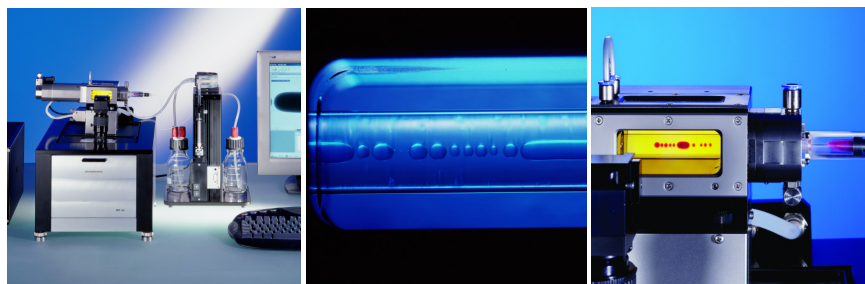


# Operating manual SVT 20

Spinning Drop Tensiometer



## Operating manual Dataphysics SVT 20

Version 2.0, English

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Software-Version from 1.13 Build 13

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# 1 INTRODUCTION

This manual is valid for the spinning drop tensiometer SVT 20.

This manual contains important advises for use of the **SVT 20**. Therefore it must always remain with the unit, especially if this is passed on to a third person!

## 1.1 Compliance

Products tested and found to be in compliance with the requirements defined in the EMC standards defined by 89/336/EEC as well as Low Voltage Directive (LVD) 73/23/EEC can be identified by the CE label on the side of the unit.

For any additional information refer to the Letter of Compliance that shipped with the unit (Declaration of Conformity).

## 1.2 Safety warnings

**Make sure you read and understand all instructions and safety precautions listed in this operating manual before installing or operating your unit.**

If you have any question concerning the operation of your unit or the information in this manual, contact your sales partner for assistance.

- Performance of installation, operation, or maintenance procedures other than those described in this manual may result in hazardous situation and may void the warranty.
- Never operate the unit for any purpose other than described in the operating manual.
- Do not use any accessories other than those supplied or approved by Dataphysics.
- You must not operate the unit if a fault is suspected.
- Ensure that all operators are fully trained in the correct use of this unit and have understood all safety precautions.
- Connect the power supply of the SVT 20 to a socket with protective plug reception only! Use a three-wire power cord. No other way of protective grounding is permitted!
- You must never open the casing of the power supply. The power supply can only be exchanged complete.
- The measuring results do not only depend upon the correct use and functioning of the unit, but may also be influenced by other factors. It is advised therefore, that the measuring results are plausibility tested before consequential actions are taken.

In addition to the warnings listed above, warnings are posted throughout the manual. These warnings are designated by a **STOP** sign and with **text highlighted in bold**. It points out a hazard and calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage of the unit, injury or loss of life. Do not proceed beyond a WARNING sign until indicated conditions are fully understood and met.



The HINT sign points out a remark. It calls attention to any additional information which might be useful for the operator.



### 1.3 Detailed security precautions

**Risk of contusion** – Never bring any body parts between the movable parts of the unit.

**Electrical connections** – The unit must only be used with cables supplied by Dataphysics or our sales partner. All cable connections **must only be closed or opened** when the unit is switched off. Make sure that the voltage of the device corresponds to the power source.

**Unpacking** – Retain all cartons and packing material until the unit is operated and found in good condition. If the unit shows external or internal damage, or does not operate properly, contact the transportation company and file a damage claim. Under ICC (International Chamber of Commerce) regulations, this is your responsibility.

**Lifting and transport** – Great care must be taken when lifting or transporting the unit. Use proper ergonomic techniques and methods of lifting and carrying this unit.

**General** – The unit should not be used in areas with high electromagnetic fields as well as in areas with danger of explosion.

Use only original Dataphysics accessories and spare parts or parts approved from Dataphysics.



**The SVT 20 must never be lifted by the motor, the measuring cell or the lens and camera system!**

## 2 GENERAL DESCRIPTION

### 2.1 Application

The spinning drop video tensiometer SVT 20 is an analytical instrument for the measuring and analysis of surface chemical and rheological quantities according to the Spinning Drop and Oscillating Spinning Drop method.

