

USER- MANUAL AKV Easy





est. 1878

INHOUD

1	SAFETY AND WARNINGS	4
2	WARRANTY	4
3	PRECAUTIONS AND HAZARDS	5
3.1	ELECTRICAL	5
3.2	FLAMMABLE SOLVENTS AND CHEMICALS	5
3.3	RECYCLING AND DISPOSAL	6
4	INSTALLATION	6
4.1	IMPORTANT	6
4.2	UNPACKING	6
5	FUNCTIONALITY OF SCREEN, SYSTEM AND POWER MODULE	7
5.1	CONNECTING CABLES	8
6	PRINTER	9
6.1	PRINTER MOUNTING	9
6.2	PRINTER PART NAMES	9
6.3	PRINTER PAPER REPLACEMENT	9
6.4	MEASURING HEAD	10
6.5	POSITON TUBE, ADJUSTMENT	10
6.6	CONNECTING THE SYSTEM	11
7	DESCRIPTION OF MEASUREMENT	12
8	CLEANING AND SAMPLE PREPARATION	14
8.1	REMOVAL OF SAMPLE AND CLEANING OF THE VISCOMETER TUBE	14
8.1	RINSING OF TUBE	15
8.2	FILLING SAMPLE	15
9	INITIAL OPERATION AND CONFIGURATION	16
9.1	MAIN MENU	17
10	QUICK START	18
10.1	FILL UBBELOHDE TUBE WITH SAMPLE	18
10.2	PLACEMENT OF UBBELOHDE VISCOMETER	18
10.3	QUICK START: MENU PRINCIPLES	19
10.4	QUICK START: SETTINGS	20
11	FULL CONFIGURATION OF THE AKV EASY	22
11.1.1	Menu settings	23
11.2	CONFIGURATION OF DRAIN	24
11.3	USER ADMINISTRATION ON OR OFF	25
11.4	USER MANAGEMENT: SET USER	26
11.4.1	Change user	27
11.4.2	Activating user management	27
11.4.3	Date and time setting	28
12	CONFIGURATIONS OF MEASURING POINTS	28
12.1	METHOD MENU	29
12.2	CONFIGURING CALCULATION / FORMULAS	31
13	RESULT DATABASE	32
13.1	LATEST TEST RESULTS	32



ISO 9001 : 2015
NL/PRO 238239125

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Manual AKV Easy R1.01.docx Rev. 1.02 UK 030-21

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Page 2/44



est. 1878

13.2	RESULTS OF THE DATABASE.....	32
13.3	PRINT SETTINGS.....	33
14	FORMULAS.....	34
15	SPECIAL MEASURING PROCESSES.....	36
15.1	MEASURING OF T0.....	36
15.2	MEASURING OF C (CALIBRATION).....	37
16	MAINTENANCE.....	37
17	TROUBLESHOOTING.....	39
17.1	SOFTWARE MESSAGES.....	39
18	TECHNICAL DETAILS.....	41
19	SPAREPART LIST.....	41
20	EC DECLARATION OF CONFORMITY.....	43
21	DISCLAIMER.....	44



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1 SAFETY AND WARNINGS

Make sure before installing or operating the equipment to read and understand all instructions and safety precautions listed in this manual. If there are any questions concerning the operation of the equipment or about the information given in this manual please contact your local dealer or our sales department first.

Performance of installation, operation, or maintenance other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

Never operate equipment that is not correctly installed. Unqualified personnel must not operate the equipment. Avoid damage to the equipment, or its accessories, caused by incorrect operation.

Important:

- When performing service, maintenance or moving the apparatus, always disconnect the apparatus at the main's socket,
- Proper skilled and trained personnel are only allowed to operate this equipment,
- Take notice of warning labels and never remove them,
- Refer service and repairs to qualified technician,
- If a problem persists, call your supplier or Tamson Instruments bv.

2 WARRANTY

Tamson Instruments bv. warrants that all their manufactured equipment is free from defects in material and workmanship, preventing the machine from normal operation. Tamson Instruments bv does not warranty that the equipment is fit for any other use than stated in this manual. The manufacturer can only be held responsible for the security, reliability and performance of the equipment, when operated in accordance with the operating instructions, extensions, adjustments, changes and/or if repair is performed by Tamson Instruments bv. or authorized persons only. This warranty is limited to one year from the date of invoicing. All equipment and materials are subject to standard production tolerances and variations.



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Page 4/44

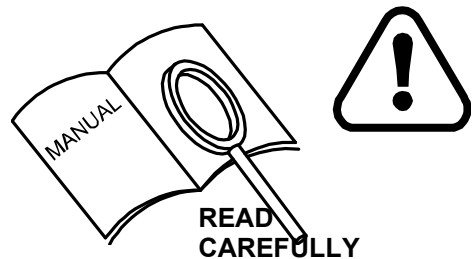
3 PRECAUTIONS AND HAZARDS

General

Before attempting to operate please read all parts of this manual carefully to insure smooth operation and avoid damage to the equipment or its accessories.

If a malfunction occurs see "Troubleshooting", page 39 at the end of this manual.

If problem persists, call your supplier or Tamson Instruments bv. Never operate the equipment if not correctly installed. The equipment must be operated only by qualified personnel. Avoid damage to the equipment or its accessories through incorrect operation.



3.1 Electrical

Danger! Electric shock caused by contact of defect cables or connectors is possible. Check cables and connectors before switching on the system. Defective cables or connectors must be exchanged. Repair of defective cables or connectors is not allowed.

Do not use or store this equipment in rooms with high humidity.

Use the power supply with the right voltage. The supported voltage is labelled on the power supply.

Use the power plug only at grounding-type socket-outlets.

Do not use extension cord without grounding.

Only use original delivered cables. If you use your own cable, make sure that the cable fulfils electrical requirements

3.2 Flammable solvents and chemicals

All relevant safety measures are to be observed when working with flammable solvents and chemicals.

Set up the system in a well-ventilated location.

Keep all sources of flame far from the workplace.

Clean up spilled liquids and solids immediately.

Follow the safety instructions of the chemical manufacturer.

3.3 Recycling and disposal

This product is covered by European Directive 2012/19/EU, WEEE – Waste from Electrical and Electronic Equipment. The correct disposal of your old equipment will help to prevent negative effects to the environment and public health.

More details about the disposal of your old equipment can be obtained from your local authorities, from waste disposal companies or from your local dealer.



4 INSTALLATION

4.1 Important

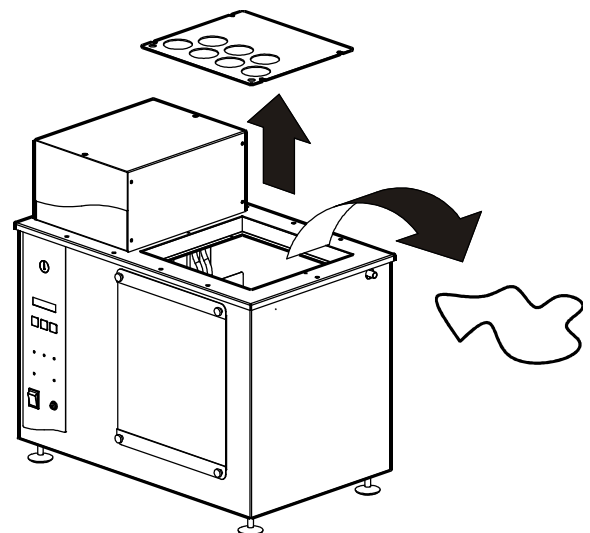
Tamson Instruments bv is not responsible for any consequential damage or harm caused by using this apparatus. Repairs on the electrical system of the bath may only be carried out by well trained and authorized staff.

4.2 Unpacking

Before leaving the factory Tamson products are adequately packed to prevent damage during normal transportation. Check the packing for external damage and make a note on the shipping documents if any damage is found. Always retain the cartons and packing material until the product has been tested and found in good condition. (Transport companies generally will not honor a claim for damage if the respective packing material is not available for examination).

The shipment contains at least the products as mentioned in the delivery checklist. Further the consignment might contain one or more viscometers, individually packed in small boxes with the calibration certificate included in the box, as well as ASTM thermometers, thermometer holders etc. Please see the packing list for details concerning total contents of consignment.

**REMOVE ALL
PACKAGE MATERIAL**



When using a thermostatic bath in combination with the system, remove any remaining packing material from its interior before filling it with bath fluid. The interior of the bath can be accessed by taking off the lid on the top of the bath

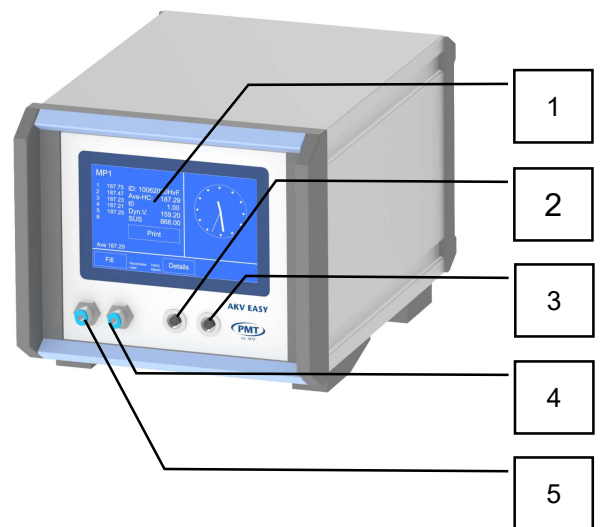
5 FUNCTIONALITY OF SCREEN, SYSTEM and POWER MODULE

The system offers following features:

- Calculation of kinematic, dynamic, relative, and intrinsic viscosity,
- Determination of the viscosity-constant K by calibration,
- Formulas and correction for the main standard calculation an dimension,
- Database (up to 8) for used viscometer,
- Database (up to 254) for results,
- Different measure methods for each measure point,
- Database (up to 8) of methods configurable,
- Different user levels with different admission (Administrator, Super User, User),
- Supported peripheries: Ubbelohde measuring head, printer.

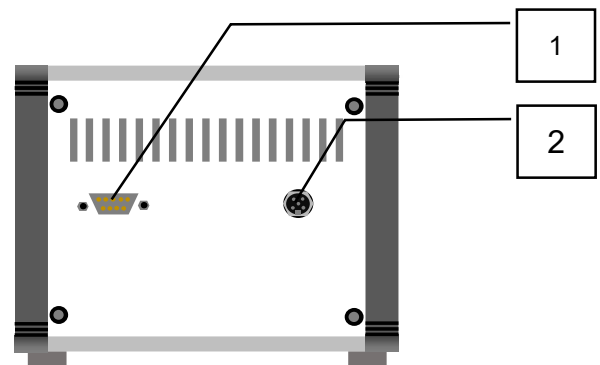
Front view " AKV - EASY"

Front of apparatus	
Item	Description
1	Touch screen
2	5 pole connector IR light barriers
3	4 pole connector Thermistor (TC)
4	Venting / discharge
5	Vacuum / Suction pressure inlet



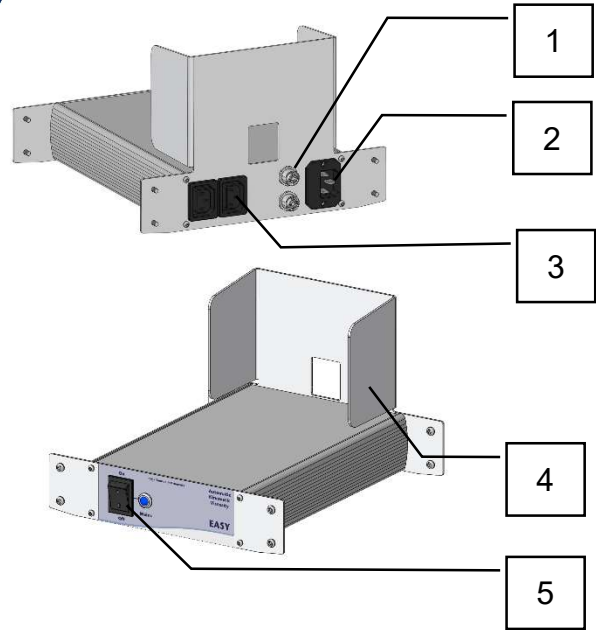
Backside view "EASY"

Backside of apparatus	
Item	Description
1	RS232 port for printer
2	24V DC Power supply



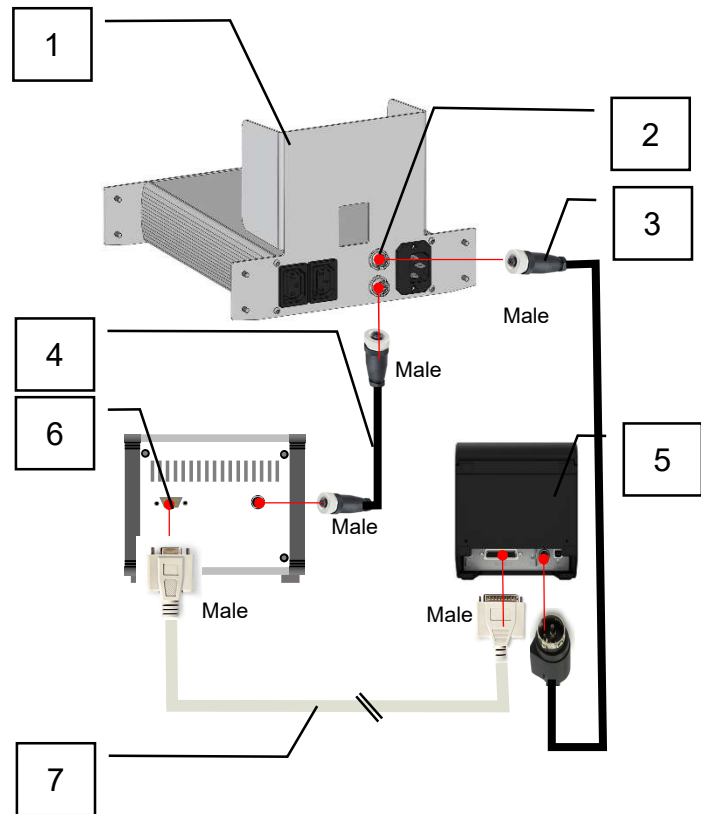
Front and backside POWER MODULE

Power module AKV Easy (01T5002)	
Item	Description
1	2 x plug 24V DC Power supply printer and easy unit Interchangeable
2	Mains in: 90 to 240 Volt 50 to 60Hz 150 Watt max Fuse 3Amp (slow)
3	2 x Spare mains socket female Via Fuse [1] (3Amp)
4	Printer bracket Hole in back for cable set
5	Power on/off with LED indicator



