



First-RM ***USER MANUAL***



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 *first*RM 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- Plastic case with foam-rubber setting
- 5- All parts listed in the customer order (joined to this package)
- 6- All accessories listed in the including accessories list (see doc of first-RM)
- 7- Dimensions of the complete installed instrument:
 - L = 300 mm
 - l = 200 mm
 - h = 600 mm
 - Weight of complete 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 **shear rate**, 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

It exist 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.

PRINCIP of MEASURE

The *first* RM 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.

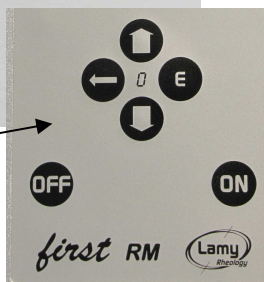
The viscometer has a very easy to read back-lighted display, on which you could read **Temperature** from the Pt100 sensor, the **Speed, Measuring spindle** reference, the measured torque and the dynamic viscosity in **mPa.s (=cPoises) (or Pa.s)**.

3- Front view / rear

Back-lighted LCD display



Multifunction Keyboard



USB Port

Parallel Port

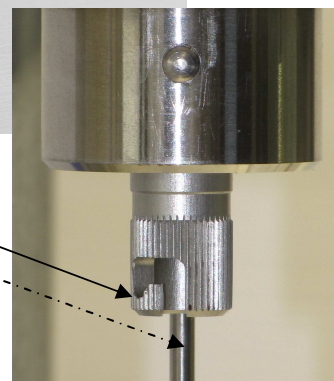


RS232 Port

Supply voltage

Coupling

Pt100 sensor



4- Installation of Instrument

- 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

- **WITHOUT MEASURING SYSTEM AND ON THE AIR**
- To press **simultaneously (AT THE SAME TIME)** on the **ON** and « 0 » keys,

The *first* RM turns to the speed memorized in order to correct the internal friction of the motor

On the display, you read :

**Zero adjustment on
the air,

Please, wait.**



This zero adjustment avoids the motor frictions, time of use.

which could appears in

IMPORTANT :

Do not disturb the *first* RM 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 the **ON** key on the *first* RM .

- **Choose the measuring mode**

The display indicates :

Temp= 23.1°C

Direct Measure

Manual

E = Valid

4.2.1-Direct Measure :

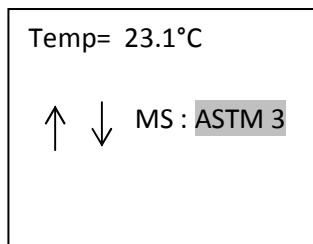
- If you want to start an identical measuring procedure like the previous one, press « **E** » to valid,
- If you want to define parameters for another measuring procedure, Go to « **Manual** » then press « **E** » to valid.

4.2.2- Manual measurement:

a- Choose the measuring system :

It must be correspond to the bob and the cup you've used for this measure, in order to calculated values will be right :

The display indicates :

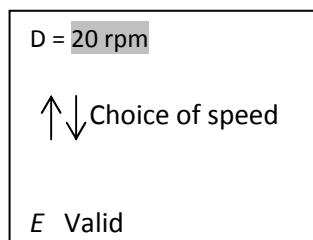


If the notified system agree to you, press « **E** » to valid,
If not read the list of geometries memorised in the instrument,
And selec the right one with « **E** ».

b- Choice of the rotating speed:

It enables to define the speed in rpm that the measure must be made:

The display indicates:

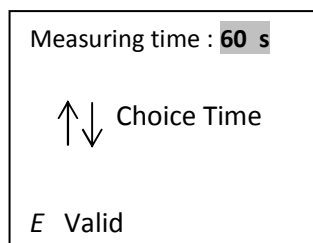


- If the notified speed is OK, Presse « **E** » to valid,
- If not read the list of memorised speed in the instrument,
with the help of arrows $\uparrow\downarrow$ and select which you want with « **E** ».

c- Time of measurement :

It enables to define a measuring time:

The display indicates:



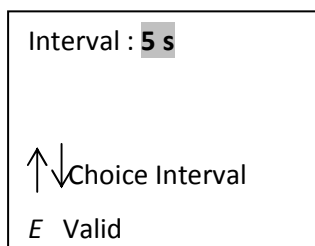
- If the displayed time is correct, press « **E** » to valid,
- If not read the list of predefined time, with arrows $\uparrow\downarrow$ and select which you want with « **E** ».

d- Printer Interval: (optional)

TO SELECT IT PRESS SIMULTANOUSLY “E” and “ON”, ENTER THE CODE “ ↑ ” “ E ” “ ↓ ” “ <--- ” AND SELECT “menu impression”, THEN “YES”:

If the *first* RM is connected to a printer by his parallel port, the results will be printed with this frequency:

The display indicates :



- If displayed interval is correct, press « E » to valid,
- If not read the list of predefined intervals , with arrows ↑↓ and select which you want with « E ».

e- Date

You could enter the date, on the following format: Day (JJ), Month (MM) and Year (AA).

