Operating Instructions

iVisc

Capillary Viscometer

LMV 830

Valid from series: 1
YAME0023/04/09

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First some safety information

Before you operate the device, read all the instructions and safety information thoroughly. If you have any questions or concerns, please feel free to call us.

Follow the instructions about installation, operation, etc., as only then can improper handling of the device be eliminated and the full warranty coverage maintained.

- The device is supplied with voltage from a computer through a USB cable.
- Transport the device with care.
- The device and its internal parts can be damaged by:

– dropping,

– vibration.

- The device may only be operated by appropriately instructed personnel.
- Do not put the device into operation when damaged.
- Only use the device for its intended purpose.
- Do not make technical modifications to the device.
- Have service and repair work carried out only by specialists.

The operating instructions contain additional safety information which is identified with a triangle with an exclamation mark ⚠. Read and follow the instructions! Ignoring the instructions can lead to severe consequences, e.g. damage to the device or other property, or to personal injury.

Technical modifications reserved.

Special symbols:

	*Caution*	This sign is used when improper handling can lead to property damage and/or personal injury.
	*Note*	Here, something in particular needs the reader's attention. In certain circumstances this includes a note about a hazard.
	*Reference*	Refers to further information in other chapters.

Table of contents

1 Safety information

1.1 General safety information

Viscosity measurements normally require very constant sample temperatures which are stabilised by means of laboratory thermostats. Hazards arise from this due to very high or very low measuring temperatures, due to fire and the general hazards arising from the application of electrical energy. The user is extensively protected by the application of the relevant standards.

Further hazard sources can arise from the type of material for which the temperature is to be stabilised or from the sample to be measured, e.g. upon exceeding certain temperature thresholds or with the fracture of the capillary and reaction with the tempering liquid.

In some cases hazardous liquids are used as solvents and cleaning agents when measuring viscosity with the iVisc. Here, it is essential to follow the instructions given in the safety data sheet for the hazardous substances.

In particular, when filling and emptying the viscometer and the reservoir and waste containers, suitable protective gloves and goggles must be worn. Before putting the device into operation, all tubing connections must be tightened to ensure there is no leakage.

Before any servicing operation or conversion all hazardous liquid residues must removed as completely as possible.

The device may only be used as intended, that is as described in these operating instructions. This includes operation exclusively by instructed specialist personnel.

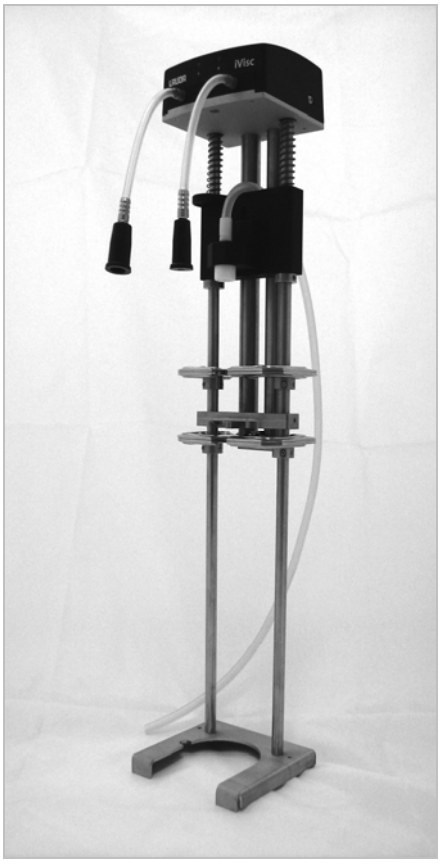
It is not feasible to include all possible situations. They remain essentially subject to the judgement and responsibility of the user or operator.

2 Package contents

After unpacking, first check the unit and accessories for complete scope of delivery and any transport damage that may have been incurred. If the device is found to be damaged, the shipping agent must be immediately informed so that verification and appropriate measures may take place. During this process, please inform the LAUDA Service Centre (⇨ 6.4) or an authorised LAUDA representative.

Damaged devices must not be put into operation.

Please check the package contents for complete scope of delivery:



