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## 1.1 AVSPro II Automatic Viscosity Sampler

•The AVSPro II is an automatic viscosity sampler for determining absolute and relative viscosity.
- It is operated using a Personal Computer (PC).
- The supplied software controls the measurement operation automatically.
- Calculation and documentation of the determined values is done by means of the PC.

To determine viscosity, the flow time between two meniscus passages in a capillary viscometer is measured. Depending on the specific requirements, this measurement can be performed in two different manners: after the opto-electronic or the thermoresistive method.
In this way it is possible to determine samples of a viscosity from 0.35 to 800 $mm^2/s$ (referred to 25°C).

Owing to the widely self-explanatory nature of the user surface of the PC software, the course of the individual measurements is simple. The screen of the connected PC displays the respective operating statuses. Arrows and icons allow a speedy identification of the status displays (e.g. measurement position, condition of the measurement program etc.), error messages or operator prompts.

**"Absolute viscosity" measurement mode for the determination of**

- kinematic viscosity
- Saybolt Universal seconds (SUS)
- Saybolt Furol seconds
- dynamic viscosity
- viscosity index

**"Relative viscosity" measurement mode for the determination of**

- specific viscosity
- reduced viscosity
- inherent viscosity
- K-value

SI Analytics

# KONFORMITÄTSERKLÄRUNG
# DECLARATION OF CONFORMITY

Wir erklären in alleiniger Verantwortung, daß das Produkt

We declare under our sole responsibility that the product

Viskositäts-probenautomat

**AVSPro II**

Viscosity Automatic Sampler

**AVSPro II**

auf das sich diese Erklärung bezieht, übereinstimmt mit dem normativen Dokument

to which this declaration relates is in conformity with the normative document

**Technische Daten**

**Viskositätsprobenautomat**

**AVSPro II**

23. Juni 2006

**SI Analytics GmbH**
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D-55122 Mainz
Deutschland, Germany

23. Juni, June 23th, 2006
AGQSF 0000-A051-02/090422

SI Analytics

Translation of the legally binding german version

# Technical data of the AVSPro II Automatic Viscosity Sampler



**CE mark:** EMC according to the directive 89/336/EWG of the EU Council;
Interference emission according to the EN 50 081 standard, Part 1
Jamming resistance according to the EN 50 082 standard, Part 2
Low-voltage according to the Directive 73/23/EWG, as amended by the Directive 93/68/EWG of the EU Council

**Country of origin:** Germany

**Sample accommodation**

Sample carrier: Standard (unheated) and heatable up to 60°C (available as an option with the order)
a) for 16 pces.
100 ml sample bottles with GL 45 DIN thread and threaded PP closing cap or
100 ml sample bottles according to DIN 12 038 with NS 29 ground finish with matching PP closing caps
b) for 56 pces.
20 ml sample bottles with GL 18 DIN thread and threaded PP closing cap, Ø 16 x 100 mm

**Dosing module**

Cylinder: Borosilicate glass cylinder, DURAN®

**Measurement parameters:**

Flow time in seconds [s]
Temperature in degree centigrade [°C]
output via RS-232-C interface by the immersion circulator

**Measurement value recording:**

Flow time: Optoelectronic or thermoresistive recording of the meniscus passage through the measurement stages of the viscometer

Temperature: Pt 100 resistance thermometer for CT 1650 thermostat head (immersion circulator) or Pt 1000 resistance thermostat for thermostat head (immersion circulator) CT 52

**Measurement ranges**

Viscosity: 0.35 ... 800 $mm^2/s$ at a sample temperature of approx. 20 ... 25°C
Time: up to 9999.99 s, resolution 0.01 s
Suction pressure: fully automatic control (from - 300 ... + 300 mbar)

**Measurement accuracy**

Precision (repeatability and comparability) according to DIN 51 562, Part 1
Time measurement: ± 0.01 s ± 1 digit, but not more accurate than 0.01 %
The measurement uncertainty with measurements of absolute kinematic viscosity in addition depends on the uncertainty of the numeric value for the viscometer constant and the measurement conditions, especially of the measurement temperature

**Selection parameters** To be set via the software
Method: Absolute or relative viscosity
Viscometer: Ubbelohde Viscometer according to DIN 51 562, Part 1; ISO 3105 (BS-IP.SL) and ASTM D 446; ASTM D 2515; ISO 3105
Micro Ubbelohde Viscometer according to DIN 51 562, Part 2
Micro Ostwald Viscometer
Cannon-Fenske Routine Viscometer according to ISO 3105; ASTM D 2515; BS 188
Micro Ubbelohde Viscometer with TC sensors following DIN 51 562, Part 2

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# Technical data of the AVSPro II Automatic Viscosity Sampler



**Selection parameters (continued)**

| | |
|---|---|
| ViscoPump: | Pump parameters (ramp, pressure) |
| Sample transfer: | Sample-carrier position, viscometer position |
| Sample identifier: | alphanumeric in manual mode, or automatically by means of barcode reader unit (option) |
| Number of measurements: | 1 … 10 for each sample |
| Number of rinsing operations: | 0 … 99 with following sample - Please note sample quantity! - or with rinsing liquid from pre-selected position |
| Tempering time: | 0 ... 20 min, selectable in increments of 1 min |

**Data transfer parameters**

| | |
|---|---|
| Data interface: | bi-directional serial interface according to EIA RS232-C |
| Data format: | word length 7 bits, 2 stop bits, 4800 baud, no parity |

**Connections**

| | | |
|---|---|---|
| Viscometer: | to be connected to the front panel of ViscoPump plug-in units | |
| Pneumatic connections | | |
| ViscoPump: | for viscometer: | Round-plug connector with bayonet catch for AVS/S (measurement tripod), 5-channel socket or for TC Viscometer, 4-channel socket*, |
| | 1 RS-232-C serial interface each | for transparent thermostats and for Daisy Chain - ViscoPump Plug connections: 9-channel sockets: Subminiature D |
| SPS: | to PC: serial RS-232-C interface; plug connection: 9-channel Subminiature D | |
| Mains connection: | Device plug with safety interrupter according to VDE 0625, IEC 320/C14, EN 60320/C14 DIN 49 457 B | |
| **Mains supply** | corresponds to Protection Class 1 according to DIN EN 61 010, Part 1, unsuited for use in hazardous environment! | |
| Mains: | manual switch-over option from 115 V/230 V ~, 50/60 Hz Power consumption: 300 VA max. without transparent thermostat | |

**Materials**

| | |
|---|---|
| Casing: | Stainless steel, aluminium and plastic components made of polyurethane hard form (PUR) with chemically resistant two-component coating |
| **Casing:** | Dimensions: approx. 1300 x 1200 x 610 mm (W x H x D) Weight: approx. 100 kg, depending on equipment (excl. transparent thermostat) |
| **Ambient conditions:** | Ambient temperature: + 10 ... + 40°C for operation and storage 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 |

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* With the current configuration of the AVSPro II only Micro Ubbelohde Viscometers with TC sensors in combination with the CT 53 transparent thermostat can be used!

# Warning and safety information

For reasons of safety the AVSPro II Automatic Viscosity Sampler must only be opened by authorized personnel.
This means, among other things, that work on the electric equipment must only be performed by trained specialists. In the case of unauthorized intervention in the AVSPro II Automatic Viscosity Sampler or negligent or deliberate damaging the warranty will lapse.
For safety reasons the AVSPro II Automatic Viscosity Sampler must not be used for any purposes other than those described in the present operating instructions. It is not suitable for operation in a hazardous environment.

Please observe as well the operating instructions of the viscometers and thermostats and those of the other equipment to be connected.

The AVSPro II Automatic Viscosity Sampler corresponds to Protection Class I.

It was built and tested according to DIN EN 61 010, Part 1, Protective Measures for Electronic Measurement Equipment, and has left the manufacturing plant in perfect condition under safety aspects. In order to maintain this condition and ensure safe operation, the user has to observe the information and warning notes contained in the present operating instructions.

⚠ Prior to switching on it has to be ensured that the operating voltage set on the AVSPro II Automatic Viscosity Sampler matches that of the mains net.

⚠ The mains plug must only be plugged to grounded sockets. The protective effect must not be cancelled by an extension cable without protective conductor. Any disruption of the protective conductor inside or outside the AVSPro II Automatic Viscosity Sampler, or any loosening of the protective conductor connection may render the AVSPro II Automatic Viscosity Sampler hazardous.
Any intentional disruption is inadmissible.