The date stay in memory

If you want to change, modify the value and valid by « E ».

f- Sample Reference

If you want to add a sample reference, in order to print or transfer the data, you could scroll caracters on the alphanumeric keyboard with arrows ↑↓ select with “O” and valid with “E”.

To print, valid by pressing « E » to the end of measurement.

5- ASTM / ISO 2555 standard :

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 60 000 Pa.s (60 x 10⁶ cP).

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 firstRM end 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.

3 Apparatus:

The rotative viscometer *first* RM, cover the complete necessary torque range, from 0.05 to 10 mNm.

Each viscometer consists of:

- The viscometer head;
- The complete stand;
- The Pt100 sensor, to measure the sample temperature;
- Six interchangeable spindles numbered from 2 to 7 (form largest to smallest) (the optional number 1 disc is available on request).
- 21 rotational 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

Measuring Systems according ASTM/ISO 2555 standard

MS ASTM-ISO2555 n°2 -7



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

With this system , The speed N is expressed in rpm.

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.

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

*On request, non supplied in standard set of the first RM.

6- 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 *first* RM, **without spring**, has no drift in the time, then the **frequent adjustment is not really necessary**. 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.

7- Thermostatisation:

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

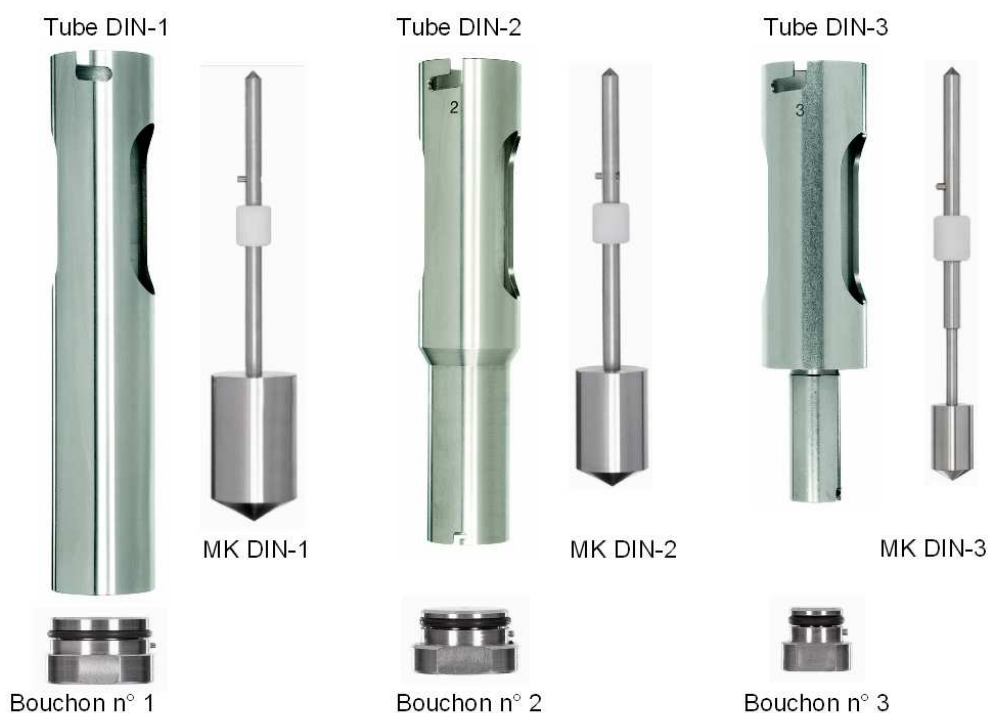
Recommended test temperatures are, in degree Celsius: 25, 40, 55, 70, 85, and 100.