iVisc Capillary Viscometer

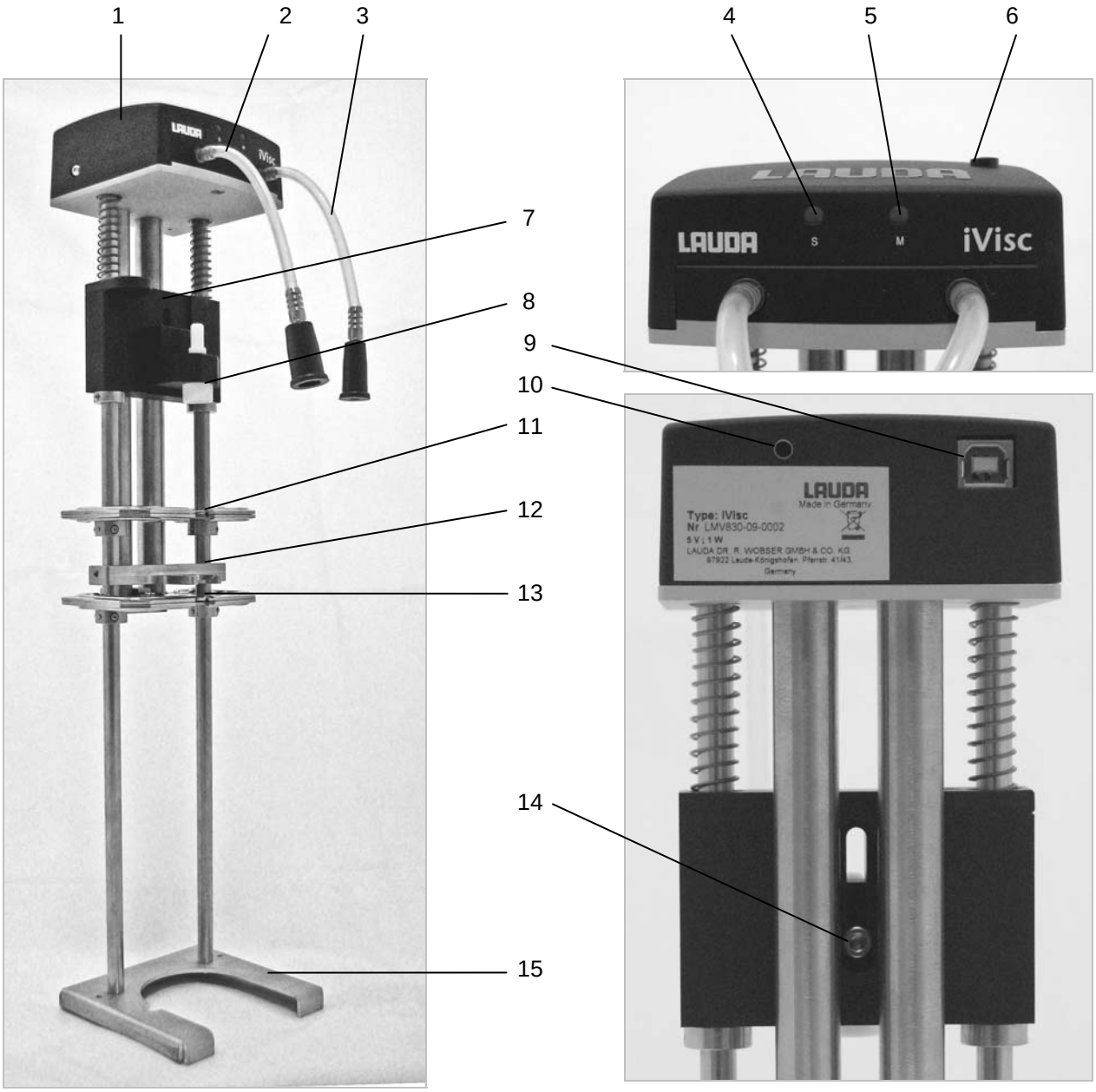
USB 2.0 connecting lead

Allen key, 3 mm AF

CD-ROM

Operating Instructions

3 Device description



1. Measuring head
2. Connection of capillary to filling tube
3. Connection of capillary to aeration tube
4. Fault indicator
5. Measurement indicator
6. Start / stop button
7. Clamping slide
8. Capillary tube connection
9. USB 2.0 connection
10. Measuring head aeration
11. Upper light barrier set
12. Viscometer capillary mounting
13. Lower light barrier set
14. Adjusting screw for capillary tube connection
15. Device base

4 Putting the device into operation

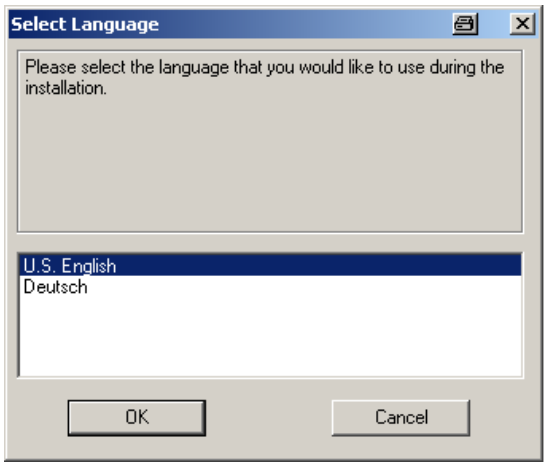
4.1 Installing the software

The iVisc only functions in conjunction with the software "LAUDA iVisc", which must be installed on a PC/ notebook/ netbook with the operating system Windows XP, Windows Vista or Windows 7.

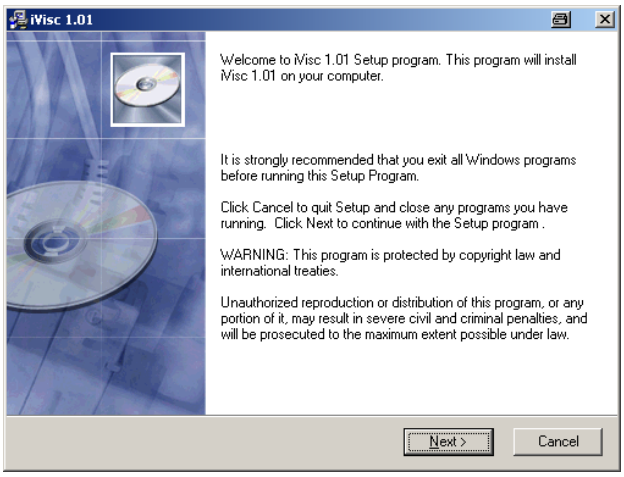
Before putting the device into operation for the first time, the appropriate software must be installed. For the initial installation the program starts automatically when the supplied CD-ROM is inserted. The program is self-explanatory. A maximum of two iViscs may be operated in parallel on one PC. The operating program is always assigned to one iVisc. If you want to operate two iViscs in parallel, you must install the software twice. When the serial number is entered, it is assigned to the corresponding device.

☞	A maximum of two iViscs can be operated in parallel on one PC.
⚠	It is essential to only connect the iVisc to the PC once the software has been installed.

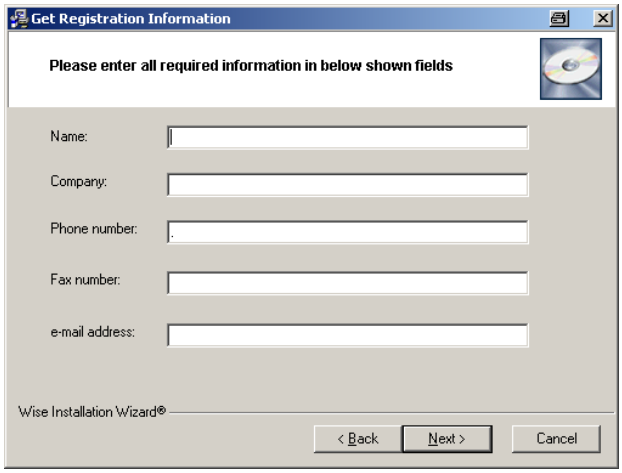
1. Language selection for the installation.