#### **Measurable quantities:**

- Static and time dependent interfacial tension between two not completely miscible liquids
- Two and three dimensional extensional relaxation of viscoelastic liquids and liquid droplets encapsulated or enclosed in membranes
- Thermal expansion coefficients of liquids

#### **Application:**

- Development of emulsions and micro emulsions, especially to optimize emulsifying agents, emulsion stabilizers and emulsion breakers
- Analysis of adsorption and diffusion processes at liquid/liquid and gas/liquid interfaces
- Measurement of temperature and time dependent material functions in mixing and separation processes
- Development of surfactant formulations for washing and separation processes (e.g. for the tertiary oil mining)
- Determination of the extensional relaxation of viscoelastic liquids, encapsulated drops or membrane covered liquid drops for pharmaceutical and technical applications
- Analysis of reactions on phase boundaries e.g. of ultraviolet radiation induced polymerizations

## 2.2 Features

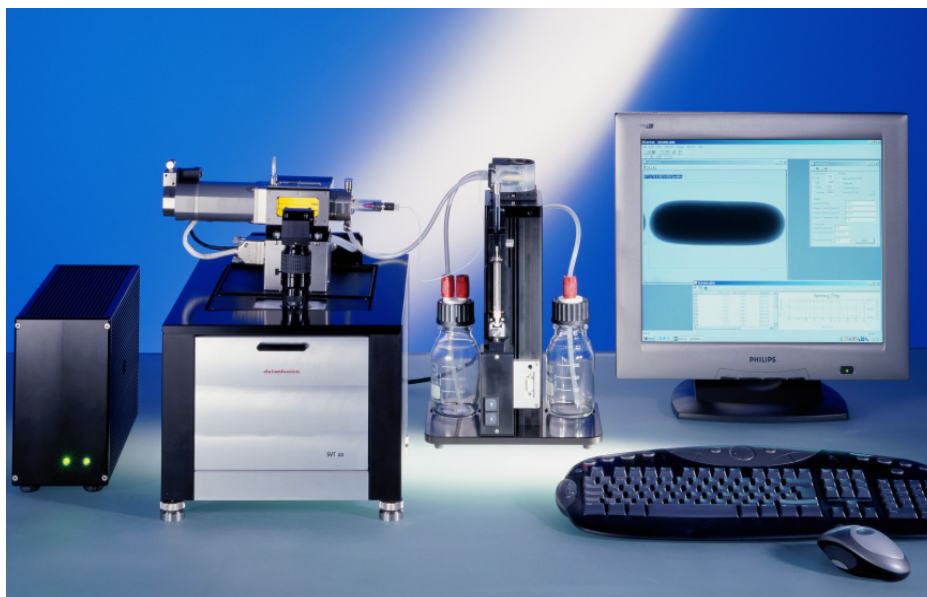


Fig. 1: SVT 20 with LDU / SVT

**The SVT 20 consists of the basic instrument with the following technical features:**

- Capillary system with electronically commutated, highly dynamic and vibration free D.C. motor
- Software controlled speed; the SVT 20 also realizes stepwise and sinusoidal variations of the rotational speed for the measurement of relaxational effects
- Intensity adjustable, permanent LED-lighting with build-in triggering of the video system for the observation of droplets in different orientations relative to the CCD-camera system
- SVT 20 with touch screen for real-time observation of temperature and other variables of state; additional manual control of capillary tilt angle, stroboscopic view angle and intensity of illumination
- Measuring capillaries with a diameter of either 12 or 6.25 mm, made of borosilicate glass; optionally made of fused silica for UV light polymerization experiments (encapsulation) of droplets
- Capillary block with software controlled tilt mechanism
- Automatic, software controlled positioning of the optical zoom lens for an easy centering of the droplet along the optical axis
- High-performance six-fold power zoom lens with an integrated continuous fine focus
- Video system with CCD-camera
- High-performance video digitizing board (frame grabber) for the PC
- Serial RS 232C interface with PC connecting cable, in the SVT 20 with additional interface for the optional liquid dosing unit LDU/SVT and other accessories
- Automatic calibration function for scaling of droplet sizes for the video system

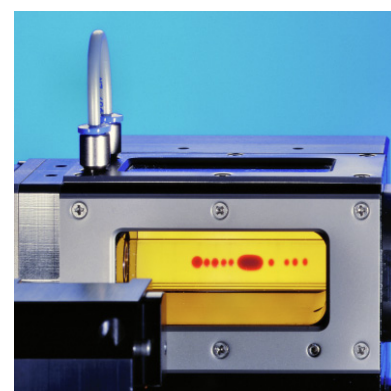


Fig. 2: Liquid drops in the measuring capillary

## 2.3 Software SVTS

### 2.3.1 SVTS 20 IFT

#### Control and calculation software for IFT

For:

- video based measurement and presentation of the time and temperature-dependent interfacial tension
- measurement by spinning drop method
- presentation of measurement values as well as the storage of video sequences for the controlled calculation of fast processes.
- control of rotational speed, the inclination of the tilting base with the measuring cell and camera position
- calculation of interfacial tensions based on spinning drop contours according to various methods including the Young-Laplace method
- automatic calibration of the drop size
- automatic temperature recording
- automatic compensation of temperature dependent changes of densities and refractive index