⚠ It has to be ensured that no fuses other than those of the specified type and with the nominal current strength are used. The use of mended fuses or short-circuiting the fuse holder is inadmissible.

⚠ If it has to be assumed that safe operation is no longer possible, the AVSPro II Automatic Viscosity Sampler has to be closed down and secured against inadvertent putting into operation.

⚠ Please switch the AVSPro II Automatic Viscosity Sampler off, remove the mains cable, and contact the device department of SI Analytics.

⚠ The built-in safety features, especially the needle protection, must never be put out of operation.

⚠ Prior to any service work on the AVSPro II Automatic Viscosity Sampler, the mains plug has to be pulled off the socket.

⚠ To avoid hazards emanating from chemicals and/or samples used, the statutory accident-prevention regulations have to be adhered to (e.g. use of protective glasses, protective clothing, protective breathing equipment).

⚠ The AVSPro II Automatic Viscosity Sampler must not be operated or stored in rooms with a damp atmosphere.

⚠ If the AVSPro II Automatic Viscosity Sampler shows visible damage, one has to assume that safe operation is no longer possible.

## 1.2 AVSPro II - Function and construction

The AVSPro II Automatic Viscosity Sampler determines viscosity by means of capillary viscometry.
Viscometry is the most accurate method for determining the viscosity of liquids with Newtonian flow properties.

The measurement process as such consists in a high-precision recording of the flow time. The measurements are used to determine the time which a specific quantity of liquid requires to flow through a capillary of a defined width. Viscosity is calculated from the flow time, with the calculation methods depending on the respective application.

The AVSPro II Automatic Viscosity Sampler consists of the following basic elements/functional units:

- **ViscoPump**
- **Viscometers**
- **Sample lift with sample carriers**
- **Sample transfer system**
- **Transparent thermostats**

**• ViscoPump**

The ViscoPump is the core element of the AVSPro II Automatic Viscosity Sampler. It controls the entire measurement process and can be connected via a serial interface (daisy chaining) to various peripherals, for instance to a PC, transparent thermostat or barcode reader unit (option).
A maximum of 8 plug-in units can be used on the AVSPro II. Corresponding ViscoPump plug-in units are available for each measurement method optoelectronic or thermoresistive.

**• Viscometer**

The meniscus passage is measured in calibrated viscometers. The type of viscometer is determined by the liquid to be measured.

The AVSPro II Automatic Viscosity Sampler is designed for use with various viscometer types:

- Ubbelohde Viscometer (DIN and ASTM)
- Micro Ubbelohde Viscometers with TC sensors
- Ostwald Viscometer
- Micro Ostwald Viscometer
- Cannon-Fenske-Routine Viscometer

**• Sample lift with sample carriers**

The electric sample lift considerably facilitates the loading of samples into the AVSPro II Automatic Viscosity Sampler. It is no longer necessary to insert them manually - a simple key stroke, and the sample lifter will take them to the corresponding position.

Two different sample carriers are available for easy handling of samples for different viscometer types:

- carrier for 16 bottles of 100 ml each, (threaded/ground bottles) or
- carrier for 56 bottles of 20 ml each

A heatable thermoblock is available as an option.

**• Sample transfer system**

The sample transfer system automatically transfers the samples to the respective viscometers. The integrated dosing module can be positioned in three axes. This means that you are free to select which sample is to be dosed into which viscometer. The desired filling quantity for each viscometer is parameterized via the PC. The entire sample-transfer process is controlled by the PC and performed by a PLC (programmable logic computer).

**• Transparent thermostats**

The transparent thermostats were developed especially for the measurement of viscosity in capillary viscometers.
They consist of a thermostat bath made of paint-coated steel with heat-resistant Tempax glass windows and an immersion circulator.
The main features of the transparent thermostats consist their high temperature constancy and the possibility of being able to watch the flow process.

## 2 Reliability by precision

The conventional method of time measurement (i.e. the human eye and a stop watch) may lead to important measurement errors. Optoelectronic or thermoresistive measurement using the AVSPro II Automatic Viscosity Sampler excludes human errors of this type.

As a matter of course, all components of the AVSPro II Automatic Viscosity Sampler meet the highest standards imposed on accuracy and reliability.
The diameter of the capillary is precise to 1/100 mm, and the transparent thermostats with their tempering bath have a temperature accuracy of ± 0.01 K at 25°C according to DIN 58 966.
This means that the devices meet the national and international standards for viscosity measurement.

## 2.1 Optoelectronic measurement method

The optoelectronic measurement method is used for limpid liquids. This type of measurement is performed using the VZ 8511 ViscoPump.

The measurement records the time which a liquid requires to flow through the measurement planes of the capillary viscometer. For this process, light is introduced in the upper and lower measurement plane. During the meniscus passage, fraction and reflection change, and thus the radiation intensity of the light arriving from the transmitter to the receiver. Sensors located in the aluminium (AVS/S) or plastic (AVS/SK-PVDP) measurement tripods record these changes and output the corresponding start and stop signals for the time measurement.

Viscosity calculation is performed automatically on the PC. It results from the flow time and the equation required for the respective application.

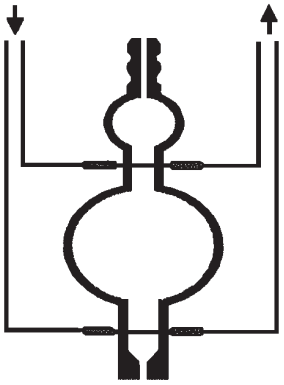


**Fig. 1 Viscometer for optoelectronic measurement**

## 2.2 Thermoresistive measurement method

The optoelectronic measurement method is used for limpid liquids. This type of measurement is performed using the VZ 8512 ViscoPump.

The measurement records the time which a liquid requires to flow through the measurement planes of the capillary viscometer. For this process, light is introduced in the upper and lower measurement plane. During the meniscus passage, fraction and reflection change, and thus the radiation intensity of the light arriving from the transmitter to the receiver. Sensors located in the aluminium (AVS/S) or plastic (AVS/SK-PVDP) measurement tripods record these changes and output the corresponding start and stop signals for the time measurement.

Viscosity calculation is performed automatically on the PC. It results from the flow time and the equation required for the respective application.

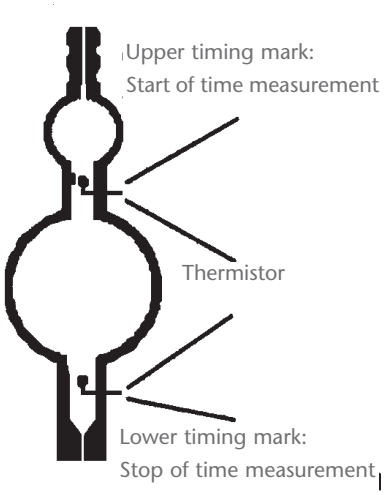



**Fig. 2 Viscometer for thermoresistive measurement**

# 3 Functional units

The ViscoPump plug-in units are the core elements of the AVSPro II Automatic Viscosity Sampler. They control the entire measurement process, and via their serial interface to the PC to the barcode reader unit or to the transparent thermostats they allow an easy and fast data exchange.

This means in detail:
Within the PC, appropriate software is used for the automatic calculation and documentation for the subsequent evaluation of the viscosity of the sample to be measured.
The barcode reader unit identifies the respective samples, and the thermostat head assumes the complete temperature supervision and control of the transparent thermostats.

A ViscoPump consists of a pump, a valve block and a measurement amplifier. The pump draws the sample liquid in the capillary of the viscometer upward, the valve block opens the ventilation tube, while the measurement amplifier automatically records the signals of the sensors and thus measures the flow times of the respective liquids.

Corresponding ViscoPump plug-in units are available both for the thermoresistive and optoelectronic measurement method.

