



**BLACK ONE**  
VISCOMETER  
*Operating  
instructions*





## LAMYRHEOLOGY

\_ viscosimètres

\_ rhéomètres



### CE CERTIFICATE OF CONFORMITY

Directive CEM 2004/108/CEE

Conformity of viscometers and rheometers :

BLACK ONE – FIRST RM – RM100 – RM200 – RM300

Verified according to the EN 55011 standard.

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## **1- Including parts in BLACK ONE Viscometer**

- 1- Electronic Measuring Head
- 2- Stand including:
  - Basis heavy feet with 1 screw for the rod
  - Stainless steel Rod (length 400 mm)
  - Aluminium arm with 2 fixation screws for the rod and the Head
- 3- Power supply with cable
- 4- All parts listed in the customers order (joined to this package)
- 5- Dimensions of the complete installed instrument:
  - L = 300 mm
  - l = 200 mm
  - h = 600 mm
  - Weight of instrument on his stand = 7 Kg



## 2-Introduction

### Viscosity

Viscosity is the capacity of a product to resist to the flow – by the way of a **Shear stress** (force by surface unit) – to a given **Shear rate** (speed which the sample is submitted).

### Influence of Temperature

Viscosity depends for a great influence of the temperature, then it must be essential that all viscosity values are associated to a reading of the sample temperature, in order to compare viscosity for different samples.

### Viscosity measurement

We impose to the fluid a certain **speed**, and we measure **The resistant Torque**. Those two values enables to calculate the viscosity value, with standard curves or coefficients related to the measuring systems used.

### Different substances

There are some products for which the viscosity, to a constant temperature, stay unchanged, even if we change the shear rate. Those samples are named **Newtonian fluids**, i.e.: Oils, Water, Glycerol, etc...However, many substances have a variation of viscosity in function of speed of shearing, and the Flow Behaviour of those samples could be determined only with the help with measuring instruments with many speeds of rotation.

## PRINCIPLE of MEASUREMENT

The viscometer is constituted with a continuous current motor with an optical encoder, in order to warranty a great accuracy of the speed of rotation of bob, on all torque range.

The viscometer has an easy back-lighted display reading, on which you could read the **Speed, Measuring spindle** reference, the measured torque and the dynamic **viscosity in mPa.s (=cPoises) (or Pa.s)**.

## 4- Installation and Measure

- Plug the stainless steel rod in this housing and fix it with the screw.
- Take in place the instrument on the Aluminium fixation bracket and fix it with the screw.
- Connect the supply box to the instrument.
- Connect the supply box to the electric current.

### 4.1- Zero Adjustment

- **In the air and without measuring spindle,**
- To press **simultaneously (AT THE SAME TIME)** on the **ON** and « **0** » keys,
- The unit turns during several seconds.

On the display, you read :

**Zero adjustment  
on the air,  
  
Please, wait.**



**This zero adjustment enables to avoid the motor frictions, which could appears with time.**

#### **IMPORTANT :**

Do not disturb the system during this adjustment.

This adjustment does NEVER be made IN A SAMPLE .

This adjustment could be made :

- After a transport,
- Before a verification of the instrument ;

**This adjustment doesn't be made before each measurement**



## 4.2- Start of measurement

Press **ON**.

**- choose the measure type :**

display shows :

**Direct measure  
Manual**

**E = enter**

### **4.2.1- direct measure:**

- if you want to the same measure than the last one, press « **E** »,

### **4.2.2- Manual :**

**a- choose the measuring system with arrows and enter it**

**Temp= 23.1°C**

**MS : ASTM 3**

↑↓ **Choice**

**E enter**

**b- Choose the speed with arrows and enter it:**

**speed = 100 rpm**

↑↓ **Speed choice**

**E enter**

**c- choose the measuring time in seconds :**

at the end of this time the display will be fixed on the last value .

**Measuring time : 60 s**

↑↓ **Time choice**

**E enter**

## **5- Calibration and Adjustment**

The adjustment and calibration of this viscometer is usually carried out by the manufacturer (LAMY RHEOLOGY) before the first sending to the customer, and with a frequency to define by the user. The measuring principle of the BLACK ONE, **without spring**, has no many drift in the time, then the **frequent adjustment can be every year or 2 years**. The **calibration, made on Newtonian, and stable oil by the user is sufficient to verify the measuring chain**: viscometer + bob + Pt100 sensor and if the result of this calibration isn't OK, then an adjustment could be decided.

## **6- Thermostatisation**

Thermostatic liquid bath, to maintain the product being tested at the test temperature with an accuracy of  $\pm 0.2^{\circ}\text{C}$ .

Recommended test temperatures are, in degree Celsius: 25, 40, 55, 70, 85, and 100.

## **7 – Choice of rotational speed and spindle**

Choose the rotational speed-spindle combination taking into account the value of viscosity to be measured, the desired precision and the velocity gradient. It is necessary to make this choice in such a way that no measurement corresponds to less than 0.05 mNm or more than 9.5 mNm of full-scale deflection. However, for the best accuracy it is advisable to choose the speed-spindle couple that it gives the highest torque. But you could decide to work with a lower accuracy to respect the same measuring conditions like another sample, above all you measure some non-Newtonian fluids, and start the reading from 0.01 mNm.

## **8- Procedure of measurement**

Mount the viscometer on its stand. Fill the beaker with the right volume (function of used cup, see tables hereafter) of sample to be tested, taking care not to introduce air bubbles, hang the cup to the head, then place it in the bath or the CT (if you have one) for a sufficient time to reach the desired temperature. If the product contains volatile matter or is hygroscopic, take care to close the beaker tightly during this operation.

Wait until the temperature of the sample is between the prescribed limits. Start the motor and run at the desired rotational speed.