5.1 Connecting cables

Printer TMT 20T Backside	
Item	Description
1	Power module Brackets for printer TM-T20
2	2 x 24V DC / 2A
3	Power cable Printer
4	Power cable AKV "Easy"
5	Printer
6	RS232 out to Printer (9 pin Sub D female)
7	Cable RS232 (Pin Sub D male 25 pin SUB D male)



6 PRINTER





6.1 Printer mounting

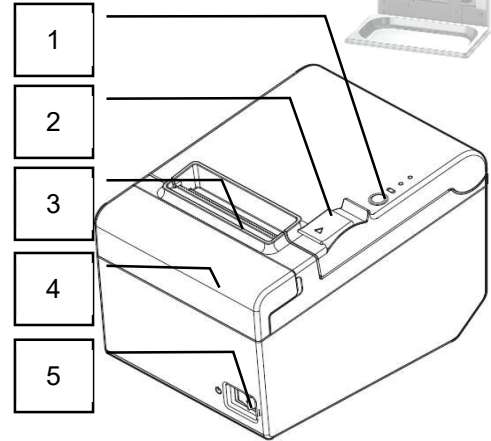
The printer is placed on top of the tower

The printer stands loose and is kept in it's position by the side brackets



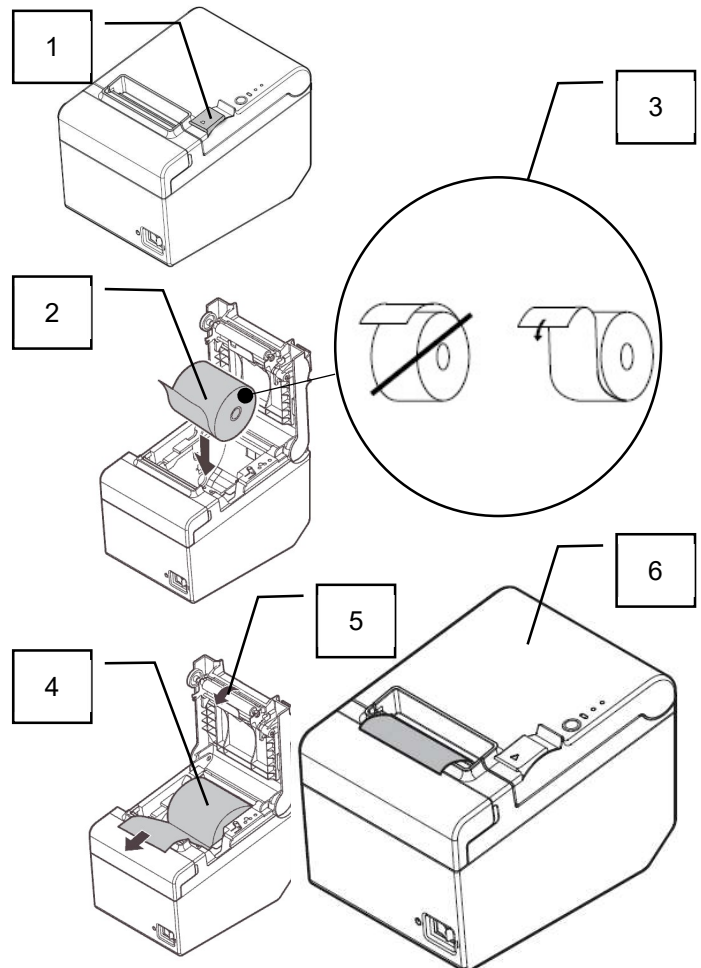
6.2 Printer part names

Printer TMT 20T	
Item	Description
1	Indicators  Error  Paper  Feed 
2	Cover open lever
3	Paper tear strip
4	Paper compartment cover
5	On/off switch (can be left on permanently)



6.3 Printer paper replacement

Printer TMT 20T Paper replacement	
Item	Description
1	Cover open lever
2	Insert the roll paper as indicated
3	Feed the thermal sensitive side on top into the printer
4	Pull out some paper, and close the roll paper cover
5	Close the cover
6	Ready to go

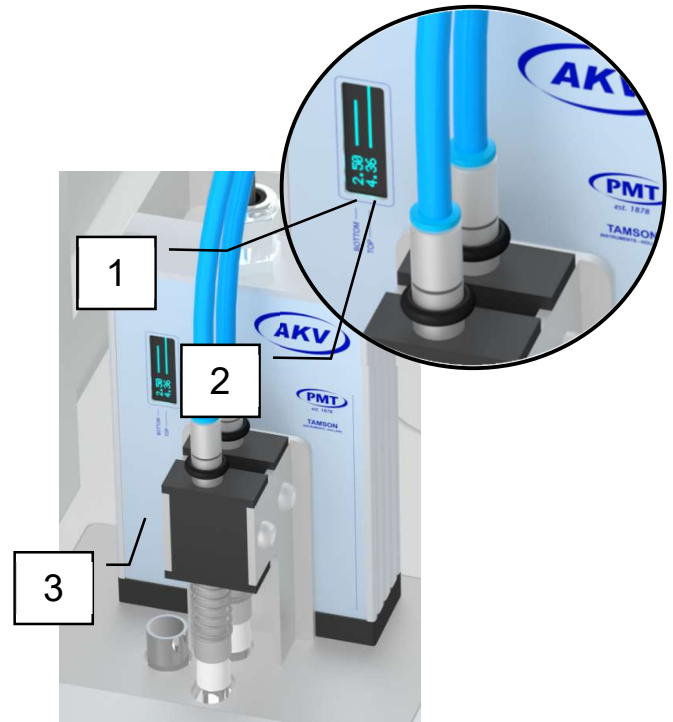


6.4 Measuring head

The measuring head has two indicators.
 The indicators give the strength of the received IR signal.
 A long bar and high value indicate a stronger signal.
 The values and length are for relative indication only.
 The values lie between 0 and 5.00.
 A value of 0 means no signal or blocked.

Placing a viscometer tube weakens the signal.
 The signals from bottom and top differ.
 The signal thus can be observed dynamically when a fluid passes.
 Transparent fluid passing strengthens the signal.
 Dark fluid passing weakens the signal strength.

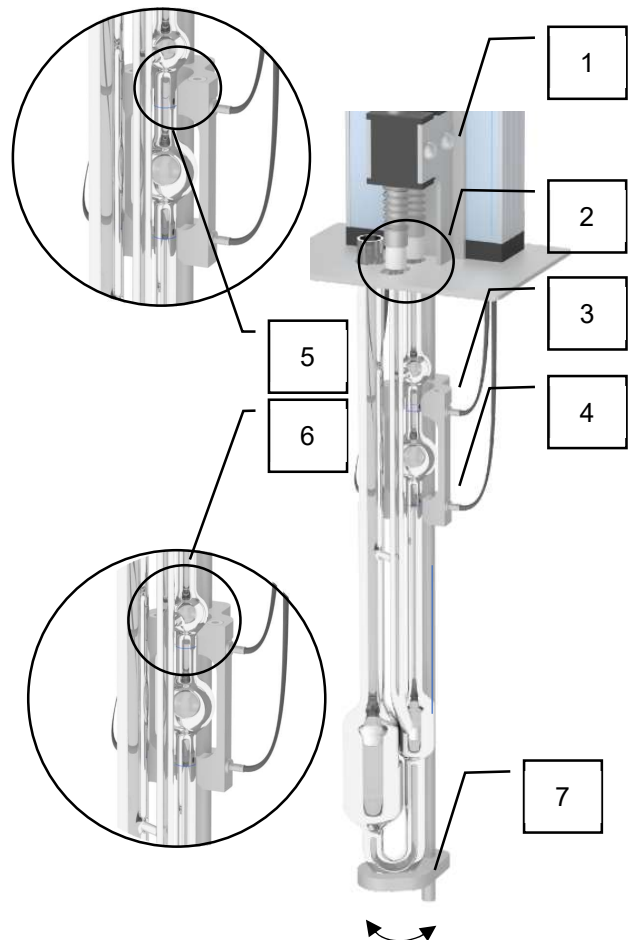
Make sure the head is free of air bubbles when placed in a water bath. Air bubbles block the signal
Air bubbles lead to measuring errors.



Measuring head Indicator	
Item	Description
1	Sensitivity bottom sensor
2	Sensitivity top sensor
3	Electronics

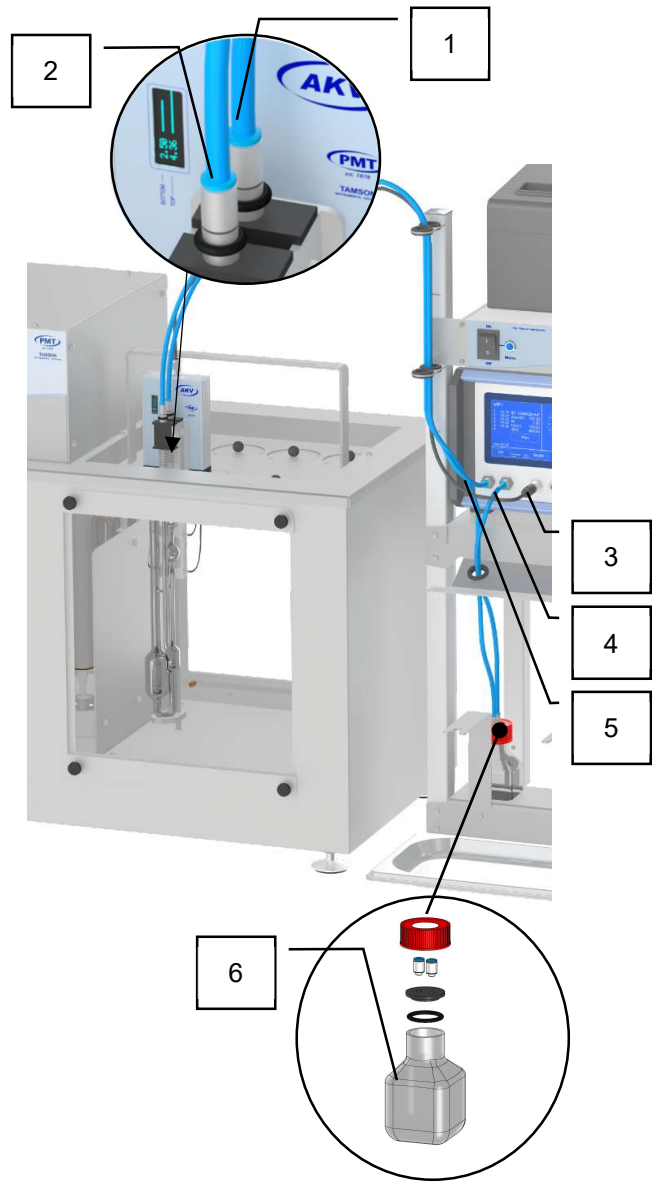
6.5 Position tube, adjustment

Adjustment Ubbelohde Viscometer tube	
Item	Description
1	Adjustment of silicone stopper The heart of these cuffs must be aligned with the heart of the viscometer tube
2	Silicone stopper
3	Top screw optics bracket
4	Bottom screw optics bracket
5	Viscometer positioned too high
6	Viscometer positioned correctly, it rests on bracket
7	Use bottom bracket to align the viscometer in the vertical position. It must be placed spirit level in the holder.



6.6 Connecting the system

Connections	
Measuring head	
Item	Description
1,5	Vacuum / Suction pressure
2,4	Venting
3	Connector measuring head (Binder 712)
6	Fluid trap <ul style="list-style-type: none"> • O-ring 20 x 3,5 70SH BLK • Quick connector for 3mm hose to M5

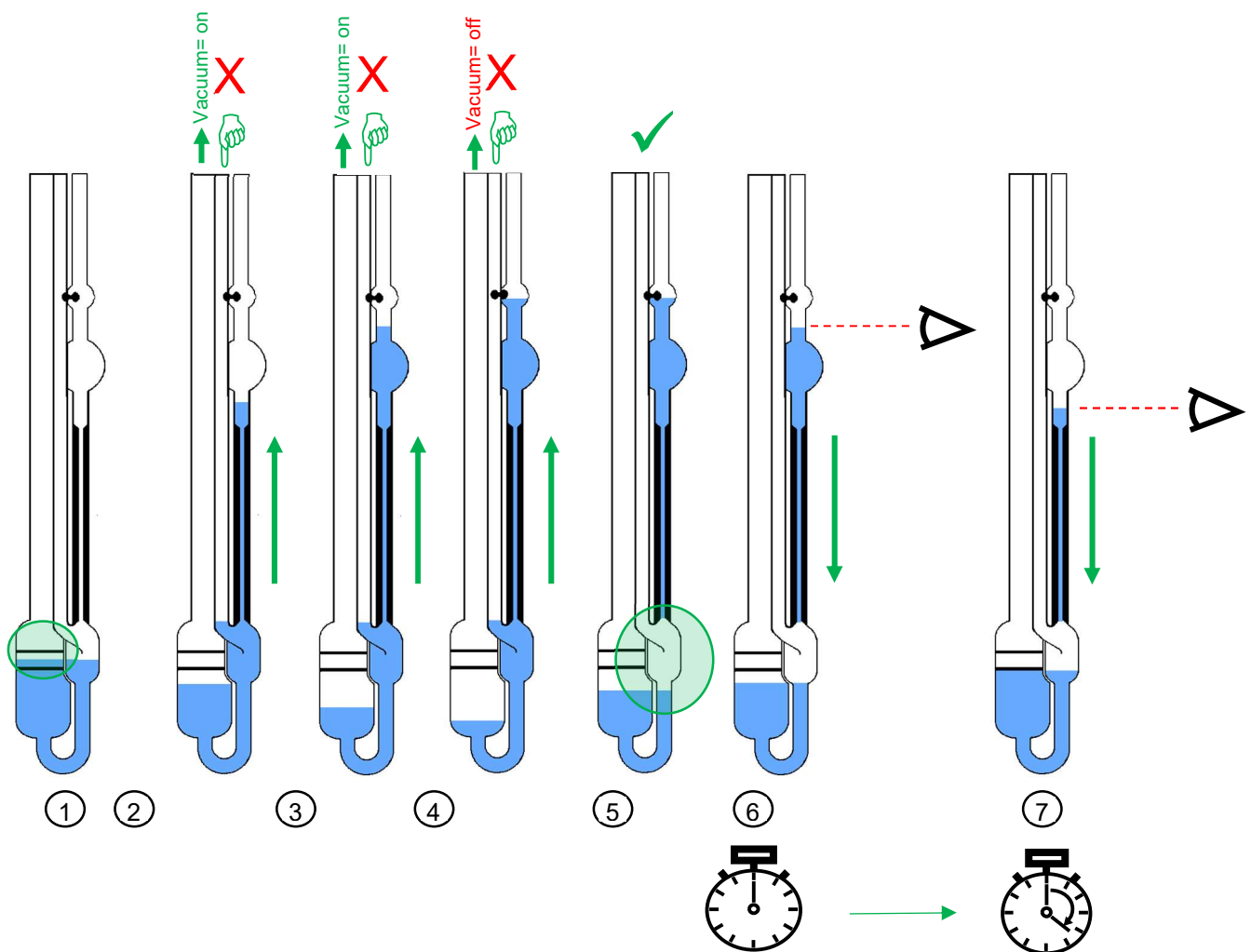


7 DESCRIPTION OF MEASUREMENT

The "AKV – Easy" measures flow time of liquids. For this purpose the unit "AKV – Easy" – is equipped with one or two channels which are connected to a Ubbelohde capillary viscometer.

