

# User Manual

## DV Series Digital Viscometer



Please read the manual before installation and operation.

**Drawell International Technology Limited**

**Shanghai Drawell Scientific Instrument Co.,Ltd**

**Chongqing Drawell Instrument Co.,Ltd**

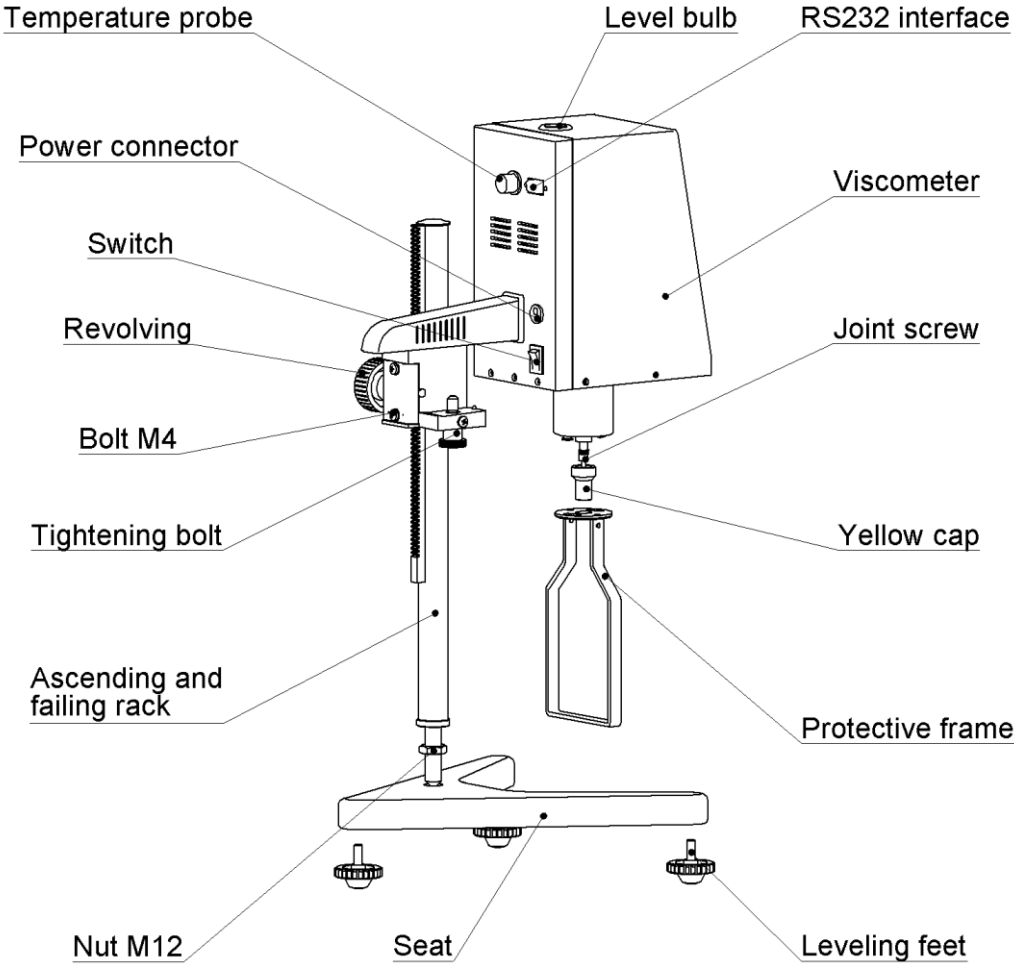
Add: Suite 2705, Building No.12, Shiyou Road No.1, Yuzhong District, Chongqing, China

