OPERATING MANUAL

AVS® 370

VISCOSITY MEASURING DEVICE

SI Analytics

a xylem brand

Wichtige Hinweise:

Die Gebrauchsanleitung ist Bestandteil des Gerätes. Vor der ersten Inbetriebnahme bitte sorgfältig lesen, beachten und anschließend aufbewahren. Aus Sicherheitsgründen darf das Gerät ausschließlich für die beschriebenen Zwecke eingesetzt werden. Bitte beachten Sie auch die Gebrauchsanleitungen für eventuell anzuschließende Geräte.

Alle in dieser Gebrauchsanleitung enthaltenen Angaben sind zum Zeitpunkt der Drucklegung gültige Daten. Es können jedoch vom Hersteller sowohl aus technischen und kaufmännischen Gründen, als auch aus der Notwendigkeit heraus, gesetzliche Bestimmungen der verschiedenen Länder zu berücksichtigen, Ergänzungen an dem Gerät vorgenommen werden, ohne dass die beschriebenen Eigenschaften beeinflusst werden.

Important notes:

The operating manual is part of the product. Before initial operation of the unit, please carefully read and observe the operating instructions and keep it. For safety reasons the unit may only be used for the purposes described in these present operating instructions. Please also observe the operating instructions for the units to be connected

All specifications in this instruction manual are guidance values which are valid at the time of printing. However, for technical or commercial reasons or in the necessity to comply with the statuary stipulations of various countries, the manufacturer may perform additions to the unit without changing the described properties.

Instructions importantes:

Le manuel d'utilisation fait partie du produit. Prière de lire et d'observer attentivement le mode d'emploi avant la première mise en marche de l´appareil, et de le conserver. Pour des raisons de sécurité, l´appareil ne pourra être utilisé que pour les usages décrits dans ce présent mode d'emploi. Nous vous prions de respecter également les modes d'emploi pour les appareils à connecter.

Toutes les indications comprises dans ce mode d'emploi sont données à titre indicatif au moment de l'impression. Pour des raisons techniques et/ou commerciales ainsi qu'en raison des dispositions légales existantes dans les différents pays, le fabricant se réserve le droit d'effectuer des suppléments concernant l´appareil pour séries de dilution qui n'influencent pas les caractéristiques décrits.

Instrucciones importantes:

El manual de instrucciones forma parte de producto. Antes de la operación inicial de aparato, lea atentamente y observe las instrucciones de operaciones y guárdelas. Por razones de seguridad, el aparato sólo debe ser empleado para los objetivos descritos en este manual de instrucciones. Por favor, observe las instrucciones de operación para las unidades a conectar.

Todas las especificaciones en este manual de instrucciones son datos orientativos que son válidos en el momento de la impresión. No obstante, por motivos técnicos o comerciales, o por la necesidad de respetar las normas legales existentes en los diferentes países, el fabricante puede efectuar modificaciones del aparato sin cambiar las características descritas.

EG – KONFORMITÄTSERKLÄRUNG / EC – DECLARATION OF CONFORMITY
CE – DECLARATION DE CONFORMITE / CEE – DECLARATION DE CONFIRMIDAD

TABLE OF CONTENT

Notes to the Manual

The provided manual will allow you the proper and safe handling of the product.
For maximum security, observe the safety and warning instructions in the Instructions.

The pictogram ⚠ has the following meaning:

- Warning of a general danger to personnel and equipment.
- Non-compliance results (can result) in injury or material damage.

ℹ Important information for device use.
🕮 Refers to another part of the operating manual.

Status at time of printing
Advanced technology and the high quality of our products are guaranteed by a continuous development.
This may result in differences between this operating manual and your product. We cannot exclude mistakes.
We are sure you understand that no legal claims can be derived from the information, illustrations and descriptions.
A potentially more recent version of this manual is available on our internet website at www.si-analytics.com.
The German version is the original version and binding in all specifications.

1 Basics

1.1 Intended Use

The AVS® 370 is a measuring unit for determining absolute and relative viscosity of liquid media. This device must only be operated by skilled personnel.

1.2 Safety guidelines

The AVS® 370 corresponds to protection class I.

It was manufactured and tested according to DIN EN 61 010 - 1, Part 1, "**Protective Measures for electronic measurement devices and control devices**" and has left the factory in an impeccable condition as concerns safety technology. In order to maintain this condition and to ensure safe operation, the user should observe the notes and warning information contained in the present operating instructions. Development and production is done within a system which meets the requirements laid down in the DIN EN ISO 9001 standard.

⚠ For reasons of safety, the device must only be used for the range of application described in the present operating instructions. Nonobservance of the intended proper use of the device may result in personal injury or damage to property.

⚠ For reasons of safety, the unit and the power supply TZ 1858 must be opened by authorized persons only; this means, for instance, that work on electrical equipment must only be performed by qualified specialists. **In case of nonobservance of these provisions the titrator and the power supply may constitute a danger: electrical accidents and a fire hazard!** Moreover, in the case of unauthorized intervention in the titrator or the power supply, as well as in the case of negligently or deliberately caused damage, the warranty will become void.

⚠ Prior to switching on the unit, it has to be ensured that the operating voltage matches the mains voltage. The operating voltage is indicated on the type plate (bottom side of the unit and backside of the power supply). Only insert the power plug into a receptacle with ground contact. Any interruption of the conductor inside or outside of the device or the loosening of a protective conductor connector is not permitted and can lead to hazardous risk situations of the device. Only use fuses of the indicated type and rated amperage as a replacement. The use of repaired fuses or shorting the fuse box is prohibited. **Nonobservance of this provision may result in damage to the unit and the power supply, or in personal injury or damage to property!**

⚠ **If it has to be assumed that safe operation is impossible, the unit has to be taken out of operation and secured against inadvertent putting to operation**! For this, switch off the unit, pull plug of the mains cable out of the power supply, and remove the meter from the work station.

Examples for the assumption that a safe operation is no longer possible,

- if the package is damaged,
- if the unit shows visible damages,
- if the power supply shows visible damages,
- if the unit does not function properly,
- if liquid has penetrated into the casing.
- if the unit has been altered technologically or if unauthorized personnel tried or succeeded to open the instrument as attempt to repair it.

In case that the user operates such a device, all thereof resulting risks are on the user.

⚠ **The relevant regulations regarding the handling of the substances used have to be observed:** The Decree on Hazardous Matters, the Chemicals Act, and the rules and information of the chemicals trade. On the part of the user it has to be ensured that the persons entrusted with the use of the unit are experts in the handling of substances used in the environment or that they are supervised by specialized persons, respectively.

⚠ For all work with chemicals: **Always wear protective goggles!** Please observe the memorandums of the employer's liability insurance associations and the safety data sheets of the manufacturers.

⚠ Please also note the corresponding Operating instructions for the devices to be connected!

1.3 Technical Specifications

Translation of the legally binding German version (Release 8. July 2016)

CE sign: CE
EMC compatibility according to the Council Directive 2004/108/EG;
applied harmonized standards: EN 61326/1:2006.
Low-voltage directive according to the Council Directive 2006/95/EG;
applied harmonized standards: EN 61 010, Teil 1.

Country of origin: Germany, Made in Germany

Measurement parameters: Flow time in seconds [s]

Capture of measurement value: Flow time: Optoelectronic or thermo-resistive capture of the meniscus passage through the measurement planes of the viscometers

Optional parameters: to be set using the WinVisco 370 software
Method: Absolute or relative viscosity
Viscometers: Ubbelohde viscometers (DIN, ASTM, micro); micro Ostwald; Cannon-Fenske routine; TC Ubbelohde viscometers and dilute-solution viscometers
ViscoPump: Pump parameters (ramp, pressure, suck over N1)
Time for temperature: adaption: 0...20 min, to be selected in increments of 1 min
Number of measurements: 1…10 for each sample

Measurement ranges:
Viscosity: "pressing" mode 0.35 … 1.800 mm^2/s (cSt) measuring temperature of approx. 20 ... 25 °C
"sucking" mode 0.35 … 5.800 mm^2/s (cSt) measuring temperature of approx. 20 ... 25 °C
Time: Resolution 0.01 s
Pumping pressure: Fully automatically controlled "sucking" action to approx. -160 mbar
Fully automatically controlled "pressing" action to approx. +160 mbar

Measurement precision: Precision (reproducibility and comparability) in accordance with DIN 51562, Part 1

Time measurement: ± 0.01 s ± 1 digit, but not more accurate than 0.01 %
measurement incertainty in the determination of absolute, kinematic viscosity furthermore depends on the incertainty of the numerical value of the viscometer constants and the /measurement conditions, especially as concerns themeasurement temperature.

Data transfer parameters:

Data interface: bi-direktional serielle interface according to EIA RS-232-C
Data format: word length 7 bits, 2 stop bits, 4800 baud, no parity

ConnectionsBack panel of the device:

Data in- and output: 2 serial RS-232-C interfaces: 9-channel sub-miniature D sockets
1st serial interface: Connection of a personal computer (PC)
2nd serial interface: Connection of a TITRONIC®, or a 2nd AVS® 370
Spill-over guard VZ 8551 for waste bottle: DIN round plug connector 4 channels with screw-type cap according to DIN 45321

Bath backlighting: Circula connectors with bayonet lock DIN 4 pin, 24 V, 350 mA
Pump connector: Cold-device socket in accordance with EN 60320 for connecting a 230 V or 115 V vacuum pump. The nominal voltage of the vacuum pump has to match the nominal operating voltage of the AVS® 370.
Max. power consumption required for the operation of the pump 2.5 A
Max. performance with 115 V: 285 VA
Max. performance with 230V: 575 VA

Mains connector: Device plug with safety interrupter according to VDE 0625, IEC 320/C14, EN 60320/C14, DIN 49 457 B

To be connected to the front panel of ViscoPump II modules:

Pneumatic connectors:	Belüften pressure/suction anzuschließen an Viskosimeter. Überlaufsicherung für Saugleitung VZ 8552	
Capacitive sensor:	DIN round-plug connector, 4-channel (ViscoPump II module) Screwed cap according to DIN 45321	
ViscoPump II module:	for viscometer: Round-plug connector with bayonet catch, DIN 5 channels for AVS®/S (measurement stand), 5-channel socket or for TC viscometer, 4-channel DIN socket	
Power supply:	Corresponds to Protection Class 1 according to DIN 57 411, Part 1 / VDE 0411, Part 1	
	Mains connection:	90 - 240 V, 50...60 Hz
	Mains fuse:	Fine-wire fuse 5 x 20 mm, 250 V~, 4 A, time-lag design
	Power consumption:	100 VA (without connection of a 115V/230V vacuum pump)
Casing:	Steel/aluminium casing with chemically resistant two-component coating, stackable	
	Dimensions:	approx. 255 x 204 x 320 mm (WxHxD)
	Weight:	approx. 5.34 kg with 1 ViscoPump II module approx. 7.67 kg with 4 ViscoPump II modules
Ambient conditions:	Ambient temperature:	+10...40°C for operation and storage
	Air humidity according to EN 61 010, Part 1: max. rel. hum. 80% for temperatures up to 31°C, linearly decreasing down to 50 % rel. hum at a temperature of 40°C	

1.4 Functioning of the device

The AVS® 370 is used to perform flow-time measurements in capillary viscometers in combination with the WinVisco 370 PC software. It is operated via a Personal Computer. The WinVisco 370 software can be used to display the time readings. The results of a measurement series can be stored on the PC.