The sample is injected into the capillary viscometer [1]. The measuring process is then started from the touch screen. A so called soak time can be defined to pre heat the sample. During this pre heating the fluid can be moved up and down to get better homogeneity. When the soak time expires measurement starts [2] The sample is sucked up passing the bottom and top IR bridge [3]. Vacuum than is turned off [4] leading to the situation of a suspended level [5]. Sample is now able to freely flows downwards without any counter pressure of the fluid below [6]. Timing starts when the top optical bridge is passed [6]. Timing stops when the fluid passes the bottom optical bridge [7]. The viscosity will now be calculated.

The vacuum (under pressure) is controlled during the suction process and has also a power "ramp". The pump starts with low suction which increases.



The sample can be pre-heated before starting the measurement, The pre-heat period can be specified. It also is possible to move the fluid when pre heating. This shortens pre-heating time and improves homogeneity in the sample. After the pre-heating, the measurement starts(2). The sample is sucked up slightly above the upper measuring mark(4). The suction stops and the venting leg opens(5). The sample

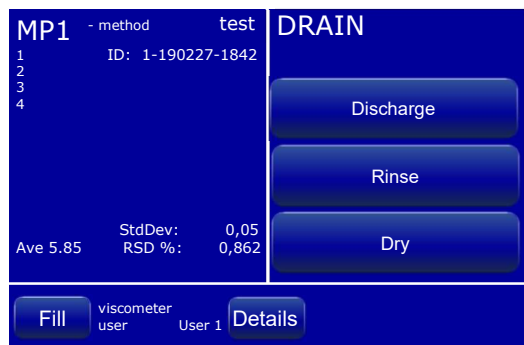
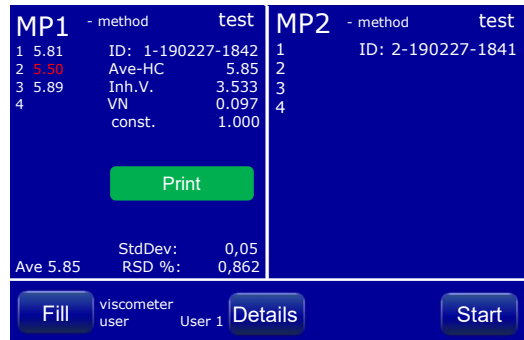
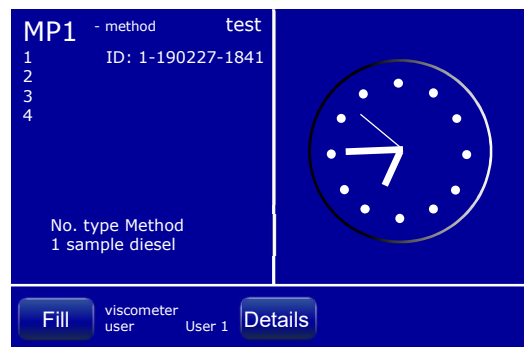
flows down under gravity. The flow time is measured beginning from the upper measuring mark (6) to the lower measuring mark (7). This is repeated until the maximum number of measurements is reached or at least the minimum number of measurements are done and the results of them are inside the required standard deviation. These parameters can be configured in one of the eight methods. The samples detected light barriers for transparent samples. On request thermistors can be used for opaque samples.

The number of measurements can be configured and up to 10 consecutive measurements are possible. For kinetic measurements up to 99 is possible with a maximum interval of 240 minutes. In addition, the maximum standard deviation can be configured. This is checked after each measurement. If it is above the permissible maximum value, the outlier is ignored and a replacement measurement is carried out. However, this only takes place as long as the number of desired measurements is less than the maximum measurements, defined in the method is reached.

"AKV – Easy" calculates the average value, which (if activated) is corrected by the Hagenbach-Couette correction. This corrected value together with the values (like concentration) entered as constant in the method or later at start are the basis for further calculations. These calculations can be configured in the method.

After the measurement has been completed, the results are stored in the results database (last 254 results). The next measurement can now be carried out with manual filling of the viscometer.

<p>AKV Easy 1P / 1S</p>	<p>Main unit containing single measure channel with: - Suction mode (Easy 1S) On special request: - Pressure mode (Easy 1P)</p>
<p>AKV Easy 2P / 2S</p>	<p>Main unit containing dual measure channels with: - Suction mode (Easy 2S) On special request: - Pressure mode (Easy 2S)</p>
<p>AKV Easy 3</p>	<p>Main unit containing single measure channel working in suction mode and a rinsing module</p>

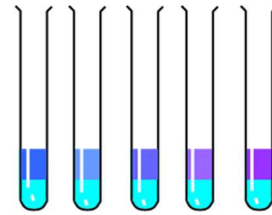


8 CLEANING AND SAMPLE PREPARATION

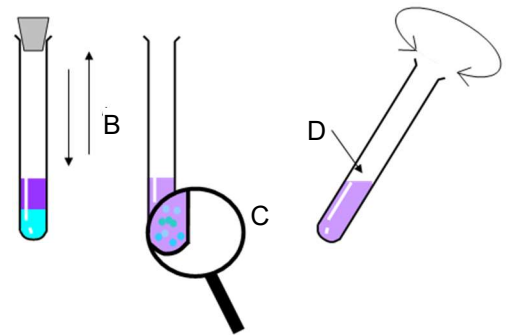
In order to clean the viscometer tubes properly, the sample and its residue must solve well in the cleaning solvent. The solvents and sample have to perfectly mix with each other, also when using a second or third cleaning fluid. In all cases the used solvent must mix with the sample or its residue.

Following procedure can be followed to observe the well mixing of both solvent and sample.

- When multiple solvents are used ("A") mix each solvent separately with the sample. For this purpose use clean transparent glass test tubes,
- Gently shake each tube "B",
- Observe each mixture "C",
- Turn the solution "D" and observe residue on the surface of the test tubes,
- If separation is detected between solvent and sample,
- Observe whether particles are formed like waxy crystals or trails. In these cases the solvent can't be used as a cleaning fluid.



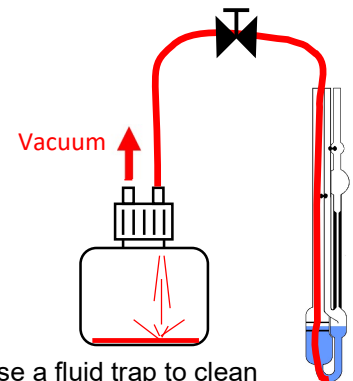
A: Multiple solvents mixed with sample



8.1 Removal of sample and cleaning of the viscometer tube

Take following in account for cleaning the Ubbelohde viscometer:

- Use filtered solvents to prevent particles, impurities or fiber left behind. A 1.6 micron Puradisc filter can be used for this purpose,
- Use a pipette for charging the Ubbelohde viscometer,
- Disposable pipette tips prevent contamination,
- Solvents like Hexane, Acetone, Petroleum - Ether can be of technical grade, impurity is not an issue when using for cleaning purpose,
- Clean the tubes upright,
- Remove solvent using a vacuum fluid trap ("E") and a small (3mm o.d.) hose inside the Ubbelohde filling leg. Clean the filling bulb from the bottom using this,
- Used nitril gloves (blue) when cleaning,
- Use dry and filtered air to dry the viscometer or use an air oven.



E: Use a fluid trap to clean the Ubbelohde Viscometer

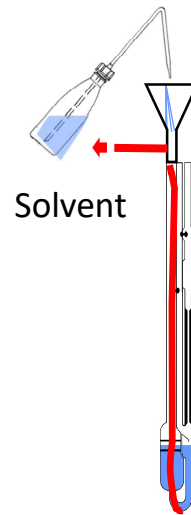


Prevent presence of fibres in the capillary

In any case do not use standard cloth or tissue but low lint

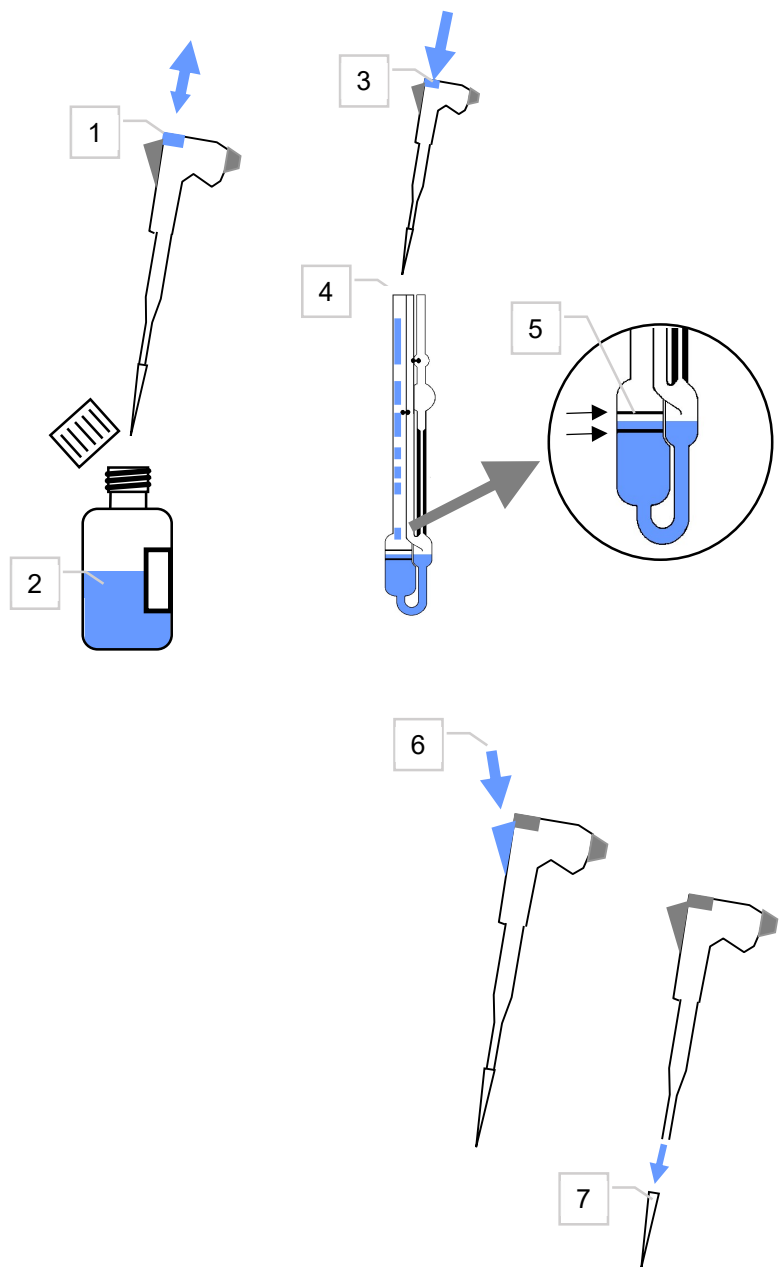
8.1 Rinsing of tube

After removing the sample using a fluid trap, rinse the viscometer tube thoroughly.



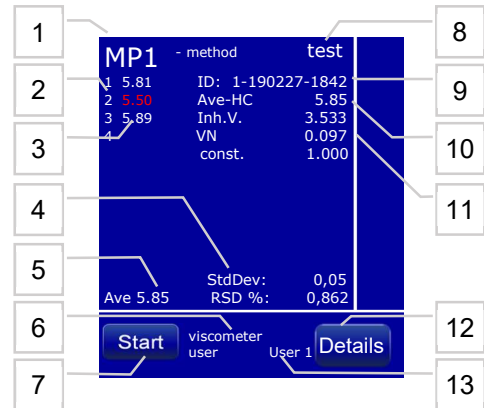
8.2 Filling sample

Item	Description
1	Suck sample into pipette
2	Sample
3	Eject sample from pipette
4	Charge tube with sample
5	Fill up between markings
6	Eject pipette tip
7	Dispose of tip