Tel: 0086-023-63268643

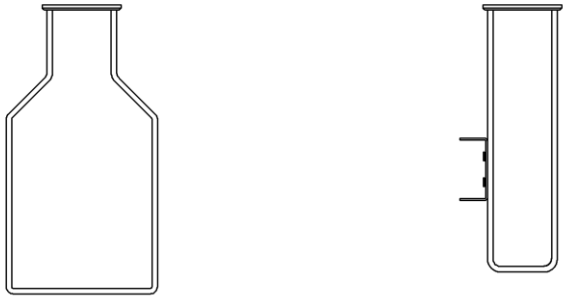
Web : [www.drawell.com.cn](http://www.drawell.com.cn)

Email : [sales05@drawell.com.cn](mailto:sales05@drawell.com.cn)

# Main Installing Chart



## Protective frame



suitable for RVDV-1, HBDV-1,  
RVDV-2 and HBDV-2 models

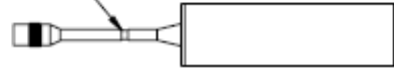
suitable for LVDV-1, LVDV-2 models



0# spindle

Special container

0#



L1



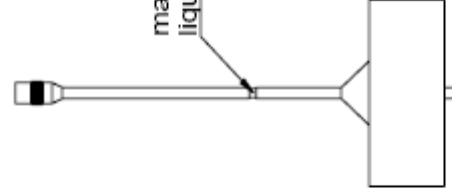
L2



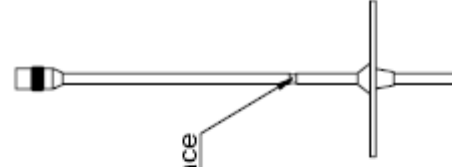
L3



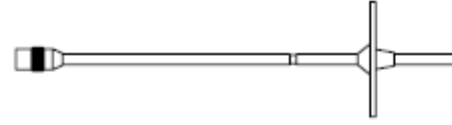
L4



R1



R2



R3



R4



R5



R6



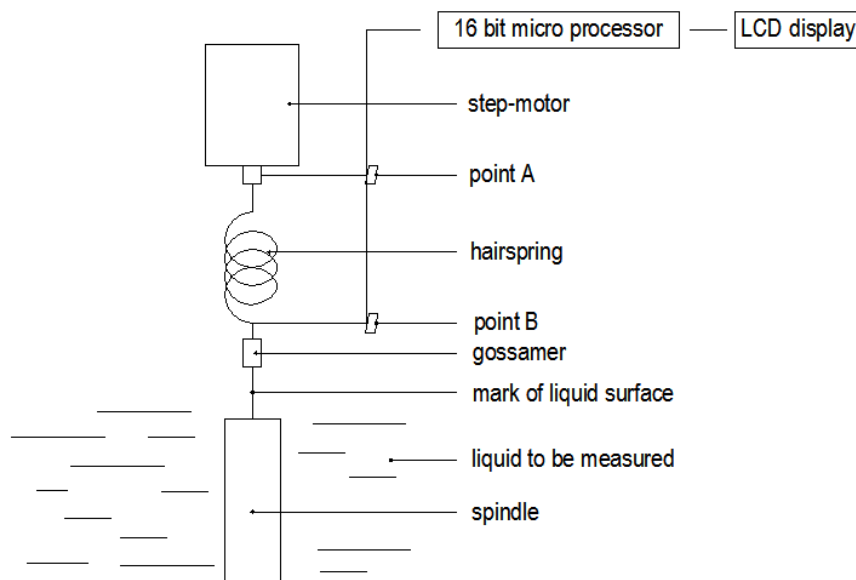
R7

## 1. Main Technical Parameters

Model	LVDV-1	RVDV-1	HBDV-1	LVDV-2	RVDV-2	HBDV-2
Standard spindle	L1~L4	R2~R7	R2~R7	L1~L4	R2~R7	R2~R7
Measuring Range (mPa·s)	12~6M	80~40M	640~320M	6~6M	40~40M	320~320M
Speed range (r. p. m. )	0.1~99.9 Stepless Gear			0.1~200 Stepless Gear		
Accuracy	±1%(FS) Newton liquid					
Repeatability	±0.5% (relative error)					
Power	Power adapter(input:100~240V 50~60Hz)					