2. Starting the installation program

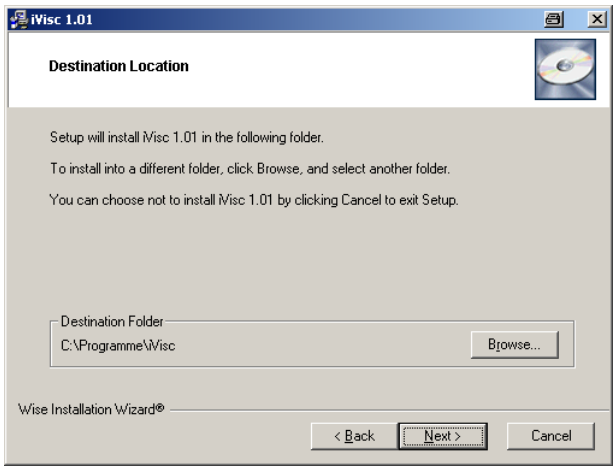


3. Registration

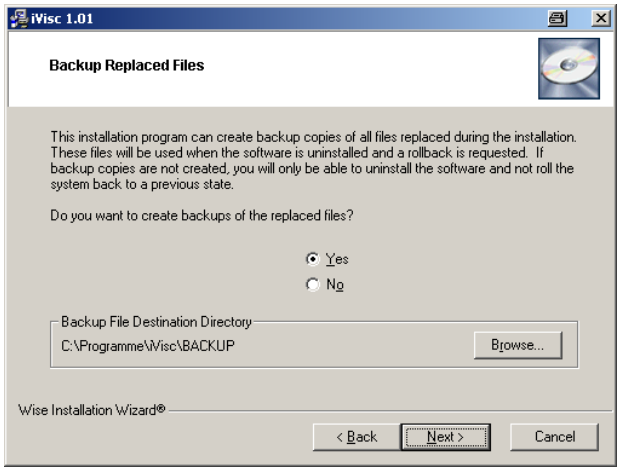


4. Serial number of your iVisc (at rear of device)

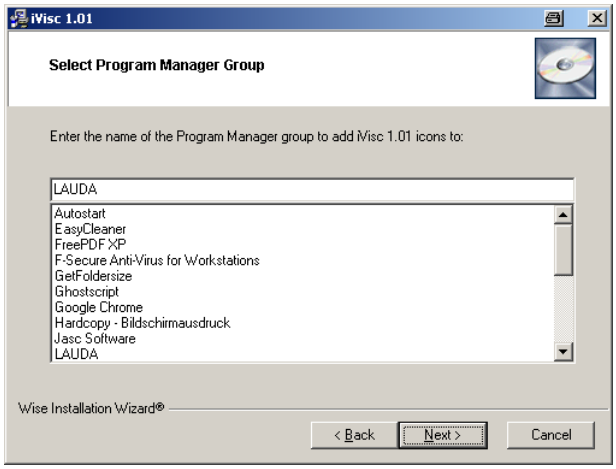
5. Select the destination folder for the software.



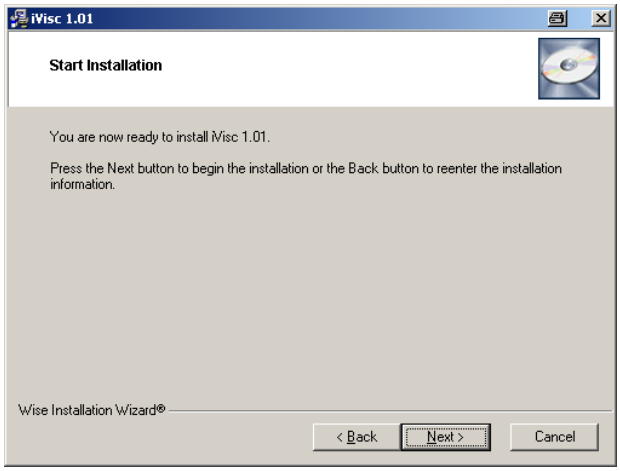
6. Backup copies for later rollback.



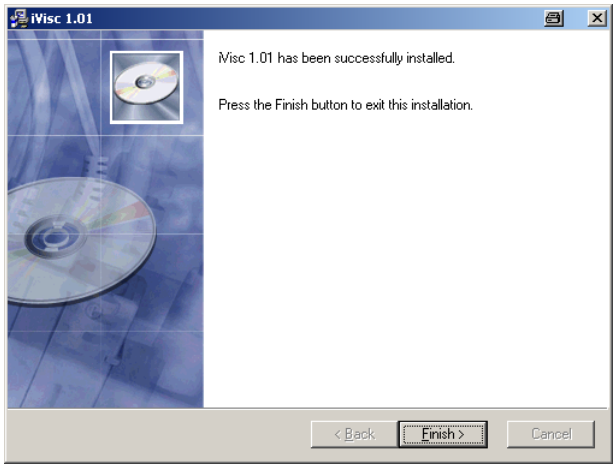
7. Select the Program-Manager Group.



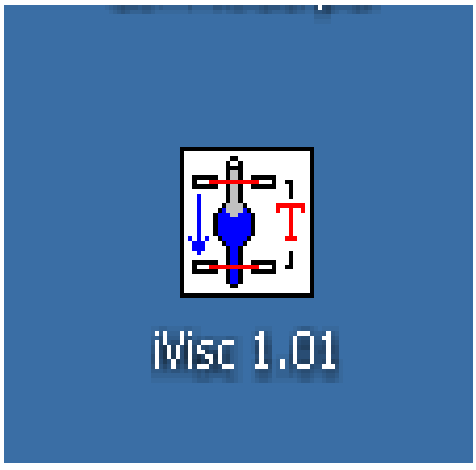
8. Install the software.



9. Finish software installation.

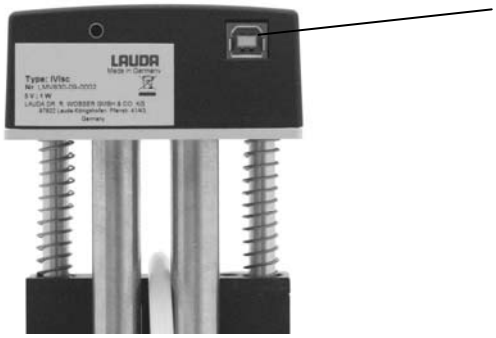


10. iVisc 1.01 icon in your destination folder



4.2 Connecting the device

Once the installation is complete the iVisc may be put into operation. Place the iVisc in a stable position in a thermostatic bath and connect it to the PC using the supplied USB 2.0 cable.



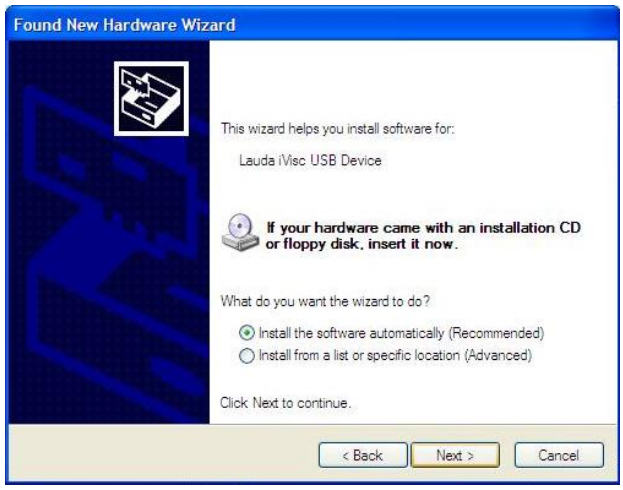
The USB 2.0 interface is located at the back of the device.

4.3 Installing the device

Once the iVisc has been connected to the PC, the Device Manager starts automatically.