The ViscoPump automatically controls the following processes:
- pre-tempering of the samples in the viscometers
- regulation of the pumping pressure as a function of the viscidity of the measurement liquidity and the viscometer used
- pumping the liquid upwards into the reservoir of the viscometer
- measurement of the flow time
- data transfer to the connected peripherals

The front panel of a ViscoPump contains various connection ports:

- black threaded port for the pneumatic connection of the hose line towards the venting pipe of the viscometer
- red threaded port for connecting the suction line via the safety bottle to the capillary tube
- electric plug-in ports for the photoelectric barriers of the viscometers (5-channel socket) and for the thermistors of the TC Viscometer (4-channel socket)
- 9-channel Sub-Miniature D plug at the RS-232-C port for connecting a thermostat

## 3.1 ViscoPump for thermoresistive measurement method

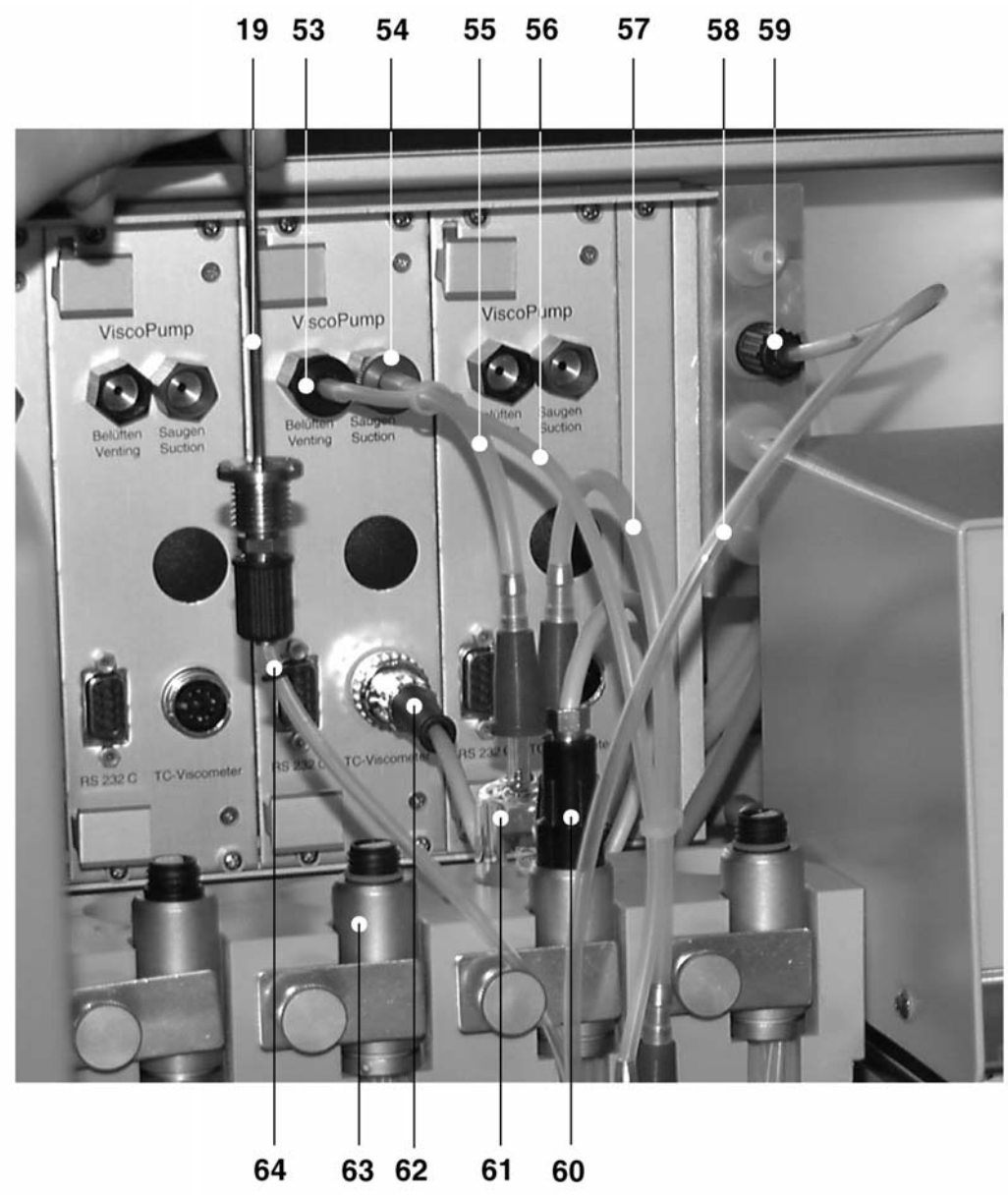



**Fig. 3 ViscoPump for thermoresistive measurement**

19 Sample needle in docking station
53 Black threaded port:
connection of venting hose
54 Red threaded port:
connection of suction hose
55 Suction hose
ViscoPump-safety bottle
56 Venting hose
ViscoPump/viscometer
57 Suction hose
Safety bottle/viscometer
58 Waste hose
Viscometer - intermediate
thread connection
Waste line - solenoid valve
59 Intermediate thread connection
Waste line
60 + 62 TC Viscometer cable plug
ViscoPump - viscometer
61 Safety bottle
63 Plug-in head of the TC Viscometer
64 Filling hose
Viscometer - docking station

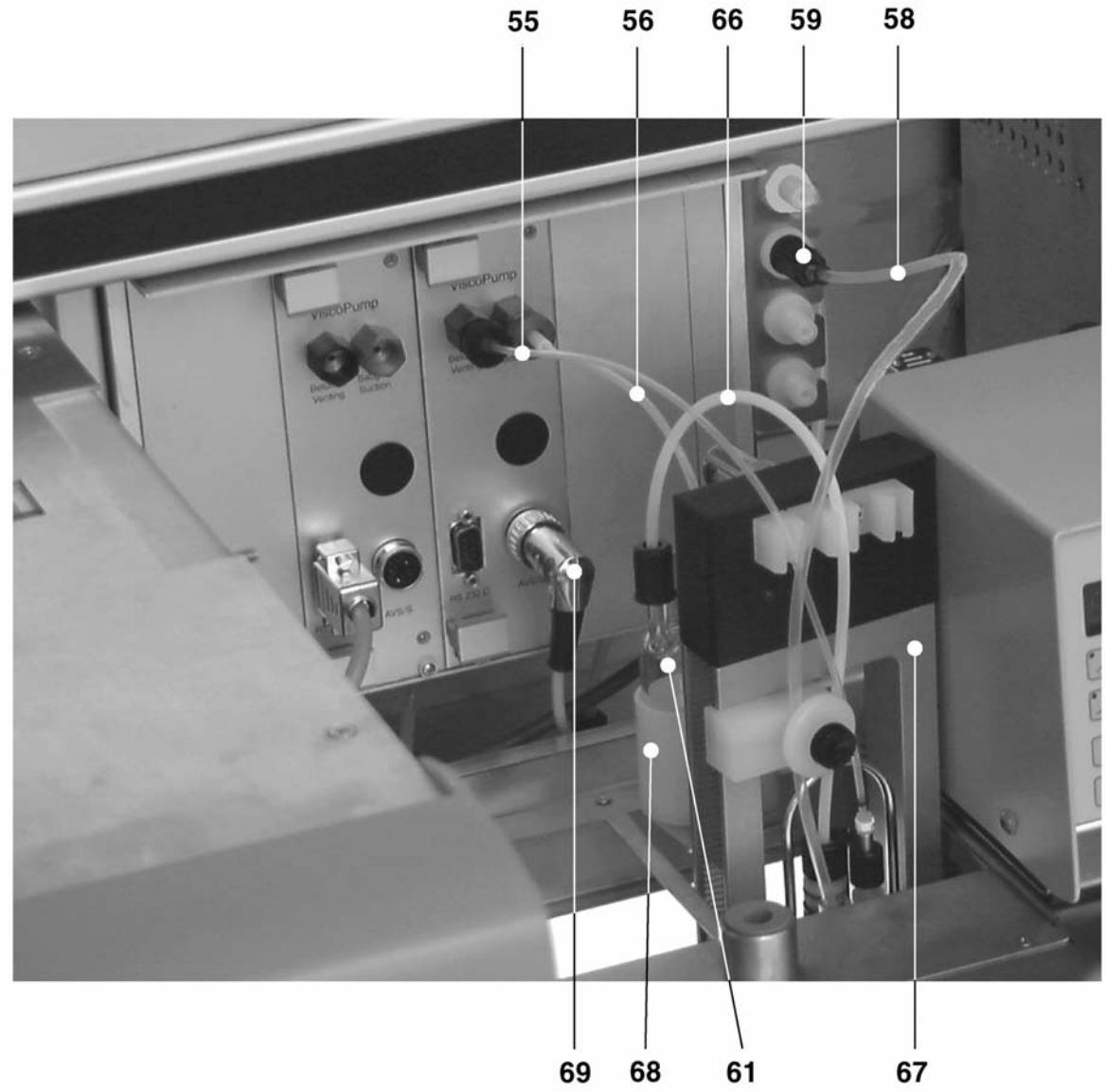



**Fig. 4 ViscoPump for optoelectronic measurement**

55 Venting hose
ViscoPump - viscometer
56 Suction hose
ViscoPump - safety bottle
58 Waste hose
Viscometer - intermediate thread connection
Waste line - solenoid valve
59 Intermediate thread connection
Waste line
Connection for waste hose ref. to item 58
61 Safety bottle
66 Suction bottle
Safety bottle -viscometer
67 AVS/S measurement tripod
68 Holder for safety bottle
69 Cable: 5-channel plug
ViscoPump - AVS/S