## 2. Structure and Principle

As shown in the picture, The pointer of the load cell driven by the high subsection driven step-motor is driving the spindle to go round and round through the hairspring and rotating axis. If the spindle is not resisted by the liquid, the pointer of the hairspring load cell is in the same position with the pointer of the load cell for the step-motor. On contrary, if the spindle is being resisted by viscous liquid, the hairspring produces the wresting square and repel and balance with the viscous resistance for reaching the balance at large. At this moment, by transmitting the output signal by the photoelectrical load cell to 16 bit micro processor for data processing, the viscous value (mPa s) will be displayed on LCD screen with the night visual function.



## 3. Apparatus Composition

### Apparatus to be equipped

- |  |       |
|--|-------|
| 3.1 digital viscosity meter                            | 1 pce |
| 3.2 ascending and falling rack                         | 1 set |
| 3.3 protective frame of spindle                        | 1 pce |
| 3.4 power adapter                                      | 1 pce |
| 3.5 standard spindle (equipped according to the model) | 1 set |

- 3.6 spanner 1 pce
- 3.7 Seat and leveling feet 1 set
- 3.8 RS232 standard output interface 1 pce
- 3.9 RTD temperature probe (Temp range: 0℃～100℃ ) 1 pce

### **Spare optional**

- 3.10 Extreme low viscometer adapter (with one spindle L0)
- 3.11 Small sample adapter (with spindle 21, 27, 28 and 29 each)
- 3.12 Temperature-controlled heater (with spindle 21, 27, 28 and 29 each)
- 3.13 Spindle R1 (suitable for RVDV-1, HBDV-1, RVDV-2 and HBDV-2 models ONLY)
- 3.14 Specially used printer
- 3.15 Special software that can complete the function in collecting the data automatically
- 3.16 DV program control download software

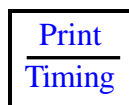
## **4. Installation (Please install as per the installing chart)**

- 4.1 Take out the seat, ascending and failing rack, viscometer, spindle support and so on;
- 4.2 Screw down the ascending and failing rack into the hole of the socket and tighten the screw with spanner.
- 4.3 By running the knob of the ascending and failing rack, check the agility and self-locking capacity of the collet of the ascending and failing rack. If loosening and tightening are found, you can adjust the bolt M4 on the back of the ascending and failing rack with the screw driver to make sure that it can be ascended and fallen. It will be better if it is screwed down more less tightened so as to prevent the viscosity meter from its going down after installed.
- 4.4 Install the viscosity meter on the ascending and failing rack and make it tighten with the bolt. The bolt that is unscrewed under the apparatus and remove and place the cap in yellow properly for next use. The cap in yellow plays a role in preventing the joint screw. It should cover the cap in yellow if it is not used for a longer time or being transported.
- 4.5 By adjusting 3 leveling feet to make sure that the bubble is in the middle position of the viscosity meter on the top.
- 4.6 Connect the RTD temperature probe with the interface.
- 4.7 Connect the viscometer and the AC power socket with the power adapter(input:100～240V 50～60Hz) provided. And then turn on the switch of the viscometer.

## **5. Function of keys**





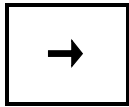
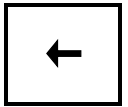
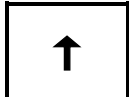
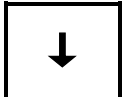
Reset the applied program



Printing/Timing function



Selection of the motor rotating speed

	Spindle Selection. The viscous value maximum measured under the current rotating	
	Start to measure	
	Shift rightwards	 Shift leftwards (DV-2, shear rate、shear force、viscosity number select Display)
	The number goes up	 The number goes down