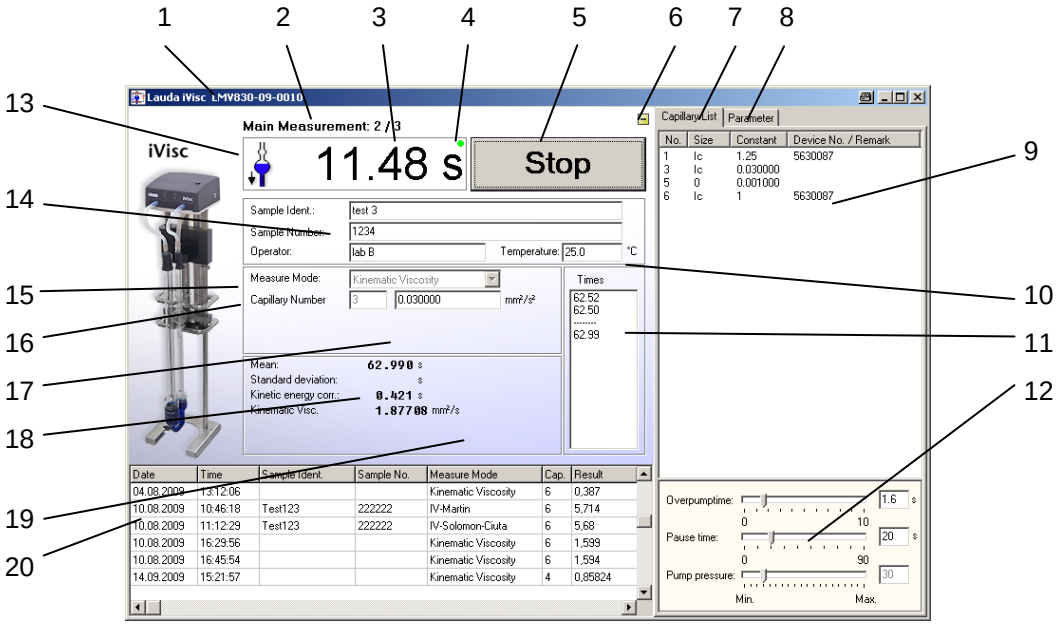
1.

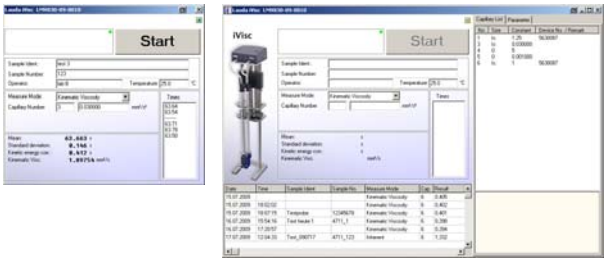
2.

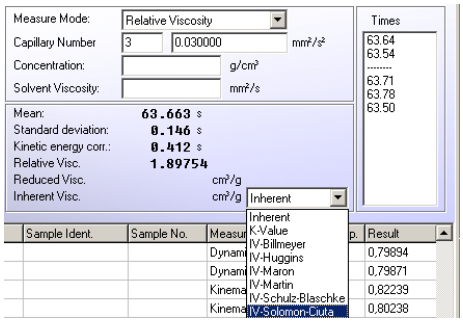


3.

4.4 User interface



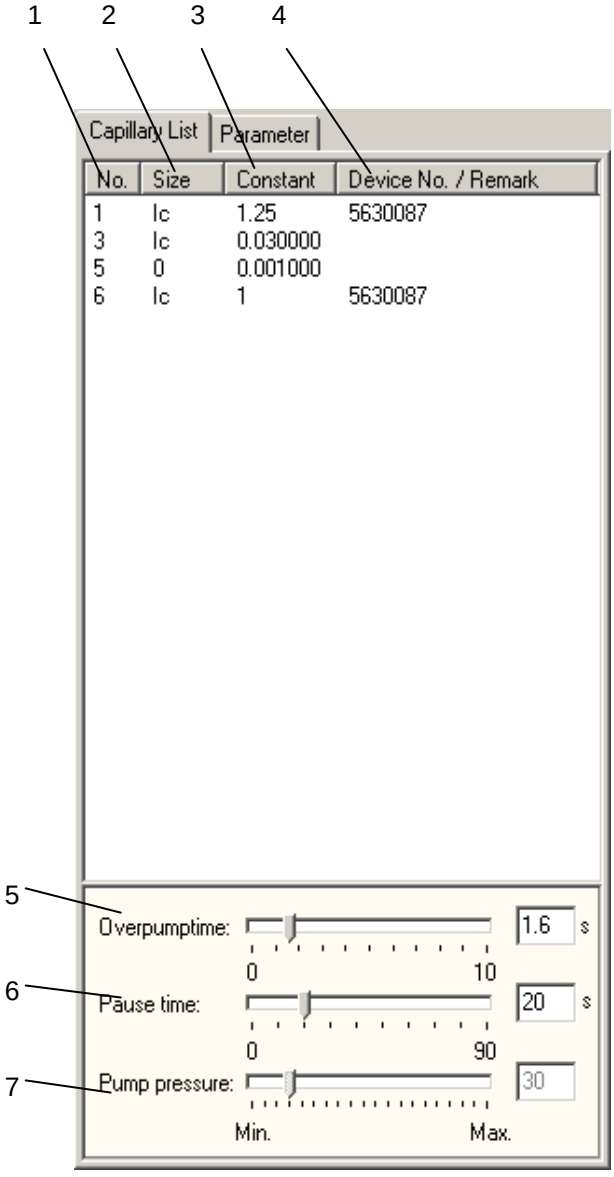
1.	Status line stating the serial number of the corresponding iVisc.
2.	Measurement status details.
3.	Duration of the test.
4.	iVisc display ● green: certified iVisc found ● red: no certified iVisc found
5.	Start / stop button.
6.	Screen enlargement / reduction for parallel operation of two systems with ⊞ or ⊟ 
7.	Capillaries tab (⇨ 3.4.1).
8.	Parameters tab (⇨ 3.4.2).
9.	Display of capillaries used (⇨ 4.4.1).
10.	Test temperature.
11.	Display of measured flow times (⇨ 5.3).
12.	Display of set capillary parameters.

13. Symbol for measurement status	Filling 	Measuring 	Drain / Pause 
14. Designation for unambiguous sample assignment	Sample ident.	Sample number	Operator
15. Measurement modes	Kinematic Viscosity	Dynamic Viscosity	Relative Viscosity
16. Selected capillary	Capillary number and capillary constant		
17. Other input fields	Relative Viscosity	Concentration Solution viscosity	[g/cm³] [mm²/s]
18. Measurements	Kinematic Viscosity	Mean of flow time Standard deviation Kin. energy correction Kinematic viscosity	[s] [s] [s] [mm²/s]
	Dynamic Viscosity	Mean of flow time Standard deviation Kin. energy correction Kinematic viscosity Dynamic viscosity	[s] [s] [s] [mm²/s] [mPas]
	Relative Viscosity	Mean of flow time Standard deviation Kin. energy correction Relative viscosity Reduced viscosity Inherent viscosity	[s] [s] [s] [cm³/g] [cm³/g]
19. Further selection menu	Relative Viscosity		
20. Display of test results.			

4.4.1 Managing capillaries

Capillaries are managed in the capillary list. Upon starting for the first time no capillaries are applied. The window is blank.

It is possible to apply new capillaries at any time, to select them and to modify and delete the parameters.

