Fungilab

ViPad

Rotational Viscometer. Instruction Manual

History inspires us in ways that leave a lasting mark on our ideologies and beliefs. We often look toward the individuals who have come before us and relish in their accomplishments, remembering their feats and successes as the reasons we are able to flourish and grow. This motivates us to move forward, to contribute to our field in ways untapped.

Here at Fungilab, we believe that innovation paves the way for a new reality, an alternate present that starts our future anew. A path that was laid out so clearly is suddenly lacking; a new road must be paved to accommodate change in all its forms.

So here we are, ready and anxious to spur a change of our own. Decades of experience has made us masters of our field, but evolution has pushed us to be even better. With locations all around the world, our global presence is heightened by our commitment to progression and ingenuity.

At the core of our values is an indelible need to support our customers with the best experience possible. In a world that can seem so large, Fungilab is ready to bridge the gap with a creativity and originality that will unite us unlike ever before.

Let's move forward together.
Fungilab Team

MOVING FORWARD

Software Version: 1.0
Manual Version 1.0

Instruction Manual

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1. Introduction

Thank you for acquiring the Vpad rotational viscometer model from Fungilab.

The Vpad is a rotational viscometer, based on the torque measurement of a rotating spindle in the sample at a specified velocity. Three different models (type L, R and H), 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.
- 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:

- Do not use the rotational viscometer without a solid connection to the ground. 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 match with the specifications for the viscometer. 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 ±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

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:	15 VA

Main supply voltage fluctuations are not to exceed ±10% of the nominal supply voltage

5. Specifications

Speeds: 0.01 – 250 RPM
Temperature Sensing Range: -40 °C to 300 °C (-40 °F to 572 °F)
USB A Port for use with temperature probe
Viscosity Accuracy: ±1.0 % of full scale range
The use of accessory items will have an effect on the measurement accuracy
Viscosity Repeatability: ±0.2 % of full scale range
Temperature Accuracy: ±0.1 °C | -40 °C to 300 °C (-40 °F to 572 °F)
Operating Environment: +5 °C to 40 °C temperature range (41 °F to 104 °F)
Non condensing humidity

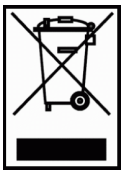
Electrical Certifications:

Conforms to CE Standards:

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

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

Notice to customers:



This symbol indicates that this product is to be recycled at an appropriate collection center

6. Conditions for use

- Indoor use
- Maximum altitude 2000 m.
- Surrounding temperature range: from +5 to 40ºC.
- 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 ±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.

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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 GS25A12-P6J power supply. Do not open, expose, modify or touch internal circuitry of the power supply.

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 label and a plastic or metal cap protecting the spindle connector
- Foot or base with 3 height adjustable knobs
- Nut
- Fastening rod
- Standard spindles
- Spindle guard
- Spindle support
- Carrying case
- Calibration Certificate
- Temperature probe and clip
- Power cable
- 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.

- USB-Memory containing the User Manual (PDF file)
- The USB-Memory might contain also the company catalogues.
- Android tablet to control de VPAD. The tablet model and specifications might vary without prior notice.