# ViscoPump - Possible applications

**Examples of liquids**

| VZ 8511 ViscoPump for use in optoelectronic meniscus scanning: | VZ 8512 ViscoPump for use in thermoresistive meniscus scanning (TC Viscometer): | At present not yet available: |
|---|---|---|
| acetone | mineral oils and transparent and opaque paraffin oils | formic acid |
| chloroform | | dichloroacetic acid |
| cyclohexanone | | trifluoroacetic acid |
| dichloromethane | | |
| ethanol | | |
| hexaflouroisopropanol | | |
| methanol | | |
| methyl ethyl ketone | | |
| m-cresol | | |
| o-chlorophenol | | |
| phenol/dichlorobenzene | | |
| sulphuric acid | | |
| transparent paraffin oils and transparent mineral oils | | |

⚠ When using Micro Ubbelohde Viscometers with TC sensors, the ignition temperature of the measurement media has to be observed: It has to be above 250°.

## 3.2 Viscometers

The AVSPro II Automatic Viscosity Sampler 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.

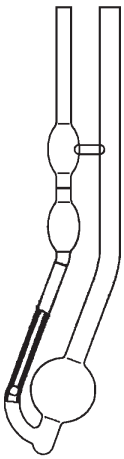
The K viscometer constant is determined individually by way of a calibration of each glass capillary viscometer. Owing to the use of high-quality measurement and testing equipment and the application of national standard gauges, SI Analytics guarantees an absolutely precisely reproducible calibration.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

### Viscometer types, racks and measurement tripods

| **Viscometer tripod** | | **Rack** | **Measurement** | |
|---|---|---|---|---|
| Type | | Type no. | Type no. | |
| Ubbelohde (DIN) | 532…<br>530… | 053 92 | AVS/S | AVS/SK |
| Ubbelohde (ASTM) | 526… | 053 92 | AVS/S | AVS/SK |
| Micro-Ubbelohde | 537… | 053 92 | AVS/S | AVS/SK |
| Cannon-Fenske-Routine | 520… | – | | AVS/SK-CF |
| Micro-Ostwald | 517… | 053 97 | AVS/S | AVS/SK |
| Micro-Ubbelohde with TC sensors | 552… | Holding device on CT 53 thermostat bath CT 53 | | |

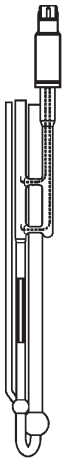
⚠ Note: The hose combinations are to be selected according to the required application, e.g. VZ 7010, VZ 7011 and VZ 7026.

Micro-Ubbelohde Viscometer



Canon-Fenske-Routine Viscometer

Micro-Ostwald Viscometer



Micro-Ubbelohde Viscometer with TC sensors

## 3.3 Sample lift

The sample lift raises and lowers the sample carrier into and out of the desired position. For loading sample bottles into the carrier, press the "down" control keys on the forward most profile bar of the lift until the carrier can be loaded conveniently.

After filling, you press the two "up" keys, and the lift raises the carrier upwards to the withdrawal position.

**Fig. 5 Sample lift**

10 Viscometer in the transparent thermostat

11 Two-hand control of the sample lift: up/down

⚠ Please note: Due safety regulations the sample rack is only moveable, while the PC program for the AVSPro II is loaded and runs and the sample needle is on ist upper position. The PC program is releasing the sample rack automatically, if there is no danger present to bend or damage the sample needle.

⚠ For operation it has to be in the uppermost position. The upper end position is reached as soon as the sample lift has switched off automatically after moving upwards.

## 3.4 Sample carrier

The AVSPro II Automatic Viscosity Sampler is designed for the use of different viscometer types (please refer to section 3.2 of the 'viscometer' table). For this reason two different sample carriers are available: depending on the required filling volume it is possible to use sample carriers for 16 bottles of 100 ml each (Ø 55 mm) or for 56 bottles of 20 mm each (Ø 16 mm).
For pre-tempering the samples (up to 60°C), two different heatable thermoblocks made of aluminium are available: for 16 or for 56 samples. In this case, too, convenient loading using a sample carrier is possible.

The temperature of the samples is controlled using an adjustment button located behind the flap of the lift. The sample carriers of both the standard and heatable designs latch in the corresponding holes of the sample lift.

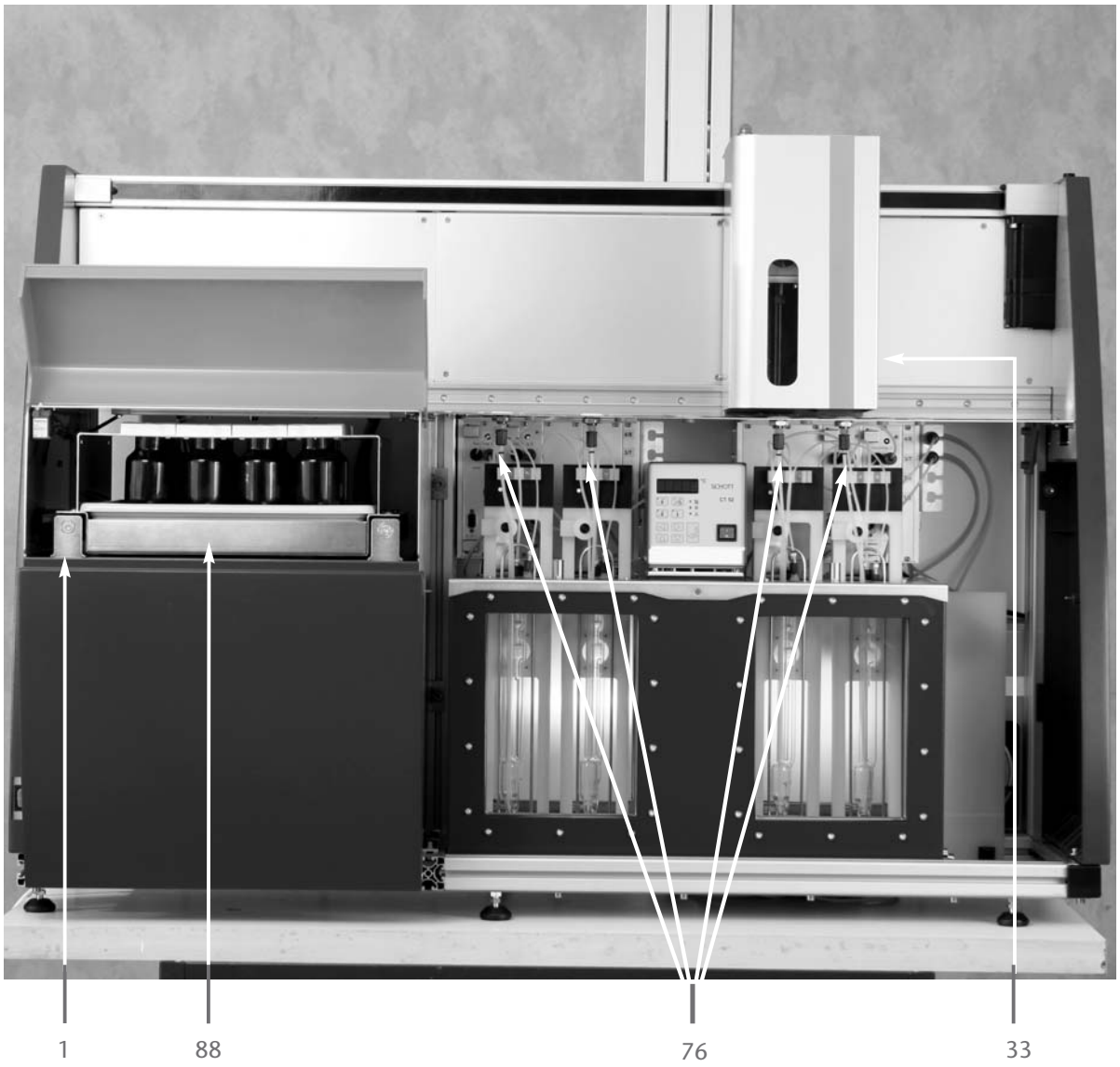



**Fig. 6 Sample carrier**
1 Sample lift
33 Cased sample-carrier unit
76 Position of sample transfer to viscometer (docking station)
88 Sample carrier, loaded with 16 sample bottles of 20 ml each

## 3.5 Sample transfer unit, linear drive and control

The sample transfer unit withdraws the samples and transfers them to their corresponding viscometer. In this process the integrated dosing system sucks the sample through a hollow needle into a glass cylinder and transfers it to the corresponding viscometer. The filling parameters for the individual viscometers are parameterized from the connected PC.