8 – 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 .**

9 - DIN / ISO 3219 systems

MS – DIN 11, 22, 33



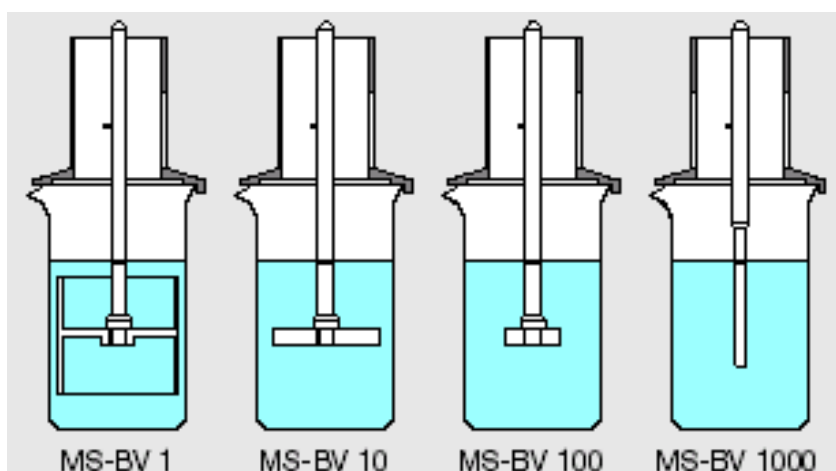


Maximum Viscosity (Pa.s) value according to speed and Systems DIN / ISO 53 019

Speed rpm	Spindle number					
	DIN11	DIN22	DIN33	DIN19	DIN12	DIN13
250	0.4	0.8	4	0.15	2.19	16.9
200	0.5	1	1.66	0.19	2.74	21.2
100	1	2	10	0.39	5.48	42.3
60	1.66	3.33	16.6	0.65	9.13	70.6
50	2	4	20	0.78	10.9	84.7
40	2.50	5	25	0.97	13.7	106
30	3.33	6.66	33.3	1.3	18.3	141
20	5	10	50	1.95	27.4	212
12	8.33	16.6	83.3	3.24	45.6	353
10	10	20	100	3.9	54.8	424
6	16.6	33.3	166	6.49	91.3	706
5	20	40	200	7.8	109.6	847
4	25	50	250	9.74	137	1059
3	33.3	66.6	333	12.9	182	1412
2.5	40	80	400	15.6	219	1694
2	50	100	500	19.5	274	2118
1.5	66.6	133	666	26	365	2824
1	100	200	1000	39	548	4236
0.6	166	333	1666	65	913	7061
0.5	200	400	2000	78	1096	8473
0.3	333	666	3333	130	1826	14122

10 - Measuring System MS-BV1 to 1000

- Select the desired measuring system : BV1, BV10 ,BV10, BV100 or BV1000,
 - Select the shear rate according the corresponding table hereafter :
- Ex. : with BV10 for 200 rpm, select 100 s-1, then viscosity will be calculated automatically in mPa.s (cPoises).



Shear rate and Viscosity for 5 mN.m according speed

Speed rpm	Measuring system Reference							
	BV1		BV10		BV100		BV1000	
	D s-1	Eta mPa.s	D s-1	Eta mPa.s	D s-1	Eta mPa.s	D s-1	Eta mPa.s
250	250	100	125	1000	37.5	10000	25	100000
200	200	125	100	1250	30	12500	20	125000
100	100	250	50	2500	15	25000	10	250000
60	60	410	30	4100	9	41000	6	410000
50	50	500	25	5000	7.5	50000	5	500000
40	40	625	20	6250	6	62500	4	625000
30	30	830	15	8300	4.5	83000	3	830000
20	20	1250	10	12500	3	125000	2	1250000
12	12	2000	6	20000	1.8	200000	1.2	2000000
10	10	2500	5	25000	1.5	250000	1	2500000
6	6	4100	3	41000	0.9	410000	0.6	4100000
5	5	5000	2.5	50000	0.75	500000	0.1	5000000

11 – 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 0.14 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 0.05 mNm.



12- Procedure of measurement with ASTM /ISO 2555 measuring system:

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, and the Pt100 sensor is immersed too. 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.

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.

13- Test report:

The test report shall include the following particulars:

- a. Reference to the ISO2555 international Standard,
- b. The designation of the product being tested,
- c. The test temperature,
- d. The reference of spindle,
- e. The reference of beaker,
- f. The speed of rotation,
- g. The value of apparent viscosity displayed and calculated by the viscometer.



14- Technical Features of first RM

Measuring Principle : Rotating Viscometer with coaxial measuring systems

21 speeds of rotation : 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 : Temperature ($^{\circ}\text{C}$), Speed (rpm), Torque (mN.m),
Dynamic viscosity (mPa.s (=cPoises) or Pa.s).

Temperature by PT100 sensor: From -20°C to $+120^{\circ}\text{C}$ (Resolution $0,1^{\circ}\text{C}$, accuracy $\pm 0,2^{\circ}\text{C}$)

Useful Temperature admitted: $+10^{\circ}\text{C}$ to $+40^{\circ}\text{C}$

Viscosity range of different measuring systems :

MS ASTM ISO 2555	20	to	185 M mPa.s
MS-DIN 11,22,33,19	5	to	42 M mPa.s
MS-BV 1-1000	3	to	10 M mPa.s

Supply voltage: 110-220 Vac 50/60 Hz

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