9 INITIAL OPERATION AND CONFIGURATION

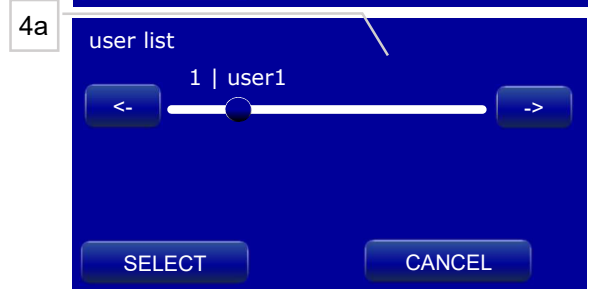
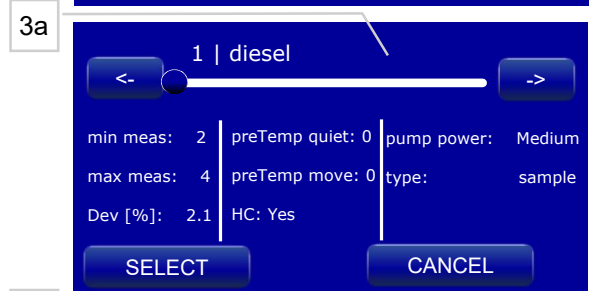
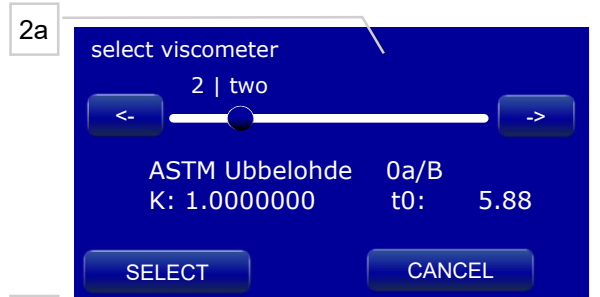
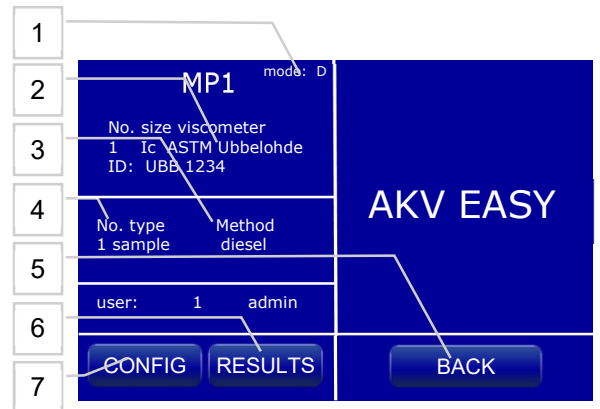
Item	Description of main menu (left)
1	- Number of measure point (e.g. "MP1") - Type of viscometer (e.g. ASTM-Ubbelohde") - Size of viscometer (e.g. "1C") - Viscometer id (e.g. "1057902") If the window frame is blue, this measure point is active. The control buttons on the right are valid for this measure point. You can activate a measure point by clicking on the corresponding window.
2	Max amount of measurement repetition
3	Measured flowtime, red means outlier
4	Standard-Deviation and coefficient of variation or relative standard deviation in percent (RSD %)
5	Measured flowtime, red means outlier
6	The name of the current selected user, who does the measurement (if user management is activated)
7	Starts / Stops the measurement
8	The name of the current selected method
9	The sample name
10	Hagenbach-corrected* (HC) flowtime average (if HC is configured as active)
11	Calculated results. Here for example "Inh.V.", "VN" and "Const".
12	Starts / Stops the measurement
13	The name of the current selected user, who does the measurement (if user management is activated)



* When flowtimes are below 200 seconds the influence of kinetic energy becomes visible. Under these conditions a correction is necessary.

9.1 Main menu

Item	Description of main menu (left)
1	Mode of the measure channel: P= Pressure / S= Suction / (D=Demo)
2,2a	The name of the current selected viscometer. Click on it to change selection
3,3a	The name of the current selected method. Click on it to change selection
4,4a	The name of the current selected user. Click on it to change selection
5	Click on it to change configuration. If user management is active, login is required.
6	Click to go back to main menu
7	Show results

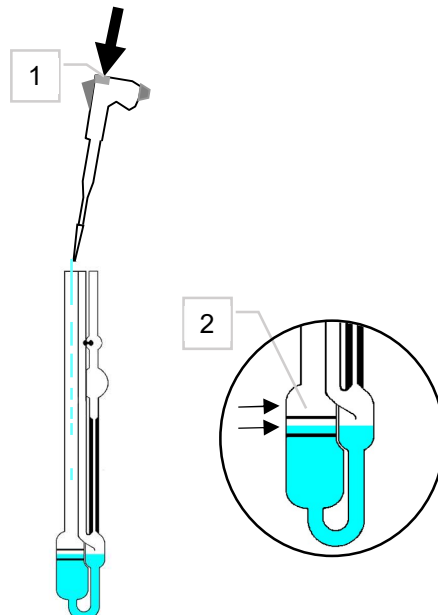


10 Quick Start

10.1 Fill Ubbelohde tube with sample

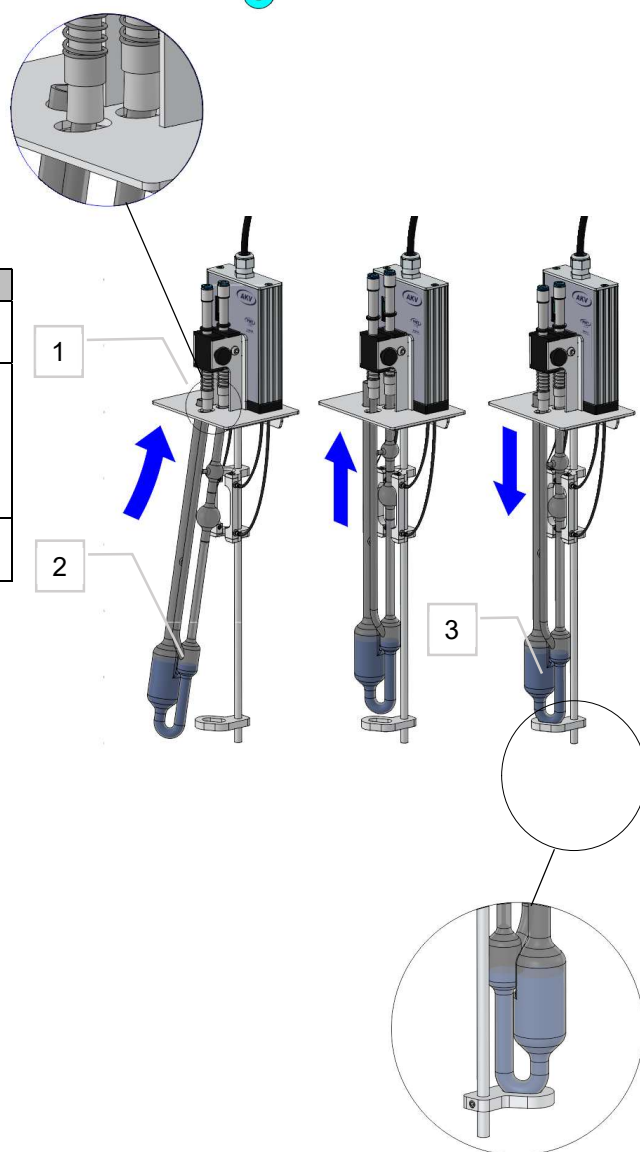
Charge the Ubbelohde tube with the sample

Item	Description of main menu (left)
1	Inject the sample in the Ubbelohde
2	Fill between the indicated markings



10.2 Placement of Ubbelohde viscometer

Item	Description of main menu (left)
1	Be gentle with the glassware. Do not force glassware into the metal parts
2	Place the Ubbelohde under an angle in the holder. Get is straight (near in parallel with the holder) Then gently push upwards
3	Release downwards. The Ubbelohde viscometer is fixated in the bracket

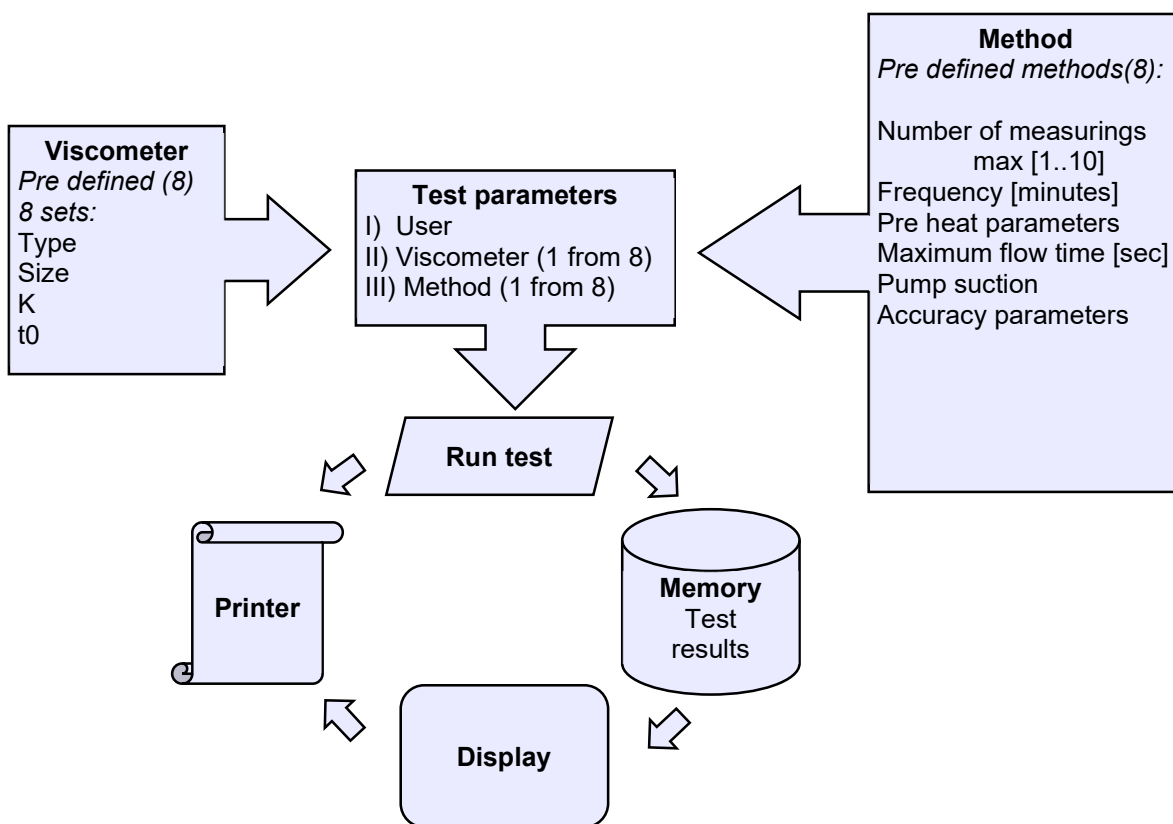


Place holder with viscometer in the bath.
Apply appropriate soak time.



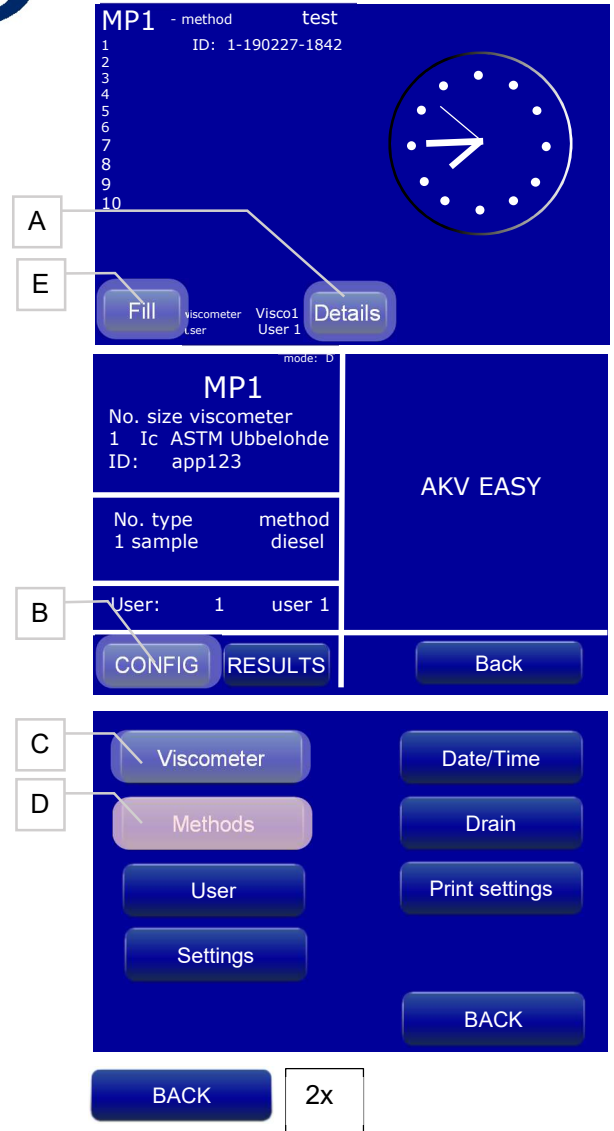
10.3 Quick start: Menu Principles

To start a measurement, the type of viscometer and method have to be selected. These parameters are needed to perform a measurement.



10.4 Quick start: Settings

Item	Method menu
A	Press Details
B	Press Config
	Parameters to alter
C	Enter viscometer settings Chose capillary and constant
D	Enter Method settings There are 1..8 methods A method selects Pump, pre heat, error
E	This table gives an overview of the available settings for the viscometer [C] and methods [D]



The image shows three screenshots of the PMT device interface. The top screenshot shows the main menu with options 'Fill', 'Details', and 'CONFIG'. The middle screenshot shows the 'CONFIG' screen with options 'Viscometer', 'Methods', 'User', 'Settings', 'Date/Time', 'Drain', 'Print settings', and 'BACK'. The bottom screenshot shows the 'BACK' button and a '2x' button.