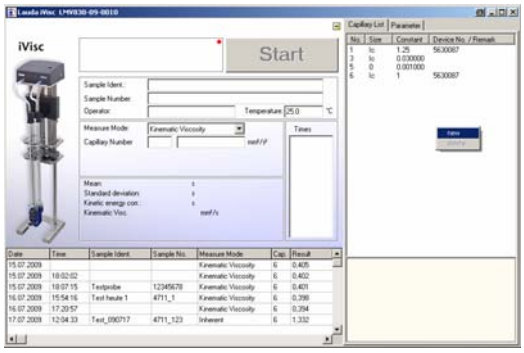


1. Capillary number.
2. Capillary size.
3. Capillary constant
4. Device No. or field for remarks.
5. The over-pump time assigned to the capillary [s]
6. The pause time assigned to the capillary [s]
7. The pump pressure assigned to the capillary

4.4.1.1 Applying / changing capillaries

The window 

appears by clicking with the right mouse key in the field Capillary list.

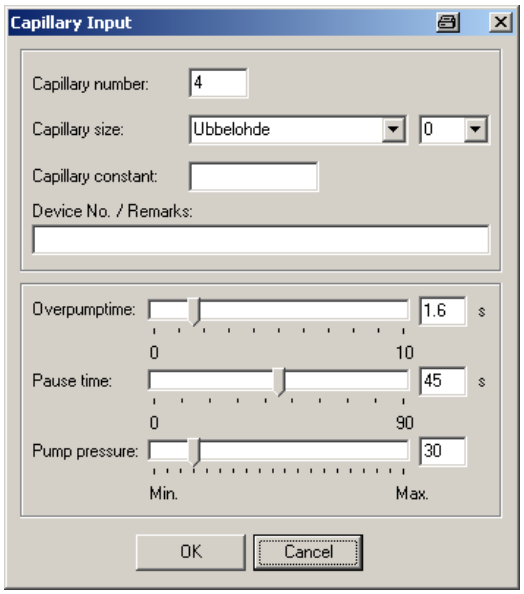


Clicking on 

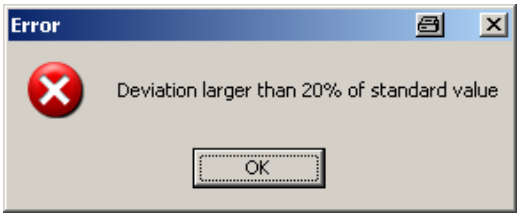
opens the window "Capillary input". Here, the appropriate capillary size can be selected and suitable values entered. The parameters are set using the slide controls.

Confirm with 

and the applied capillary appears in the capillary list.



☞	The capillary constant specified by the manufacturer must be entered. If entry is incorrect, an error message is displayed.



With a double click on an already applied capillary the window "Capillary input" appears and the parameters and capillary can be adapted. The capillary number is however retained.

4.4.1.2 Deleting capillaries

Mark the capillary to be deleted in the capillary list and 

appears on clicking with the right mouse key.

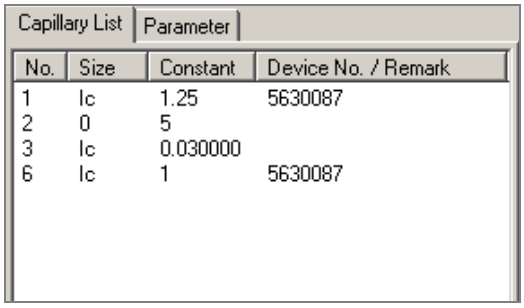
Click on 

and a warning message appears.

Confirming with 

deletes the capillary and 

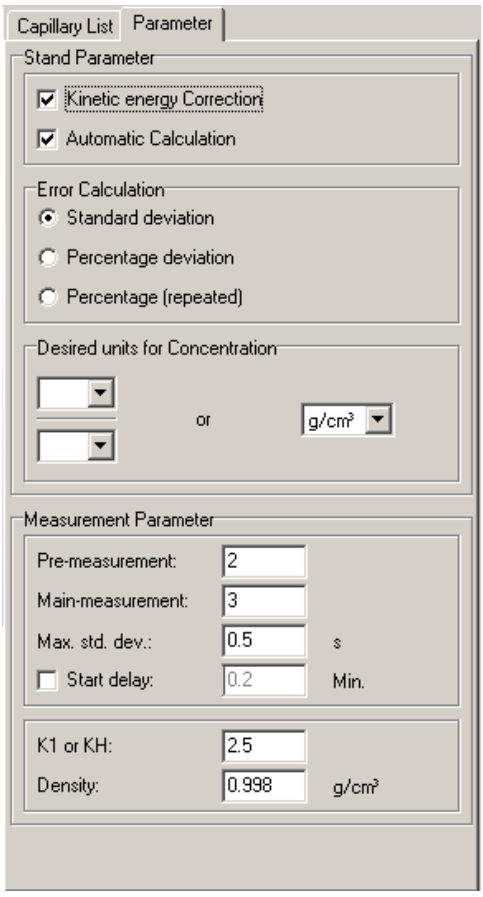
aborts the action.



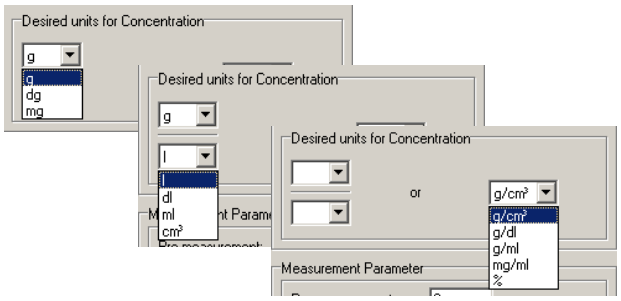
4.4.2 Managing parameters

Access to the appropriate menu is obtained by clicking the tab Parameter.

Here, all the necessary parameters can be set.



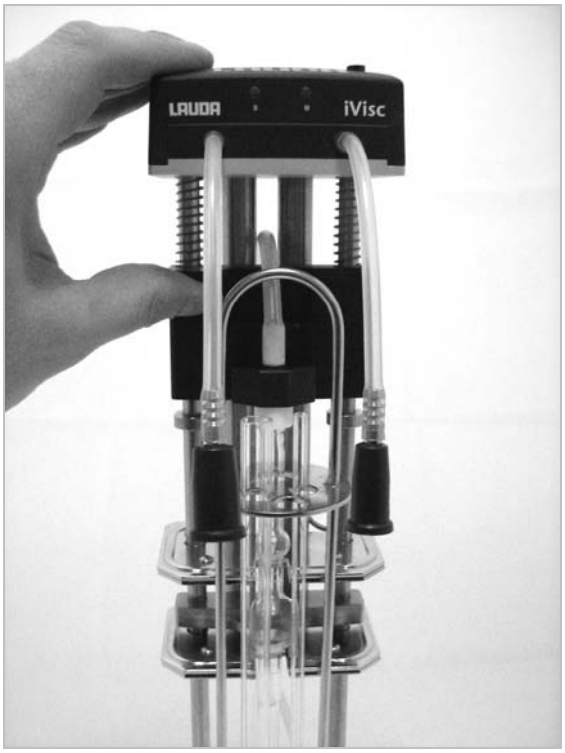
Changing the input and output units by clicking the pull-down menus.