When using up to four different modular ViscoPump II units, the AVS® 370 can be upgraded in two ways to beused for meniscus sensing.

The available capillary viscometers enable viscosity measurements 0.35 of approx 5,000 mm^2/s (cSt) to be carried out at a measuring temperature of approx. 20 ... 25 °C.

TC viscometers can also be used to handle colour-less and transparent liquids just as easily.

Connecting TC viscometers to the ViscoPump II VZ 8512 module will also enable the measurement of black and opaque liquids. As an alternative option it is possible to use viscometers in combination with the light-optical ViscoPump II VZ 8511 module viscometers for meniscus sensing with the measurement stand, e.g. the AVS ®/S.

Time recording extends up to 9999.99 seconds with a resolution of 0.01 s.

Prior to the measurement as such, the liquid to be measured is sucked upwards inside the capillary viscometer though two measurement planes (N2 and N1) which are designed as light barriers or thermistor sensors, depending on the viscometer type (fig. 1 and 2).

The pumping pressure is controlled automatically by the AVS® 370 via the ViscoPump II module.

When using Ubbelohde viscometer, the design of the program ensures that the suspended spherical level will form prior to the start of the measurement.

The AVS® 370 is equipped with two RS-232-C interfaces for data transfer; these interfaces also allow several units to be chained.

The number of devices which can be connected to the computer depends on the software being used (presently it is limited to two AVS® 370, with 4 ViscoPump II modules each).

1.5 Capillary viscometry

Capillary viscometry is the most accurate method for the determination of the viscosity of liquids with a Newtonian flowing behaviour. The measurement as such consists in a time measurement. The time measured is that which a specific quantity of liquid requires to pass through a capillary having a defined width and length. Conventionally, this process is watched with the human eye, and the flow time is measured manually using a stop watch.

In the case of the AVS® 370, as with all viscometry measuring devices from SI Analytics®, the liquid meniscus is captured on the measurement planes, either in an optoelectronic manner by means of light barriers, or else on a thermo-resistivity basis by thermistors.

1.6 Measurements principles

a) Optoelectronic sensing of the liquid meniscus

The near-infrared light which is generated in LEDs located in the upper section of the measurement stand AVS®/S is conducted through a glass-fibre light-conductor cable onto the measurement planes. The light shines through the viscometer before it arrives at another light-conductor cable located on the opposite side; inside this second cable, the light is conducted to a receiver in the upper section of the measurement stand. While the liquid meniscus passes through the measurement planes, the lens-like effect of the meniscus causes a short-term darkening of the light beam, followed by a magnification. This process generates a measurement signal which can be evaluated accurately.

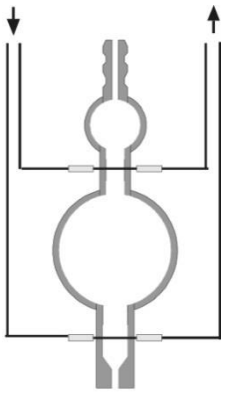


Fig.1 Viscometer for optoelectronic measurements

b) Viscometer with thermistor sensors (TC viscometer)

In the case of TC viscometers, glass-coated thermistors serving as sensors are molten in on the level of the measurement planes. While the meniscus passes through the measurement planes, the differences in the thermal conductivity properties of air and liquid lead to a change in the heat balance. The thermistors of the TC viscometers are molten hermetically tightly into the glass coating of the viscometer, so that the viscometers located inside are chemically resistant to all kinds of substances other than strong leaches, fluoric solutions, or concentrated hot phosphate solutions.

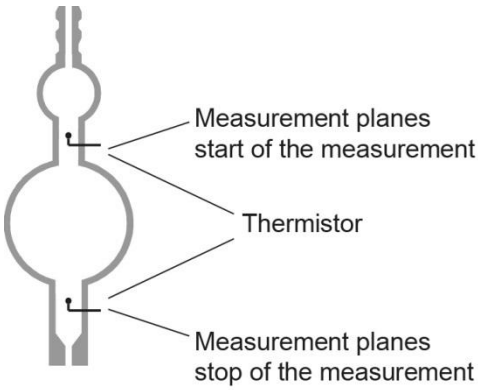


Fig. 2 Viscometer for optoelectronic measurements

2 Initial operation

2.1 Unpacking

The installation of the AVS® 370 and the connection of the desired additional devices is generally conducted by a trained service technician.

Please observer the operating voltage!
It is indicated on the type plate (back side of the device).

The device may be placed and operated on a plane surface.

We recommend placing on the VZ 8571.

Up to two device may be stacked.

2.2 Connecting the devices

2.2.1 Connecting cables

Descriction	Lenght	Connects:	to:
TZ 3085	2.0 m	AVS® 370	PC
VZ 7116	4.0 m	AVS® 370	PC
TZ 3089	10.0 m	AVS® 370	PC
VZ 7115	0.9 m	AVS® 370	AVS® 370
TZ 3084	1.5 m	AVS® 370	AVS® 370
TZ 1587	0.5 m	AVS® 350/360	AVS® 350/360
TZ 1594	1.5 m	AVS® 350/360	AVS® 350/360
TZ 3095	1.5 m	AVS® 350/360	TITRONIC® universal
TZ 3084	1.5 m	AVS® 370	TITRONIC® 110Plus
TZ 3087	1.5 m	AVS® 370	TITRONIC® universal/ TITRONIC® 300
TZ 3094	1.5 m	TITRONIC® universal/ TITRONIC® 300	TITRONIC® universal/ TITRONIC® 300

2.2.2 Deployable hose combinations

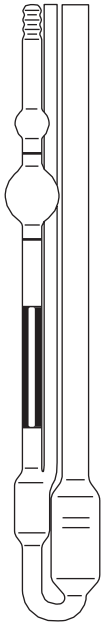
Hose combinations Type no.	Description	Application
VZ 5505	Silicone hose kit, oppressive, for Ubbelohde viscometers (3 legs), and Cannon-Fenske and Ostwald viscometers	Standard, but please observe: the sample can leak from the capillary tube during a malfunction
VZ 5505 + VZ 8526	Silicone hose kit, suctioning, for Ubbelohde viscometers (3 legs)	Standard, safer than oppressive operation, as the sample cannot leak from the capillary tube. Unsuitable for volatile samples.
VZ 8523	PTFE hose set, suction, for Ubbelohde viscometer (3 legs)	For aggressive samples that attack silicone, such as sulphuric acid. Hose lengths are designed to fit the AVS® 370 on the support console VZ 8571. All hose sets for suctioning operation can be combined with the suction set and the sample fill set.
VZ 8524	PTFE hose kit, suctioning, with soda lime filter VZ 7215 for Ubbelohde viscometers (3 legs)	For aggressive samples whose vapors are absorbed by soda lime filters to protect the ViscoPump. Depending on the sample, an active carbon filter VZ 7216 can be used instead of the soda lime filter VZ 7215. Hose lengths are designed to fit the AVS® 370 on the support console VZ 8571.
VZ 8530	PTFE hose kit, suctioning, with soda lime filter VZ 7215 for Ubbelohde viscometers (4 legs)	For Ubbelohde viscometers with additional 4th pipe for filling and cleaning Hose lengths are designed to fit the AVS® 370 on the support console VZ 8571.
VZ 5606	For TC viscometers (3 and 4 legs) with screw connections: Silicone hose fittings with connecting cable. For oppressive operation	For TC viscometers (3 and 4 legs) with 4th pipe for filling and cleaning Typical applications are measurements of oils.

The hose combinations are to be selected on the basis of the required application, e.g. VZ 8521, VZ 8523, and VZ 8524.

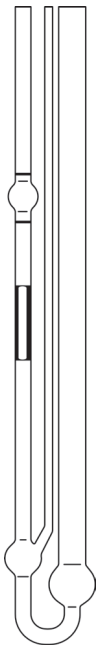
⚠ When using Micro Ubbelohde viscometers with TV sensors, the ignition temperature of the media to be measured has to be taken into account!
It has to be higher than 250°C.

2.2.3 Suitable viscometer types, racks, and measurement stands

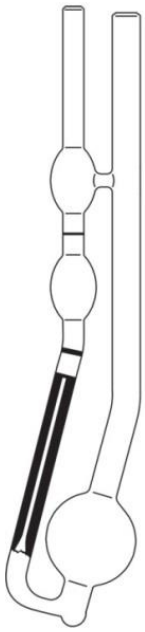
Viscosmeter (Type)	**Gestell** (Type no.)	**Messstativ** (Type)
Ubbelohde (DIN) 532… 530… 501… 541…	053 92	AVS®/S AVS®/SK
Ubbelohde (ASTM) 525… 526… 527… 545…	053 92	AVS®/S AVS®/SK
Mikro Ubbelohde 536… 537… 538…	053 92	AVS®/SAVS®/SK
Ubbelohde dilute-solution viscometers 536…	---	AVS®/SK-V
Cannon-Fenske-routine 513… 520…	---	AVS®/SK-CF
Mikro-Ostwald 517…	053 97	AVS®/S AVS®/SK
Ubbelohde (TC) 562… 563… 564… 567… 568… 569…	053 93	---
Mikro-Ubbelohde (TC) 572… 573… 574…	053 93	---



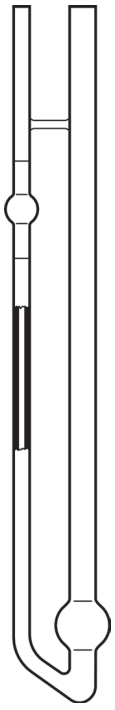
DIN-Ubbelohde-viscometer



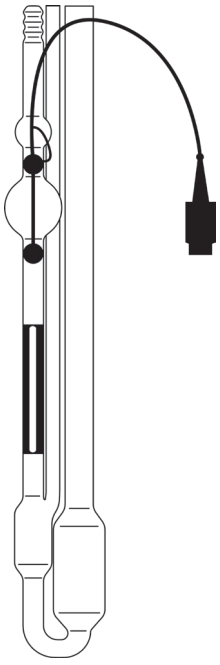
Mikro-Ubbelohde-viscometer



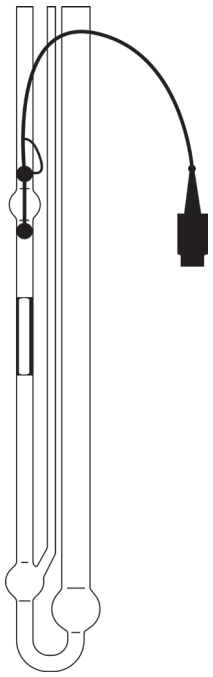
Canon-Fenske-Routine-viscometer



Mikro-Ostwald-viscometer



Ubbelohde-viscometer
with TC sensors



Mikro-Ubbelohde-viscometer
with TC sensors

Fig. 3 Suitable viscometer types

2.3 Connecting the viscometers and other devices

The AVS® 370 Viscosity Measuring Unit allows the use of most various viscometer types:

DIN, ASTM, Ubbelohde and Micro Ubbelohde viscometers as well as Cannon-Fenske Routine, Micro TC and Micro Ostwald viscometers.