Start the rotation, until the displayed value become stable, or impose a measuring time if the sample has a viscosity which decrease during time: thixotropic samples.

## **9- ASTM / ISO 2555 Standard**

### 9.1- Scope and field application:

This international Standard specifies a method of determining an apparent viscosity of sample, using a rotational viscometer.

The viscometer used must measure from 0.02 Pa.s (20 cP) to 470 000 Pa.s ( $470 \times 10^6$  cP).

### 9.2 - Principle:

A spindle of cylindrical or related form (disc), is driven by a motor at a constant rotational frequency in the product being studied.

The resistance exerted by the fluid on the spindle, which depend on the viscosity of the product, **causes resisting torque on the motor, measured by a current (mA)**, directly related to the dynamic viscosity of sample.

The apparent viscosity is obtained by multiplying this value by a coefficient which depends on the rotational frequency and characteristics of the spindle.

**This coefficient is inside the memory of the RM100 and it is selected when you choose the spindle reference before the test.**

The products to which this international Standard is applicable are generally non-Newtonian and the measured viscosity depends on the velocity gradient to which the products are subjected during the measurement.

With these types of spindles, the velocity gradient is not the same for every point of the spindle. Thus, for a non-Newtonian fluid, the result is not strictly the true "viscosity at a known velocity gradient" and therefore is conventionally called the apparent viscosity.





## MS ASTM-ISO2555 n°1 -7

MK -ASTM n°1  
Réf. 111000+111001



MK -ASTM n°2  
Réf. 111000+111002



Disque ASTM n° 3  
Réf. 111003



Disque ASTM n° 4  
Réf. 111004



Disque ASTM n° 5  
Réf. 111005



Disque ASTM n° 6  
Réf. 111006



MK -ASTM n° 7  
Réf. 111007

### 9.4- Procedure of measurement in ASTM Standard:

Mount the viscometer on its stand. Fill the beaker with 500 ml of sample to be tested, taking care not to introduce air bubbles, then place it in the bath (if you have one) for a sufficient time to reach the desired temperature. If the product contains volatile matter or is hygroscopic, take care to close the beaker tightly during this operation.

With the beaker still in the bath (or in room temperature), hold the spindle at the head of instrument, and immerse it in the product. Take care to bubbles appears under the disc !

Adjust the position of viscometer in the sample, in order the sample immerse the rod of bob until the level mark on the shaft. Be careful that the end of the bob is more than 10 mm from the bottom of the beaker.

Wait until the temperature of the sample is between the prescribed limits. Start the motor and run at the desired rotational speed.

**You must choose the spindle in function of the viscosity you would to measure:**

- For a low viscosity measurement, choose the ASTM 2, and turn at a high speed 100 rpm for example.
- For a High viscosity measurement, choose the ASTM 7, and turn at a low speed 1 rpm for example.



9.5- Maximum Viscosity (Pa.s) value according to speed and ASTM /ISO 2555 spindle

Speed rpm	Spindle number						
	Astm1*	Astm2	Astm3	Astm4	Astm5	Astm6	Astm7
250	0.56	2.22	5.56	11.12	22.26	55.65	222.6
200	0.69	2.78	6.95	13.91	27.82	69.55	278.2
100	1.39	5.56	13.91	27.82	55.65	139.1	556.5
60	2.31	9.27	23.18	46.36	92.75	231.8	927.5
50	2.78	11.13	27.82	55.65	111.3	278.2	1113
40	3.47	13.91	34.77	69.54	139.1	347.7	1391
30	4.63	18.55	46.36	92.72	185.5	463.6	1855
20	6.95	27.82	69.55	139.1	278.2	695.5	2782
12	11.59	46.37	115.9	231.8	493.7	1159	4937
10	13.91	55.65	139.1	278.2	556.5	1391	5565
6	23.18	92.75	231.8	463.6	927.5	2318	9275
5	27.82	111.3	278.2	556.5	1113	2782	11130
4	34.77	139.1	347.7	695.5	1391	3477	13910
3	46.36	185.5	463.6	927.2	1855	4636	18550
2.5	55.64	222.6	556.5	1112.8	2226	5565	22260
2	69.55	278.2	695.5	1391	2782	6955	27820
1.5	92.73	371	927.3	1854	3710	9273	37100
1	139.1	556.5	1391	2782	5565	13910	55650
0.6	231.8	927.5	2318	4636	9275	23180	92750
0.5	278.2	1113	2782	5565	11130	76800	111300
0.3	463.6	1855	4636	9272	18550	128000	185500

\*Available on request.

With this system, the speed N is expressed in rpm and not in s-1 because a shear rate can't be calculated.

$$1 \text{ Pa.s} = 10^3 \text{ cP}$$

9.6 – Additional accessory

Beaker, 90 to 92 mm in diameter and 115 to 160 mm in height is recommended to correspond to this Standard. **The normal volume of a such vessel is 600 ml .**

## 10- Technical features of the BLACK ONE viscometer

Measurement Principle : Rotational viscometer

34 rotations speeds : 0.3, 0.5, 0.6, 1,1.5, 2, 2.5, 3, 4, 5, 6, 10, 12, 20, 30, 40, 50, 60, 100, 200, 250 rpm (accuracy  $\pm 0,5$  %)

Torque range : 0 to 10 mN.m (accuracy  $\pm 1$  %)

Accuracy: +/- 1% of full range

Repeatability: +/-0.2%

Digital display: speed (rpm/min) ,Torque (mN.m), Dynamic viscosity (Pa.s) .

Admissible surrounding temperature : + 10° C to + 40° C

Viscosity range of different measuring systems :

MS ASTM ISO 2555	20	to	185 M mPa.s
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Power supply : 110-220 Vac 50/60 Hz

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