## 6. Content Description on screen (Take LVDV-1 viscometer under certain condition as an example)

It is displayed when switching on and resetting the apparatus

LVDV-1

LVDV-1=Model of the apparatus, it will be displayed after 3 seconds

20.0	℃	60.0	RPM	45.7%
4	5	7	0.0	SP L4
				mPa • S

20.0 ℃ stands for the temperature measured by RTD temperature probe at ℃

SP L4 stands for Spindle L4, L0 stands for spindle L0, R 1 stands for spindle R1,..... The rest can be known in such sequences

60.0 RPM stands for the current rotating speed at RPM

4570 mPa • s stands for the maximum viscous value measured under the current rotating speed for the selected spindle at mPa • s

45.7 % stands for the mark of percentage meter, or called wrestling square. The mark of the percentage meter between 20% and 90% is regarded as normal figures. The viscosity meter will alarm if it beyond this figures. As result, the user will change the rotating speed and spindle.

## 7. Operation Steps (For items (1) and (2) please refer to the main installing chart)

- 7.1 Make sure that the set-up steps have been finished.
- 7.2 Install the guard leg of spindle on the viscometer (revolving clockwise for installing and anticlockwise for uninstalling with top-view method)
- 7.3 Lift the motor shaft slightly with left hand and hold it firmly, then hold the upper part of the spindle with right hand and screw clockwise (from a top view) the spindle and the motor shaft

to fix it.

- 7.4 Switch on the viscometer by pressing the button on the left side of the rear, then the screen flashes, the mainframe is on standby and the step motor does not work.
- 7.5 Input the spindle code, the displayed spindle code will be changed once the “spindle” key is pressed and the code is circulated among L1→L2→L3→L4→L0. The input is over when the selected spindle code is displayed.
- 7.6 Selecting the rotating speed: Once pressing the key for the speed, 60 or 60.0 will be displayed and “6” flickers if the speed is set at 60 in the previous operation. At this time, you can press the key for number going up or going down to set the tens digit of the rotating speed. And then press the key shifting rightwards to set the single digit and the tenth digit. If the shift is needed in reverse direction, press the key shifting leftwards. In this way, you can set the value of other digit. Press the key for confirmation when the setting is over.
- 7.7 By revolving the knob of the ascending and descending rack, the viscometer will go down slowly and the spindle will be immersed into the liquid that will be measured until the mark of the spindle is in the same level with the liquid. And then adjust the position of the viscometer to the horizontal level.
- 7.8 By pressing the “Run” key, the step motor start to work, then you can measure the viscosity and the torque of the spindle under the current rotating speed. If the liquid is non-Newtonian, the figures will change slowly.
- 7.9 In the course of measurement, if you need to change the spindle, you can press the “reset” key. At this moment, the motor stops and the viscometer is on standby. After the spindle is changed, you can continue to measure with the procedures from 7.5 to 7.8 mentioned above.
- 7.10 Pressing “Print/Timing” key to perform printing or timing measurement function.

Select the printing and timing measurement function: Switch on the power of the viscometer, and then press “Print/Timing” key when the viscometer is not in measuring state. Once “P:XX:XX” is displayed on the screen, the printing setting is selected. Press “Print/Timing” key again, once “T:XX:XX” is displayed on the screen, the timing setting is selected.

#### 7.11 Setting the time interval for printing

Press the “Print /Timing” key until “P:00:05” displayed on the screen. And then press one of the four direction keys to set the time interval according to your need. Using the direction keys <→> and <←> to move the cursor and the numerical increasing key <↑> and decreasing key <↓> to set the time interval. And press the “Print /Timing” key for final confirmation.

After the printer is connected, press the “Print /Timing” key to start the printing. “on” will be printed out and the printing will be performed at the interval time set. To stop printing, press the “Print /Timing” key again, “off” will printed out and the printing stops.