Owing to careful manufacture and quality-assurance procedures, all viscometers from SI Analytics® meet the highest accuracy standards.

The K viscometer constant is determined individually by way of a calibration of each glass capillary viscometer. Owing to the use of high-quality measurement and testing equipment and the application of national standard gauges, SI Analytics® guarantees an absolutely precisely reproducible calibration. For Ubbelohde viscometers having the same constant, the same correction seconds (Hagenbach correction) are valid. Gauging by the user is not necessary, since the corrections correspond to the theoretical values as taken from the operating instructions for the viscometers. This statement is true for both Ubbelohde viscometers of normal size as well as for micro viscometers.

It is also possible to connect or control other devices (such as absorption traps, overflow guards etc.). Depending on the intended use of the AVS® 370, it may be highly recommendable to connect these devices, please refer to the items below.

2.3.1 TC-Viskosimeter mit Thermistor-Sensoren

Fill the viscometer (approx. 18 - 20 ml), then place it in the thermostat bath. Connect the AVS® 370 Viscosity Measuring Unit and the TC viscometer using the hose/cable combination which comes with the device. To do so, place the device in the holders, then attach the quadruple plug of the cable to the viscometer and the ViscoPump II module (first plug, then screw); subsequently, make the screwed connections in accordance with the numbers indicated on the hoses and the rack. In the case of “pressing” operation, the capillary tube remains open, for “sucking” operation the filling tube is to be left open. Please observe the colour codes (red = sucking, black = venting) when attaching the pneumatic screwed connections to the ViscoPump II module of the AVS® 370.

2.3.2 Viskosimeter mit Lichtschrankenabtastung

Use the hose/cable combination to make an electrical and pneumatic connection between the AVS® 370 and the measurement stand. The plugs are firmly connected to the sockets by rotating the union sleeve. Please observe the colour codes (red = sucking, black = venting) when screwing the threaded pneumatic connections into the ViscoPump II module. Please insert the selected capillary viscometer into the fixating rack as is shown in fig 4., then fill it. Insert the fixating rack together with the viscometer into the measurement stand (with the cut-out at the bottom sheet pointing forwards). The cut-out will latch into the lug provided. Pressing the viscometer slightly against the fixating rack will latch it into the holding spring located on the measurement stand.

Fig. 4 Inserting or replacing a viscometer with light-barrier sensing

2.3.3 Connection of VZ 7215 absorption traps

In the “sucking” mode (vacuum), volatile components can enter the ViscoPump II module.
This is particularly problematic for corrosive solvents such as formic acid or dichloroacetic acid.

For these cases, a hose fitting “suctioning” VZ 8524 must be used!
(includes the absorption traps VZ 7215 and appropriate connecting hoses).

The absorption traps which prevent contaminations from penetrating into the pneumatic system of the ViscoPump have to be inspected at regular intervals. If sodium lime is used as an absorption agent with acidic solvents, the colour condition of the indicator is to be checked on a daily basis. As soon as this condition has shifted to BLUE in the half of the absorber material, this is the very last moment to replace the material for safety reasons.

If such a colour shift cannot be observed over an extended period of time, this may be attributable to the fact that an acidic over-saturation of the material has caused a decolouration; this may then appear as “normal”, but it will definitely result in the destruction of the pneumatic system after some time! This situation is explicitly excluded from the warranty coverage!
For non-corrosive solvents and oils, which contain volatile constituents, absorption traps with activated carbon filling are available. When using activated carbon as an absorption agent (e.g. with solvents or used mineral oils), a replacement should be made at intervals between 1 and 2 weeks; this depends on the load factor which, in turn, is a function of the volatility of the materials.

2.3.4 Connection of the VZ 8552 overflow guard

We urgently recommend the connection of the VZ 8552 overflow guard (available as an option) for the suction-mode operation of the ViscoPump II module. The connection of the VZ 8552 overflow guard (capacitive sensor for the safety bottle) excludes over-pumping in suction mode (contamination of the ViscoPump II module). The holder on the safety bottle accommodates the capacitive sensor.
When using the ViscoPump II module VZ 8511 (meniscus sensing by light barriers) the holder for the safety bottle is to be attached to the measurement stand, e.g. the AVS®/S. When using the ViscoPump II module VZ 8512 (thermo-resistive measurement) the holder for the safety bottle is to be attached to the “viscometer gallows” provided for the TC viscometer 5732.

Should any liquid be over-pumped into the safety bottle, the safety sensor will trigger a stop. After emptying the safety bottle, the lateral LED on the capacitive sensor will go out. You may continue with the measurements.

The electrical connection of the VZ 8552 overflow guard is made using DIN plugs on the front side of the respective module of the ViscoPump II.

The sensitivity of the capacitive sensor has to be adapted to the medium being used.
To do so, please use the enclosed screw driver to adjust the lateral set screw in such a manner, that the capacitive sensor in the built-in condition (i.e. without medium) are just close from responding (i.e. the LED is on).

2.3.5 Connection of the overflow guard for the VZ 8551 waste bottle

We urgently recommend the connection of the VZ 8551 (weighing balance) overflow guard for the waste bottle (available as an option) for rinsing and dry operation. The connection of the weighing balance prevents the VZ 5379 waste bottle (2000 ml) from spilling over.

The sensitivity of the weighing balance has to be adapted to the medium being used!
To do so, please adjust the set screw in such a manner that the weighing balance triggers as soon as the desired filling volume has been reached. After emptying the waste bottle, you may continue with the measurements. When making the connection, please make sure that the VZ 8551 overflow guard is correctly assigned to the ViscoPump II modules.

2.3.6 Transparent thermostats

Viscosity depends on the temperature of the sample liquid. This means that the viscometers must always be thermostated during the measurement. The measurement temperature has to be kept constant in order to achieve an accurate result.

The transparent thermostats from SI Analytics® which were developed especially for capillary viscometry, meet the requirements imposed on precision and constancy. The CT 72/2, CT 72/4 thermostats, for instance, guarantee a temperature constancy of ± 0,02 K at a command temperature in the range of 10° to 40° C, and a maximum fluctuation of the ambient temperature of ± 3 K.

As a rule of thumb, you may suppose that the temperature deviation, expressed in degrees, multiplied with a factor of 10 will correspond to the deviation from the result in terms of %. This means that a deviation of 0.05 °C corresponds to a possible error of 0.5%.
In principle, two different transparent thermostats can be used on the AVS® 370:
for measurements at different temperatures, the CT 72/2, CT 72/4 transparent thermostats are available. These thermostats can be equipped with two or four viscometers including other equipment. For measurements up to 60 °C, the thermostat CT 72/ P of acrylic can be used.

The bath body of the thermostat CT72/P consists of acrylic (PMMA)!
Acrylic can be damaged by a variety of organic solvents as well as by concentrated acids/bases. Therefore, a contact of the bath body with such substances should be avoided, as the acrylic may be damaged.
Please read the separate operating manual of the transparent thermostats as well.

2.3.7 Flow coolers

As was mentioned above, viscosity measurement is highly dependent on temperature constancy. For reasons of control technology (self heating of the thermostat head), it is therefore necessary to use a CK300/CK310 flow cooler as a counter cooler at bath temperatures exceeding 40°C.
Please read the separate operating instructions of the transparent thermostats as well.

2.3.8 ViscoPump II module

The ViscoPump II modules control the entire measurement process, among other things the temperature pre-adaptation process of the samples in the viscometers, the process of pumping the liquid up into the storage containers of the viscometers, the measurement of the flow times etc. The serial interface of the AVS® 370 Viscosity Measuring Unit ensures a speedy and simple data transfer with the PC.

To replace the ViscoPump II module, please proceed as follows:

- Remove the pneumatic and electrical connections from the front panel of the ViscoPump II module to be replaced.
- Loosen the screws located at the corners of the front panel.
- Use the upper and lower insertion handles to leverage the ViscoPump II module out of its rearside plug connection.
- Pull the ViscoPump II module out of the AVS® 370.
- After inserting the new ViscoPump II module, please secure it again with the screws of the front panel. Re-establish the electrical and pneumatic connections.

2.3.9 System enhancements

A number of functional units of the AVS® 370, such as the viscometers and the ViscoPump II modules, can be replaced or added.

Make sure that the AVS® 370 is always the first device you switch off!
Prior to replacing any functional unit, please be sure to the mains plug must be pulled out of the mains socket. **Caution: Liquid dripping off may be hazardous to the user!**

2.3.10 Troubleshooting

Check whether the AVS® 370 is switsche on.

Trouble	Troubleshooting
Air bubbles in viscometer	• Is the filling quantity sufficient? - Check, fill viscometer if required. • Is the viscometer of properly connected? - in the case of pressing operation, please checked whether the filling tube is connected; if necessary connect properly. - for operation in suction mode, please check whether the capillary tube is connected; if necessary, connect properly. - please check whether the venting port is tightly connected; if necessary re-tighten its screwed connection.
Excessive pumping of measuring medium into the thermostat bath or into the safety bottle	• Is the viscometer properly connected? - for pressing operation? - for operation in suction mode? <u>When using AVS measuring tripods</u> • check position of the rack within the stand • check the electrical connection from the viscometer to the ViscoPump type • Is the green LED on the measuring stand illuminated? <u>When using TC viskometers</u> • Is the viscometer properly connected?
The data transfer to the PC is not functioning properly.	• Are you using a suitable cable? - Please refer to 🕮 **2.2.1** • Cable properly connected? - Check cable connection - are the screws on the PC side properly • Correct COM port selected? - The correct COM port must be selected in the WinVisco software. - COM ports 1 through 4 can be selected. • up. Cable defective? - replace cable • ViscoPump II module? - The software version must be equal of greater than 3.06

3 Data transfer

3.1 RS-232-C Interfaces

The AVS® 370 has two RS-232 C interfaces. Interface 1 is used to communicate with the computer; interface 2 is used to connect to another viscosity meter AVS® 370 and burettes or viscosity meter AVS® 350/360.

Connection between more than one AVS® 370
To establish the data transfer between more than one AVS® 370, please proceed as follows:

- Make a RS-232-C connection from the computer to interface 1 of the first device.
- Then use another cable to make a connection from interface 2 of the first device to interface 1 of the second device.

The device address of the second connection viscosity measuring device AVS® 370 must be different from the address of the first viscosity measuring device AVS® 370. Therefore, a jumper must be moved on the second device when connecting a second AVS® 370 device. Please contact the service (backside of these operating manual).

If burettes are used, these can be connected to interface 2 of the second AVS 370 via an RS-232-C cable.

3.2 Interface configuration

The interface parameters cannot be changed! All transmission parameters are firmly set to the following values:

Baud rate	4800
Parity	None
Stop bits	2
Data bits	7

All other devices to be connected (burettes, AVS® 350, AVS® 360) must have the same parameter settings.