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

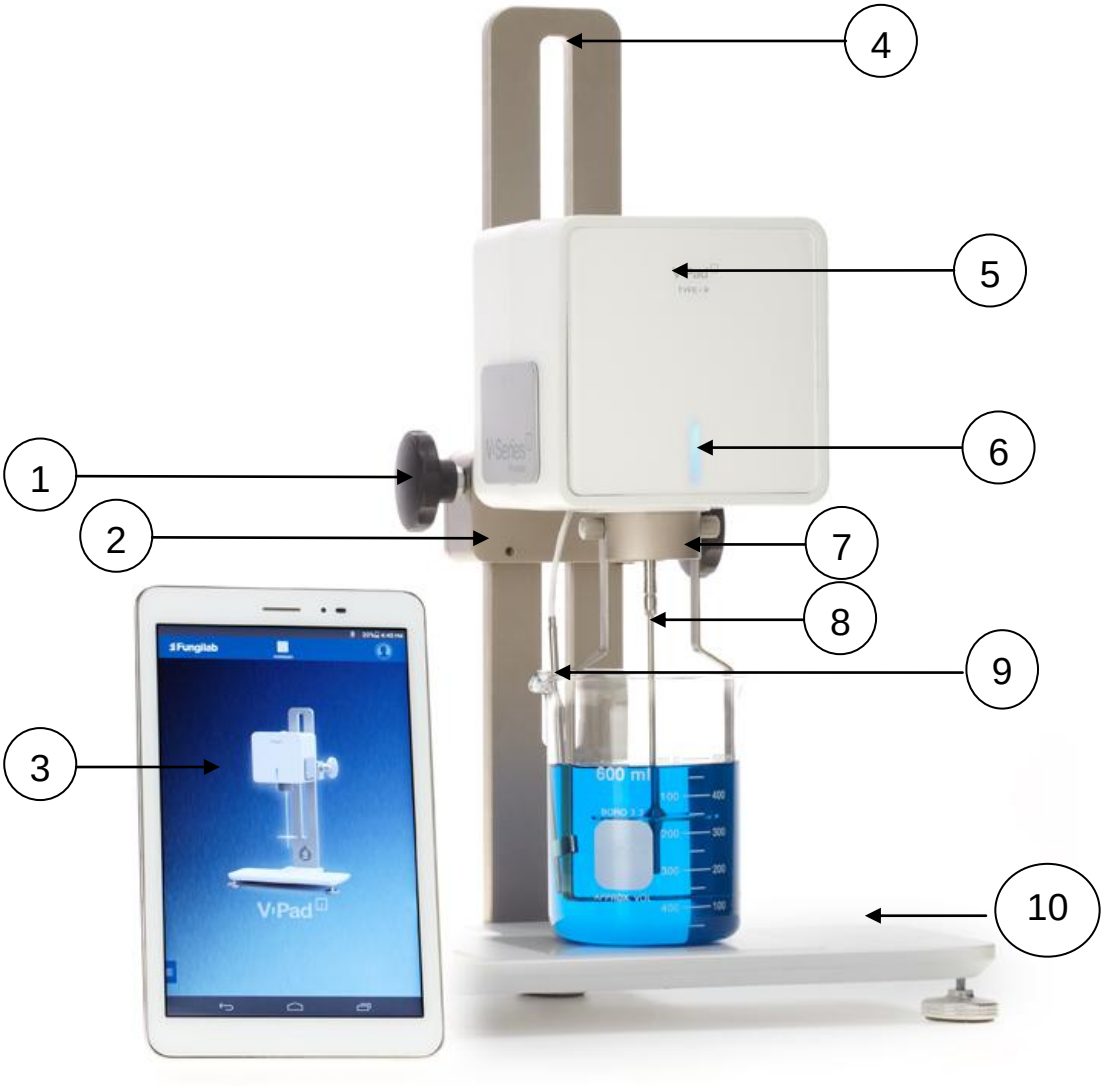


Fig. 2 Frontal view of the equipment

1. Levelling knob
2. Nut
3. Control tablet
4. Column
5. Front cover
6. LED display
7. Spindle guard
8. Spindle
9. Temperature probe
10. Base (viscometer stand)