5 Measurement

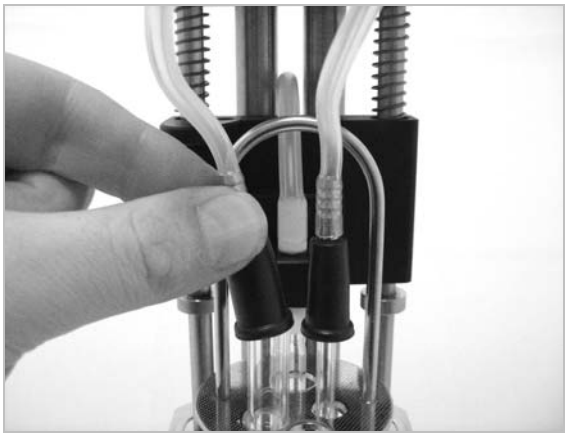
5.1 Preparing for a measurement

Insert the selected and filled capillary into the iVisc. The capillary can be used both with a stand or without a stand.



☞	Use Adapter HKB 532 for viscometer types 3 and 4 (Micro-Ubbelohde).

Connect capillary and connect the iVisc to the PC (USB 2.0).

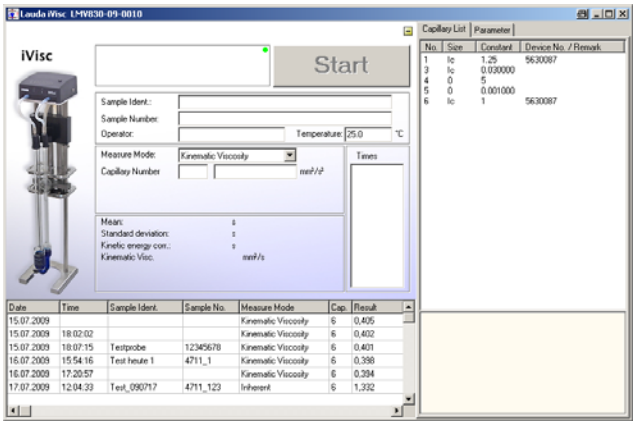


⚠	The aeration tubing must be connected to prevent the risk of chemical burns when using hazardous substances

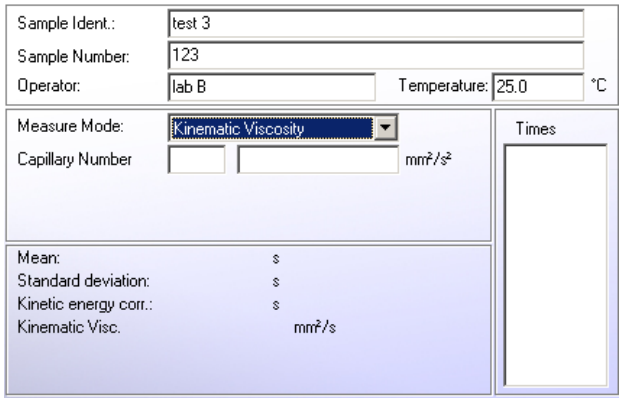
☞	The aeration connection remains free when using Cannon-Fenske or Micro-Ubbelohde.

5.2 Starting the measurement

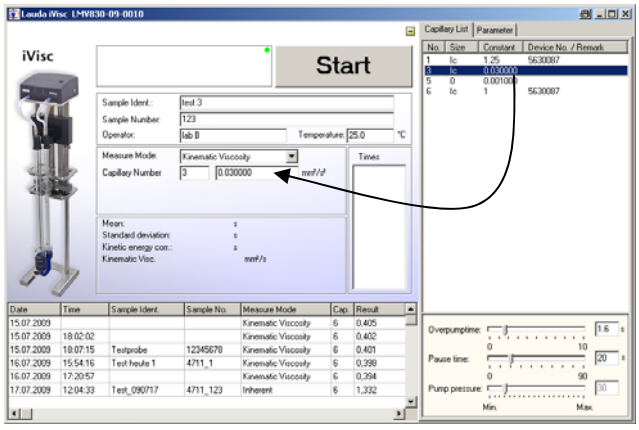
1. Start the "LAUDA iVisc" program



2. Enter sample details and select measurement method



3. Add the capillary by drag & drop

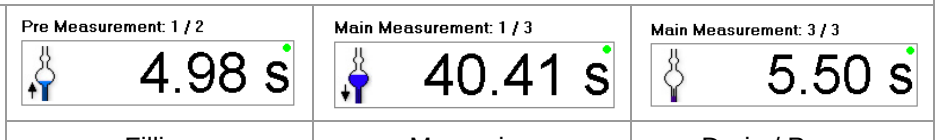


Start the measurement

Click on **Start** or press the start button.

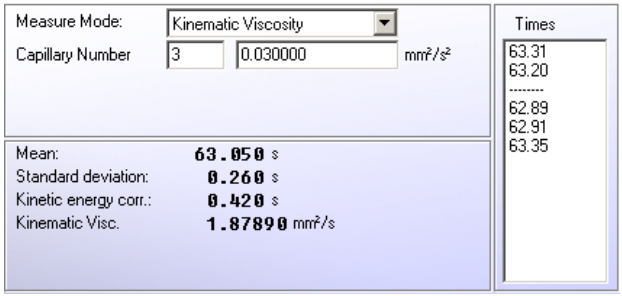
The measurement runs automatically and the results are displayed immediately. The measurement can be interrupted at any time by clicking on **Stop** or pressing the start button.

Symbols, description and seconds display indicate the status of the measurement.



Filling	Measuring	Drain / Pause

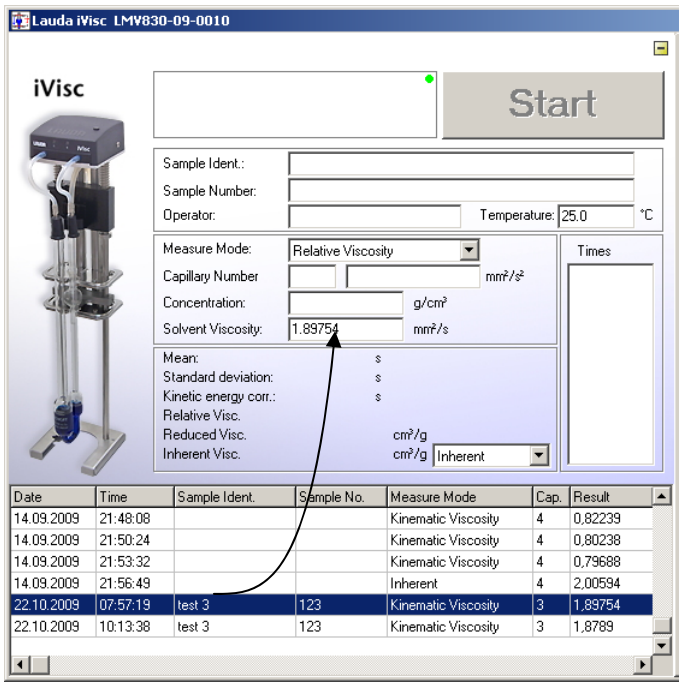
Display of flow times and results.