3.3 Connetion to a USB port on the PC

The AVS® 370 can also be connected to a USB port on the computer if suitable adapters are used USB serial. We recommend the adapter USB-RS232 TZ 3080.
This adapter is part of the delivery scope of the AVS® 370.

3.4 Device address

In order for the devices to be addressed by the software, you need unique addresses.
The communication protocol used allows the addressing of 16 devices.
The addresses used are 0 to 15.

3.4.1 Automatic address assignment with the AVS® 370

Within **an** AVS® 370 module, the ViscoPump inserts are automatically populated based on their positions at the addresses 1 (first slot) to 4 (fourth slot).

When using **an additional** AVS® 370 module, this address must be moved by moving a jumper, so that the addresses 5 to 8 are allocated in this module.

All other sizes (burettes, AVS® 350, AVS® 360) must be set to a unique address manually.
Please check the instructions for use of the respective devices.

The WinVisco software expects viscosity measurement devices in the address zone 1 to 8 (ViscoPump, AVS® 350, AVS® 360). Burettes are expected in the address range 9 to 15 and at address 0.

3.4.2 Address assignment for burettes when rinsing with solvents:

When rinsing with solvents by means of connected burettes (see 🕮 **section 4.8**), one or two burettes are connected to each measurement slot, depending on whether you are rinsing with one or two different solvents. The following addresses have to be set for the burettes:

	Address for burette solvent 1	Address for burette solvent 2
1. Measuring point	9	13
2. Measuring point	10	14
3. Measuring point	11	15
4. Measuring point	12	0

Fig. 5 Address allocation for burettes

When rinsing with solvents, only the first 4 measuring points can be supported by burettes.

4 Software WinVisco

4.1 Introduction

With the WinVisco 370 software described herein, it is possible to control up to 8 ViscoPump II modules. The measurement values determined by the ViscoPump II modules are received and evaluated by the software. The results can be output on a printer (report). You can generate them as a PDF file or saved in a text file (CSV format). In parallel operation of up to 8 measurement rigs, flexible and fast viscosity determination is possible. The user has the possibility of storing a variety of measurement parameters within a method file (Access format). Below please find a description of the installation, functioning, and operation of the software.

The following description refers to the software version 3.83.00!

4.2 Hardware and software requirements

Basically, the computer must be sufficient in its processing capacity/resources (pulse frequency, memory, hard drive memory, etc.) for the intended operating system.

The following operating systems are suitable: Windows XP/Windows 7

The operating system Win 7 can only be used starting with WinVisco Version 3.81.20!

To connect the AVS® 370 to the computer, you will need a RS-232-C interface (COM) or, as an alternative, a USB interface (see 🕮 **Chapter 3**).

4.3 Installation

- Insert the installation CD into the CD drive of the computer
- Run the setup file “SetupWV38300.exe” and then
- select the desired language during installation

As is the case with Windows programs, you will be guided through the installation process.

After the installation is complete, start the program WinVisco 370 (“Start” > “Programs” > “WinVisco 3.83” or the icon on the desktop).

4.4 Language

The language can be switched between German and English by choosing the menu item “Language” in the main menu.

The menu item “Language” is only available during startup, it will be hidden after you switch to a different menu item and can only be retrieved by restarting the program.

4.5 Hardware management

4.5.1 Device detection

When starting the software, the connected devices (ViscoPump II) are read by the system first. In order to check whether the ViscoPump II modules were detected correctly, click on the menu item “System/Maintance” in the main menu and select the submenu (tab) “Hardware”.

When starting the software, the connected devices will be checked.

The devices with their names and addresses should be displayed in the top list (Fig. 6). If you click on a device in the list, the “Device ID”, the “Device Status” and the software version number will be displayed in the device information. If the devices are not detected, an incorrect COM port may have been selected. In this case, please select the correct COM port of the computer, which the AVS® 370 is connected to. There are eight COM ports available. After changing the COM port, please click on “Scan” – the devices connected to this port will be checked again.

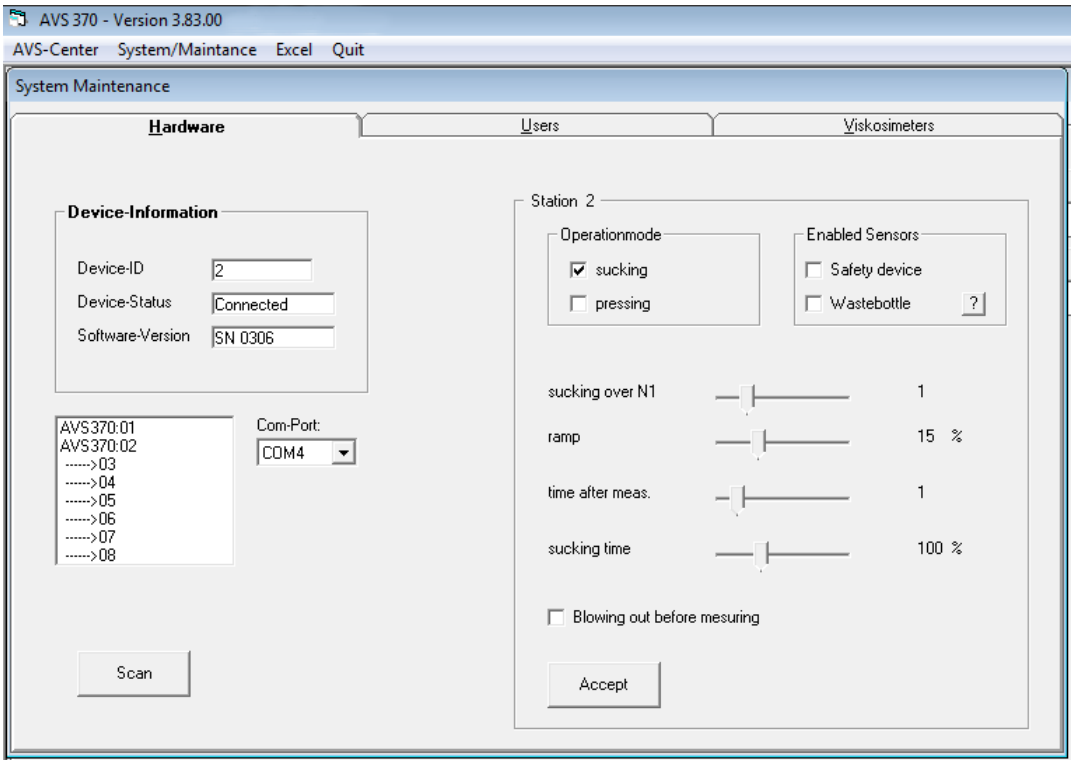


Fig. 6 Hardware management: Device information and operating parameters

4.5.2 Changing the operating parameters for a measuring point

The operating parameters are selected in the right half of the “Hardware” tab. Please keep in mind that the settings you select refer to the measuring point (1, 2 ...) listed under “Device-Information”. The measuring point for the respective device is selected by clicking on respective device below the device information in the list.

Changing the operating parameters is only possible with those measuring points where no measurement is active.

4.5.3 Operating mode suction/oppressive

The desired operating mode (“Operationmode”) is selected by switching between “sucking” and “pressing”. The operating mode “sucking” is preset.

The hose set for the pneumatic connections between the ViscoPump II and the Viscometer must match the respective operating mode! If the connection is not correct, the measurements will not work, and there is the additional risk that the sample will exit from the viscometer or will be suctioned into the ViscoPump II!

4.5.4 ViscoPump parameters

The following operating parameters influence the operation of the ViscoPump II and therefore the measuring process.

The values of these parameters should remain at their preset state and only be changed as needed!

Sucking over N1
The sample to be measured is suctioned up into the measuring sphere or pressed into it until the sample reaches the top light sensor (N1). To ensure a reliable measurement process, the liquid is suctioned a little further, in order to fill the advance sphere, e.g. for Ubbelohde viscometers and to form a suspended spheric level during the runoff. The duration of the pumping time above the top light sensor is preset by this parameter. The preset value is 1.

Ramp
When pressing or suctioning the liquid into the measuring sphere, the pressure (or the vacuum pressure) is increased with time. The speed of the pressure change can be changed via these parameters. The value 15 % is preset.

Time after measurement
At the end of the measurement of a running time, the liquid meniscus of the sample will trigger the bottom light sensor. After that, a certain amount of time will pass until the measuring sphere and the capillary tube have been emptied completely; only after that, the sample can be suctioned back into the measuring sphere for a repeated measurement. This waiting period can be changed via this parameter. The value 1 is preset.

Sucking time
For AVS® 370 systems, which are connected to a waste system, the parameter “sucking time” defines the suction time for “Rinsing with next sample”. This suction time is the running time of a separate vacuum pump, which suctions the rinsing agent (sample or solvent) into a waste bottle. The suction time is preset to a value of 100 %. In many cases, a shorter time is sufficient for the suction time in order to completely suction off the sample. In these cases, we recommend changing the value to shorten the cleaning process.

Blowing out before measuring
“Blowing out before measuring” can only be activated during the suctioning operating mode. After the activation, the capillary is blown out for about 1 second before the start of the running time measurement. This function is used to prevent air bubbles. Air bubbles can be created when sample residue remains in the capillary after a measurement, which will form air bubbles when the sample is suctioned up with air afterwards. By blowing out the capillaries, this sample residue is removed so that no air bubbles are formed.

Enabled sensors
There are two safety sensors (“Enabled sensors”) that can be connected to the AVS® 370: “Safety device” and “Wastebottle”. If these sensors are to be used, they must be connected to the AVS® 370 and activated under “Enabled sensors”.
The status of the sensors can be checked by clicking the “?” to the right of “Waste bottle”. If a safety sensor is connected and has not triggered, it will have a green background, otherwise, it will be red. In the case shown in Fig. 7, the sensor “Safety device“ is connected and activated, but not “Wastebottle”.

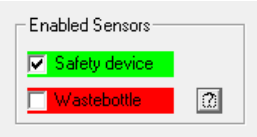


Fig. 7 Safety sensors

Safety device
This is the capacitive sensor VZ 8552, which is highly recommended during suctioning operating modes to monitor the safety bottles VZ 7021 or VZ 7022. The safety bottle is installed in the pneumatic hose connection between the ViscoPump II and the capillary tube to detect an inadvertent oversuctioning of the sample into the ViscoPump. This capacitive sensor VZ 8552 will emit an error signal if the ViscoPump suctions liquid all the way into the safety bottle due to a malfunction. The sensor is connected to the front panel of the ViscoPump II (refer also 🕮 section **2.3.4**).

Wastebottle
This is the overflow safety system (scale) VZ 8551 for the waste bottle, which is used if a waste system is connected. (refer also 🕮 section **2.3.5**).

4.6 „AVS-Center“ - „Overview“

Select the tab “AVS-Center”-> “Overview”, and the read devices will be displayed on the screen.

Fort the AVS® 370 they will represent the existing modules ViscoPump II.