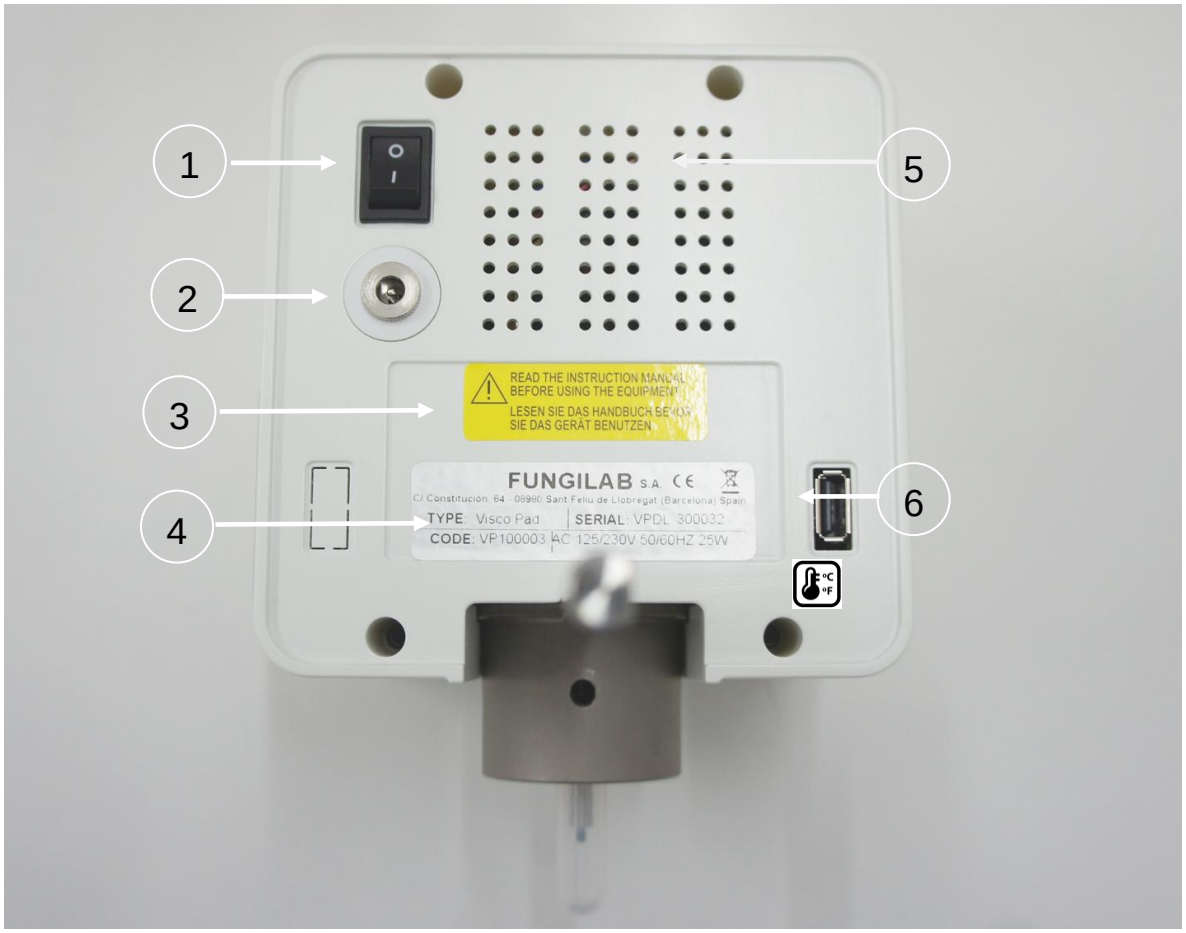


Fig. 3 Back view of the equipment

1. Power switch
2. Power cable slot
3. Warning Label
4. Serial number label
5. Air ventilation
6. USB Temperature probe connector

Fig. 4. Equipment identification label

Description of the equipment identification label:

1. Viscometer model
2. Viscometer code
3. Electronic equipment, do not throw in trash.
4. Serial number of the equipment
5. Voltage and power requirements AC 125/230V power is converted to 12VDC by the power supply.

9.1 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 T-shaped base (A).
- Mount the fastening column (C) with the holding screws (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 horizontal 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.

Note:

For the correct adjustment of the boss head, once introduced into the column, tighten the side screws (lower right and left screw top) with a M x 1,5mm Allen key supplied in the standard delivery. (fig 5.a)