[C] Viscometer		[D] Method		
Select one of the 8 stored viscometer tubes		Select one of the 8 stored methods		
Type	ASTM Ubbelohde DIN,etc.	Test method	Sample T0 Kinetic	Sample
Size	0,0c,	Numer of runs	1..10	4
Tubes' constant [K]	This must be determined using reference oil or a so called calibration oil	Measure frequency		
t0		Pump power	Very low : Very high	medium
		Pré-temp quiet		
		Pré-temp move		
		Max flowtime		
		Formulas	see page 34, "FORMULAS"	



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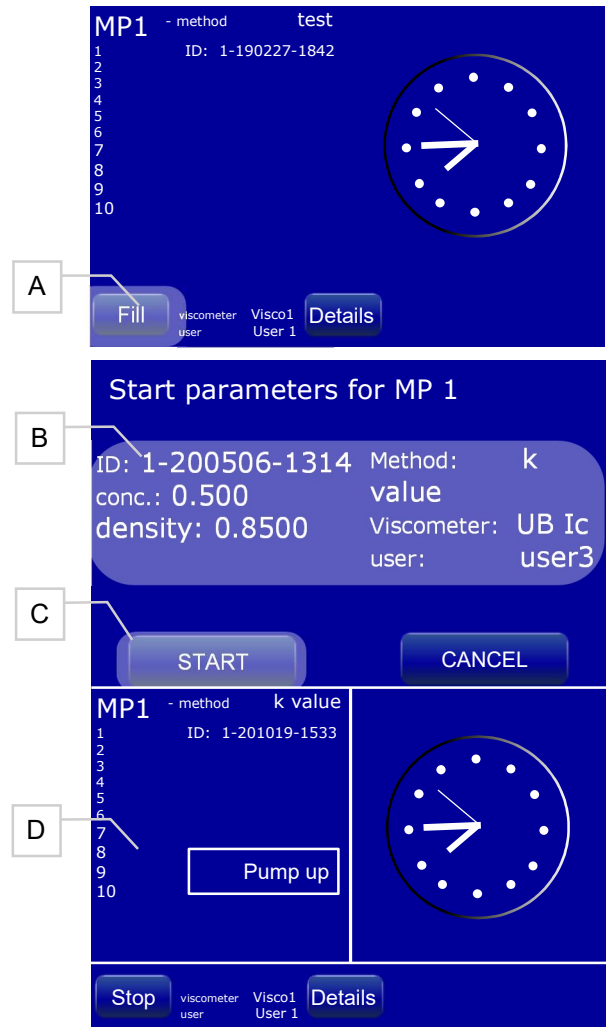
Tamson Instruments bv

E-mail: sales@tamson.com
Website: www.tamson.com

VAT: NL 80 66 34 984 B01
Bank account no.:
NL28 INGB 0007 350 370
NL95 RABO 0160100046
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Quick start: Run test

Item	Method menu
A	Press Fill to start a test
B	An overview of the test parameters By pressing open menu to change these parameters
C	Select start to start the test
D	The test is running, sample is pumped



The screenshots illustrate the following steps:

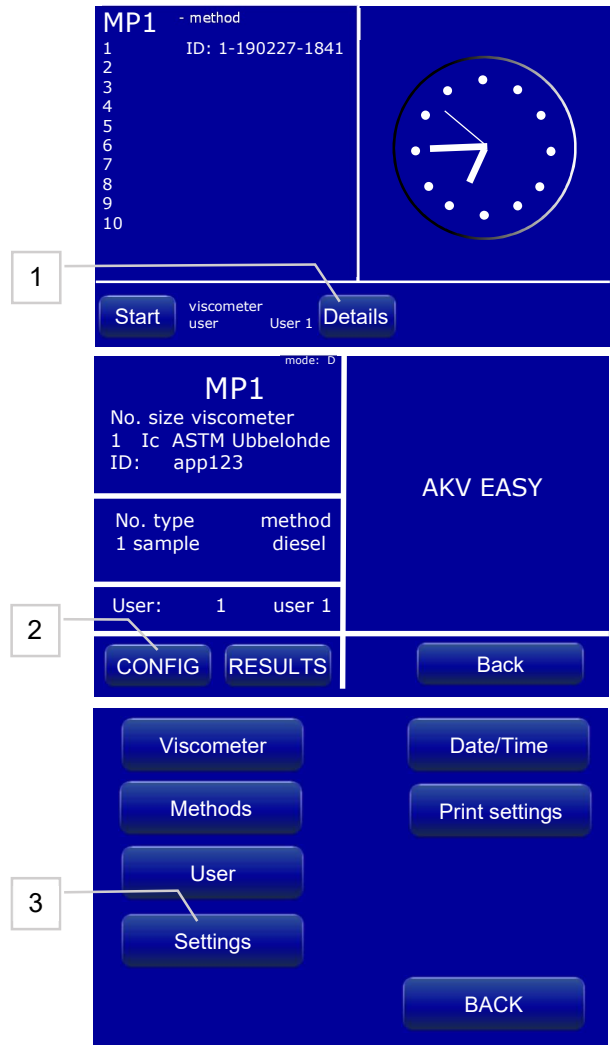
- A:** The main menu shows a 'Fill' button to initiate the test.
- B:** The 'Start parameters for MP 1' screen displays test details: ID: 1-200506-1314, Method: k value, conc.: 0.500, density: 0.8500, Viscometer: UB Ic, user: user3. 'START' and 'CANCEL' buttons are visible.
- D:** The test is running, showing 'MP1 - method k value' and ID: 1-201019-1533. A 'Pump up' button is present, and a clock indicates the test duration.



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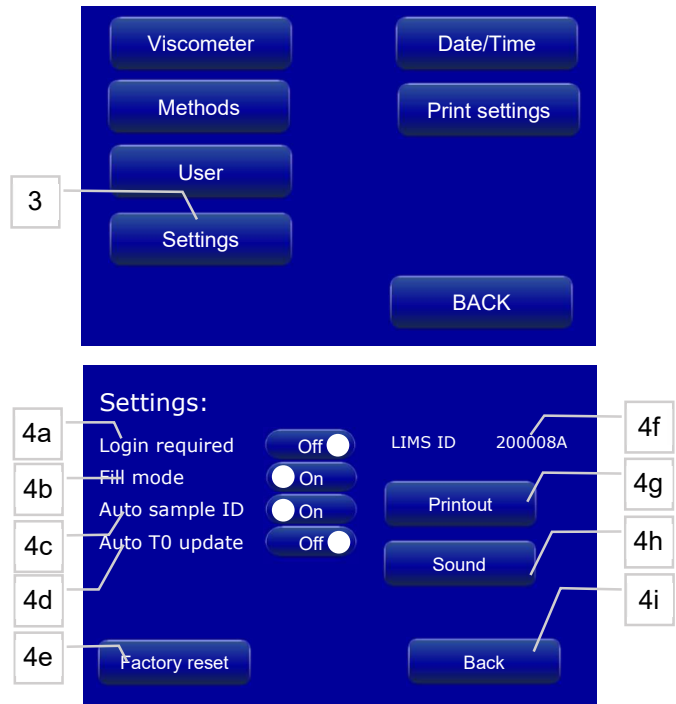
11 Full Configuration of the AKV Easy

Item	Description of main menu (left)
1	Click "Details" in main menu of
2	Click "CONFIG" and login in case user management is active
3	The configuration menu is open and multiple buttons are visible. Click "Settings"

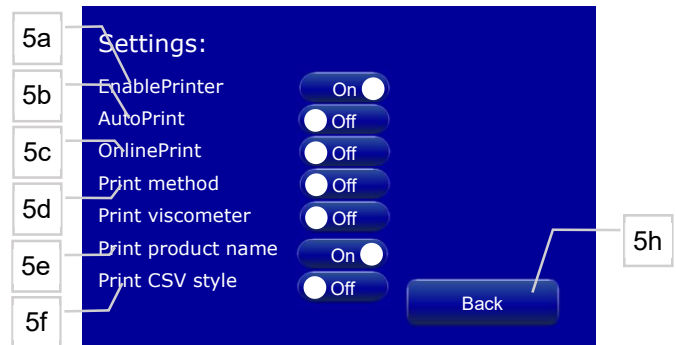


11.1.1 Menu settings

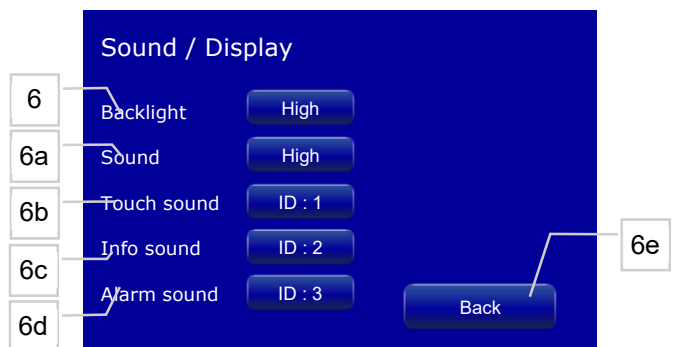
Item	Description of menu settings
4a	Password required
4b	
4c	Automatic increment of sample identifier followed by date/time stamp The ID has the structure <number> - yymmdd-hhmm
4d	On: The result of the measurement, in case the selected method has type t0, is automatically written into the T0 value of the selected viscometer. Off: a request to update the viscometer t0 value pops up to ask, if the measured value should be used as new t0 (only if selected method is type t0)
4e	Reset values to initial factory values
4f	Identifier for Laboratory Information Management System (LIMS)
4g	Printer settings
4h	Sound settings
4i	Return to previous menu



Item	Description of menu settings
5a	On: When the printer is connected results will be printed out Off: Printing is disabled
5b	On: Print results when runs are completed
5c	On: Each single flowtime is printed
5d	On: Additional information of the selected method is printed after each measurement
5e	On: Additional information of the product is printed in header
5f	On: Only data are transferred (featured option)
5g	Return to previous menu



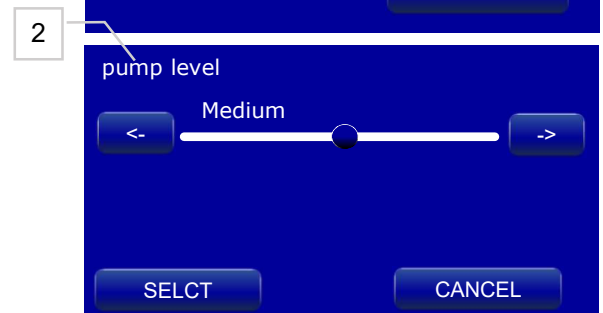
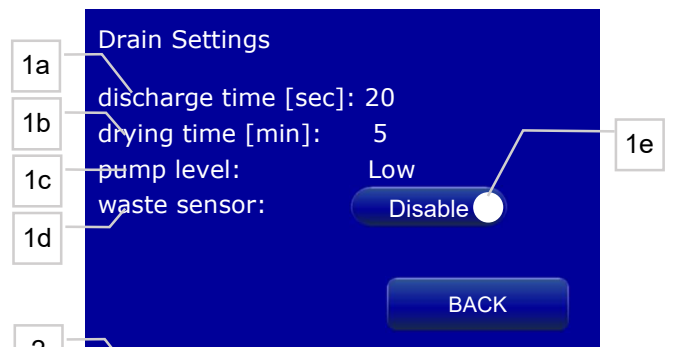
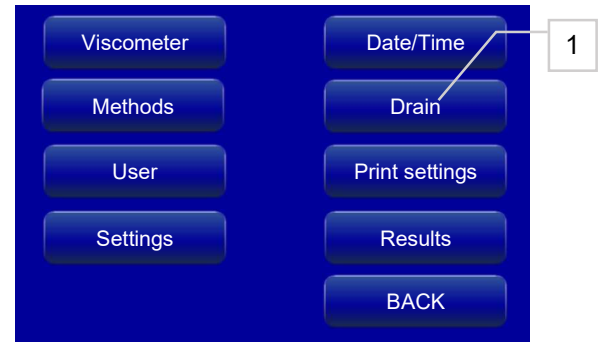
Item	Sound and Display
6	Backlight brightness
6a .. d	Set the specific sound levels
6e	Return to previous menu



11.2 Configuration of drain

Item	Rinsing module
1	Click "Drain" in the configuration menu
1a	Set the discharge time in seconds. Click "Discharge" in the main menu, the discharge stops automatically after this time. Min. value is 1 second, max. value is 240 seconds
1b	Drying time in minutes. Click "Drying" in the main menu, the drying stops automatically after this time. Min value is 1 minute, max. value is 240 minutes
1c	See sub menu 3 "pump level" to set the power of the pump for discharge and drying. There are 5 levels from very low to very high
1d 1e	Waste sensor, if "enable" AKV Easy guards, if the waste bottle is full. When full and alarm occurs and no further measurement or discharge is possible unless the waste bottle is emptied

Item	Pump level
2	There are 5 levels from very low to very high



11.3 User administration on or off

In case Login required is OFF, everyone can do anything below "Config" (changing values area), user management menu is disabled

In case Login required is ON, there are three levels, you can give to any user in the user menu:

Level: Description

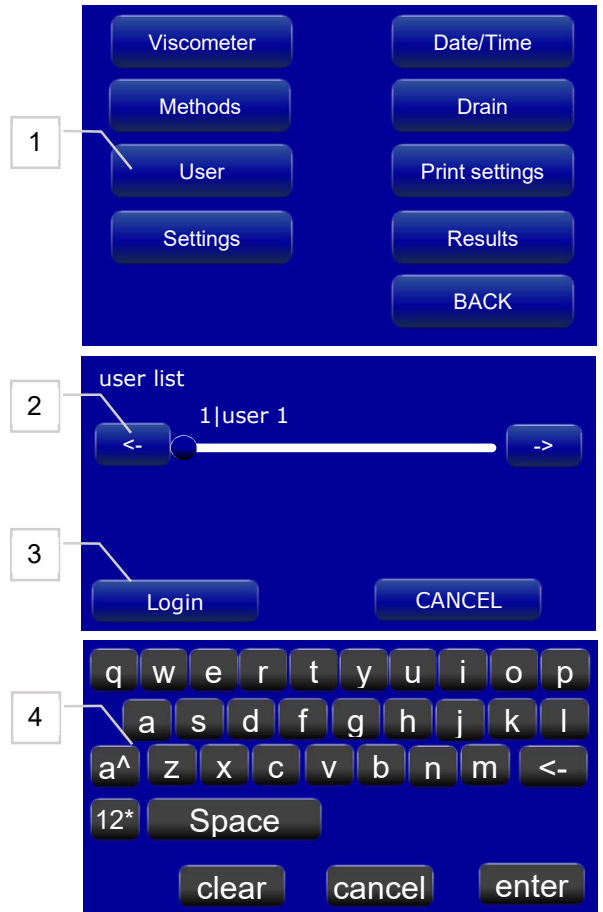
User: no rights, can't do any changes (**just selecting** in "Details" the used method, used viscometer and current user (for protocol))

Supervisor: all rights, except changing other users, just can change own password or name in user menu.

Admin: all rights like supervisor, but including changing user rights, password and names from other users. Admin can not lower his own level to ensure someone can do all

All rights means changing method, viscometer, date settings,...

You can personalize the name from e.g. "user 2" to "mr Clean" in the user menu



Item	Login procedure
1	Press "Config" in the "Details" menu
2	If the user management is activated, the user list selection menu opens
3	Select your user
4	Click "Login"
5	Notepad opens to enter your password
With the correct password and the associated user rights or with deactivated password protection you enter the configuration menu	



est. 1878

11.4 User management: set user

Via

Details

Config

Login Required

Off

Feature disabled. No user settings.