### 2.3.2 SVTS 21 Oscillation

#### Control and analysis software for oscillation-experiments

For:

- time-dependent control of the rotational speed, the inclination of the tilting base with the measuring cell, and the camera position for observing the drops,
- recording and evaluation of video sequences for analyzing fast relaxational oscillations and elongations of drops
- determination of dilatational interfacial elasticity, yield points, and other rheological parameters of viscoelastic and viscoplastic materials
- Runs only with SVTS 20 IFT



## 3 INSTALLATION AND SETUP

Make sure you have read and understood all instructions and safety precautions listed in this operating manual before installing your unit. The installation should be carried out in the same order as described in the following pages.

### 3.1 General preparations

Please open all packages on the designated openings. Avoid all damages to the packing material.

The SVT 20 is best protected in the original packing!

Find yourself a comfortable working place where you want to set up your SVT 20 system with its peripheral equipment. There should be sufficient room to set up the base unit, the substances to be measured and the peripheral equipment (e.g. printer, computer and thermostat).

For the connection of the SVT 20 power supply to the mains, you need a grounded mains socket with corresponding fuse protection (see technical data). You do require some additional sockets for the connection of the peripheral equipment.

Your working environment and the place where you store your SVT 20 mustn't be extremely hot or extremely cold.

Also, avoid places in which the temperature and the atmospheric moisture greatly fluctuate.

Furthermore, make sure that the SVT 20 is not exposed to

- heavy dirt or dust
- direct sunshine
- objects which emit great heat (e.g. radiators)
- objects with a strong electromagnetic field (e.g. loud speaker, motors,...)
- liquids or corrosive chemicals (except in the measurement devices that are designed for it)

The instrument must be tempered to room temperature before you install and operate it (if it comes out of a cold ambient atmosphere watch out for condensed water).

## 3.2 Checklist of delivered items

Please check that all items of the delivery were unpacked and in good condition.

A standard delivery consists of:



SVT 20 with a build-in liquid thermal chamber (the measuring cell)



power supply with a power cord



connection cable between power supply and SVT



two serial cables to the PC



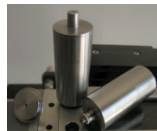
video connection cable



bypass tube with mounted quick couplings and quick couplings for mounting the circulator bath



auxiliary connectors for cleaning the capillary with tube



Two metal funnel tubes with cover lids



bubble level and tools for exchanging the measuring capillary and the shaft sealing rings (open-ended spanner size 7 mm, two lock pins, hexagon screwdriver wrench size 2.5 mm, 2 mm and 1.5 mm, water level)



syringes with 1 ml (10 pieces), 10 ml (5 pieces) and needles (10 pieces)



septa (10 pieces)



silicon oil (100 ml) with a funnel



CD-ROM with software SVTS 20 IFT (control of instrument and measurement)



operating manual

Optional available are:

- software SVTS 21 Oscillation
- liquid dispense unit LDU/SVT
- standard capillary CT-SVT 1200/800
- small capillary CT-SVT 625/245
- easy clean capillary ECC 1200/800
- different types of liquid bath circulators
- PC-system with MICROSOFT Windows XP®

To run the software SVTS your PC must be able to run MICROSOFT Windows XP® without failure. The following specifications are our recommendation for comfortable work with the SVTS:

- Pentium 4 processor with 2.0 GHz or more
- 512 MB RAM or more
- MICROSOFT Windows XP® with Service Pack 3
- 17" color monitor (min 1024 x 768 Pixel)
- Windows conform printer
- Two serial COM ports

## 3.3 Installation of the SVT 20

The Installation of the SVT 20 is described in the chapters below.

### 3.3.1 Leveling the measuring device

The SVT 20 should be always leveled before you start to measure. In the delivery lot you will find a bubble level.

Put the bubble level onto the housing. The leveling could be carried out with the four height adjustable feet.

A proved way to level is to try it with only three feet (without the one in the left front). First turn all feet till the unit is on the lowest height, and then turns the left back foot down about two turns. Level the unit first with the right back foot. Now level it with the right front foot. Finally turn down the left front foot until it touches the base.