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

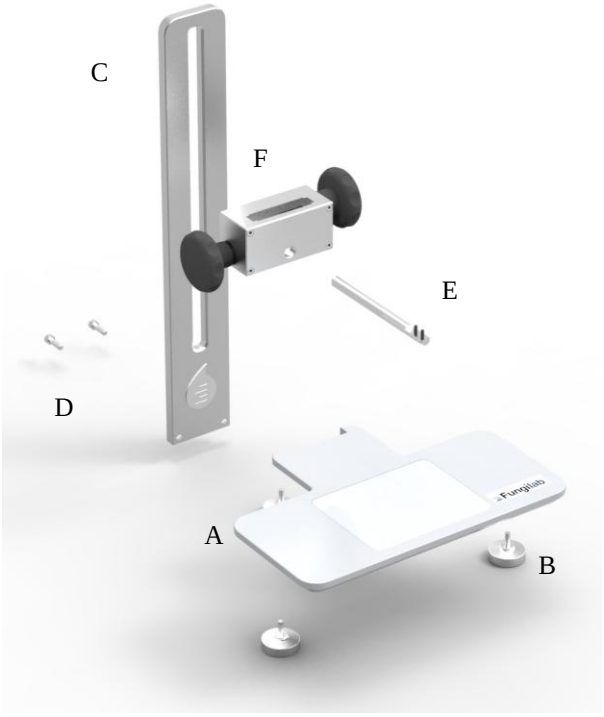


Fig. 5 Set-up for the viscometer base

Fig. 5.a Boss head adjustment

- 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 viscometer is correctly levelled.
- Plug the power cable into the connector located on the back of the equipment (Fig. 3 position 2) and plug it into the power source.

WARNING:

The socket in 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 of the viscometer (see the identification label Fig. 4, for more information). 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 ±10% of the nominal voltage

10. 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.

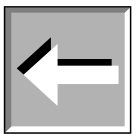
The viscosity of time-dependent non-Newtonian fluids is dependent on the temperature, on the speed gradient and on time.

Tixotropical 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 tixotropical 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 ±1% from the bottom of the speed/spindle combination scale and a repetition of ±0.2%.
The precision of temperature measurement is ±0.2 ºC.

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:

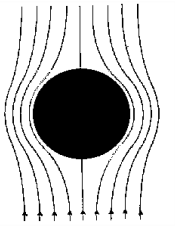
The obtained viscosity results must be between 15% and 100% of the torque range, for whichever spindle/rotational speed combination.
The viscosity reading must be executed under laminar flow condition, not turbulent flow conditions.

The first consideration is linked to the precision of the instruments. All of the FUNGILAB rotational viscometers guarantee a precision of (±) 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 (±) 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.

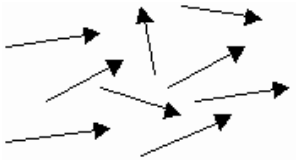
The flow lines represent speed and fluid flow direction.

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.

11. Accessories

11.1. Low viscosity adapters (LCP and LCP/B)

Low viscosity adapters (LCP and LCP/B) are not included in the standard delivery. Any of these two versions (with or without thermostatic flow 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 determine Shear Rate and Shear Stress.
Only a small quantity of a sample is required (16 ml.)

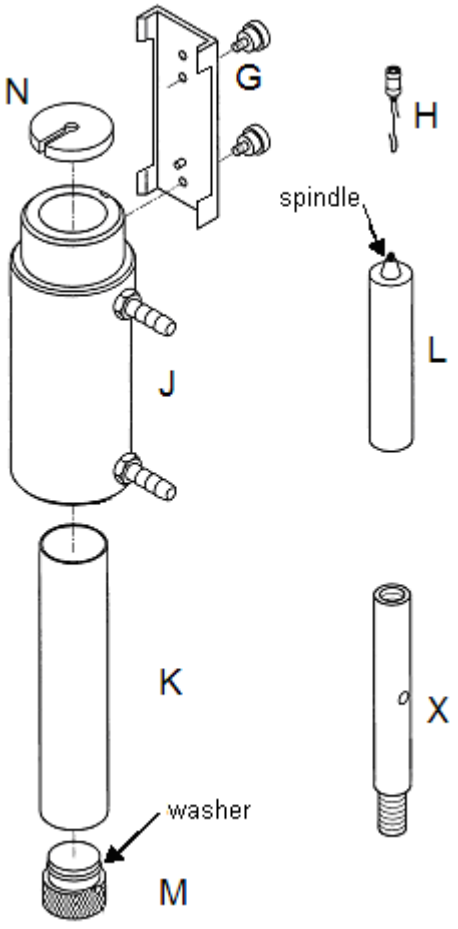


Fig. 7: LCP Spare parts

11.1.1 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 thermostatic flow jacket (J) and a container (K) and the LCP/B only incorporates a container (K). The LCP screw its thermostatic flow jacket (J) to the connector (G), on the other hand, the LCP/B screws the container directly to the connector (G). The LCP assembly process is detailed below:

- 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.

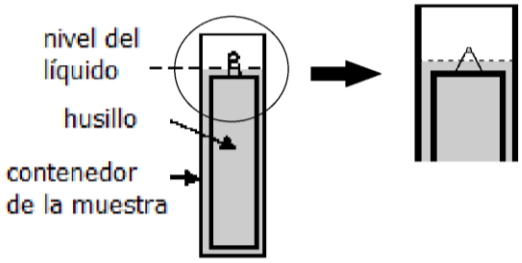


Fig. 10: Full LCP adapter.