⚠ The materials used for the dosing unit allow the use of almost any liquid. In the case of very aggressive (corrosive) liquids, however, it is advisable to look them up in the table of applications
(please refer to chapter 3.1).

The traversing motion and the positioning of the sample within the dosing module is performed by three linear drives.

The first linear drive positions the sample carrier with the sample to be measured under the withdrawing aperture (line). The second linear drive moves the dosing module over the sample (column). The third one lowers the needle on the dosing module into the sample bottle. Subsequently, the parameterized sample volume can be extracted through the dosing module from the sample bottle.
After the needle has moved out of the sample bottle again, the dosing module moves to the selected viscometer.
The sample is then filled through the docking station (please refer to chapter 5.6) into the viscometer.

The central control unit (PLC) of the linear drives is integrated in the AVSPro II Automatic Viscosity Sampler and controlled from the PC. The latter controls the measurement process and is connected via a serial interface cable (RS-232-C) with the central control unit.
For a smooth running of the linear drives the control unit monitors the signals of the safety switches and reports possible errors to the PC. This ensures the precise and disturbance-free operation of the AVSPro II Automatic Viscosity Sampler under all circumstances.

⚠ The sequence of the program must only be started with the sample-lift flaps and the thermostat cover being closed.

## 3.6 Casing and profile frame

The casing of the AVSPro II Automatic Viscosity Sampler consist of a profile frame made of anodized extruded aluminium profile. The lining materials used are stainless-steel sheets and PUR plastics with a chemically resistant paint coating.

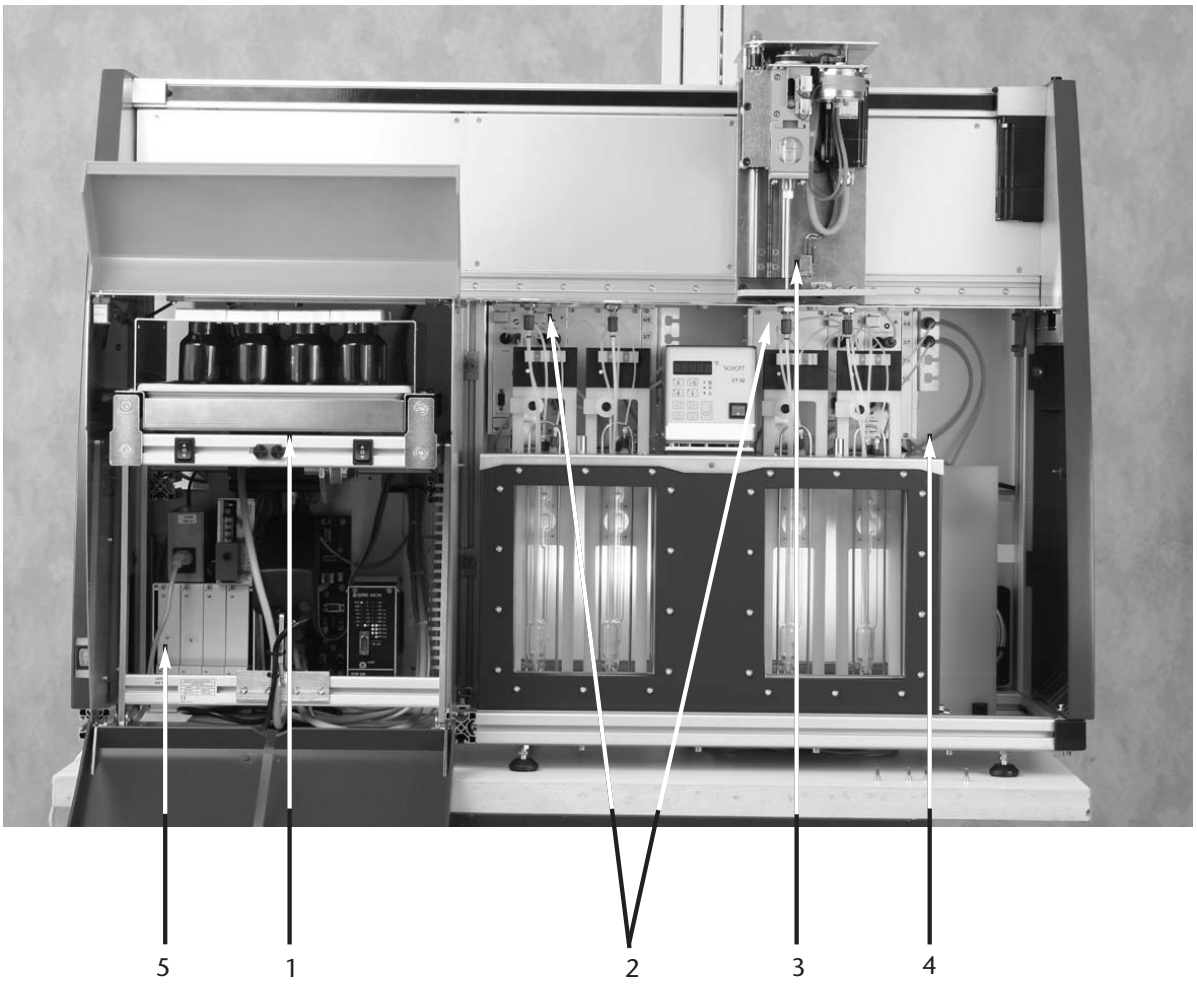



**Fig. 7 Profile frame with back panel and fan for ventilating the interior of the AVSPro II**

1 Sample lift
2 Component carrier for 4 ViscoPump plug-in units
3 Sample transfer and dosing module
4 Waste hoses from 4 viscometers
5 Control elements

## 3.7 Transparent thermostats

Viscosity depends on the temperature of the sample liquid. This means as a general principle that the viscometers have to be thermostat-controlled during the measurement. The measurement temperature has to be kept constant in order to obtain an accurate result.

This is possible on the AVSPro II Automatic Viscosity Sampler. The SI Analytics transparent thermostats which were especially developed for capillary viscometry meet the requirements imposed on precision and constancy. The CT 53, CT 1650/4 and CT1650/4 HT, for instance, guarantee a temperature constancy of + 0.02 K at a command temperature of 10° to 40°C and a max. ambient-temperature variation within a range of ± 3 K.

As a rule of thumb, one can assume that the temperature in terms of degrees multiplied by the factor of 10 represents the %-deviation from the result. This means that a deviation of 0.05 K corresponds to a possible error of 0.5%.

As a principle, two different transparent thermostats can be used with the AVSPro II Automatic Viscosity Sampler. For measurements at varying temperatures the CT 53 transparent thermostat is available. The AVSPro II Automatic Viscosity Sampler can be equipped with two CT 53 with four Micro Ubbelohde Viscometers each.

The larger CT 1650 transparent thermostat can be used with 4 measurement tripods, e.g. AVS/S.

⚠ Please read through the separate operating instructions of the transparent thermostats as well.

## 3.8 Back lighting

As an option, an illuminated panel with an illuminated surface of approx. 600 x 250 mm is available for the AVSPro II Automatic Viscosity Sampler.
It is fastened behind the glass pane of the transparent thermostat and facilitates the visual control of the temperature values of the thermostat bath at the verifiable, or calibrated, glass thermometers as well as the control of the liquid levels within the viscometers during the measurement.

## 3.9 Flow-through cooler

As was mentioned above, viscosity measurement is highly dependent on the temperature constancy.
For reasons of control technology (self heating of the thermostat head), it is therefore necessary to use a CK 300 or CK 310 flow-through cooler as a counter cooler at bath temperatures exceeding 40°C.