### 3.3.2 Mechanical connection

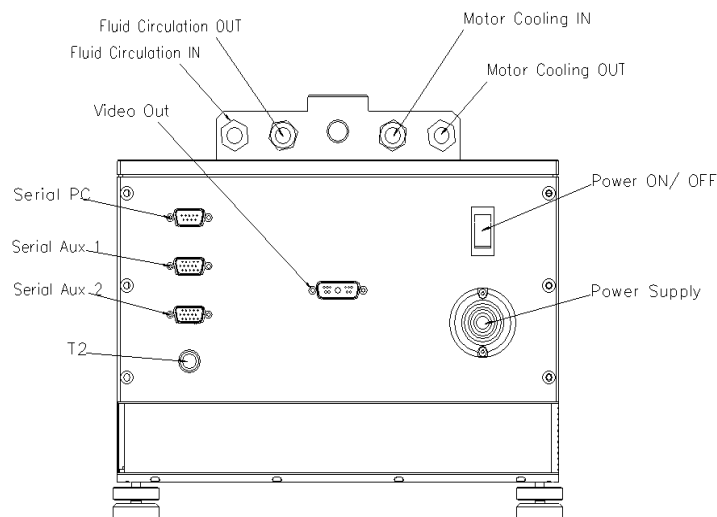


Fig. 3: Rear view of SVT 20

Connect the tubes and cables to the SVT 20. See the rear view for the exact positions.

On the rear of the SVT 20 you can connect a liquid circulator bath to the both sockets **Fluid Circulation IN** and **OUT**. For this you can use the delivered quick couplings.

If you use temperatures over 60 °C you should cool the motor by a second liquid circulator connected to the both sockets **Motor Cooling IN** and **OUT**.

If you use temperatures below 60 °C you can cool the motor with the same circulator by using the delivered bypass tube with mounted quick couplings to connect the socket **Fluid Circulation OUT** to the socket **Motor Cooling IN**.



Fig. 4: Bypass tube with mounted quick couplings and quick couplings for mounting the circulator bath

### 3.3.3 Electrical connection

The SVT 20 uses an external power supply as power source. If the voltage displayed in the small window of the voltage selector on the back of the power supply does not match with your local voltage you must select the correct voltage before you connect the mains cable.

- Ensure that the mains cable is not connected.
- Open the lid of the voltage selector by means of a small screwdriver. This lid also holds the both fuses.
- Take the selector-insert out.
- Turn the voltage selector-insert and put it back in, so that the voltage you need to set is visible.
- Ensure that the fuses are in good condition and in position and close the lid of the voltage selector.
- Connect the power supply cable to the socket **Power Supply** on the back of the SVT 20.
- For the connection of the power supply to the mains, you need a grounded mains socket with corresponding fuse protection.

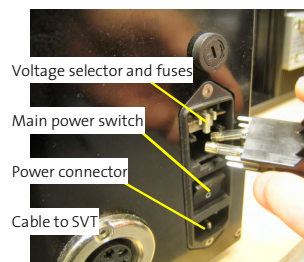


Fig. 5: Rear view of power supply



Fig. 6: Voltage selector-insert



**Ensure that the correct mains voltage is selected at the voltage selector, before connecting the mains cable!**  
**Connect the power supply to a socket with protective plug reception only!**  
**Use a three-wire power cord.**  
**No other way of protective grounding is permitted!**



**All cable connections must only be closed or opened when the unit is switched off.**

- Connect one serial cable from the socket **SERIAL PC** on the SVT 20 to any free serial port on the computer.
- Connect the second serial cable from the socket **SERIAL AUX 1** on the SVT 20 to any free serial port on the computer.
- The socket **SERIAL AUX2** is for the connection of additional units like the liquid dispensing unit LDU/SVT.
- Plug the video cable from the frame grabber board in the computer to the **Video OUT** socket on the SVT 20. With the standard frame grabber use the delivered adapter (BNC to Cinch) and connect the video cable to the **Composite Video 0**.
- The socket **T2** is for the connection of a secondary PT 100 temperature probe.

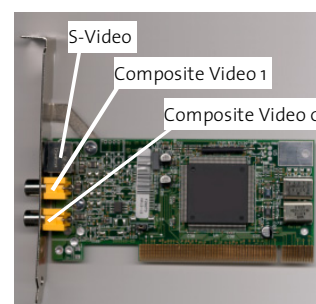


Fig. 7: Connectors on the standard frame grabber board

### 3.3.4 Removal and mounting of Standard Capillary (CT-SVT)

For the SVT 20 there are two different standard measuring capillaries available. The mounting and removal of both will be carried out in the same way.