***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 brand viscometers.
The bottom hole is to screw to 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'.

11.1.2 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 compatible with the LCP adapter material!

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

11.1.3 Technical specification for LCP accessories

Measurements range:

- Sample L: 0.9* to 2 000 mPa.s or cP
- Sample R: 3.2** to 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 range of the circulation jacket & thermostatic flow conditions:

- Temperature range allowed: -10 a +100°C (14 a 212 °F)
- Use a thermostatic bath with demineralised water or special refrigeration fluid. Change thermo fluid regularly. Recommended flow: 15 l/min.

Materials:

- The metallic parts are made of stainless steel; the lids 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 lid inferior washer is made with black Delrin. It is designed to withstand a maximum temperature of 100ºC (212 ºF)
- The circulation jacket is made of acetal 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).

11. 2. Small sample adapters APM and APM/B

NOTE:

Small sample adapters (APM and APM/B) are not included in the standard delivery. Any of these two versions (with or without thermostatic flow 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 model (L, R or H).

Small sample adapters allow more precise measurements than the standard spindles and reaching lower viscosity ranges.

Thanks to its known cylindrical geometry it is possible to obtain Shear Rate and Shear Stress determinations. Only a small quantity sample is required.

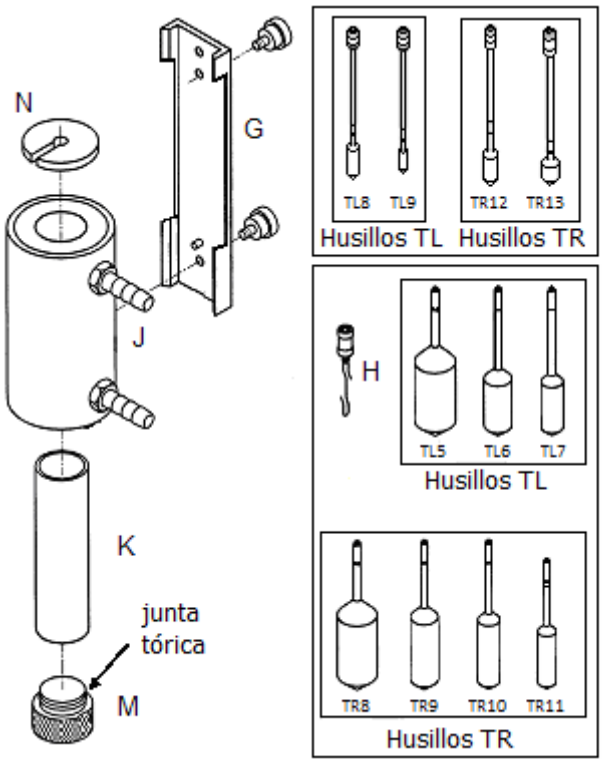


Fig. 11 APM accessory parts

Fig. 12 Set APM

11. 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 thermostatic flow jacket (J) and a container (K) and the APM/B only incorporates a container (K). The APM screw its thermostatic flow jacket (J) to the connector (G), on the other hand, the APM/B screws the container directly to the connector (G).
The APM assembly process is detailed below:

- 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.

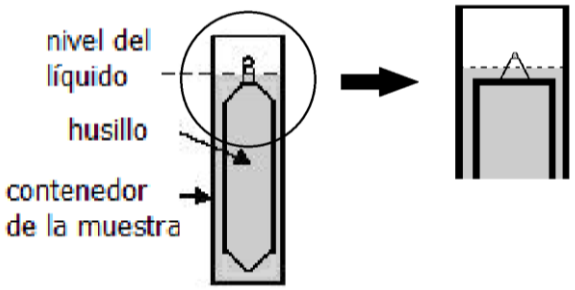


Fig. 14: Full APM adapter.

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

11. 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.

