP	L1	L2	L3	L4
0,3	20K	100K	400K	2000K
0,5	12K	60K	240K	1200K
0,6	10K	50K	200K	1000K
1	6K	30K	120K	600K
1,5	4K	20K	80K	400K
2	3K	15K	60K	300K
2,5	2,4K	12K	48K	240K
3	2K	10K	40K	200K
4	1,5K	7,5K	30K	150K
5	1,2K	6K	24K	120K
6	1K	5K	20K	100K
10	600	3K	12K	60K
12	500	2,5K	10K	50K
20	300	1,5K	6K	30K
30	200	1K	4K	20K
50	120	600	2,4K	12K
60	100	500	2K	10K
100	60	300	1,2K	6K

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 9. Basic L Special spindle selection

Maximum guideline values in cP (mPa·s)

RPM/SP	TL5	TL6	TL7
0,3	10K	100K	200K
0,5	6K	60K	120K
0,6	5K	50K	100K
1	3K	30K	60K
1,5	2K	20K	40K
2	1,5K	15K	30K
2,5	1,2K	12K	24K
3	1K	10K	20K
4	750	7,5K	15K
5	600	6K	12K
6	500	5K	10K
10	300	3K	6K
12	250	2,5K	5K
20	150	1,5K	3K
30	100	1K	2K
50	60	600	1,2K
60	50	500	1K
100	30	300	600

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 10. Low Viscosity Adaptor with Basic L

Maximum guideline values in cP (mPa·s)

RPM	cP
0,3	2.000,00
0,5	1.200,00
0,6	1.000,00
1	600,00
1,5	400,00
2	300,00
2,5	240,00
3	200,00
4	150,00
5	120,00
6	100,00
10	60,00
12	50,00
20	30,00
30	20,00
50	12,00
60	10,00
100	6,00

ATTENTION:
Sample Volume = 16 ml.
Shear Rate = 1,2236·rpm

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

Table 11. Basic R Standard spindle selection

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	66,6K	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

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 12. Basic R special spindle selection

Maximum guideline values in cP (mPa·s)

RPM/SP	TR8	TR9	TR10	TR11
0,3	166,6K	833,3K	1,6M	3,3M
0,5	100K	500K	1M	2M
0,6	83,3K	416,6K	833,3K	1,6M
1	50K	250K	500K	1M
1,5	33,3K	166,6K	333,3K	666,6K
2	25K	125K	250K	500K
2,5	20K	100K	200K	400K
3	16,6K	83,3K	166,6K	333,3K
4	12,5K	62,5K	125K	250K
5	10K	50K	100K	200K
6	8,3K	41,6K	83,3K	166,6K
10	5K	25K	50K	100K
12	4,16K	20,83K	41,6K	83,3K
20	2,5K	12,5K	25K	50K
30	1,6K	8,3K	16,6K	33,3K
50	1K	5K	10K	20K
60	833,3	4,16K	8,3K	16,6K
100	500	2,5K	5K	10K

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 13. Low Viscosity Adaptor with Basic R

Maximum guideline values in cP (mPa·s)

RPM	cP
0,3	21.333,00
0,5	12.800,00
0,6	10.666,00
1	6.400,00
1,5	4.266,00
2	3.200,00
2,5	2.560,00
3	2.133,00
4	1.600,00
5	1.280,00
6	1.066,00
10	640,00
12	533,00
20	320,00
30	213,00
50	128,00
60	106,00
100	64,00

ATTENTION:
Sample Volume = 16 ml.
Shear Rate = 1,2236·rpm

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

Table 14. Basic H standard spindle selection

Maximum value guidelines, in units of poise

RPM/SP	R1	R2	R3	R4	R5	R6	R7
0,3	2,6K	10,6K	26,6K	53,3K	106,6K	266,6K	1,06M
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

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 15. Basic H special spindle selection

Maximum value guidelines, in units of poise

RPM/SP	TR8	TR9	TR10	TR11
0,3	13,6K	66,6K	133,3K	266,6K
0,5	8K	40K	80K	160k
0,6	6,6K	33,3K	66,6K	133,3K
1	4K	20K	40K	80K
1,5	2,6K	13,3K	26,6K	53,3K
2	2K	10K	20K	40K
2,5	1,6K	8K	16K	32K
3	1,3K	6,6K	13,3K	26,6K
4	1K	5K	10K	20K
5	800	4K	8K	16K
6	666	3,30K	6,6K	13,3K
10	400	2K	4K	8K
12	333	1,6	3,3K	6,6K
20	200	1K	2K	4K
30	133	666	1,3K	2,6K
50	80	400	800	1,6K
60	66	333	666	1,3K
100	40	200	400	800

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 16. HELIO STAND's special spindle selection for Basic L

Maximum guideline values in cP (mPa·s)