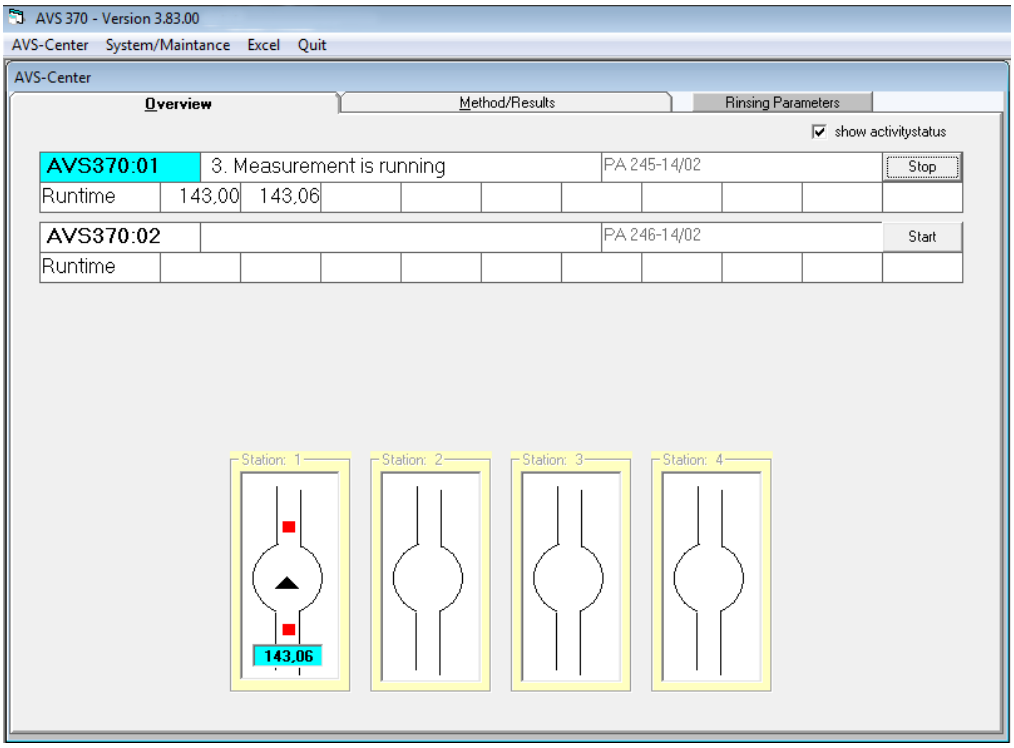


Fig. 8 AVS-Center, „Overview“

There will be a table displayed for each device, which will look as follows:

Equipment: Address (00-08), status message, start/stop key and measuring values 1 to max. 10.

By selecting “show activity status”, the operating status of the viscometer will be displayed in the bottom part of the window. The direction of the black triangle in the stylized measuring sphere shows whether the sample is being pumped up or drained. The little red squares are displayed if the liquid is above or below the top light sensor.

4.7 „AVS-Center“ - „Method/Results“

The tab “Method/Results” is the central input place for measuring parameters, administration of measuring methods, the selection of the viscometer as well as for the evaluation and protocolling/ logging of the results.

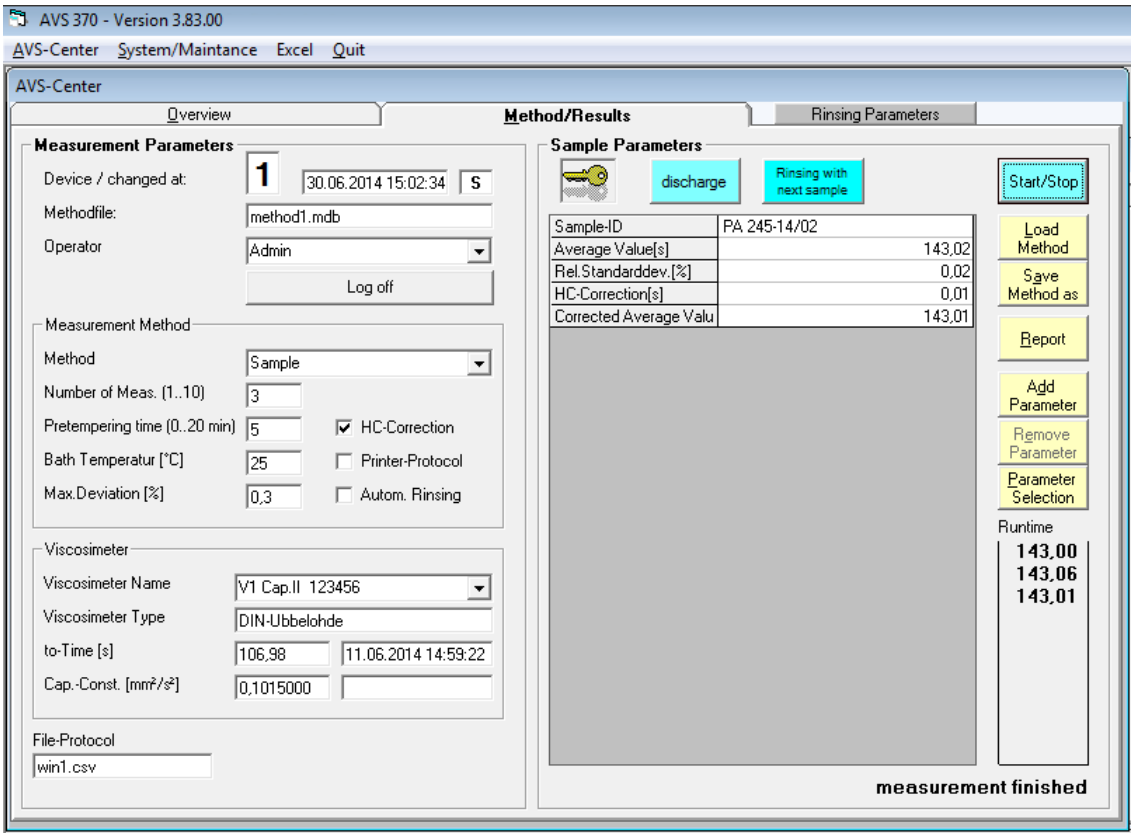


Fig. 9 AVS-Center, “Method/Results”

Here, the measuring parameters are listed on the left and the sample parameters and the evaluation results on the right.

Under measuring parameters, the number by the “Device” indicates the number of the respective measuring point. All settings in this tab “Method/Results” refer to this measuring point. In order to switch measuring points, you need to activate the desired measuring point on the “Overview” tab and switch back to the tab “Method/Results”.

4.7.1 Measurement parameters

4.7.1.1 Operator

Here, the user will log in using his user ID and his password, if you are working with user administration (see 🕮 section **4.10**).

Depending on the user level, you can enter data here and use the keys. If you have user level 2, there are no restrictions. For level 1 users, you may merely select measuring levels, enter parameter values, and select viscometers and measure. You cannot change the measuring parameters under “Measurement methods” nor can you change the evaluation (formulas).

4.7.1.2 Measurement methods

Enter the individual measuring parameters in this area:

Method
Here, you select among “Sample”, “t_0” and “Constant”. Usually, “Sample” is selected if a sample is to be measured. In the case of polymer solutions, the additional blind value ”t_0” is required to determine the running time of the pure solvent in a viscometer. For measurements of t_0 there will be a query at the end of the measurement, whether the determined value should be saved in the database of the respective viscometer. The value of the calibration constant can be checked by means of the “Constant” method. For this, a sample of known viscosity must be measured. The viscosity value must be entered to the right below “Sample Parameters” in the field “Kin.Viscosity [mm^2/s] “. In order to determine the calibration constant, you must ensure exact tempering of the sample (control of bath temperature!). Just like with the determination of blind values, there will be a query at the end of the measurement, whether the determined value should be saved in the database of the respective viscometer

Number of Measurement
Defines the number of running times to be measured for a sample.
The value can be selected between 1 and 10.

Pre-tempering time
Defines the pre-tempering time in minutes. The value can be selected between 1 and 20 minutes. During the pre-tempering phase, the liquid is suctioned up into the measuring sphere after 1 minute, similar to a measurement: The movement accelerates the heat transfer and therefore the temperature adaptation between the sample and the thermostat bath.

Bath-temperature [°C]
The value entered here is used for documentation purposes. This value is not transferred to the bath thermostat as a nominal value.

Max. Deviation [%]
The value indicated here is the max. deviation allowed between the median value and the individual running times. If this value is exceeded, one or more repeated measurement (s) will be conducted. Measurements with deviating measuring results will be identified as outliers by a mathematical algorithm (outlier test) and will not be used for further evaluations (median value of running times and all subsequent calculations).

HC-Correction
When this box is selected, the running times are corrected as per Hagenbach-Couette.
The Hagenbach-Couette correction depends on the viscometer type used and on the running time.

Printer-Protocol
The results are printed on the selected standard printer after the measurement and the evaluation.

Autom. Rinsing
For AVS® 370 vsystems with waste system and connected burettes for the rinsing with solvents: If this parameter is selected, the sample is automatically suctioned after the measurement and the viscometer is rinsed with solvent as per the selected rinsing parameters. If “Automatic rinse“ is not activated, and if burettes are connected, you can manually activate rinsing with solvents by pressing “Rinse”. The advantage here is that the sample will not be disposed of after the measuring results have been evaluated so that a repeated measurement is possible.

4.7.1.3 Viskosimeter

Viscometer name
Here, you select a viscometer. If you are not able to select a viscometer here, you must enter a viscometer in the menu “System/Maintenance” – “Viscometer” (see 🕮 Section **4.11**).

Viscometer type
This is an information field, which indicates the type of viscometer selected under “Viscometer designation”.

t_0- time [s]
Shows the blind value t_0, which was either entered directly into the viscometer master data or which was most recently determined by means of the method t_0. In addition, it will show when the value was measured.

Cap.-Const. [mm^2/s^2]
Shows the value of the calibration constant of the viscometer from the viscometer master data.

4.7.1.4 File-Protocol

The results and all settings are logged in a csv file. You can select the name of the file in this input field. You can check this data if you select the menu item “Excel” in the main menu: Then, the respective csv file will be opened in the Microsoft® program “Excel”. For this, “Excel” must be installed on the computer.

The csv is stored in the installation directory by default. If you wish to save in a different directory, e.g. if there may be problems with the writing rights in the installation directory, the data path for dynamic data can be changed. For this, you must make a change in the file “application.ini” in line 8 and the files must be copied into the new directory.

Details for this procedure can be found in the instructions “ApplicationIniV383GE.pdf” on the installation CD.

Regarding the log file and other possibilities for the documentation of results, see 🕮 Section **4.11**.

4.7.2 Measurement run

Start the measurement by clicking on the “Start/Stop” key or switch to the “Overview” tab and click on Start. You will receive an error message in case missing or incorrect data.

The measurement begins. Immediately after starting the measurement, the text on the “Start” key changes to “Stop”. If this key is pressed, the measurement will be stopped immediately and a note will appear in the status field.

After ending the runs, the respective measuring values for the running times will be displayed. During the measurement, you can switch to the Methods tab and look at the sample parameters.