#### 7.12 Setting timing measurement

Since the spindle, rotating speed and measurement time should be selected in measuring the “non Newton liquid”. The operator can set different measurement time according to the properties of the samples. The detailed procedure is given as follows:

Press the “Print /Timing” key before it comes into the measurement state. Do not release the “Print /Timing” key until the LCD display has changed from “P:00:00” to “T:00:00”, and then a cursor will be found flickering on the screen. Using the direction keys <→> and <←>

and the numerical increasing key  $\langle \uparrow \rangle$  and decreasing key  $\langle \downarrow \rangle$  to select the measurement time. It should be noted that “T:00:00” stands for no timing; “T:00:10” stands for ten-second measurement; “T:05:00” stands for five-minute measurement and so on. When the measurement time is displayed on the screen, press the “Print /Timing” key once to exit the state of “edit”. Thus, the setting of timing measurement function has been completed.

Since the timing measurement has been selected and set, when the measurement time reaches a certain value for each measurement, the viscometer meter will stop measuring. And the LCD screen will display the current viscosity and be locked as well. This function provides the operators the convenience to record, compare and analyze the progress and result of the “non Newton liquid” measurement.

In case that this function has to be cancelled, set the measurement time to “T:00:00” in the same procedures above.

#### 7.13 Selection the display of shear rate and shear stress

This function is only provided in DV-2 series. At the standby state, press  $\langle \leftrightarrow \rangle$  key, display is circulated among viscosity measurement range (unit: mpa.s), shear rate (unit: 1/s) and shear stress (mpa). Note that the display of shear rate and shear stress are only applicable to cylindrical spindles.

## 8. Cautions

- 8.1 Be careful in installing and uninstalling the spindle. When installed and uninstalled, you should operate by uplifting the joint bolt slightly. Do not do it more forcibly. Do not make the spindle receiving the force horizontally to prevent the spindle from being bended.
- 8.2 Do not put the viscosity meter that is already installed aside or lay it down;
- 8.3 Keep the connecting side of the joint bolt with the spindle and the screw thread itself clean. Otherwise, it will effect the shacking degree of the spindle;
- 8.4 You should hold the ascending and failing rack in your hand when it is on raise and down to prevent it from dropping due to its deadweight;
- 8.5 After changing the spindle, you should input the new number of the spindle. The spindle that is used and changed should be cleaned first and then put on the rack of the spindle. Do not leave the spindle on the meter and clean it.
- 8.6 When the liquid is changed, you should clean (wipe up) the spindle and the protective frame of the spindle to avoid the error caused by the interblended liquid for measurement.
- 8.7 The viscosity meter is matched with the spindle. Do not interblend several viscosity meters with the spindles
- 8.8 Do not dismantle and adjust the spare parts in the viscosity meter with liberty.
- 8.9 When the viscosity meter is moved and transported, the yellow cap should be on the joint screw and the bolt should be screwed down and packed in the box.
- 8.10 After the spindle is installed, you do not circumrotate it for a longer in case of no liquid to prevent it from being damaged.
- 8.11 The suspended and confused liquid, high polymer and the other more condensed liquid have a lot of “ non Newton liquid”. Their viscous values are varied with the shear speed and the time. Therefore, their checking results under the different spindles and rotating speed are different. This is the normal case. It is not the error caused by the meter. Normally, you should regulate



the spindle ,rotating speed and time to measure the non Newton liquid.

## **9. The following points you should pay more attention for more accurate data**

- 9.1 More precisely control the temperature of the liquid to be measured
- 9.2 Clean the spindles and protective frame before measurement, When spindle L1-L4, R1-R7 is used the spindle protective frame must be installed;
- 9.3 When measured, the spindle is placed in the center of the vessel. Make the mark on the spindle and liquid surface at the same level. Adjust the viscometer to be horizontal.
- 9.4 Putting the spindle into the liquid to be measured for an enough longer time and keep the same temperature for both
- 9.5 You should turn off the apparatus at time when the measurement at high speed is changed into the measurement at low speed at one or keep a less longer time at the low speed to overcome the error that may be caused by the circumvolved inertia of the liquid.
- 9.6 When measuring the low viscosity, L1 of the spindle is chosen, and L4 of the spindle for the high viscosity.
- 9.7 The measure time for the viscosity measured at low speed is relatively longer.
- 9.8 The viscosity meter can be replaced by revolving the ascending and failing rack when you need to change the spindle and liquid to be measure in process of the measurement. Make sure to adjust the viscometer to be horizontal.
- 9.9 Test the viscometer frequently with standard viscosity liquid to check the performance.