RPM/SP	PA	PB	PC	PD	PE	PF
0,3	62,4K	124,8K	312K	624K	1,56M	3,12M
0,5	37,44K	74,88K	187,2K	374,4K	936K	1,872M
0,6	31,2K	62,4K	156K	312K	780K	1M
1	18,72K	37,44K	93,6K	187,2K	468K	936K
1,5	12,48K	24,96K	62,4K	124,8K	312K	624K
2	9,36K	18,72K	46,8K	93,6K	234K	468K
2,5	7,488K	14,976K	37,44K	74,88K	187,2K	374,4K
3	6,24K	12,48K	31,2K	62,4K	156K	312K
4	4,68K	9,36K	23,4K	46,8K	117K	234K
5	3,744K	7,488K	18,72K	37,44K	93,6K	187,2K
6	3,120K	6,24K	15,6K	31,2K	78K	156K
10	1,872K	3,744K	9,36K	18,72K	46,8K	93,6K
12	1,560K	3,12K	7,8K	15,6K	39K	78K

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 17. HELIO STAND's special spindle selection for Basic R

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

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 18. HELIO STAND's special spindle selection for Basic H

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

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 19. VANE special spindle selection for Basic L

Maximum guideline values in cP (mPa·s)

RPM/SP	V71	V72	V73	V74	V75
0.01	245K	1.04M	5.01M	50.8M	21.6M
0.3	8.18K	34.6K	167K	1.69M	721K
0.5	4.91K	20.8K	100K	1.01M	433K
0.6	4.09K	17.3K	83.5K	848K	360K
1	2.45K	10.4K	50.1K	508K	216K
1.5	1.63K	6.93K	33.4K	339K	144K
2	1.22K	5.20K	25.0K	254K	108K
2.5	982.2	4.16K	20.0K	203K	86.6K
3	818.5	3.46K	16.7K	169K	72.1K
4	613.9	2.60K	12.5K	127K	54.1K
5	491.1	2.08K	10.0K	101K	43.3K
6	409.2	1.73K	8.35K	84.8K	36.0K
10	245.5	1.04K	5.01K	50.8K	21.6K
12	204.6	867.0	4.17K	42.4K	18.0K
20	122.7	520.2	2.50K	25.4K	10.8K
30	81.85	346.8	1.67K	16.9K	7.21K
50	49.11	208.0	1.00K	10.1K	4.33K
60	40.92	173.4	835.7	8.48K	3.60K
100	24.55	104.0	501.4	5.08K	2.16K
200	12.27	52.02	250.7	2.54K	1.08K

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 20. VANE special spindle selection for Basic R

Maximum guideline values in cP (mPa·s)

RPM/SP	V71	V72	V73	V74	V75
0.01	2.6M	11.1M	53.5M	543M	231M
0.3	87.3K	370K	1.78M	18.1M	7.69M
0.5	52.3K	222K	1.07M	10.8M	4.62M
0.6	43.6K	185K	891K	9.05M	3.84M
1	26.1K	111K	535K	5.43M	2.31M
1.5	17.4K	74.0K	356K	3.62M	1.54M
2	13.0K	55.5K	267K	2.71M	1.15M
2.5	10.4K	44.4K	214K	2.17M	924K
3	8.73K	37.0K	178K	1.81M	770K
4	6.54K	27.7K	133K	1.35M	577K
5	5.24K	22.2K	107K	1.08M	462K
6	4.36K	18.5K	89.1K	905K	385K
10	2.62K	11.1K	53.5K	543K	231K
12	2.18K	9.25K	44.5K	452K	192K
20	1.31K	5.55K	26.7K	271K	115K
30	873.3	3.70K	17.8K	181K	77.0K
50	524.0	2.22K	10.7K	108K	46.2K
60	436.6	1.85K	8.91K	90.5K	38.5K
100	262.0	1.11K	5.35K	54.3K	23.1K
200	131.0	555.0	2.67K	27.1K	11.5K

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

Table 21. VANE special spindle selection for Basic H

Maximum guideline values in cP (mPa·s)

RPM/SP	V71	V72	V73	V74	V75
0.01	209K	888K	4.28M	43.4M	18.4M
0.3	6.98K	29.6K	142K	1.44M	615K
0.5	4.19K	17.7K	85.6K	868K	369K
0.6	3.49K	14.8K	71.3K	724K	307K
1	2.09K	8.88K	42.8K	434K	184K
1.5	1.39K	5.92K	28.5K	289K	123K
2	1.04K	4.44K	21.4K	217K	92.4K
2.5	838	3.55K	17.1K	173K	73.9K
3	698	2.96K	14.2K	144K	61.6K
4	523	2.22K	10.7K	108K	46.2K
5	419	1.77K	8.56K	86.8K	36.9K
6	349	1.48K	7.13K	72.4K	30.8K
10	209	888	4.28K	43.4K	18.4K
12	174	740	3.56K	36.2K	15.4K
20	104	444	2.14K	21.7K	9.24K
30	69.8	296	1.42K	14.4K	6.16K
50	41.9	177	856	8.68K	3.69K
60	34.9	148	713	7.24K	3.08K
100	20.9	88.8	428	4.34K	1.84K
200	12.27	52.02	250.7	2.54K	1.08K

ATTENTION:
K Indicates thousands. Example: 7,8K = 7.800
M Indicates Millions Example: 1,56M = 1.560.000

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

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