If the measured values are outside the tolerance range listed under “Max. Deviation [%]”, a new measurement will be started. This will be the case until approx. 10 measurements have been reached. Then the measurement will be stopped.

If you want to determine a constant or the t_0 value, a screen will appear at the end of the measurement which will inquire whether the new constant/t_0 value should be transferred to the database. In addition, the relative deviation from the old constant/t_0 value will be indicated.

4.7.3 Loading/saving methods

We recommend saving the measuring parameters a methods. The measuring parameters and evaluation parameters will be saved in this method file. The operating parameters from “System/ Maintenance” - “Hardware” and the rinse parameters if using burettes to rinse with solvents will not be saved. These parameters are saved at the respective measuring point. Furthermore, the selected viscometers are also saved at the respective measuring points.

The advantage:

- The method can be saved. If this is changed accidentally, it can be reloaded.
- If you are working with several different methods, you can easily change these.

If you click on “Load Method” a dialog box will open where you will be able to select a new method file (*.mdb) and open it. This method will apply to the respective measuring point only.

If you click on “Save Method as” a dialog box will open where you can save the method file under a new name.

After saving as the new file name, this file will appear on the screen with the same measuring parameters. The old method file will not be deleted. The system will create a copy of the old method file and save it under the new name.

4.7.4 Evaluation: Adding/editing parameters

4.7.4.1 Select parameters

You can select or deselect pre-programmed standard parameters. Click on “Parameter Selection”.

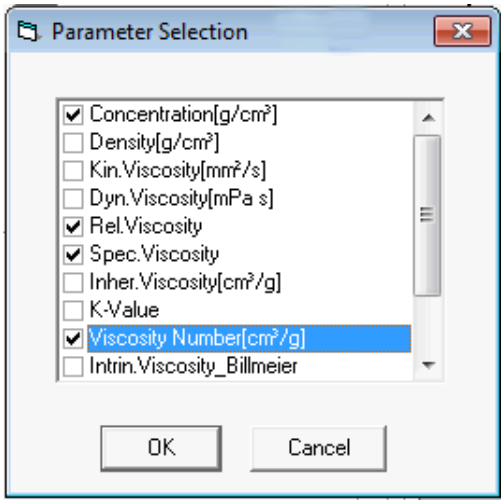


Fig. 10 Parameter-Auswahl

You can select evaluation formulas and sample parameters as parameters.
For sample parameters, an entry is required (text or number).

The preset sample parameters are:

- Sample name
- Concentration
- Density.

The parameter kinematic viscosity must only be entered for the method “Constant“, as the kinematic viscosity is normally calculated from the running time.

4.7.4.2 Adding parameters

If you would like to enter a new user-defined parameter or an evaluation formula, click on “Add Parameter” and the Formula/parameter editor will appear.

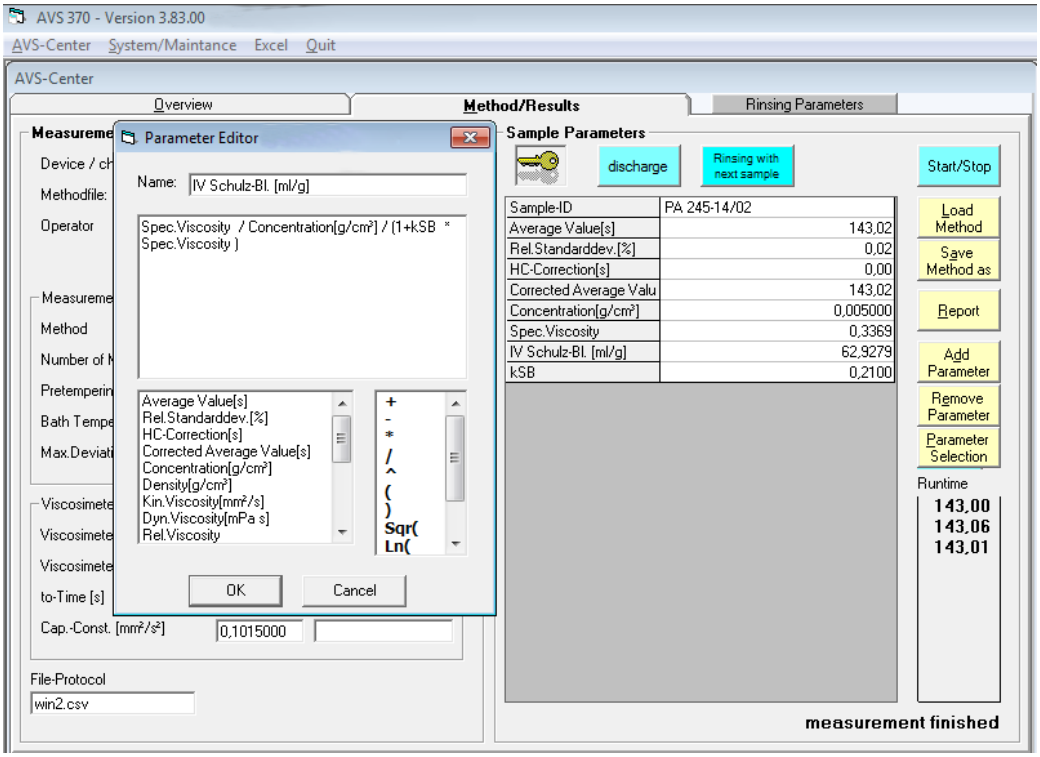


Fig. 11 Parameter-Editor

Enter a permissible name into the top field (the descriptor must not contain any mathematical operators).

Now, you can enter a number, a formula or your choice of text into the field below. If you wish to enter a formula, you can use the two lists below. You can select a random entry either by double-clicking or using the space bar. If you click on OK, the result will be displayed in the table.

The formula must be syntactically and semantically correct, otherwise, the formula will be displayed instead of a result in the parameter table.

4.7.4.3 Editing parameters

You can edit all user-defined parameters by means of the parameter editor. In order to edit an existing parameter, double-click with the left mouse key on the respective parameter line or press Enter. Either an input field or the parameter editor will appear.

4.7.4.4 Deleting parameters

If you wish to delete a user-defined parameter click on “Remove Parameter” or press the DEL key and a security inquiry will be displayed. If you select “Yes”, the respective parameter will be removed from the table.

If the respective parameter is contained in other formulas, this will cause errors.

4.8 „AVS-Center“ - Rinsing parameters

The AVS® 370 can be configured for rinsing with the next sample or for rinsing with solvents. In the second case, the rinsing solvent is filled into the viscometers using burettes (e.g. TITRONIC® universal, TITRONIC® 300, TITRONIC® 500) by SI Analytics®. For this, a fill funnel will be used that has two threaded connections to connect max. 2 burettes per measuring point.

If you select the “Rinsing Parameters” tab in “AVS-Center” the window “Rinsing Parameters” will open (see Fig. 12). The rinse parameters are used to parameterize the rinse sequence.

When rinsing with solvents, one or two rinsing solvents can be used. Here, one or two burettes must be connected to each measuring point for this. The solvents must be adapted to the application: Solvent 1 must loosen the sample residue in the viscometer. Solvent 2 must remove the residue of solvent 1 and must be sufficiently volatile to be able to completely remove all solvent residues during the subsequent drying process. In some cases, the solvent used in the first step is already sufficiently volatile to be able to skip the second solvent. The following applies to those cases:

If you only use one solvent, the burette(s) must be connected as solvent 2 via the address assignment (see 🕮 Section **3.4**).

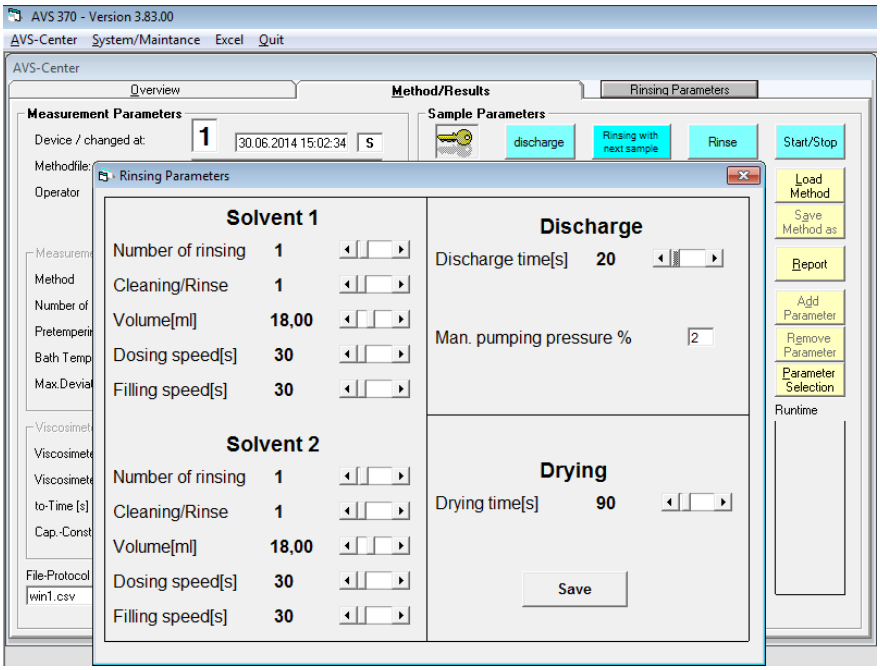


Fig. 12 AVS®-Center, Rinsing parameters

Number of rising
This parameter indicates how often the respective solvent was refilled for rinsing.

Cleaning/Rinse
The value indicates how often the viscometer fill (solvent) used for rinsing was pumped into the measuring volume. Usually, a value of 1 or 2 is sufficient.

Volume [ml]
Indicates the volume of solvent metered by the burette for one rinse process.

Dosing speed [s]
Is a measure for the metering/dosing speed of the respective solvent? Indicates the time required to meter the content of a 50 ml burette cylinder. The value 30 is preset, according to a metering/dosing speed of 100 ml/min.

⚠ **The metering speed must be adapted to the viscosity of the solvent!**
If the metering speed is too high, the burette can be damaged. The preset value of 30 may only exclusively be used for solvents like acetone, ethanol or petroleum spirit. For solvents with a higher viscosity, the value for “Dosing speed [s]” must be doubled to at least 60, the metering speed must be reduced accordingly. If the metering speed is not reduced, the burette can be damaged! A high damage risk is especially present, if aggressive solvents such as sulphuric acid or dichloroacetic acid are used.

Filling speed [s]
Indicate the time in second which is required to fill the burette from the storage bottle.
The value 30 is preset. If this value is increased, the fill speed will decrease.

⚠ **If the fill speed is too high, there will be air bubbles in the burette!**
The value of 30 for “Filling speed [s]” can only be used for low-viscosity solvents like acetone, ethanol or petroleum spirit.

Discharge time [s]
Indicate the suction time in second. The value is the time during which the suction pump is turned on, after you click on the button “discharge” in the “Method/Results” tab in “AVS-Center”. The suction time is also used for rinsing with solvents by means of burettes (Rinse button), as the sample is suctioned first at the beginning of the rinse cycle.

The parameter “discharing time” does not affect the time used to rinse with the next sample.
This time is created by the parameter “sucking time” under “System/Maintenance” -> “Hardware”.