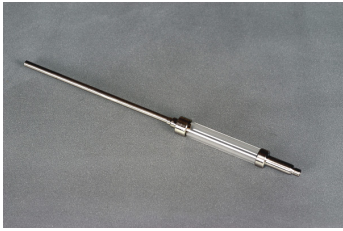


Fig. 8: Measuring capillary CT-SVT 1200/800

**CT-SVT 1200/800** Ready to use measuring **capillary tube** assembly

Made of Borosilicate glass

- Outer diameter: 12.00 mm
- Inner diameter: 8.00 mm
- Length: 229 mm
- Visible length: 54 mm
- Temperature range: up to 130 °C



Fig. 9: Measuring capillary CT-SVT 625/245

**CT-SVT 625/245** Ready to use measuring **capillary tube** assembly

Made of Borosilicate glass

- Outer diameter: 6.25 mm
- Inner diameter: 2.45 mm
- Length: 229 mm
- Visible length: 61 mm
- Temperature range: up to 130 °C

The CT-SVT will be sealed on both sides by a septum. The septum must be inserted into the corresponding holder.

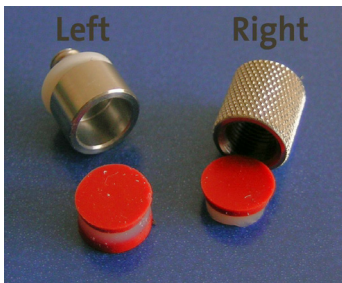


Fig. 10: Septa and holder for left and right side of capillary



**Before you can remove a build-in capillary you must drain the measuring cell.**

**Required tools for exchanging a capillary:**

- ✦ Hexagon screwdriver wrench size 1.5 mm
- ✦ Open-ended spanner size 7 mm
- ✦ Two lock pins

**Carry out the following procedure to remove a CT-SVT from the measuring cell.**

- Drain the measuring cell (*see chapter 3.3.6 Draining of the measuring cell page 16*)
- Take off the plastic protection covers from both side of the cell.
- Screw off the holder for the septa from both side of the CT-SVT.
- Take out the shaft sealing ring from the right side of the cell.

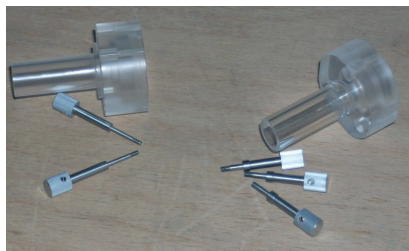


Fig. 11: Protection covers for left and right side

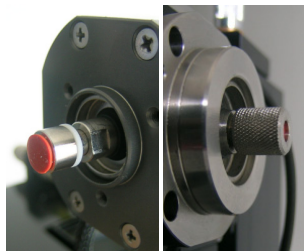


Fig. 12: Septa holder left and right

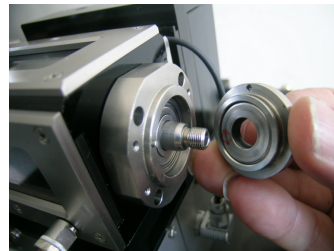


Fig. 13: Shaft Sealing ring right side

- Insert the both lock pins into the holes beside the funnels; if they do not get in smoothly you must turn the CT-SVT until the pins will slip in by oneself.
- Loosen the CT-SVT by turning the spanner (open-ended spanner size 7 mm) anti-clockwise about **one turn**.
- Unscrew the four screws of the right bearing (Hexagon screwdriver size 1.5 mm).
- Remove the right bearing flange carefully without bending the CT-SVT.



Fig. 14: Lock pins

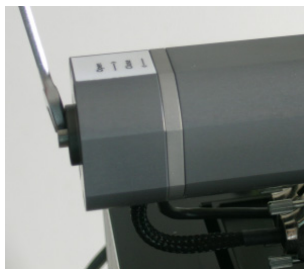


Fig. 15: Loosening CT-SVT

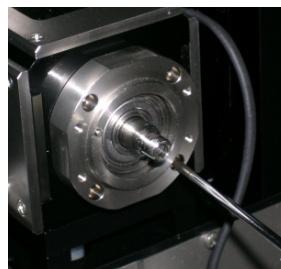


Fig. 16: Right bearing flange

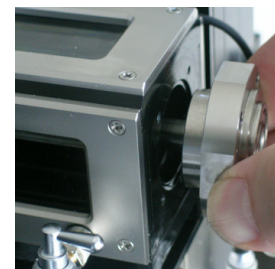


Fig. 17: Remove bearing flange

- Push on the CT-SVT at the left side (motor housing) and pull out the CT-SVT carefully (avoid any cross forces) from the right side. Please handle the CT-SVT very carefully and bear in mind that it can be very lubricious (from the silicone oil which was in the cell).