5.2.1 Relative viscosity

For the measurement of relative viscosity there is the possibility of using the test result of an existing measurement as a reference value in that it is simply transferred by drag & drop from the results table into the field "Solvent viscosity".

However, this procedure is only possible if the desired reference value is the result of a measurement of the kinematic viscosity.

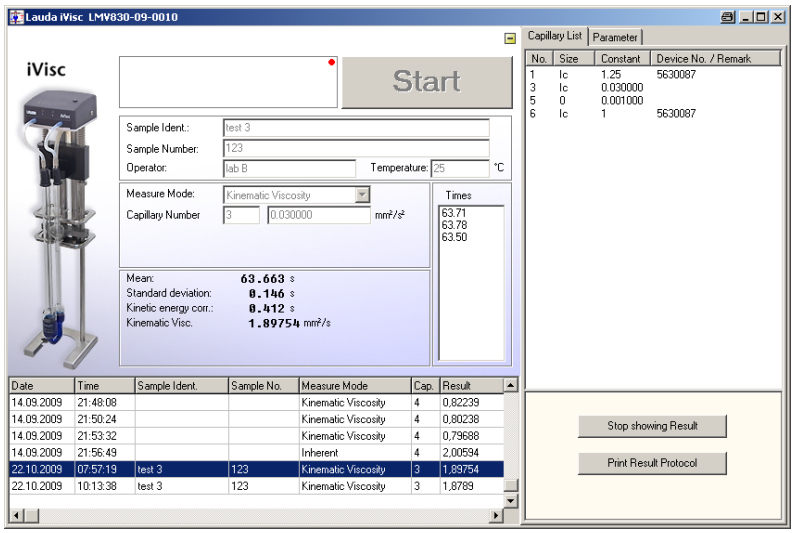


5.3 Displaying saved measurement results

Results are permanently saved and displayed in the results table. A detailed display is obtained by double clicking on the relevant results row.

Clicking on 

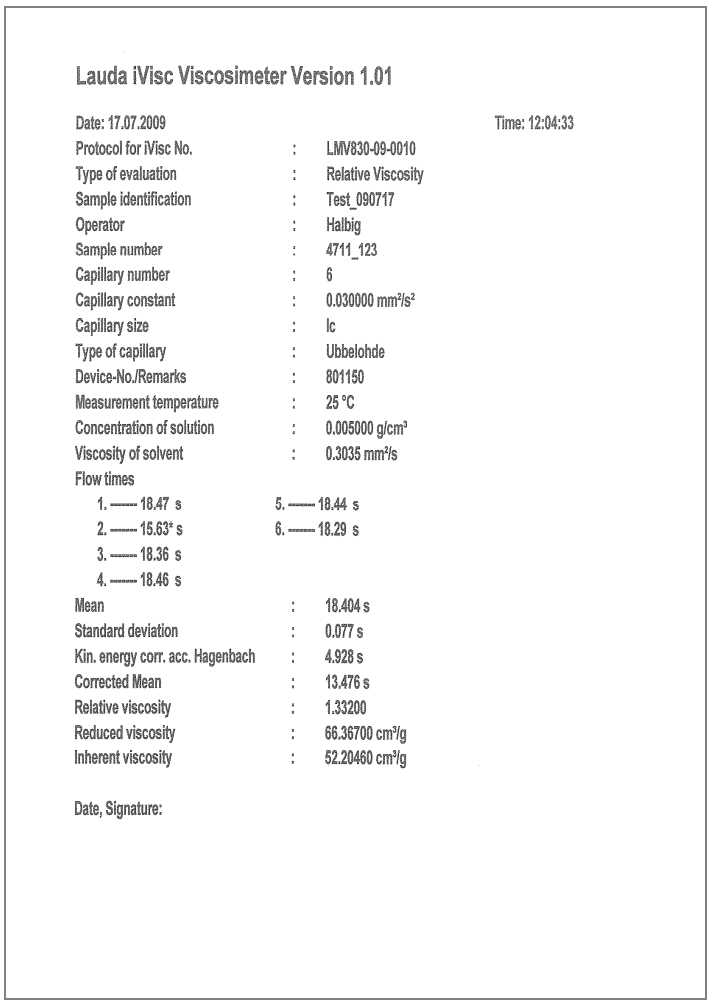
resets the user interface to the starting status.



5.3.1 Printing out the result protocol

Click 

to print out a result protocol.



Lauda iVisc Viscosimeter Version 1.01

Date: 17.07.2009 Time: 12:04:33

Protocol for iVisc No.	:	LMV830-09-0010
Type of evaluation	:	Relative Viscosity
Sample identification	:	Test_090717
Operator	:	Halbig
Sample number	:	4711_123
Capillary number	:	6
Capillary constant	:	0.030000 mm²/s²
Capillary size	:	Ic
Type of capillary	:	Ubbelohde
Device-No./Remarks	:	801150
Measurement temperature	:	25 °C
Concentration of solution	:	0.005000 g/cm³
Viscosity of solvent	:	0.3035 mm²/s
Flow times		
1. ------ 18.47 s		5. ------ 18.44 s
2. ------ 15.63* s		6. ------ 18.29 s
3. ------ 18.36 s		
4. ------ 18.46 s		
Mean	:	18.404 s
Standard deviation	:	0.077 s
Kin. energy corr. acc. Hagenbach	:	4.928 s
Corrected Mean	:	13.476 s
Relative viscosity	:	1.33200
Reduced viscosity	:	66.36700 cm³/g
Inherent viscosity	:	52.20460 cm³/g

Date, Signature:

6 Appendix

6.1 Formulas used

The computational formulas implemented in the iVisc software are given in the following. First the quantities and correction used for the absolute viscosity values (⇨ 6.1.1), then the computations implemented for the solution viscosity values (⇨ 6.1.2) and the current approximation formulas for estimating the intrinsic viscosity values for plastics and other macro-molecules (⇨ 6.1.2).