Drying time [s]
In order to dry the capillary viscometer after rinsing with solvents, the running time of the suction pump is extended after the suctioning of the last solvent fill by the set drying time. This will suction airflow through the viscometer, which makes the solvents evaporate. The drying time must be selected to be long enough for the solvent residue to evaporate completely. The drying time depends on the volatility of the solvent and the viscometer used (suction via suction pipe or suction hose in the fill pipe).

4.9 Logging the results

The protocol file (see 🕮 Section **4.7.1**) contains all data per measurement rig (method, measurement values, standard parameters, formulae, results, viscometers, etc). This file is stored in the ASCII-CSV format, individual fields are separated by a semicolon “;”.

After each measurement, a new data set is attached to the file. The log file can be opened with any text editor. In most cases, the use of the table calculating program Excel seems easiest and clearest. To open this program, click on the menu item “Excel” in the main menu. You can also open other programs in WinVisco370 instead of Excel (see 🕮 Section **4.12**).

Independent of the log file, all measurement results are saved as PDF files in reports in the folder “Report’ in the installation directory by default. These reports can also be printed on a printer. Only the data shown on the screen will be printed. If the check box “Printer profile” is activated, there will be a report printed at the end of a measurement.

4.10 User administration: „System/Maintance“-„User“

The program WinVisco 370 has a user administration for users to possess different levels of authorization depending on their user level. In order to activate this user administration, you must make a change in the file “application.ini”. The file “application.ini” is located in the installation directory, usually “C:\Programme\AVS_370\”. The file “application.ini” can be opened with the Windows program “Editor”.

When activating user administration, you must enter the number “1” instead of “0” after “user=” in the 4th line. Save the file “application.ini”.

If the user administration is activated, a key icon will appear in the “Method/Results” tab in “AVS-Center”.

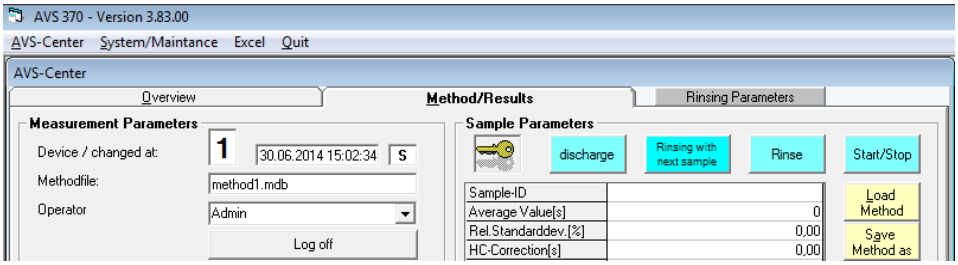


Fig. 13 User administration activated: Key icon will appear

In order to manage users, go to “System/Maintenance” and select the “User” tab.
The input window “WinVisko Security” will appear.

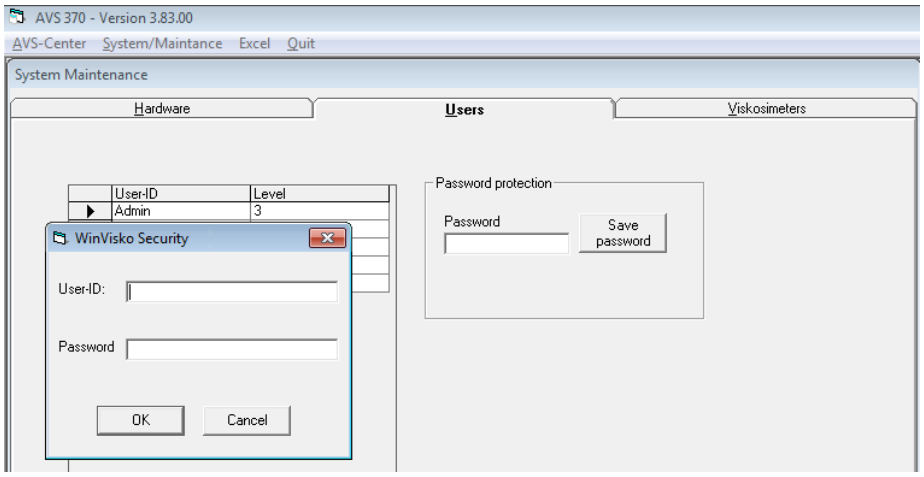


Fig. 14 Logging into user administration

After the installation, you can first log in with the user idea “Admin” and no password as the administrator. In the software WinVisco 370, you distinguish between 3 user levels:

Level 1	„Normal operator”	has the authorisation to load and save methods, to input parameters (no formulae) and to select viscometers
	Alle powers of level 1	+ the authorisation to modify methods (e.g.measurement method), delete parameters, create new parameters, modify formulae, administer viscometers.
Level 3	Administrator	All powers of level 2 plus operator administration

Every user receives a user ID, a level and a password. The user ID and the level are shown in the table. An administrator can delete individual users after marking them by using the DEL key.

In addition, the administrator may assign a password. As soon as you enter this password, only asterisks will appear in the text field. You can save this password following a security inquiry via “save passwor”.

If new users are input, the passport is always empty, and the default user level is 2.

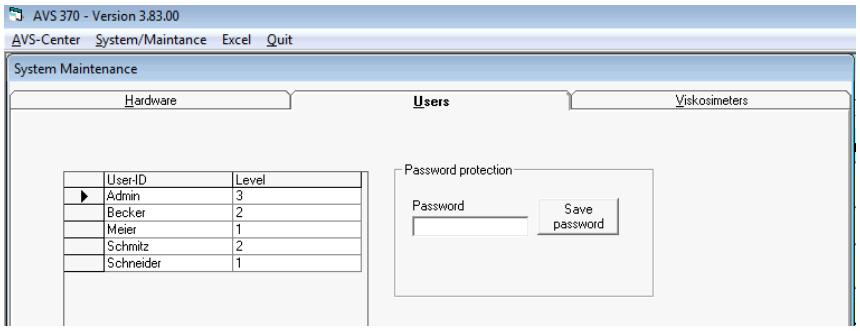


Fig. 15 Operator administration

4.11 Viscometer administration

The “Viscometers” file can be used to input various viscometers in a table. The name of a viscometer must be unique, otherwise a corresponding message will appear. You can select the type of a viscometer from a list. Moreover, you can input a constant and a t_0 value. Subsequently, the message “... modified on “00:00:00” will appear in the field; this means that a manual input was made. If you wish to determine the constant of the t_0 value in a measurement, the date and time will be added automatically. The old value (constant/ t_0) will then be stored in the “old constant/t_0” field. The user will thus obtain a comparison between the old and the new values. The “type“, “modified on“ and “old constant/t_0” columns are not available for manual input.

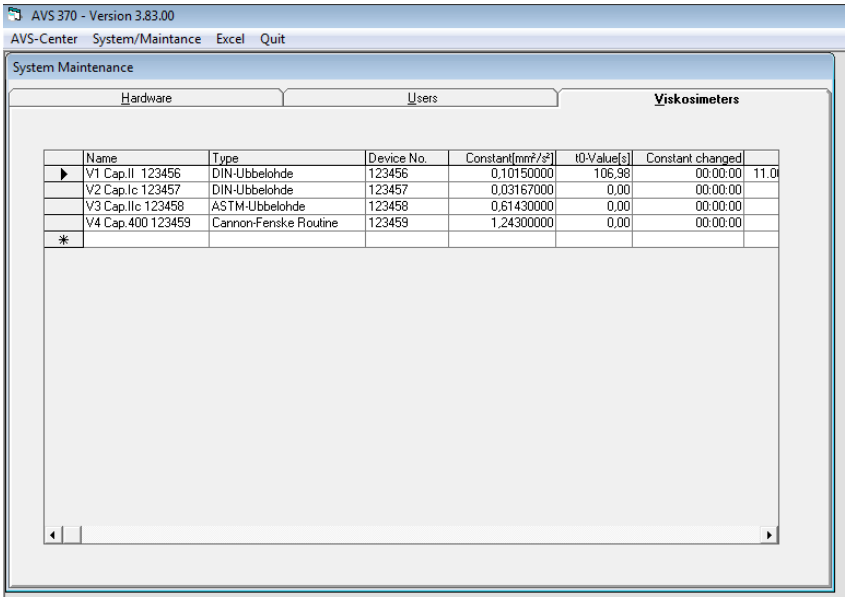


Fig. 16 Viskometer administration

It has been proven effective to name the viscometer in the “Name” column similar to the names shown in Fig. 16. I.e., the name “V2 Cap.Ic 123457” means: Viscometer 2, capillary size Ic, app. no. 123457. This way, the name contains all important information the user needs for the selection of the viscometer in the “Method/Results” tab.

4.12 User program „Excel“ or alternatives

By clicking “Excel” in the main menu, the program Excel is started and the log file is opened (see 🕮 Section **4.7.1**). If you prefer another user program instead of Excel to open the csv files, you can configure the WinVisco370 software accordingly:

Open the file “application.ini” in the installation directory and enter the name for the program menu into the first line instead of Excel and the installation path and the file name of the exe file of the user program into the second line. Save the file “application.ini”. When starting the program WinVisco, another program will be displayed instead of the menu item “Excel”. When selecting this menu item, this user program is started with the open log file (CSC file) if it is available.

4.13 Operating using the keyboard

All functions can be accessed by means of the keyboard. However, the use of a mouse is highly recommended, since operation using the keyboard is far more complex.

Program items in the main menu	Alt o. F10 -> <- Alt + underlined letter
Selecting a device in the overview window	<arrow up> or <arrow down>
Selecting a file	-> <- Alt + underlined letter
Calling the parameter editor	<Enter>
Deleting a parameter from the table	<delete>
View the viscometer list	<space key>
Selecting a viscometer type from the viscometer list	<Enter>
Selecting a parameter from the list in the parameter editor	<space-key>
Selecting a mathematical operand from the list in the parameter editor	<space-key>
Selection of a general object	< tab-key>

4.14 General Information

 To modify a data record in the viscometer and user tables, you have to exit the current data record (e.g. using the cursor keys or the enter key), only then will be modification become effective.

 You should not change or delete any data in the viscometer table in the course of a running measurement, since this may lead to unpredictable errors.

5 Maintenance and care of the device and the viscometers

Maintaining the proper functioning requires certain inspection and maintenance work.

Maintenance and service work includes:
- Visual check
- Interface function, ViscoPump II, and rinsing burettes
- Once per quarter, the electrical contacts have to be inspected for corrosion, if the viscosity measuring unit is used in premises with an occasional occurrence of corrosive matters in their atmosphere.

Maintenance intervals

Normal operation	intervals for carrying out all work is 6 months
Under particular strain	the max. intervals for carrying out all maintenance work are 4 weeks
In case of disturbances	the work has to be carried out immediately

5.1 Maintenance work to be carried out

- Check the hoses, screwed connections for signs of visible damage, contamination, and leaks.
- Check the electrical plug contacts for corrosion and mechanical damage (on the device and on the cables).
- If necessary, the exterior of the casing of the viscosity measuring unit can be cleaned with a piece of cloth soaked with a household cleaning agent. The lower and rear sections have to be dry-treated.
- In no case must liquid penetrate into the interior of the lower section.
- Defective parts must be repaired or replaced with new ones.
- Defective glass parts must always be replaced.