11. 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^{-1}] *)	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^{-1}] *)	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
TR12C	T12BC	12.7	42.7
TR13C	T13BC	12.7	22.9
STC	STBC	19.05	7

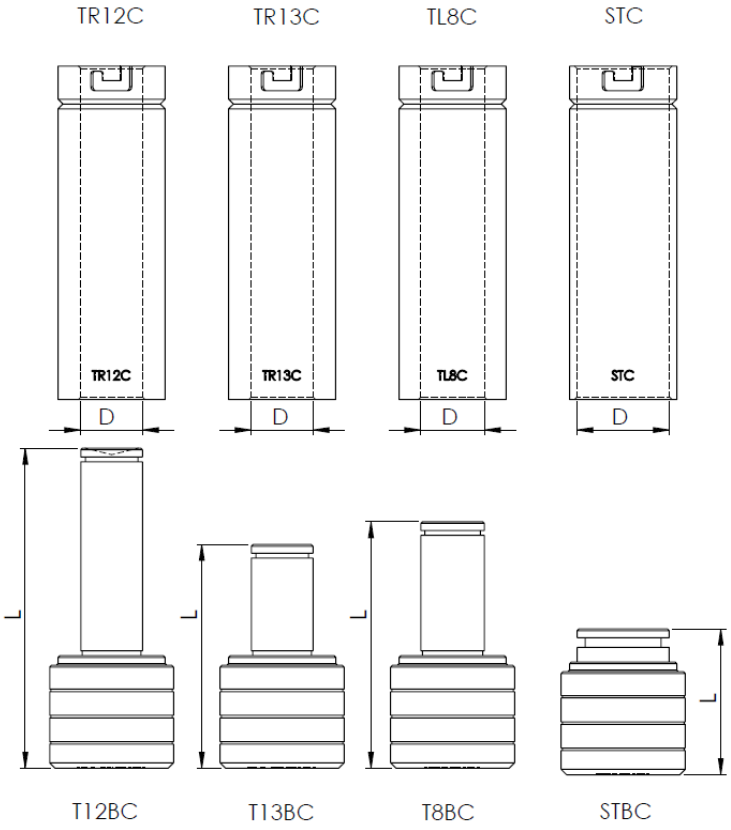


Fig. 15 Container dimensions

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 100ºC (212 ºF)
- 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).

11.3 HELDAL UNIT – Helicoidally Movement Unit

NOTICE:

The Heldal adapter it's not included in 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). It's motor moves the viscometer slowly in a vertical movement and at the same time the spindle makes the rotation movement. This generates a helicoidally movement so 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.