**Please fasten the four screws of the bearing flange crosswise!**



**Be sure that both lock pins are removed, the CT-SVT is clamped taut and can rotate smoothly before you reconnect the power source.**

**The SVT 20 mustn't be operated if the CT-SVT is clamped!**

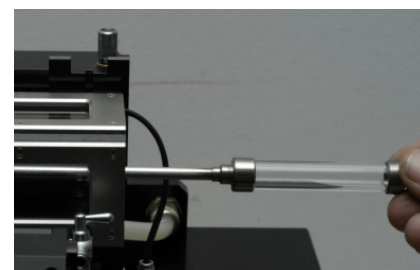


Fig. 18: Removal/insertion of CT-SVT

**For mounting the CT-SVT follow the procedure above in reverse order.**

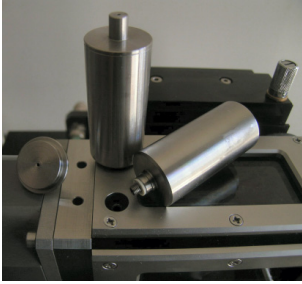


Fig. 19: Mounting of metal funnels



Fig. 20: Filling of the measuring cell

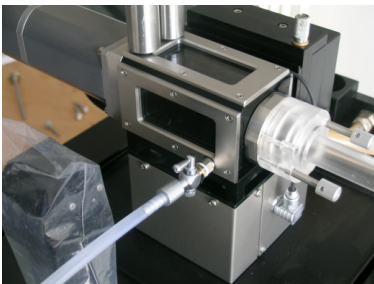


Fig. 21: SVT 20 with draining tube

### 3.3.5 Preparing and filling of the measuring cell

Before you start to measure with the SVT 20 you have to install a measuring capillary into the measuring cell (see chapter 3.3.4 Removal and mounting of Standard Capillary (CT-SVT) page 14). A measuring capillary is already installed and ready to use at delivery state. You must only fill the measuring cell with the delivered silicone oil.

- Be sure the drain valve (stopcock) is closed.
- Put a cover (i.e. a plastic bag) over the zoom lens to protect it from splattering oil.
- Screw in both metal funnel tubes on top of the cell; they are used to fill in the silicone oil and as expansion reservoirs.
- Tilt the platform completely to the right side (let the air bubbles get out easier).
- Fill in the silicone oil into one of the tubes until the cell is filled completely and the oil in the second tube (overflow funnel) increases about 2 mm.



**Please fill the chamber very slowly and carefully.**

- The cell must be filled completely with oil without any air bubbles (pump oil with the aid of your thumb from one funnel to the other).
- Put the top lids onto the tubes.
- Screw on the plastic protection covers onto both sides of the cell.

### 3.3.6 Draining of the measuring cell

The draining of the measuring cell is necessary before you can change the capillary or replace the shaft sealing rings.

**Required tool for draining the measuring cell:**

- ✂ Draining tube with LuerLock connector

Carry out the following procedure to drain the measuring cell:

- Switch off the power supply and unplug the mains cable.
- Put a cover (i.e. a plastic bag) over the zoom lens to protect it from splattering oil.
- Connect one side of the draining tube to the stopcock (LuerLock connection) and the other side into an adequate waste bottle.
- Open the stopcock and remove the lids from the fill in funnels.
- To improve the draining of the silicone oil you can tilt the cell to the right side.



### 3.3.7 Removal and mounting of Easy Clean Capillary (ECC)

The ECC will be sealed on the right side by a septum. The septum must be inserted into the holder.



**Before you can remove a build-in capillary you must drain the measuring cell**

#### Required tools for exchanging an ECC:

- ✂ Hexagon screwdriver wrench size 1,5 mm
- ✂ Open-ended spanner size 7 mm
- ✂ Two lock pins
- ✂ Adjustment tool

#### Carry out the following procedure to remove the ECC from the measuring cell.

- Drain the measuring cell (*see chapter 3.3.6 Draining of the measuring cell page 16*)
- Take off the plastic protection covers from both sides of the cell.
- Screw off the holder for the septa from the right side of the capillary.
- Take out the shaft sealing ring from the right side of the cell.

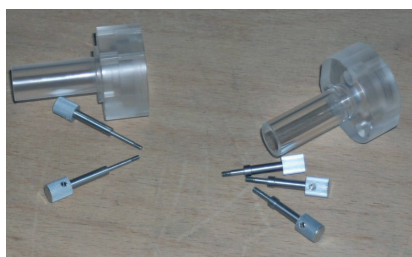


Fig. 24: Protection covers for left and right side



Fig. 25: Septa holder

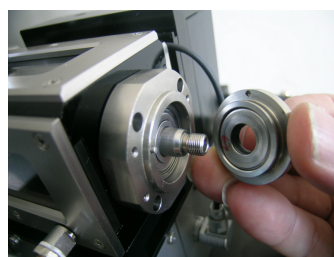


Fig. 26: Sealing ring right side

- Insert the both lock pins into the holes beside the funnels; if they do not get in smoothly you must turn the ECC until the pins will slip in by oneself.
- Loosen the ECC by turning the spanner (open-ended spanner size 7 mm) anti-clockwise about **one turn**.
- Unscrew the four screws of the right bearing (Hexagon screwdriver size 1.5 mm).
- Remove the right bearing carefully without bending the ECC.