5.2 Wartung und Pflege der Absorberfläschchen VZ 7215

The VZ 7215 absorption traps which prevent contaminations from penetrating into the pneumatic system of the ViscoPump have to be inspected at regular intervals.

⚠ **The measurements will not work if there is an incorrect connection!**
There is a risk of the sample leaking from the viscosimeter or being suctioned into the ViscoPump II.

⚠ **If sodium lime is used** acidic solvents **as an absorption agent**, the colour condition of the indicator is to be checked on a daily basis.

- As soon as this condition has shifted to BLUE in the half of the absorber material, this is the very last moment to replace the material for safety reasons.
- If such a colour shift cannot be observed over an extended period of time, this may be attributable to the fact that an acidic over-saturation of the material has caused a de-colouration; this may then appear as “normal”, but it will definitely result in the destruction of the pneumatic system after some time.
- This situation is explicitly excluded from the warranty coverage!

⚠ When using **activated carbon as an absorption agent** (e.g. with solvents or used mineral oils), a replacement should be made monthly. This depends on the load factor which, in turn, is a function of the volatility of the materials

5.3 Periods without operation

If the capillary viscometers are not used over a long period of time, the liquids contained in the system, in particular aggressive solutions, have to be drained. If the liquid is left in the system, one has to reckon that the solutions used will alter in the course of time and attack the glass, in particular the capillaries.

⚠ **Cleaning agents should be matched to the previous samples or impurities!** In many cases, an aqueous cleaning agent (glass cleaners, detergents) or organic solvents (such as acetone or hydrocarbons) are sufficient.

⚠ **Strong oxidizing cleaning agents such as chromic acid may only be used by trained personnel and must be suitably disposed for safety and environmental reasons** - the current guidelines for handling hazardous materials must be observed.

⚠ In the last rinse cycle, the viscometer should be rinsed with a suitable solvent with a low boiling point (such as acetone), and dried by an air flow, which is preferably generated by underpressure (for example, water jet pump). The viscometer is dry and dust-free by this treatment and can thus be used for manual and automatic measurements.

5.4 Reproducibility of results

The measurement or analysis results depend on a variety of factors. Please check the plausibility of the measurement results or analysis results at regular intervals, and carry out the required reliability tests. In this regard, please adhere to the usual validation procedures and especially to the “Viscometers within quality assurance systems” chapter.

5.5 Viscometers within quality assurance systems

Recommendations for companies that have introduced a quality assurance system in accordance with the DIN EN ISO 9001 standards. In this quality assurance system, an inspection of the measuring equipment is planned. The intervals and required accuracy can be defined by each company according to its own requirements. The standard DIN/ISO 10 012, Part 1 serves as a guideline in this matter. We recommend regular inspection of the viscometers in defined intervals.

Inspection of the viscometer constants:

a) Calibration using comparative measurements with reference measuring standards
Comparative measurements must be performed with a viscometer (reference measuring standard) which was tested at the PTB (Federal German Physical-Technical Institute) and provided with a constant. During this comparative measurement, the viscometer to be inspected and the PTB - tested viscometer were placed simultaneously in the same thermostat bath. The test liquid tested, the viscosity of which must not be known exactly, is filled into both viscometers, tempered and the flow-through time then measured. The constants of the viscometers to be inspected are then calculated according to the following equation:

$$K = \frac{K_{PTB} \times t_{PTB}}{t}$$

K	constant of the tested viscometer
K_{PTB}	constant of the standard reference viscometer
t	low time (HC) of the tested viscometer (corrected by Hagenbach-Couette)
t_{PTB}	flow time (HC) of the standard reference viscometer (corrected by Hagenbach-Couette)

Within the quality assurance system in accordance with DIN EN ISO 9001, traceability of the measuring equipment to national measuring standards is demanded. This traceability can be achieved by inspecting the comparative viscometers (reference measuring standards) at regular intervals at the PTB. The time intervals are defined according to the specifications made in the quality assurance system of the user.

b) Calibration of the capillary viscometer with normal oils of the PTB
During this calibration, a normal oil from the PTB with known viscosity is used as a reference measuring standard. The measurement is performed by means of flow-through measurement of the PTB normal oil in the viscometer to be inspected in a temperature bath, the temperature of which must correspond precisely to the test temperature of the PTB. In this case, it is extremely important to make sure that the temperature is absolutely correct. In case of temperature variation, this will always result in a constant for the viscometer that deviates from the constant applied. A temperature variation of 0.01 K, for instance, will result in a measuring error of up to 0.01 %. The calibration of the deviating temperature into the viscometer constant is not permitted.

c) Inspection by Xylem Analytics Germany with a quality certificate in accordance with DIN 55 350-18, 4.2.2
The inspection at the manufacturer is carried out by means of comparative measurements using viscometers as reference measuring standards that were tested at the PTB (corresponds to Item 1).

General Information on the stability of viscometer constants
Each inspection (even with a certificate) can guarantee the technical measuring direction only for a limited period of time. The constants of viscometers made of the borosilicate glass DURAN®, however, can remain unchanged for long periods of time if the viscometers are kept away from altered influences. Especially extreme changes can be expected, for instance, during the use of liquids that attack glass, in particular hot caustic soda hydrated (NaOH) orduring glass-blowing repairs (even for apparently insignificant repairs).

Liquids whose components adhere to the glass wall also cause errors. In such cases, regular cleaning is required whereby the corrosive action cleaning agent on the glass must be eliminated.

For this reason, we recommend that the user should write up a special processing instructions for all important measurements and include them in his quality assurance manual in accordance with DIN EN ISO 9001. In all cases the user is responsible for the correctness of his measuring and testing equipment and is not released from his responsibility for quality (cp. DIN 55 350, Part 18).

6 Guarantee

We provide guarantee for the device described for two years from the date of purchase. This guarantee covers manufacturing faults being discovered within the mentioned period of two years. Claim under guarantee covers only the restoration of functionality, not any further claim for damages or financial loss. Improper handling/use or illegitimate opening of the device results in loss of the guarantee rights. The guarantee does not cover wear parts. The breach of glass parts is also excluded. To ascertain the guarantee liability, please return the instrument and proof of purchase together with the date of purchase freight paid or prepaid.

7 Storage and transport

If the AVS® 370 is intended to be stored intermediately or transported again, the original packaging will provide the best conditions to protect the devices. However, in many cases, this packaging is no longer available, so that a similar packaging must be created. Sealing of the unit in foil is advantageous here.

The devices should be stored in a room with a temperature between + 10 and + 40°C and the (relative) humidity should not exceed 70% (rel.).

If viscometers have to be stored over some time, or to be dislocated, the fluids inside the system, especially aggressive solution have to be removed.

8 Recycling und Entsorgung

Please observe the applicable local or national regulations concerning the disposal of “waste electrical and electronic equipment”.

The AVS® 370 and his packaging are manufactured as far as possible from materials which can be disposed of environmental-friendly and recycled in a technically appropriate manner. If you have any question regarding disposal, please contact the service (see backside of this manual).

SI Analytics®

EG - KONFORMITÄTSERKLÄRUNG
EC - DECLARATION OF CONFORMITY
CE - DÉCLARATION DE CONFORMITÉ
CEE - DECLARATIÓN DE CONFORMIDAD

Wir erklären in alleiniger Verantwortung, dass das folgende Produkt	We declare under our sole responsibility that the following product	Nous déclarons sous notre seule responsabilité que le produit ci-dessous	Declaramos bajo nuestra única responsabilidad, que el producto listado a continuación
Viskositäts-messgerät	**Viscosity measuring unit**	**Appareil de mesure de la viscosité**	**Equipo medior de viscosidad**
AVS® 370			
auf das sich diese Erklärung bezieht, übereinstimmt mit den folgenden EG Richtlinien.	to which this declaration relates are in conformity with the following EC directives.	auxquels se réfère cette déclaration est conforme directives CE soul vantes	todo lo relativo a esta declaración está en conformidad con las directivas CEE siguientes
EMV EG-Richtlinie 2014/30/EU Sicherheit EG Richtlinie 2014/35/EU	EMC EC-Directive 2014/30/EU Safety EC-Directive 2014/35/EU	CEM CE-Directive 2014/30/EU Sécurité CE-Directive 2014/35/EU	CEM CEE siguientes 2014/30/EU Seguridad CEE siguientes 2014/35/EU
Angewandte harmonisierte Normen oder normative Dokumente	Applied harmonized standards or normative documents	Normes harmonisées ou documents normatifs appliqués	Estándares armonizados aplicados o documentos normativos
EMV EN 61326-1:2013 Sicherheit EN 61010-1 :2010	EMC EN 61326-1:2013 Safety EN 61010-1 :2010	CEM EN 61326-1:2013 Sécurité EN 61010-1 :2010	CEM EN 61326-1:2013 Seguridad EN 61010-1 :2010

Mainz den 07.07.2016

Dr. Robert Reining
Geschäftsführer, Managing Director

Konf. No.: AVS001b

Xylem Analytics Germany GmbH
Dr.-Karl-Slevogt-Str. 1
82362 Weilheim
Deutschland, Germany, Allemagne, Alemania

Typ / type / type / tipo **AVS ® 370**

Bescheinigung des Herstellers

Wir bestätigen, dass oben genanntes Gerät gemäß DIN EN ISO 9001, Absatz 8.2.4 „Überwachung und Messung des Produkts“ geprüft wurde und dass die festgelegten Qualitätsanforderungen an das Produkt erfüllt werden.

Supplier’s Certificate

We certify that the above equipment has been tested in accordance with DIN EN ISO 9001, Part 8.2.4 "Monitoring and measurement of product" and that the specified quality requirements for the product have been met.

Certificat du fournisseur

Nous certifions que le produit a été vérifié selon DIN EN ISO 9001, partie 8.2.4 «Surveillance et mesure du produit» et que les exigences spécifiées pour le produit sont respectées.

Certificado del fabricante

Certificamos que el aparato arriba mencionado ha sido controlado de acuerdo con la norma DIN EN ISO 9001, sección 8.2.4 «Seguimiento y medición del producto» y que cumple con los requisitos de calidad fijados para el mismo.

SI Analytics

a xylem brand

Hersteller
(Manufacturer)
Xylem Analytics Germany GmbH
Dr.-Karl-Slevogt-Str.1
82362 Weilheim
Germany

SI Analytics
Tel. +49(0)6131.66.5111
Fax. +49(0)6131.66.5001
E-Mail: si-analytics@xyleminc.com
www.si-analytics.com

Service und Rücksendungen
(Service and Returns)
Xylem Analytics Germany Sales GmbH & Co.KG
SI Analytics

Gebäude G12, Tor Rheinallee 145
55122 Mainz
Germany

Tel. +49(0)6131.66.5042
Fax. +49(0)6131.66.5105
E-Mail: Service-Instruments.si-analytics@xyleminc.com