⚠ Please read through the separate operating instructions of the CK 300 or CK 310 flow-through cooler as well.

## 3.10 Waste hoses

Each viscometer contains an evacuation hose leading via a solenoid valve to a central waste hose. Two different solenoid valves are available for connecting the evacuation hoses:

- VZ 7146 type:
  PTFE version for all - even aggressive - liquids
- VZ 7147 type:
  Brass version for mineral oils, not suitable for aggressive liquids.

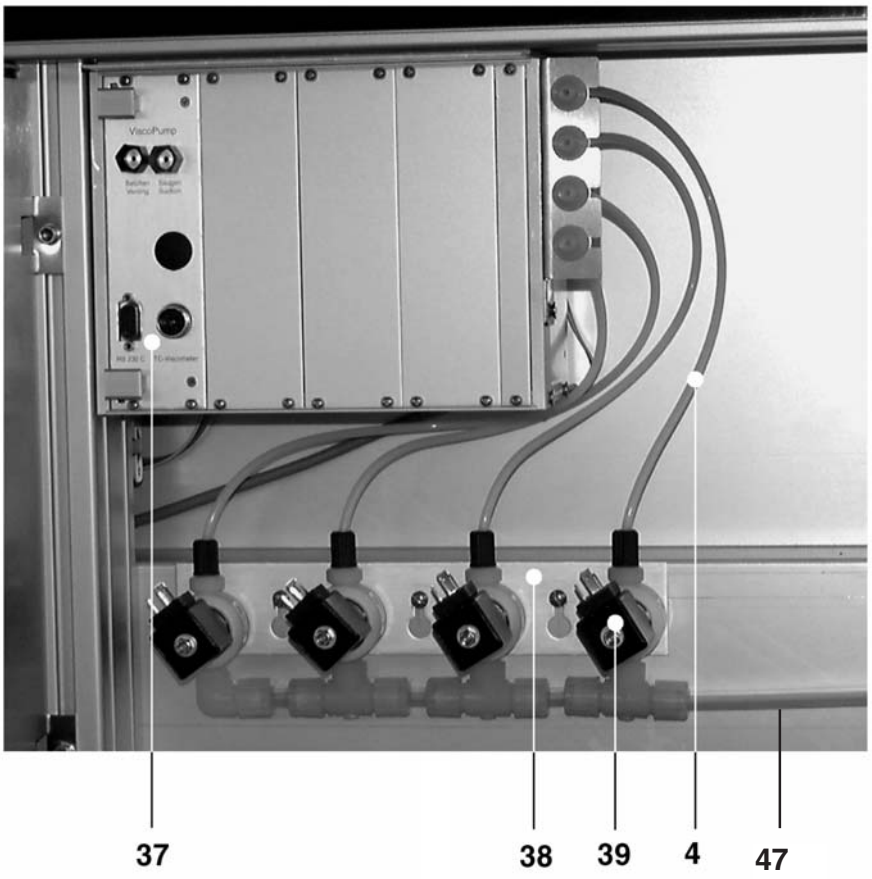



**Fig. 8 Waste valves**

4 Waste hose to measurement point 1:
Intermediate thread connection-Waste hose - solenoid valve
37 ViscoPump - measurement point 1
38 Holding sheet for 4 solenoid valves
39 Solenoid valve to measurement point 1
47 Common waste line to waste bottle
(PFA waste hose oØ 10 mm)

## 3.11 Evacuation pump

To avoid splashing or spraying of the liquids during emptying the viscometer, the AVSPro II Automatic Viscosity Sampler uses a vacuum emptying feature. The vacuum-controlled evacuation pump builds up the required vacuum, the sample liquid is guided via the solenoid valves through the evacuation hoses of the viscometers into the common waste hose and automatically emptied into the waste bottle.

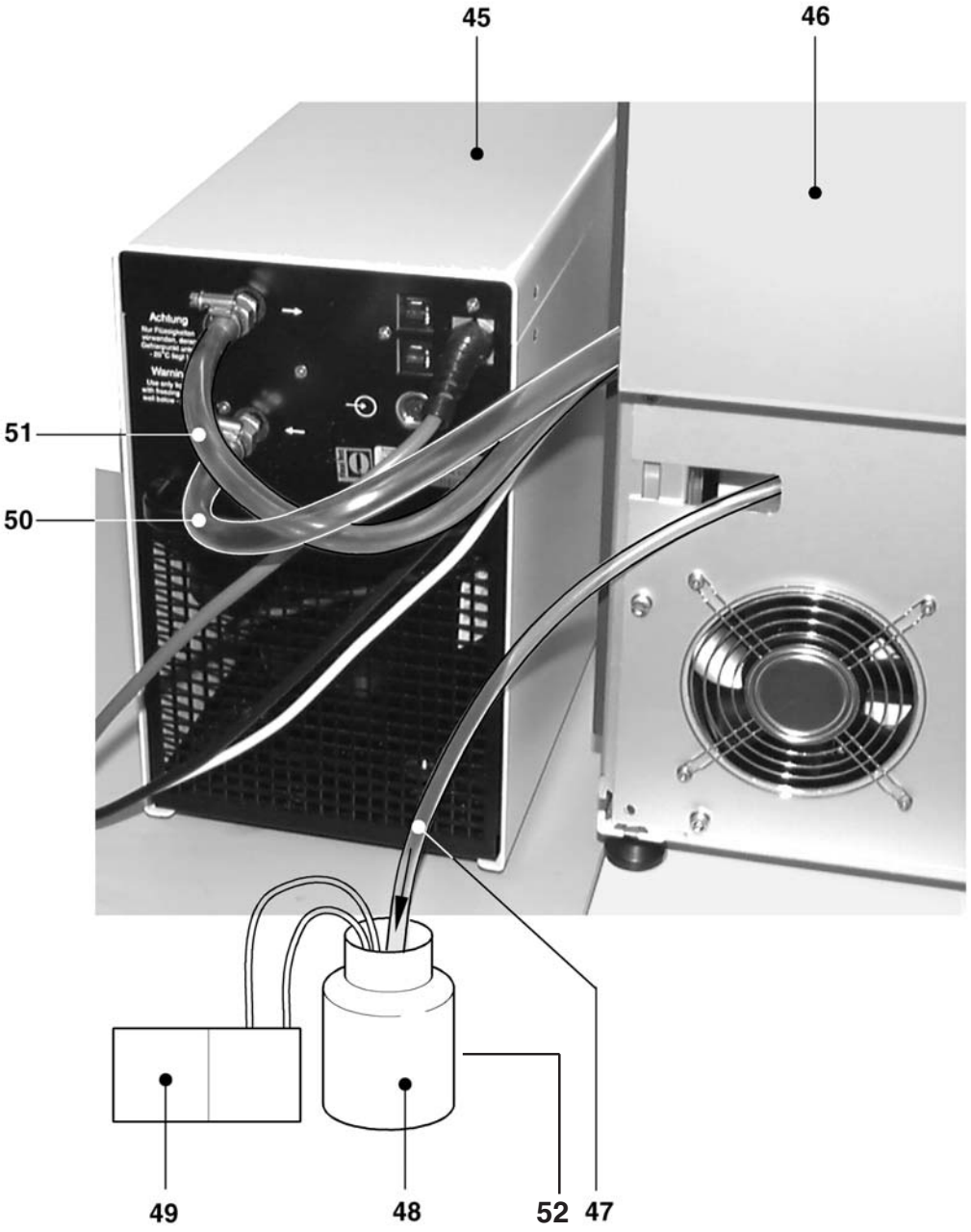



**Fig. 9 Back panel of the AVSPro II Automatic Viscosity Sampler and CK 300 flow-through cooler**

45 Flow-through cooler back panel
46 AVSPro II Automatic Viscosity Sampler back panel
47 Common PFA waste hose
48 Waste bottle: 5l suction bottle, TÜV-approved
49 Waste evacuation pump
50 Connection of counter cooler - reverse-flow immersion circulator
51 Connection of counter cooler-fore-runner immersion circulator
52 Overfill sensor

## 3.12 Waste bottle

For reasons of safety, only TÜV approved waste bottles may be used, such as the VZ 7142 5l clear-glass evacuation bottle from SI ANALYTICS.
Each waste bottle is equipped with an interchangeable bottle unit with an overfill sensor. If this sensors signals the control unit that the bottle is full, an optical warning message will be displayed on the screen of the PC immediately.
If this warning message is ignored, the AVSPro II Automatic Viscosity Sampler will suspend all further measurement operations.
If the bottle is not emptied within one measurement cycle, the AVSPro II Automatic Viscosity Sampler will abort the entire measurement process.