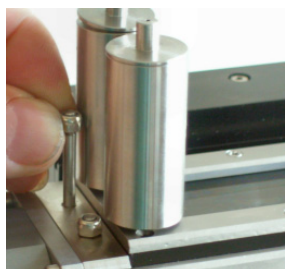


Fig. 27: Lock pins

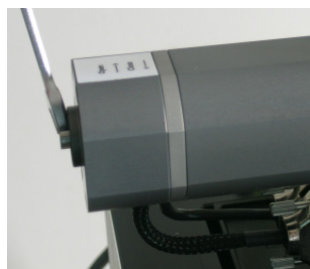


Fig. 28: Loosening ECC

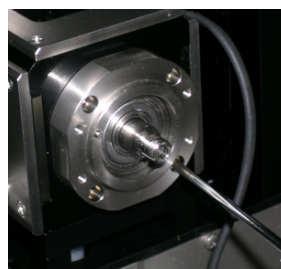


Fig. 29: Screw off right bearing

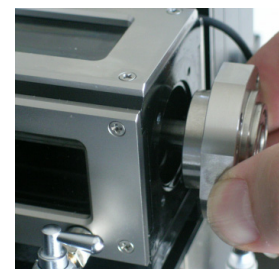


Fig. 30: Remove right bearing



Fig. 22: Easy clean capillary ECC 1200/800



Fig. 23: ECC adjustment tool

- Push on the ECC from the left side (motor housing) by means of the adjustment tool and pull out the ECC carefully (avoid any cross forces) from the right side. Please handle the ECC very carefully and bear in mind that it can be very lubricious (from the silicone oil which was in the cell).

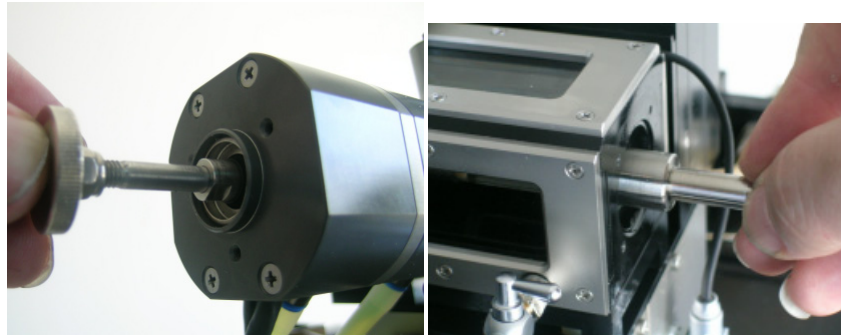


Fig. 31: Removal of ECC



Fig. 32: Adjustment tool for ECC

**Carry out the following procedure to insert the ECC to the measuring cell.**

- Insert the ECC carefully into the measuring cell up to the end stop.
- Mount the bearing flange without canting it.
- Fasten the four screws of the bearing flange crosswise.
- Push in the adjustment tool from the left side. This will displace the ECC about 0.5 mm apart from the limit stop.
- Fasten the ECC with the open-ended spanner size 7 mm.
- Remove the lock pins.
- Insert the shaft sealing ring. Pay attention that the alignment pin on the bearing flange fits into the corresponding hole at the sealing ring.
- Insert a septum into the holder and mount the septa holder on the right side of the ECC.
- Mount the plastic protection covers to both sides of the cells.

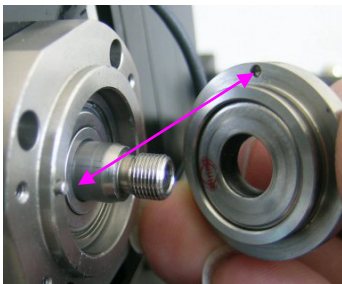


Fig. 33: Alignment pin



**Be sure that both lock pins are removed, the ECC is clamped taut and can rotate smoothly before you reconnect the power source.**

**The SVT 20 mustn't be operated if the ECC is clamped!**

## 3.4 PC setup

Information for the setup of your computer system and MICROSOFT Windows XP® you can take out of the particular documentation delivered with your computer system.

The PC must be compliant to the EN60950. The PC needs two free serial ports and minimum one free PCI slot.

### 3.4.1 Installation of frame grabber

The video camera of the SVT 20 must be connected to a so-called frame grabber board.