## **10. Sampling measurement for unknown viscosity**

- 10.1 The General Principle for Measurement: For the sample with high viscosity, you should choose the little dimensioned spindle ( L3, L4) and slow rotating speed. For the sample with low viscosity, you should choose the large dimensioned spindle ( L1, L2) and fast rotating speed. When measured ,the mark measured by the percentage meter between 20% and 90% is the normal value. The viscous value measured within this range is the correct value.
- 10.2 You should estimate the viscous range of the sample to be measured first and then choose the little dimensioned spindle and the slow rotating speed as per the sample with high viscosity and choose the large dimensioned spindle as per the sample with low viscosity. In most cases, you should choose the spindle and then choose the approximate rotating speed. For example, when the spindle SP is L1,the rotating speed 60RPM , the full capacity displayed on the screen is 100mPa.s. And when the rotating speed is changed into 6RPM,the full capacity is 1000mPa.s.
- 10.3 When you can not estimate the viscosity of the sample to be measured, you should decide on the rationality of the spindle and the rotating speed as per the mark of the percentage meter (wresting square).The mark of the percentage meter between 20%—90% (10%-90% for spindle L0) is the normal value. If the value is not beyond this limit, the viscosity meter will alarm, reminding the user to change the rotating speed and spindle. Never forget to change the spindle as per the principle that the spindle is changed with changing the number of the spindle SP.

## 11. Simple troubleshooting

Facts	Possible Reasons	Solutions
The level bulb can NOT be adjusted to the center	The slope of the working desk is large	Put some rubber pieces under the seat to adjust the horizontal level
The value is NOT accurate in measuring the Newton liquid	Protective frame is not installed	See Item 9.2
	The spindle used and the code displayed are not coherent	See the main installing chart and Items 7.5 and 8.5
	The viscometer is not adjusted to horizontal level; or the level is changed due to other operations.	See Items 7.7 and 9.8
	the surface of liquid is under the liquid surface mark of the spindle	See Item 9.3
	Spindle is not installed properly	See Item 8.3
	The spindle is not cleaned after last measurement	See Item 8.6
	The spindle does not match the viscometer	See Item 8.7
	The sample temperature varies in Measurement	See Item 9.1 and Item 9.4
	Mechanical parts of the viscometer is aging or damaged	See Item 9.9
No display of temp	RTD temperature probe is not equipped	See Part 3
Display of temp is abnormal	RTD temperature probe is damaged	Change a new one
	The probe and the viscometer is not connected properly	Connect them again
Measurement stops automatically	Measurement time of the timing function is activated.	See Item 7.12
Viscometer alarm	Exceed the measurement range (Torque should be within 20% and 90%. For spindle code L0, the range is from 10% to 90%.)	Change the speed or spindle
Value always varies in measurement	The sample measured is non Newton liquid	See Item 7.10, 7.12 and Item 8.11
	The sample temperature varies in Measurement	See Item 9.1 and Item 9.4
	Mechanical parts of the viscometer is aging or damaged	See Item 9.9

**Drawell International Technology Limited**

**Shanghai Drawell Scientific Instrument Co.,Ltd**

**Chongqing Drawell Instrument CO,.Ltd**

Tel: 0086-023-63268643

Web : [www.drawell.com.cn](http://www.drawell.com.cn)

Email : [sales05@drawell.com.cn](mailto:sales05@drawell.com.cn)