**Emptying the waste bottle**

To empty, the waste bottle, you have to stop the measurement program and switch off the waste pump. Subsequently, separate the waste hose from the bottle, and remove the interchangeable bottle unit including the overfill sensor. Please dispose of the contents in adherence to the environmental regulations.

⚠ Under certain circumstances there may be a hazard of etching oneself! Please take the required precautions!

## 3.13 Specifications of the Personal Computer

The software of the AVSPro II Automatic Viscosity Sampler is rated for PCs meeting the following minimum requirements:

- Pentium processor with a min. clock frequency of 166 MHz
- 32 MB RAM min.
- 1 GB hard disk min.
- Drive: compact disc (CD-ROM)
- 3.5" disk drive (floppy)
- PS 2 mouse
- 2 serial interfaces
- Operating system: Windows XP.

Printer:
For data logging, any (Centronics) printer running under Windows XP can be used.

# 4 Working with the AVSPro II Automatic Viscosity Sampler

### Power-up and settings

- Switched the AVSPro II Automatic Viscosity Sampler on with the mains switch located on the left side of the cover
- Set the desired language on the PC
- Select the calculation method
- Set the parameters
- Select the appropriate viscometer
- Check the filling levels of the thermostat baths
- Switch on the transparent thermostat with its mains switch
- You can start the measurement process only after the desired temperature has been reached

### Loading the sample carrier

⚠ Prior to moving the sample carrier, you should check the position of the sample needle: it has to be in the upper end position!

For loading the sample carrier, open the flaps of the sample lift: The upper flap folds upwards and latches at the round pin on the right side, the lower flap can be opened by simply pulling it. When open, it is held in position by a chain.
Now you can press the "down" keys to move the sample lift in its lower basic position and withdraw the sample carrier.

⚠ When working with the bar-code reader unit, make sure during loading the sample bottles that the labels are properly aligned - they have to point backwards!

The filled sample carrier has to latch in the corresponding holes of the sample lift. Subsequently, you can move the lift upwards by pressing the two "up" keys. To close the upper flap, unlatch it by pressing the round pin.
As soon as the two flaps are closed you can start the measurement process.

⚠ Prior to the start make sure that the sample lift is in its uppermost position

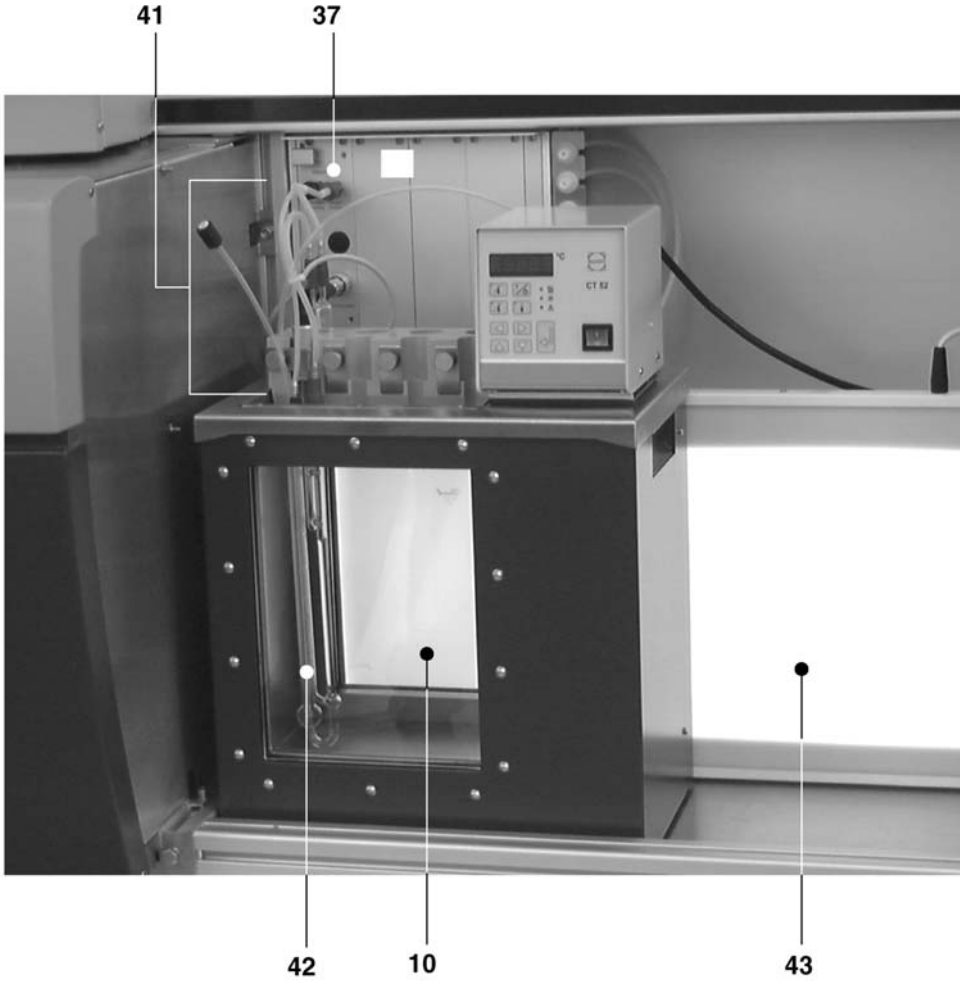



**Fig. 10 Transparent thermostat**

10 Bath of the CT53 transparent thermostat
37 ViscoPump on measurement point 1 for TC Viscometer
41 Hose set for viscometer
42 Micro TC Viscometer
43 Light box for back lighting

# 5 System expansion

Various functional units of the AVSPro II Automatic Viscosity Sampler, such as the viscometers and the ViscoPump, can be replaced or added.

⚠ Prior to replacing any functional unit, the mains plug MUST be pulled off from the mains socket!

⚠ Caution!
Dripping liquids may cause hazard to the user!

## 5.1 Changing the ViscoPump

- Remove the pneumatic and electric connections from the front plate of the ViscoPump plug-in unit to be changed.
- Loosen the screws located at the corners of the front plate.
- Use the upper and lower plug-in handle to lever the ViscoPump out of its rear-side plug connection.
- Pull the ViscoPump out of the plug-in unit.
- After inserting the new ViscoPump plug-in unit, secure it again with the front-plate screws.
- Re-establish the electric and pneumatic connections.

## 5.2 Replacing the Micro Ubbelohde Viscometers with TC sensors

1. Loosen the knurled screw, then bend the clamping sheet by 90° upwards
2. Remove the viscometer upwards, insert the new viscometer into the holder
3. Now rotate the clamping sheet by 90° to the right and downwards into its horizontal position; align the viscometer straight, then re-tighten the knurled screw.