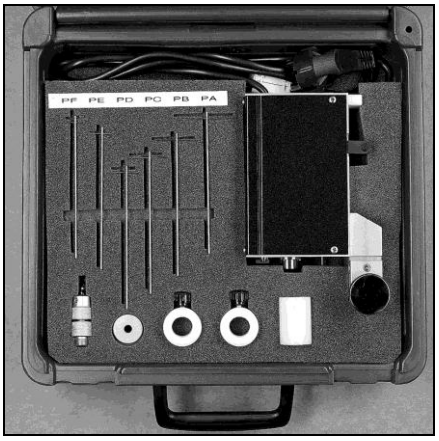


Fig. 16 Heldal Unit in its case

11. 3. 1 Heldal unit mounting

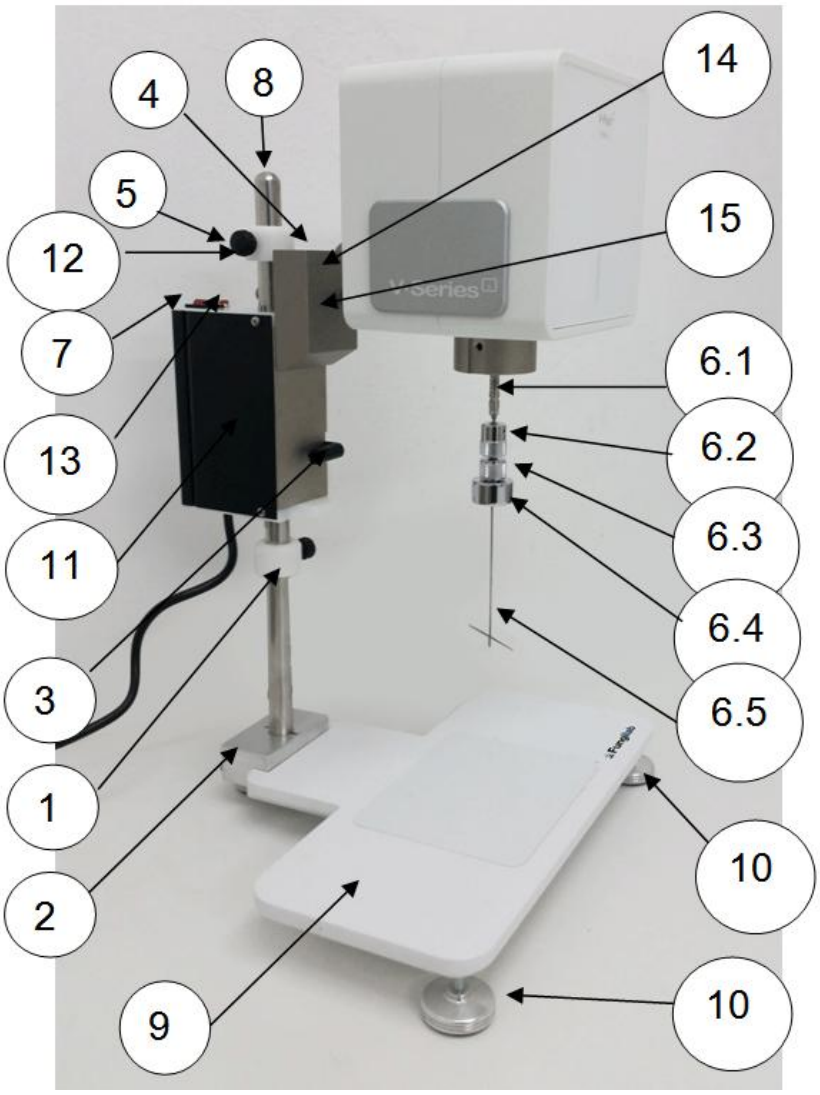


Fig. 16 Heldal unit set in the viscometer

1. Lower stop ring	9. Base
2. Rib joint	10. Levelling knobs
3. Displacement command	11. Heldal motor 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 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 Heldal 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 bottom of the container. If so, the viscometer's axe 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 main connection.

OPERATION:
The Heldal unit (which moves helicoidally) is moved up and down between the two stopper rings. When the motor touches one of them, the unit changes direction.
The Heldal unit will keep moving, until turned with the ON/OFF switch (7).

12. Model/Spindle correspondence tables

Standard Spindles + R1 (Table 1):

Viscometer model	Spindle
VPAD L	L1
	L2
	L3
	L4
	L5
VPAD R	R1
	R2
	R3
	R4
	R5
	R6
	R7
VPAD H	R1
	R2
	R3
	R4
	R5
	R6
	R7

SPECIAL SPINDLES FOR APM ADAPTER (Table 2):

Viscometer model	Spindle
VPAD L	L2C
	L3C
	TL5
	TL6
	TL7
	TL8
	TL9
VPAD R	TR8
	TR9
	TR10
	TR11
	TR12
	TR13
VPAD H	TR8
	TR9
	TR10
	TR11
	TR12
	TR13

SPECIAL HELDAL SPINDLES (Table 3):

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

SPECIAL SPINDLES FOR LCP ADAPTER (Table 4):

Viscometer model	Spindle
VPAD L	LCP/SP
VPAD R	LCP/SP

SPECIAL VANE SPINDLES (Table 5):

Viscometer model	Spindle
VPAD L	V71
	V72
	V73
	V74
	V75
VPAD R	V71
	V72
	V73
	V74
	V75
VPAD H	V71
	V72
	V73
	V74
	V75

13. 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	
TR13	
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	
TR13	

14. VPAD 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

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.

15. VPAD 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

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.

16. VPAD 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

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.

17. VPAD 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

Table 12.

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. VPAD 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

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.

19. VPAD L special Heldal 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.

20. VPAD 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

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.

21. VPAD 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	625K
30	1.6K	8.3K	16.6K	33.3K	16.6K	416.6K
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

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.

22. VPAD 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	44.2K
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

Table 17.

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. VPAD 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

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.

24. VPAD R special Heldal 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.

25. VPAD 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

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.

26. VPAD 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

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.

27. VPAD 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

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.

28. VPAD H special Heldal 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.

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.

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