A user can still be selected

The user name appears in the measurement data (Database, Operator and Printout)

On

Login Required, see below

Select per user

function as supervisor, administrator, user

Password

Administrator

Administrator settings and below

Viscometer Type Size K t0	User up to 8 users Name Password Level	Date Time Date Time
Method Test Method Min. Measuring Max Measuring Pump PWR Pre Temp Quit Pre Temp Move Max Flow Limit Formulas	Settings enable Printer Auto Print Online Print Print Method Print Viscometer Auto Sample ID Login Required Fill mode auto T0 update LIMS ID backlight Sound Factory reset	Print settings

Supervisor

See "Administrator"

however the supervisor can not change user rights

User

Select Viscometer 1..8 Using pre defined settings (administrator or supervisor)	Select Method 1..8 Using pre defined settings (administrator or supervisor)
--	--



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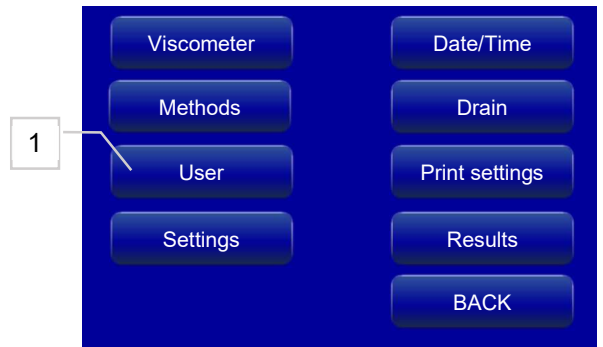
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E-mail: sales@tamson.com
Website: www.tamson.com

VAT: NL 80 66 34 984 B01
Bank account no.:
NL28 INGB 0007 350 370
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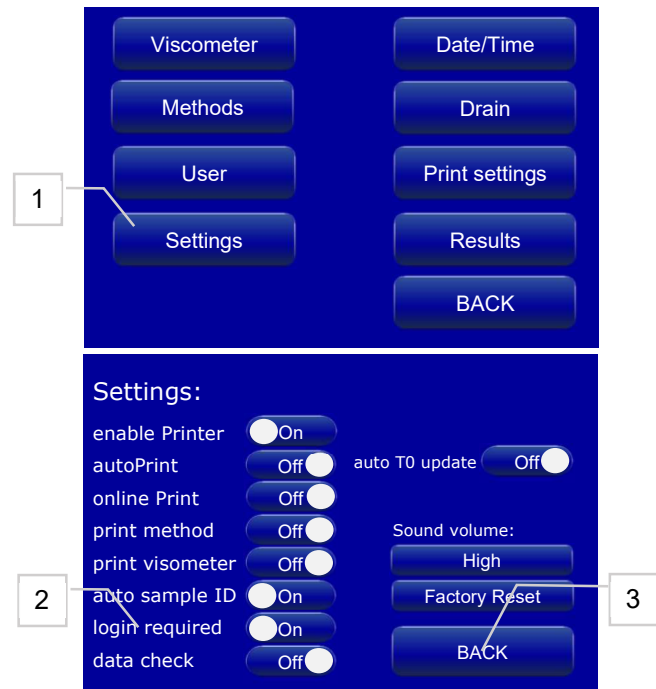
11.4.1 Change user

Item	Login procedure
1 (User)	Here you can change the name of the user. The registered word serves as a user name and can be chosen during log in and for the report of a measurement.
2 (Pass word)	Here you can add passwords for users. When the password protection is activated you need those passwords to log in.
3 (level)	Here you can choose the user level. The level is given in numbers [1] – User – Can take measurements, see the measurement results, print results, and lock/unlock measurement places. [2] - Super User – Access to every feature, except the user database. [3] – Administrator – Access to every feature
4	Save changes



11.4.2 Activating user management

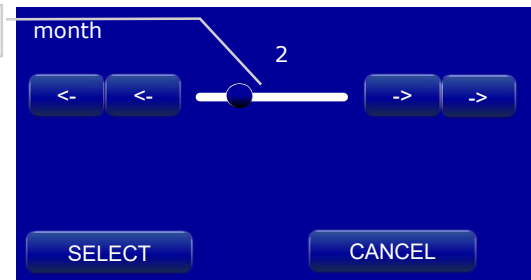
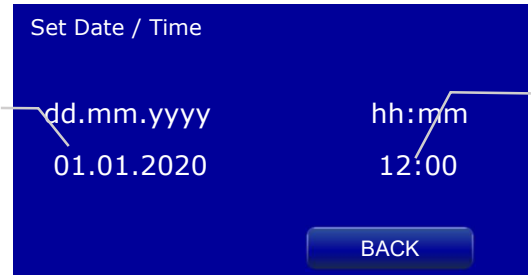
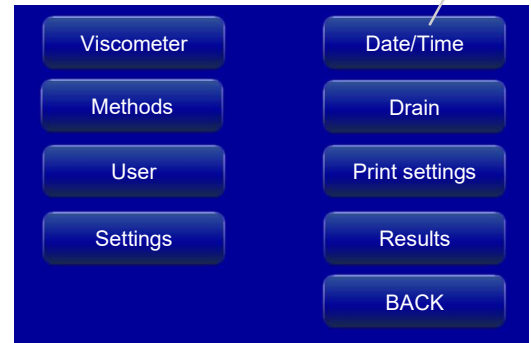
Item	Login procedure
1	Activate menu via settings
2	Switch "Login required" to "On"
3	Use Back keys



11.4.3 Date and time setting

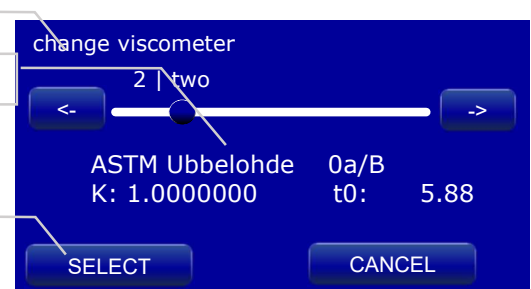
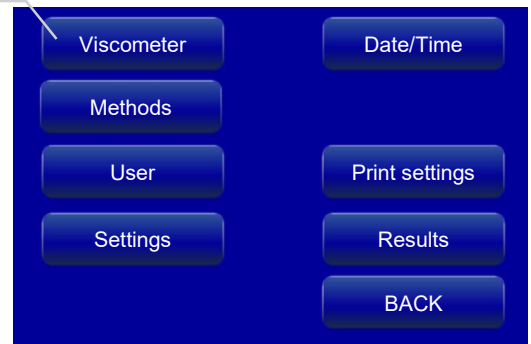
The AKV Easy has a RTC module for precise time vale. The time s in 24h-format.

Item	Login procedure
1	Activate RTC menu via settings
2 + 3	To change the date or time click the value
4	A scrollbar pops up to change the value

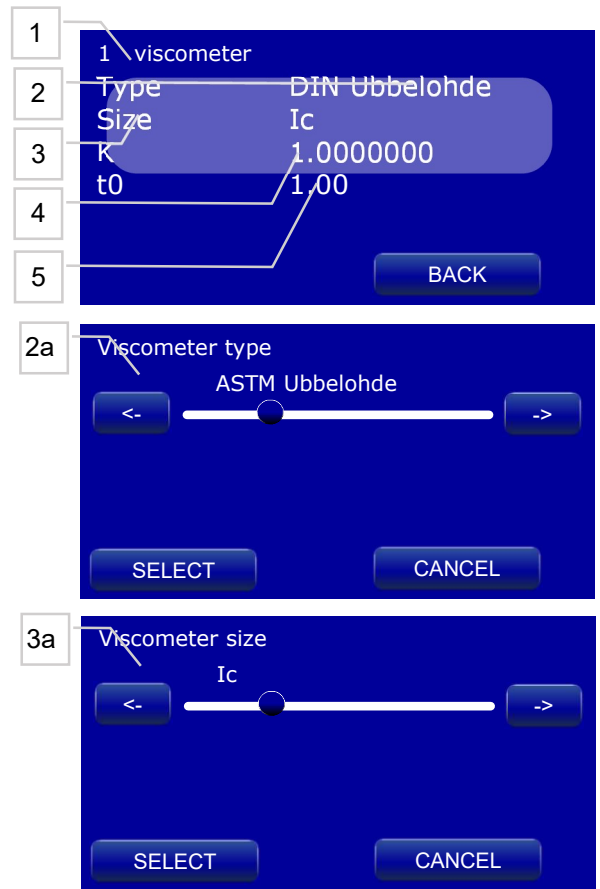


12 CONFIGURATIONS OF MEASURING POINTS

Item	Login procedure
1	Select option "Viscometer"
2	Scroll through the list and select the viscometer
3	Press here to change the values
4	Select this viscometer

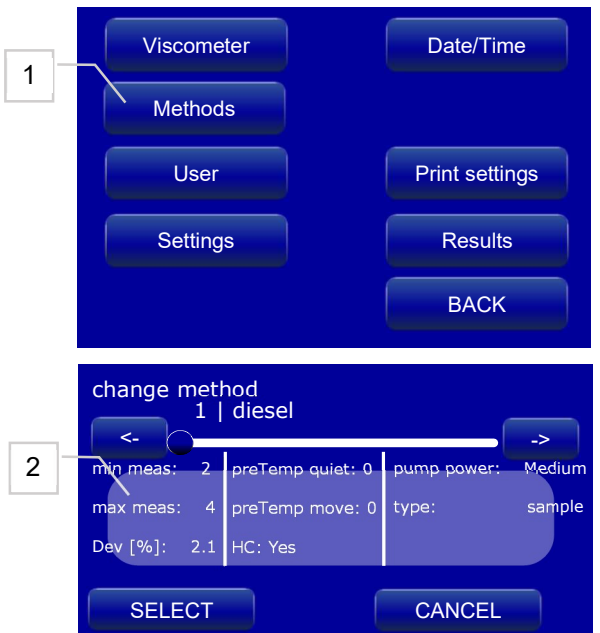


Item	Viscometer menu
1	Click here and a notepad opens. You can edit an ID of the viscometer (e.g. serial number)
2,2a	Click here a list of possible viscometer types is visible and you can select your type. Possible selections: "-----" inactive "ASTM Ubbelohde","DIN Ubbelohde","Micro Ubbelohde","TC Ubbelohde","Micro-TC Ubbelohde","Micro Ostwald","Cannon Fenske Runtime"
3,3a	Viscometer size Possible selections: "-----" inactive "0";"0C";"0B";"1";"1C";"1B";"2";"2C";"2B";"3";"3C";"3B";"4";"4C";"4B";"5";
4	Set constant of the viscometer
5	Set the t0 value (blank value). An automated update of this value is also possible. Therefore the method of type "t0" must be used for measurement. Please see method configuration.
Leaving the "Viscometer" menu the changes made are now stored in the database and the viscometers can be selected in the detail menu.	

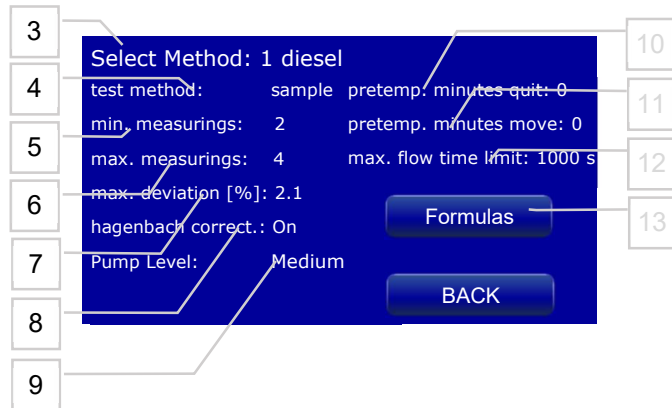


12.1 Method menu

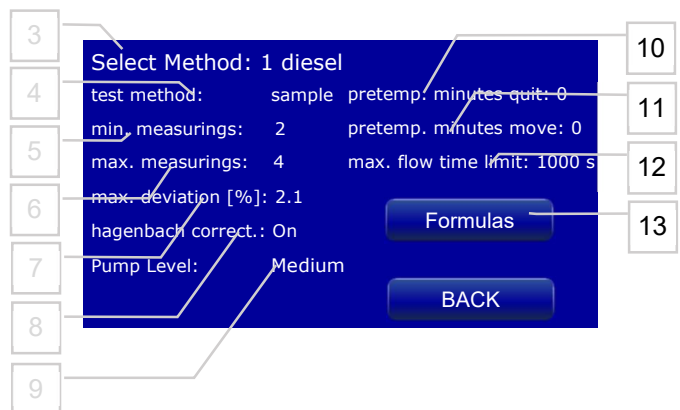
Item	Method menu
1	Click in the configuration menu on "Methods"
2	Scroll through method list and select the viscometer, you want to change
3	Click here and a notepad opens. You can edit an ID of the method (e.g. material, blank)
4	Click here a list of possible method types is visible and you can select your type. Possible selections: "_____" -> inactive "sample" -> standard measurement of type sample "t0" -> result can be automatically updated in the used viscometer "Kinetic" -> long term measurement (up to 99) with defined frequency between measurements
5	Minimum amount of measuring repetition. Range is from 1 to 10.



	Reaching the minimum of measurements the calculation and the check, if all results are inside the standard deviation are performed
6	Maximum amount of measuring repetitions. Range is from 1 to 10. Measurement stops when maximum of measurements is reached
7	Perceptual value of the max. accepted deviation between the repeated measurements of one sample. This value is base for the outlier calculation and decision, if another measurement is done or not. The value lies between 0.1 to 25.5%
8	If this field is selected, the average value of the measurements is corrected by the Hagenbach-Couette correction. The corrected value is then used for further calculations. The corrected value is marked "Ave HC" in the main menu. If the correction is deactivated, the uncorrected average value is indicated again. For flowtime below 200 seconds the kinetic energy correction must be enabled. This is the Hagenbach-Couette" correction or "HC".
9	The pump level can be set from "very low" to "very high". In dependence to the sample you can adjust the pump power. The higher the viscosity, the stronger the pump should be. For volatile samples a lower pump level is recommended.