6.1.1 Computation of absolute viscosity values

Method	Formula	Terms	Unit
Kinematic viscosity:	$v = k \times (t - \Delta t)$	v Kinematic viscosity k Capillary constant t Flow time Δt Kinetic energy correction time	mm^2/s mm^2/s^2 s s
Kinetic energy correction according to Hagenbach	$\Delta t = \frac{E}{k \times t^2}$	E Kinetic energy correction factor	$s\ mm^2$
Dynamic viscosity	$\eta = \rho \times v$	η Dynamic viscosity ρ Density	g/cm^3

6.1.2 Formulas used for solution viscosity values

Method	Formula	Terms	Unit
Relative viscosity:	$v_{rel} = \frac{v_{solution}}{v_{solvent}}$	v_{rel} Relative viscosity	---
Specific viscosity:	$v_{spec} = v_{rel} - 1$	v_{spec} Specific viscosity	---
Reduced viscosity: (Viscosity number, VZ)	$v_{red} = \frac{v_{rel} - 1}{C}$	v_{red} Reduced viscosity	cm^3/g
Inherent viscosity (log. viscosity number)	$v_{inh} = \frac{\log v_{rel}}{C}$	v_{inh} Inherent viscosity C Concentration	cm^3/g g/cm^3
K-value accord. to Fickentscher e.g. for polyvinyl chloride (PVC), polyvinyl acetate (PVA)	$K = \frac{a - 1 + \sqrt{1 + \left(\frac{2}{C} + 2 + a\right) \times a}}{150 + 300C}$ $\text{where}: a = 1.5 \times \log v_{rel}$	K K-value C Concentration	--- g/cm^3

6.1.3 Approximation formulas for estimating the intrinsic viscosity

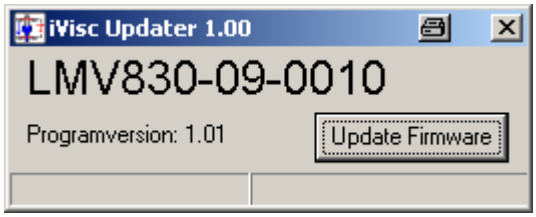
Listed below are the available approximation formulas for estimating the intrinsic viscosity values for plastics and other macro-molecules by using the above solution viscosity coefficients for a specified polymer concentration and polymer-specific adaptation parameters.

In contrast to the LAUDA PVS system, with the iVisc it is not possible to automatically accept a dilution series for the determination of the intrinsic viscosity according to the extrapolation method nor is it possible to graphically display it.

Method	Formula	Terms	Unit
Solomon-Ciuta e.g. for: PMMA and others	$v_{\text{int}} = \frac{\sqrt{2 \times (v_{red} \times C - \ln v_{rel})}}{C}$	v_{int} Intrinsic viscosity v_{red} Reduced viscosity C Concentration	cm^3/g cm^3/g g/cm^3
Schulz-Blaschke e.g. for:PE (polyethylene), PP (polypropylene) and others	$v_{\text{int}} = \frac{v_{red}}{1 + K_{SB} \times C \times v_{red}}$	K_{SB} Schulz-Blaschke constant (e.g.: K_1 = 0.27 for PE)	---
Billmeyer e.g. for: PETP , PBTP (polyethylene(butylene) terephthalate) and others	$v_{\text{int}} = \frac{1}{4} v_{red} + \frac{3 \times \ln v_{rel}}{4C}$	(No other parameters required)	---
Huggins e.g. for: PS (polystyrene) and others	$v_{\text{int}} = \frac{\sqrt{1 + 4K_H \times v_{spec}} - 1}{2 \times C \times K_H}$	K_H Huggins constant	---
Martin e.g. for: cellulose, -acetate and others	$\log v_{red} = \log v_{\text{int}} + K_{MT} \times v_{\text{int}} \times C$	K_{MT} Martin constant (e.g.: K_{MT} =0.13 for CED)	---
Maron For special polymers	$v_{\text{int}} = \frac{v_{spec} + K_{MR} \times \log v_{rel}}{(1 + K_{MR}) \times C}$	K_{MR} Maron constant	---

6.2 Update

It is possible to install a current firmware update for your iVisc via the LAUDA home page.



☞	When updating the software, only one iVisc must be connected to the computer!

6.3 Technical data

iVisc Capillary Viscometer		
Meniscus detection		Optical (near infra-red)
Light barrier control		µP
Sample temperature range	°C	-20 to 150
Ambient temperature	°C	10 to 45
Time measuring range	s	up to 9999.99
Recommended measuring range for flow time	s	30…1000
Viscosity range	mm²/s	0.3 to 30000
Time measurement resolution	s	0.01
Time measurement error	ppm	1
Overall power consumption	W	1
Dimensions (WxDxH)	mm	95x96x425
Voltage supply		USB
Weight, net	kg	1.4

6.4 Accessories

Description	Application / function	LAUDA order no.
Stand	Secure mounting of capillary	UG 003
Adapter	Mounting for Micro-Ubbelohde	HKB 532
Connection cap, small	Aeration connection	HKA 147
Connection cap, large	Pressure connection	HKA 148
Viton tubing 3×1.5	Tubing (available by the meter)	RKJ 021
USB 2.0 AB cable	Power supply for iVisc	EKS 083
Centring piece	Overflow connection	HX 630
PC; notebook; netbook	Control of the iVisc	Upon request

6.5 Repair and service information

Have repairs carried out only by specialists.

When sending in a device, please ensure that it is carefully and properly packed. LAUDA cannot be held liable for any damage due to improper packing.

If you want to send in a device for repair, it is essential to first consult the LAUDA Instrument Service or an authorised representative.

Your contact for maintenance and expert service support:

LAUDA Instrument Service SMG

Phone:

+49 (0)9343/ 503-148 Mr. Stastny (Techn. Support)

+49 (0)9343/ 503-128 Ms. Brömel (Support)

We are available at any time for questions, concerns, ideas and feedback.

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BESTÄTIGUNG / CONFIRMATION / CONFIRMATION

An / To / A:
LAUDA Dr. R. Wobser • LAUDA Service Center • Fax: +49 (0) 9343 - 503-222

Von / From / De :

Firma / Company / Entreprise: _____

Straße / Street / Rue: _____

Ort / City / Ville: _____

Tel.: _____

Fax: _____

Betreiber / Responsible person / Personne responsable: _____

Hiermit bestätigen wir, daß nachfolgend aufgeführtes LAUDA-Gerät (Daten vom Typenschild):
We herewith confirm that the following LAUDA-equipment (see label):
Par la présente nous confirmons que l'appareil LAUDA (voir plaque signalétique):

Typ / Type / Type :	**Serien-Nr. / Serial no. / No. de série:**

mit folgendem Medium betrieben wurde
was used with the below mentioned media
a été utilisé avec le liquide suivant

_____

_____

_____

_____

Darüber hinaus bestätigen wir, daß das oben aufgeführte Gerät sorgfältig gereinigt wurde, die Anschlüsse verschlossen sind, und sich weder giftige, aggressive, radioaktive noch andere gefährliche Medien in dem Gerät befinden.

Additionally we confirm that the above mentioned equipment has been cleaned, that all connectors are closed and that there are no poisonous, aggressive, radioactive or other dangerous media inside the equipment.

D'autre part, nous confirmons que l'appareil mentionné ci-dessus a été nettoyé correctement, que les tubulures sont fermées et qu'il n'y a aucun produit toxique, agressif, radioactif ou autre produit nocif ou dangeureux dans la cuve.

Stempel **Seal / Cachet.**	**Datum** **Date / Date**	**Betreiber** **Responsible person / Personne responsable**

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