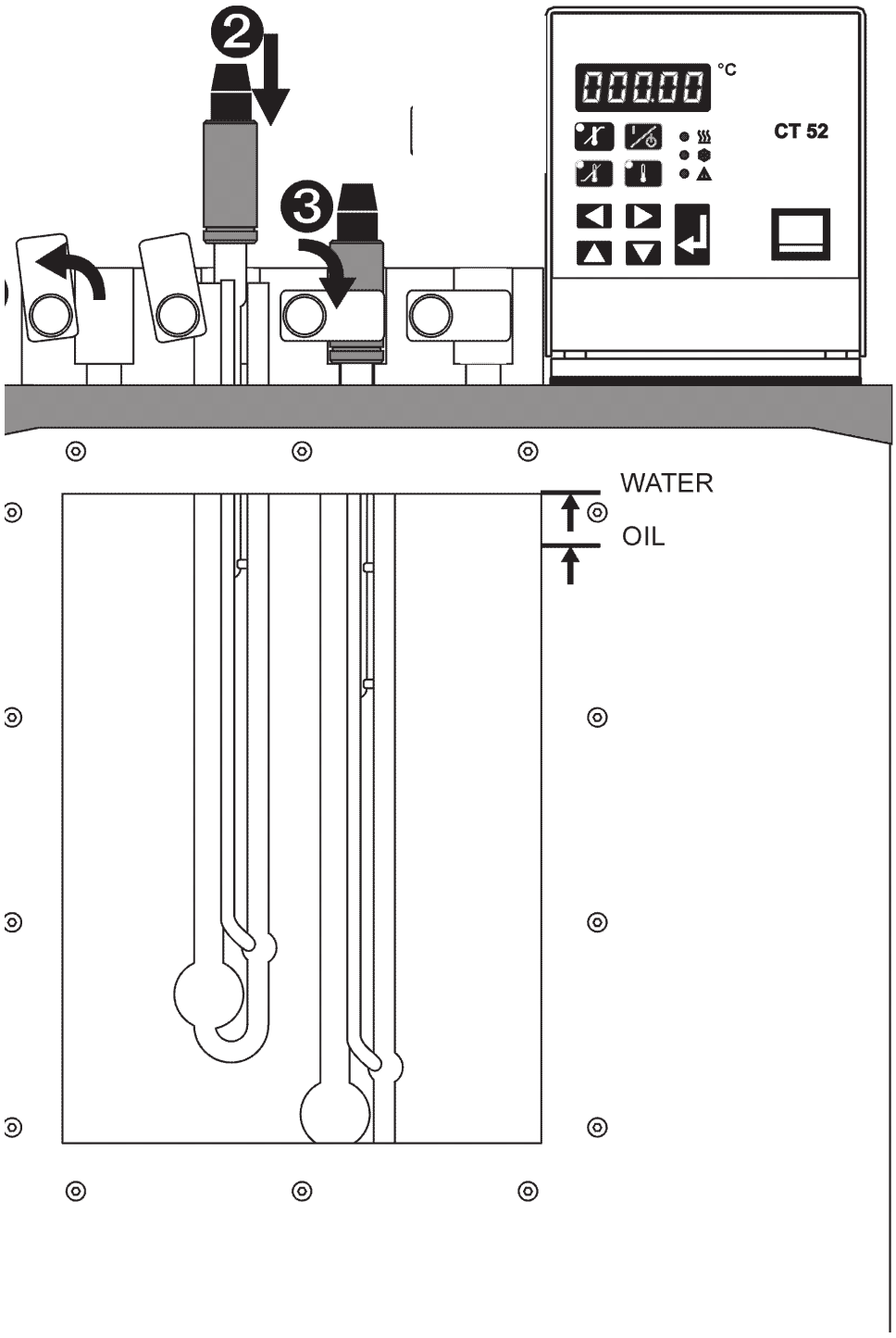



**Fig. 11 Replacing the viscometer**

## 5.3 Replacing optoelectronic viscometers

Open the cover segment of the CT 7650/4 transparent thermostat. Remove the hose set (suction hose and venting line plus filling and evacuation line) from the viscometer and the measurement tripod.
Remove the viscometer together with the rack from the AVS/S tripod.

Place the new viscometer in the viscometer rack.
Subsequently, place both parts - aligned with the guide cam - in the tripod.

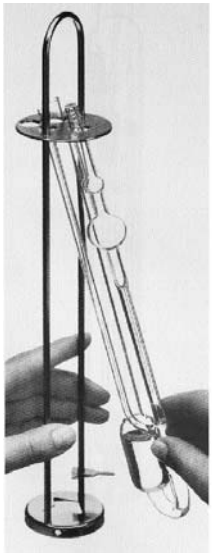


**Fig.12 Replacing the viscometer**

## 5.4 Replacing the dosing module

To replace the dosing module, rotate – while the system is shutdown – the upper toothed-belt wheel of the spindle to move the piston to the bottom position.

⚠ Do not turn as far as it will go!

As soon as the piston has reached the bottom position, you can pull the module out of the key and insert a new one.

17 Dosing module

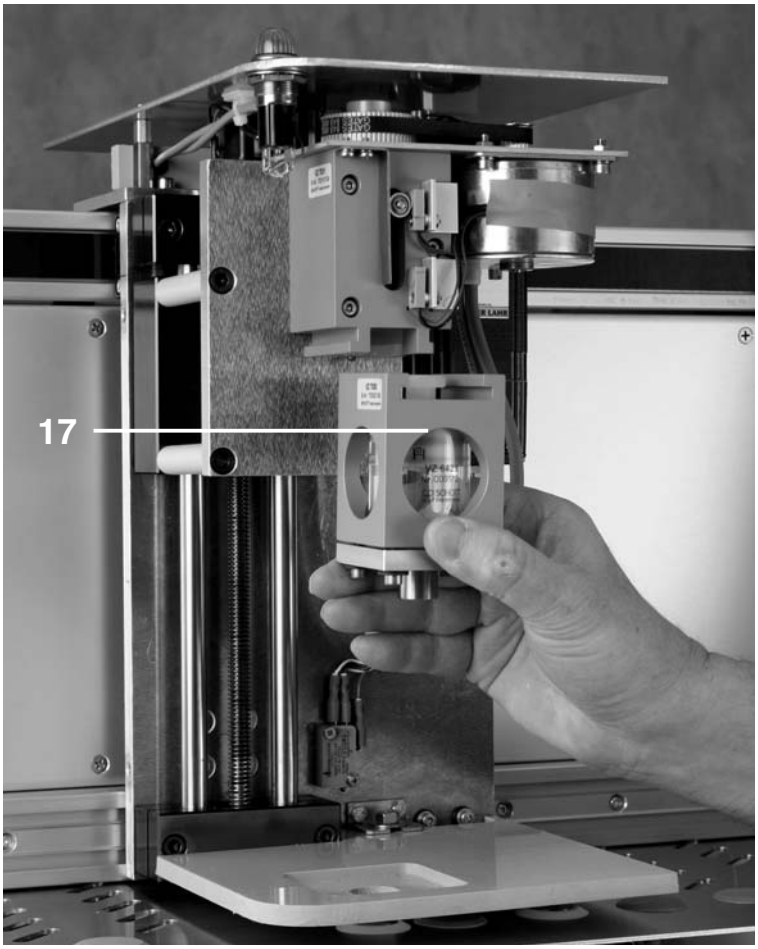



**Fig.13 Replacing the dosing module**

## 5.5 Replacing the needle

⚠ Switch the AVSPro II Automatic Viscosity Sampler off!

Remove the plastic cover of the dosing drive by loosening the two lateral cross-recessed screws, then unlatch the cover upwards.

⚠ Watch out for spilling liquid! It may be hazardous to your health!

⚠ It is inadmissible to operate the AVSPro II Automatic Viscosity Sampler without the plastic cover!

## 5.6 Docking station - installation and disassembly

The docking station serves as transfer point of the sample into the viscometer (through the filling hose). The needle is centred by the funnel in the docking station.
The O-ring in the docking station seals the needle while the liquid is pressed into the filling hose.
This O-ring may wear over time.

⚠ Switch the AVSPro II Automatic Viscosity Sampler off!

**Replacing the O-ring**
To replace the O-ring, manually loosen the union nut of the filling hose. Using a (size 10) fork wrench, loosen the O-ring guide nut, then unscrew it clockwise. Now you can remove the O-ring and insert a new one.
Subsequently, replace the O-ting guide nut and tighten it using the fork wrench. Use the union nut to fasten the filling hose, then tighten the union nut manually.

To change the entire docking station, you should proceed as follows:
Loosen the union nut of the filling hose by hand. Adjust a pin spanner for the bore holes of the two holders, then hook it in. Use a (size 22) fork wrench to loosen the nut on the bottom side.
Remove the docking station, and insert the new one. To fasten it, proceed in reverse sequence described for dismantling.

⚠ Watch out for spilling liquid! It may be hazardous to your health!

## 5.7 Maintenance of the driving spindle of the dosing unit

The driving spindle of the dosing unit with ist bearings is a wearing part. To guarantee an undisturbed use over a longer period, it is necessary to carry out regular maintenance.
After every 5-6000 working hours (2000 working hours in continuous operation) the driving spindle has to be lubricated by using the lubricant give along.

Regardless of the regular maintenance the driving spindle has to be relubricated, if running noise will be observated.

**Typ / type** **Viskositätsprobenautomat AVSPro II**

**Viscosity Automatic Sampler AVSPro II**

## Bescheinigung des Herstellers

Wir bestätigen, dass das oben genannte 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 equipment was verified according DIN EN ISO 9001, part 8.2.4 "Monitoring and measurement of product" and that the specified requirements for the product are met.

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Printed in Germany EDV 008 8272293 Version 090422 M