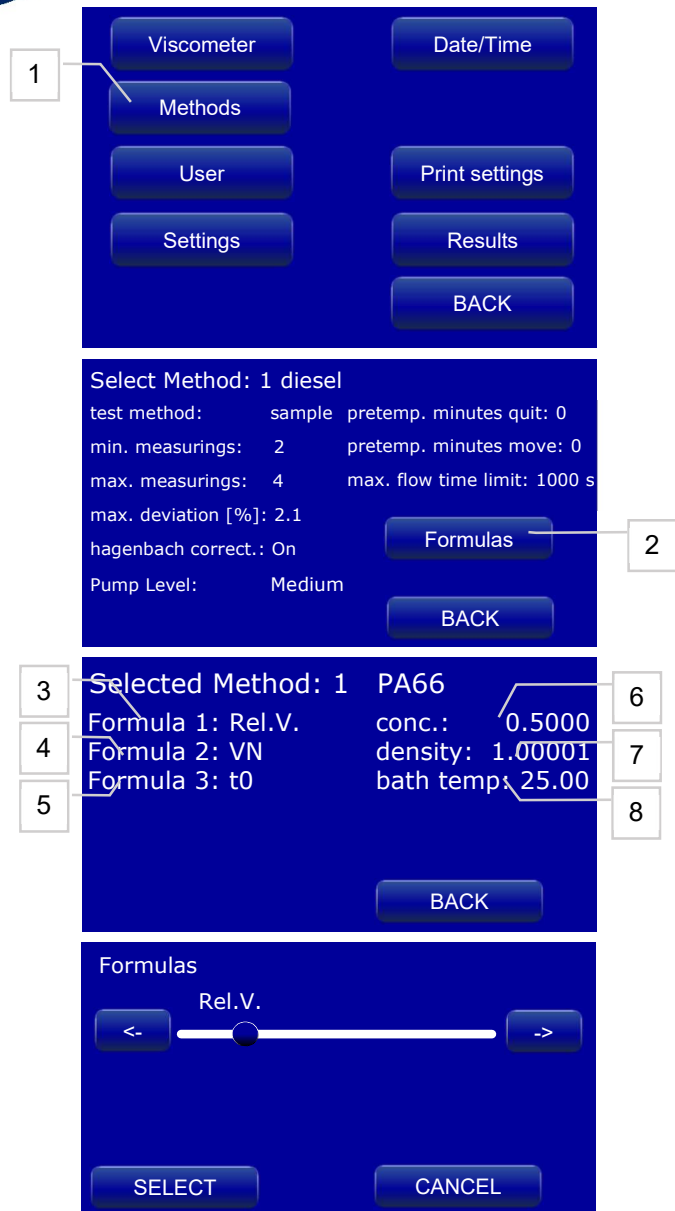


10	Specify the desired time for unmoving pre-heating of the sample. During this time the sample acclimate to the desired temperature of the control bath. Pumping does not take place Value can be between 0 - 100 minutes
11	Enter the desired time for moving pre-heating. Pumping processes take place when the pre-heating is moving. Specify the desired time for moving pre-heating of the sample. During this time the pump is active and the sample acclimate to the desired temperature of the control bath. Value can be between 0 - 100 minutes
12	If flow time reaches this value, the measurement aborts, because there is an indication that something went wrong.
13	Here you enter the formula menu



12.2 Configuring calculation / formulas

Item	Method menu
1	Chose "Methods"
2	Chose "Formulas"
3	Formula 1, see "item 9"
4	Formula 2, see "item 9"
5	Formula 3, see "item 9"
6	Concentration of a polymer solution in grams per 100 ml (0,1 liter). This input is needed to calculate the inherent viscosity. The viscosity number, the intrinsic viscosity and the K value. This value is used as default. If "data check" (see settings menu) is active, you can update this value at start of the measurement in the start menu
7	Density of the sample in kilograms per litre. This input is required to calculate the dynamic viscosity. This value is used as default. If "data check" (see settings menu) is active, you can update this value at start of the measurement in the start menu
8	Bath temperature [°C]. Enter here the temperature of the bath. This input is required to calculate SUS and SFS. This is NOT monitored / controlled by the AKV Easy and can be controlled directly via the temperature control bath. In AKV Easy, this parameter is used exclusively for documentation purposes and is included in the database entry of the respective measurement.
9	See table with formulas available.



The screenshots show the following steps:

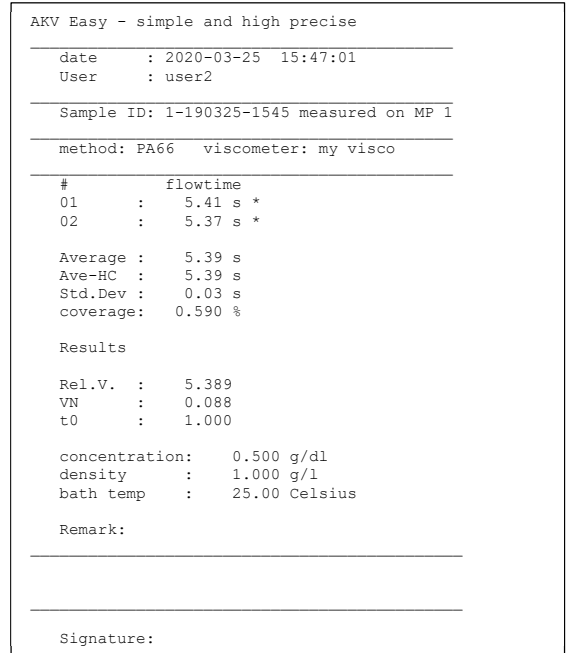
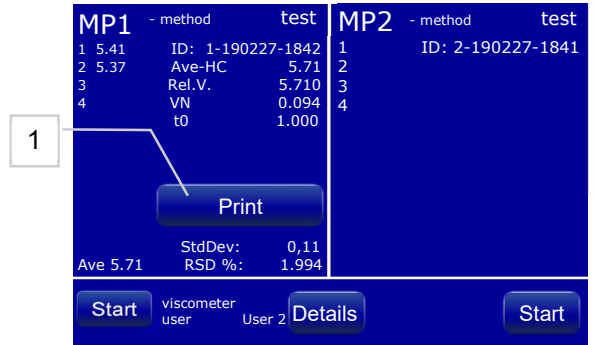
1. Main menu with buttons: Viscometer, Date/Time, Methods, User, Print settings, Settings, Results, BACK.
2. "Select Method: 1 diesel" screen with parameters: test method, sample, pretemp. minutes quit: 0, min. measurings: 2, pretemp. minutes move: 0, max. measurings: 4, max. flow time limit: 1000 s, max. deviation [%]: 2.1, hagenbach correct.: On, Pump Level: Medium. A "Formulas" button is highlighted.
3. "Selected Method: 1 PA66" screen showing formula selections: Formula 1: Rel.V., Formula 2: VN, Formula 3: t0.
4. Input fields for: conc.: 0.5000, density: 1.00001, bath temp: 25.00.
5. "Formulas" screen with a slider for "Rel.V." and "SELECT" / "CANCEL" buttons.
- 6-8. Callouts pointing to the concentration, density, and bath temperature input fields in the previous screenshot.

Available Formulas		
" "		no formula
t0	[mm ² /s]	t0 value from the used viscometer
const.	[mm ² /s ²]	Capillary K
Rel.V.		relative viscosity
Sp.V.		specific viscosity
VN		Viscosity number
Inh.V.		inherent viscosity
I.V.(B)		intrinsic viscosity (Billmeyer)
I.V.(S)		intrinsic viscosity (Solomon-Ciuta)
K value		K value
Kin.V.	[mm ² /s ²]	kinematic viscosity
Dyn.V.	[mPas]	dynamic viscosity (parameter density necessary)
SUS		Saybolt Universal Seconds
SFS		Saybolt Furol Seconds

13 RESULT DATABASE

13.1 Latest test results

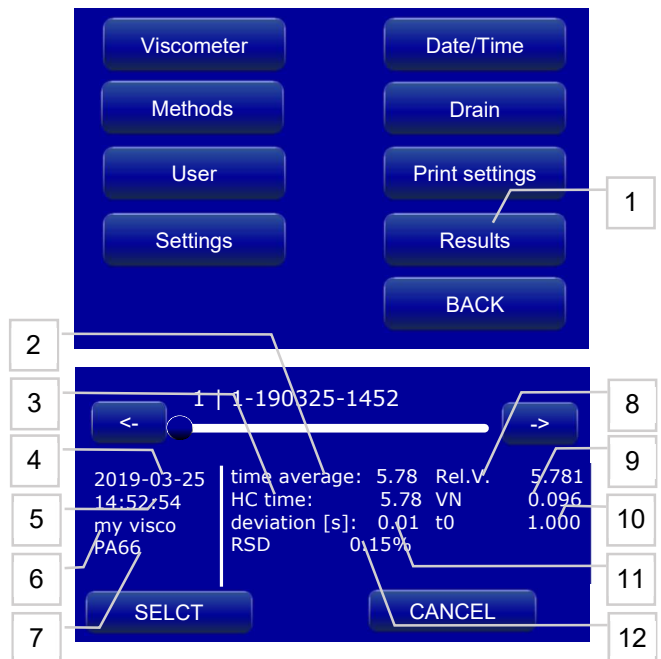
The latest measured results are displayed in the main menu. When the printer is enabled (see settings) a "print" button [1] is visible after the measurement has finished.



13.2 Results of the database

The last 254 measurements are stored in a database. You can see them by clicking "Results" in menu.

Item	Method menu
1	Choose "Results"
2	Time of measurement
3	Average of corrected flow time (Hagenbach-Couette-Correction)
4	Date of measurement
5	Time of measurement
6	Name of the used viscometer
7	Name of the used method
8	Name and result of formula 1 which was configured in the method
9	Name and result of formula 2 which was configured in the method

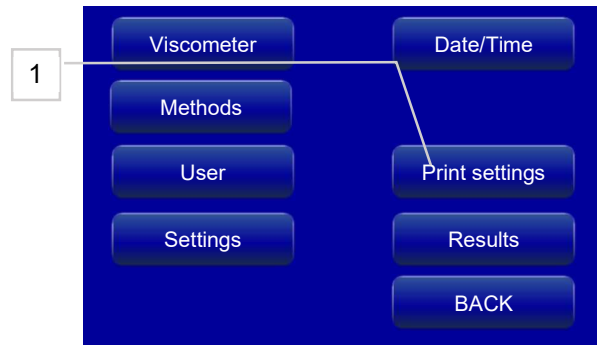


10	Name and result of formula 3 which was configured in the method
11	Standard deviation in seconds of the measured flow times
12	Coefficient of variation in percent

13.3 Print Settings

An overview of the settings, users, all methods and viscometers can be print out for documentation purposes to the printer.

Clicking on button, the settings are sent to printer.



```

AKV Easy - simple and high precise
-----
date       : 2020-03-25 15:47:01
User       : user2
-----
viscometers:

viscometer : my visco
k-value    : 1.0000000
t0         : 1.00
type       : DIN Ubbelohde
size       : Ic
-----
methods:

method name           : PA66
method type           : sample
minimum measurings   : 2
maximum measurings   : 4
Dev [%]               : 2.1
Pretemperature quiet [minutes]: 0
Pretemperature move [minutes]: 0
Hagenbach correction : enabled
pump power            : Medium

method name           : tt
method type           : sample
minimum measurings   : 3
maximum measurings   : 10
Dev [%]               : 0.1
Pretemperature quiet [minutes]: 0
Pretemperature move [minutes]: 0
Hagenbach correction : enabled
pump power            : Medium
mode (channel: 1):   undefined mode
mode (channel: 2):   undefined mode
-----
users:

user1 Level: user
user2 Level: user
user3 Level: user
user4 Level: user
user5 Level: user
user6 Level: user
user7 Level: user
admin Level: admin
-----
settings:

enablePrinter : Enabled
autoPrint     : Disabled
onlinePrint   : Disabled
print method  : Disabled
print viscometer : Disabled
auto sample ID : Enabled
login required : Disabled
data check    : Disabled
auto T0 update : Disabled
=====

```



14 FORMULAS

- t: Average of the measured flow times in seconds [s] adjusted by Hagenbach-Couette correction (when activated)
- K: Viscometer constant of the capillary viscometer in use in square millimeters per second squared [mm²/S²]
- U: Kinematic viscometer in square millimeters per second [mm²/S], 1mm²/S is equivalent to 1 centistoke [cSt]

Kinematic Viscosity

$$v = K * t \quad K = \frac{\left(\frac{v_1 + v_2}{t_1 + t_2}\right)}{2}$$

Dynamic viscosity

- 0₀: Dynamic viscosity of the pure solvent n millipascal-seconds [mPas], 1mPas is equivalent to 1 centipoise [cP]
- ρ: Density of the sample in kilogram per liter [kg/l]
- 0: Dynamic viscosity in millipascal-seconds [mPas], 1 mPas is equivalent to 1 centipoise [cP]

$$0 = v * \rho$$

Relative viscosity

The relative viscosity is calculated as the quotient of dynamic viscosity of a polymer solution and dynamic viscosity of the pure solvent. At low polymer concentration, it is assumed that the densities of the solution and of the pure solvent do not differ. Therefore, the relative viscosity is calculated as the quotient of flow times. The flow time of the pure solvent can be measured by methods of the type t₀ and is stored for each viscometer in the viscometer database and is used for relative viscosity measurements with the respective viscometer.

t₀ Flowtime of the pure solvent in seconds [s]

0_{rel} Relative viscosity

$$0_{rel} = \frac{0}{0_0} \approx \frac{t}{t_0}$$

Specific viscosity

Similarly is the calculation of the specific viscosity. Here only the flow times are used for the calculation.

0_{sp} Specific viscosity (dimensionless)

$$0_{rel} = 0_{rel} - 1$$



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Chamber of commerce 27 16 95 41

Intrinsic viscosity

With the concentration (to be entered by the user) the AKV - Easy calculates the intrinsic viscosity according to Billmeyer and / or Solomon-Ciuta as follows:

c Concentration in grams per deciliter [g/dl]

IV_{Bill} Intrinsic viscosity, calculated according to Billmeyer, in deciliter per gramm [dl/g]

$$IV_{Bill} = \frac{0_{rel} + 3x \ln(0_{rel})}{4xC} 0_{rel}$$

IV_{sc} Intrinsic viscosity, calculated according to Solomon – Ciuta, in deciliter per gram [dl/g]

$$IV_{Bill} = \frac{\sqrt{2x(0_{sp} - \ln(0_{rel}))}}{C}$$

Viscosity number

In addition, the viscosity number and the inherent viscosity can be determined:

VN Viscosity number in deciliter per gram [dl/g]

$$VN = \frac{0_{sp}}{C}$$

0_{inh} Inherent viscosity, in deciliter per gram [dl/g]

$$0_{sp} = \frac{\ln(0_{sp_{rel}})}{C}$$

AKV Easy specifies the viscosity number in millilitre per gram [ml / g], this means the value is multiplied by 100 in the calculations.

Other key figures to calculate are the K-value according to Fikentscher and the Saybolt Universal Seconds, as well as the Saybolt Furol Seconds:

K-Value According to Fikentscher [dimensionless]

$$K - value = 1000x \frac{1,5 \log_{10}(0_{rel}) - 1 + \sqrt{1 + \left(\left(\frac{200}{C} \right) + 2 + 1,5 \log_{10}(0_{rel}) \right)^2}}{150 + 3 * \left(\frac{C}{100} \right)}$$

Saybolt Universal Seconds

The Saybolt Universal Seconds depend on the temperature and are calculated for **kinematic viscosities <= 75cSt** according to the following formulas:

SUS_T Saybolt Universal Seconds at temperature T in degree Fahrenheit [°C]

T_F Temperature in degree Fahrenheit [°F]



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$$SUS_{100} = 4,6324 * v + \frac{1 + 0,3264 * v}{(3930,2 + 262,7 * v + 23,97 * v^2 + 1,646 * v^3) * 10^{-5}}$$

$$SUS_T = (1 + 0,000061 * (T_F - 100)) * SUS_{100}$$

The basic value at 100 °F is adjusted at deviating temperatures. The temperatures are entered in the AKV Easy in degrees Celsius [°C]. UVS® Easy automatically converts the temperatures to degrees Fahrenheit [°F] before the formulas are applied. The following formula is used for kinematic viscosities > 75cSt:

$$SUS_T = \left(4,632 + (T - 100) * \frac{0,032}{110} \right) * v$$

The Saybolt Furol Seconds is calculated as a function of temperature according to the following formulas (for kinematic viscosities in the range of 48 cSt - 1300 cSt): At temperatures up to and including 167 °F the calculation is carried out with the formula for 122 °F. The formula is used for 210 °F. The following formulas are used for

SFS_T Saybolt Furol Seconds at temperature T in degree Fahrenheit [°F]

$$SFS_{122} = 0,4717 * v + \frac{13924}{v^2 - 72,59 * v + 6816}$$

$$SFS_{210} = 0,4792 * v + \frac{5610}{v^2 + 2130}$$

$$SFS_{122} = 0,4717 * v$$

$$SFS_{210} = 0,4792 * v$$

kinematic viscosities > 1300cSt:

Temperatures are converted by UVS® Easy according to the following formulas between degrees Celsius [°C] and degrees Fahrenheit [°F]:

The automatic conversion to Fahrenheit (in the formula for the SUS and SFS) also takes place according to the above formula.

T_c Temperature in degree [°C]

$$T_F = T_C * 1,8 + 32$$

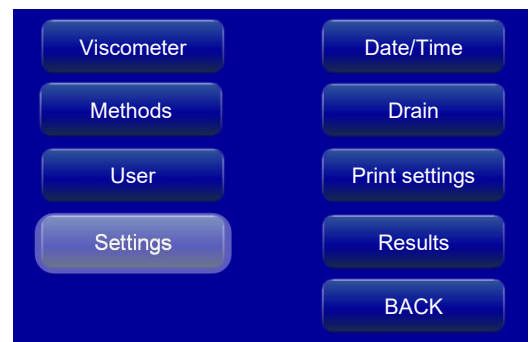
$$T_C = (T_F - 32) * \frac{5}{9}$$

15 SPECIAL MEASURING PROCESSES

15.1 Measuring of t₀

When measuring polymers the value t₀, which is required and indicates the flow time of the pure solvent. Flow times of polymer solutions are thus compared in the calculations.

You can store this value manually (if known) in the viscometer database or measure with methods of type t₀. For measurement, simply carry out a measurement operation with the pure solvent.



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Select a method of type t0 for the measurement method so that the results are automatically transferred to the viscometer database, if automated t0 update is activated in the settings menu.

15.2 Measuring of C (Calibration)

The viscometer constant K is required for the calculation of the kinematic viscosity.

You can store this constant per viscometer manually.

For calibration, simply carry out a measurement with a calibration oil. Select a method of type K for the measurement method or a manual calculation is also possible. For this, the formula for calculating the kinematic viscosity is simply solved for K and the average value is formed for several calibration oils used. For example: using one calibration oils:

$$v = K * t$$

Or two calibration oils:

$$K = \frac{\left(\frac{v_1}{t_1} + \frac{v_2}{t_2}\right)}{2}$$

Example:

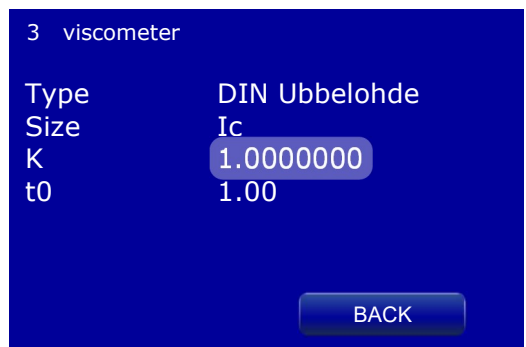
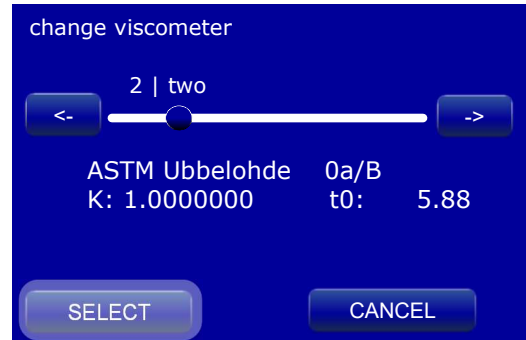
Calibration oil @40°C has 18.12 mm²/s

Runtimes

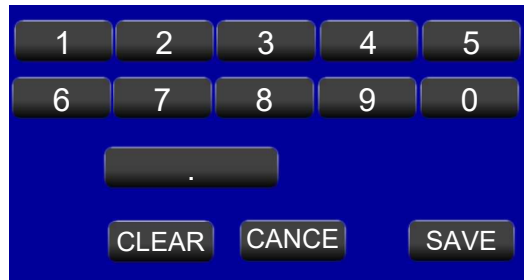
- 221,44 [sec]
- 221,43 [sec]
- 222,50 [sec] (we do not use this)
- 221,48 [sec]

Average runtime 221,45 [sec]

K = 18,12 / 221,45 = 0,0818



0.0818_



16 MAINTENANCE



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Maintenance schedule		
Interval	Activity	Remarks
When required	Cleaning the housing with a damp cloth and household cleaning detergent.	Always clean the underside and the rear side dry! No liquid may enter the housing.
Before any use	Visual inspection: Check all equipment, hoses and screw locks for visible damage, contamination and leaks.	Damaged parts must be changed immediately!
After every drain of waste bottle(s)	Visual inspection: Check if bottles are fissured Make sure the lid is screwed on leakproof	Immediately exchange bottle!
1x per quarter	Check the electrical contacts for corrosion if the UVS® is used in environments where the atmosphere may contain corrosive substances.	



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Page 38/44

17 Troubleshooting

Follow ASTM D445 guidelines on sample preparation and measuring errors. See TABLE X1.1 -Troubleshooting Guide. This manual contains some extra and specific information for the users help. ASTM D445 is leading.

17.1 Software messages

Error message	Possible cause	Remedy
Not enough privileges	Missing user rights	Ask administrator to get rights
Not allowed during measurement	During measurement system denies going into configuration	Wait till measurement is finished or stop measurement
MD communication error	Internal communication error	Retry measurement, if still occurs, call service
Lower signal not detected	No sample or too less filled in Defective pumps Leaky tubes Max pump power in the method to low	Check all tubes for leaks Check method config
Upper signal not detected	Wrong viscometer for the high-viscosity sample. Leaky tubes Max pump power in the method to low	Change to viscometer with higher constant Check all tubes for leaks Check method config
Light barrier not connected	Impurities on sensors Connection cable defective Sensors or glass fibres too old	Clean sensors Changing defective cables Maintenance
Max flowtime reached	Measuring time over 10000 seconds	Configure maximum measuring time under "Config" -> "methods" -> "max. flow time limit"
Communication Error	Device off Hardware defective Cables not plugged in	Turn the device on Replace hardware Plug in all cables

Hardware

Error	Possible Causes	Remedy
Drift of flow times	Pre-Temperature of sample not completed	Select higher pre-heating times
	Drift of bath temperature	Protect the thermostat from direct radiation. If necessary, replace the thermostat
	Evaporation of a highly volatile component; Reaction of the sample with the air or humidity	Reduce power level under "Method"
	Condensate in sample	Before placing the viscometer tube in the holder, remove condensate from the cover plate. Use cloth to dry.
	Air bubbles forming on IR sensors	Lift measuring head out of the bath. Remove bubbles between viscometer tube and holder, try




		drying with cloth. Submerge holder again.
Increased stochastic scattering of the measured values	Impurities in the viscometer	Drain and clean the viscometer; Repeat measurement
	Impurities in the sample	Drain and clean the viscometer; Repeat the measurement with the filtered sample; If necessary, use filters with a smaller pore width
	Bubbles in the viscometer	a) Sometimes the sample itself forms gaseous bubbles by short-term temperature increase. Try using longer soak time and use movement of sample during soak. b) Suction speed is too high. The sample is spraying from the capillary and forming large or very small bubbles. Try to lower suction. c) Not enough sample. During suction air passes through the bottom tube due to lack of sample. Use more sample. d) Silicone cuffs do not fit properly. Air leaks from the top and disturbs the suction process. Adjust silicone cuffs.
	Bubbles on the IR sensors	Lift measuring head out of the bath. Remove bubbles between viscometer tube and holder, try drying with cloth. Submerge holder again. When viscometers has "fresh" water it contains air. The air forms air bubbles on the measuring head. After a few days of use, the water is dead and this problem is less likely to occur.
Very strong stochastic scattering in automatic measurements with light barriers	Defilement of optical sensors	Clean the sensors with a soft, alcohol imbued cloth
	Fault release of the light barriers by bubble, foam or liquid lamella formation	Use TC-UBBELOHDE, Ostwald or CANNON-FENSKE routine viscometers.
Very strong stochastic scattering with automatic measurements with TC viscometer	Incrustation of the sensors (with thermally unstable media)	Transparent media: use optical flow measurement Non-transparent media: Use a tube-type viscometer
	Wear of sensors	Change Viscometer
Increased stochastic scattering at short flow times	Starting deformation of the hanging level	Choose a viscometer with a small capillary diameter

Periodically fluctuating flow times		Check cooler and bath temperature
-------------------------------------	--	-----------------------------------

18 TECHNICAL DETAILS

Size (WxHxD)	185 x 165 x 266	[mm]
Voltage	90 to 240V AC	[Volt AC]
	50 to 60Hz	[Hz]
Wattage	130 max	[Watt]
Weight	2,3	[kg]
Measure unit	Flowtime	[sec]
Viscometer	Ubbelohde	
Measuring flowtime	0,10 – 9999,00	[sec]
Resolution	0,01	[sec]
Accuracy (Flowtime: 0-100 s):	± 0,01	[sec]
Accuracy (Flowtime: > 100 s):	< 10	ppm
Ambient temp error of time base	< 4	ppm
Measuring range		
Pressure mode	0,35 – 1000	mm ² /s
Pumping pressure	> +300	hPa
Suction mode	0,35 – 10000	mm ² /s
Suction pressure	< -300	hPa
Measuring accuracy		
precision (reproducibility and comparability) in accordance to: DIN 51562-1 ASTM D445 ISO 3105	measurement uncertainty in the determination of absolute, kinematic viscosity furthermore depends on the uncertainty of the numerical value of the viscometer constants and the measurement conditions, especially as concerns the measurement temperature	
Configurable parameter		
Tempering period (quiet):	0 – 100	min
Tempering period (liquid moved):	0 – 100 + flow time	
Number of measurements:	1 – 10 (up to 99 in Kinetic mode)	min
Minimum and Maximum of pump power combined with rising time (Ramp) of pump power:	5 levels (very low – very high)	
Materials		
Pump	PTFE, FFKM, PPS (Housing)	
Valve	ETFE, FFKM	
Cover	Anodize Aluminium	
Internal tubes	PTFE	

19 SPAREPART LIST

Part No.	Photo	Description
02T0231		Fluid trap
24T0386		O-Ring 20 x 3,5 mm
28T4139		Blue 3x0,5mm hose. 50 meters

28T4165		Connector 3mm Hose to M5
01T5002		Power module AKV Easy
27T9201		Serial Printer TMT 20T
28T7037		Thermal Printer paper, 80mm, 5 pcs
24T0403		O-ring measuring head 6x2,5 FPM
24T0386		O-ring fluid trap 20 x 3,5 70SH BLK
24T7078		Rubber Grommit 20 x 16mm
06T1723		Silicone stopper
24T0035		Power supply EPS-65S 24V MEANWELL open-frame 65W 24V/2,71A



est. 1878

20 EC DECLARATION OF CONFORMITY

Following equipment is in compliance with EMC Directive 2014/30/EU:

Product: Viscosity measurement device
Models: 01T5000 Tower
16T0001 AKV EASY
00T087- Measuring head
Serial code: Effective from 20T0000
Manufacturer: Tamson Instruments bv
van 't Hoffstraat 12
2665 JL Bleiswijk
The Netherlands

The products are in conformity with the following specifications:

Item	Reference	Description	Test result
a	RoHS Directive	2011/65EU	p
b	EN61010-2-010	Safety requirements for electrical equipment for measurement, control, and laboratory use. Particular requirements for laboratory equipment for the heating of material	
c	Machine Directive 2006/42/EC	Machinery Directive, of the European Parliament and of the Council of 17 May 2006/42/EC 2nd Edition June 2010	p
d	EN 60204	Machinery Directive and Safety requirements	p, p ⁱ
e	EN60950-1	Low Voltage Directive	p
f	EN61000-3-2	Harmonics	p
g	EN61000-3-3	Flicker	p ³
h	EN61000-4-2 +A1+A2	ESD	p
i	EN61000-4-3 +A1+A2	Radiated immunity	p (anechoic room)
j	EN61000-4-4	Electrical Fast Transients	Minimum requirements pass
k	EN61000-4-5+A1	Surges	Minimum requirements pass
l	EN61000-4-6+A1	Conducted immunity	p
m	EN61000-4-11 +A1	Voltage dips and Voltage variations	p
n	EN55016-2-1	Conducted emission	p
o	EN55016-2-3	Radiated emission	p (anechoic room)

p = Pass

pⁱ = Individually tested

p³ = Pass, condition of operating during Pst measurement: Operational with heating element 1400W.

P_{st} and P_{It} are not evaluated in accordance with A.5 of Annex A of EN 61000-3-3(1995) + A1(2001).



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Page 43/44



est. 1878

not applicable were:

Conducted discontinuous emissions (Clicks)

Radiated emission (OATS)

Magnetic field immunity

The equipment conforms with all the specifications and norms in this regard.

The equipment conforms without any further notice.

Entity responsible for marking this declaration :

Manufacturer, Tamson Instruments bv, van 't Hoffstraat 12, Bleiswijk The Netherlands,

Name	:		R.C. van Hall
Function	:		Director
Date	:		June, 2020
Version	:		1.01

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