Your PCI system BIOS must be compatible with the **PCI 2.1 specification** and be able to recognize a PCI-to-PCI bridge configuration and initialize the VGA display controller residing on the other side of the PCI bridge. The standard frame grabber needs an additional graphic board. The graphic boards must be compatible with MICROSOFT Windows XP®.

- Ensure that the relative humidity of your work area is at least 50%
- Remove the power cable and other connection cables from the computer
- Unscrew and remove the cover of the PC housing



**Discharge possible static electric from yourself  
by touching the power supply housing.**

- Insert the frame grabber board into an empty PCI slot and screw the bracket tight.
- Replace the cover on the PC housing and screw it tight
- Now the connection cables and the power cable can be re-plugged into the computer
- At the first start of Windows XP® the new hardware (the frame grabber) will be detected automatically. The Required driver can be found on the SVTS CD.

## 3.5 Software setup

### 3.5.1 General

The SVTS software is developed as a 32-bit application for MICROSOFT Windows XP®.

MICROSOFT Windows XP® should be already installed and must work on your computer before you can install the SVTS. You need **Administrator rights** to install any software; to execute the SVTS it is sufficient to have **Power user rights** on your local PC.

### 3.5.2 First setup of SVTS software

- Put the SVTS CD into your CD-ROM drive.
- If the **SVTS Setup** menu does not start automatically execute the file **SetupMenu.exe** onto your SVTS CD.
- First have a look to the **READ ME** file for latest information about the setup procedure.

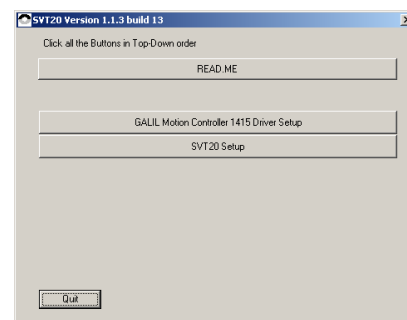


Fig. 34: Setup-Menu

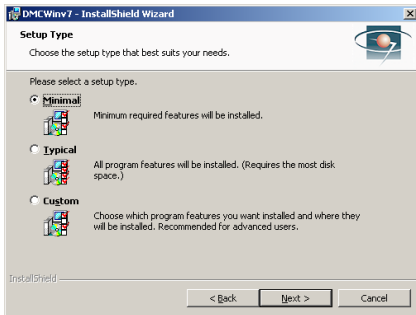
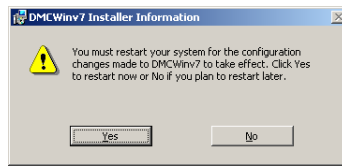


Fig. 35: Setup type of GALIL motion controller

- Execute the **GALIL Motion Controller Setup**. Please select the setup type **Minimal** and restart your computer when you will be prompted at the end of the installation.



- Execute the **Setup SVTS** after the restart of the PC and follow the advices on the screen. You have to accept the **license agreement** before the setup can be continued.
- When prompted for the **User Information** please enter the correct **Full Name** and **Organization** into the corresponding text boxes, if they are not already filled by the operating system.
- If more than one person should use the program we recommend selecting **Anyone who uses this computer** and not **Only for me**.
- The **software key** that you have to enter can be found onto the CD-ROM and on the CD inlay or cover.
- You can select the **Destination folder**. We recommend using the default folder **C:\Program files\Dataphysics\**. With Browse you can select another folder.



Fig. 36: Setup for GALIL motion controller

At the first start of the software the GALIL motion controller must be initialized. Open the SVTS software in service mode (not on desktop; use **Start—program files—dataphysics—SVT2o\_service**). Click to the menu **Service—SubSystems—Rotational Term**. After click to **New Controller** add a new controller entry by selecting the **DMC-1415**. Select the entered controller DMC-1415 and click to **Properties**. Select the connected **Comm-Port** (the one you connected at the PC from Serial Aux 1) and the **Comm Speed** 19200 .

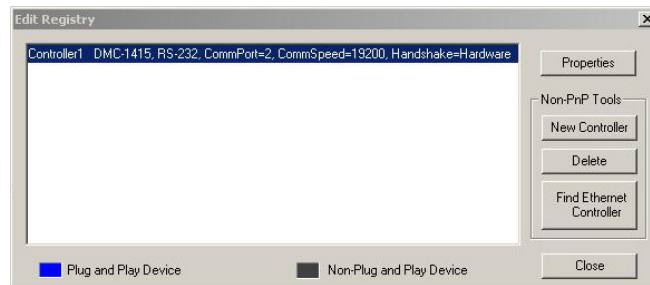


Fig. 37 Dialog GALIL motion controller setup

### 3.5.3 Remove and Update of the SVTS software

Before you can update the SVTS you have to remove the present version of the SVTS.

- Insert the update SVTS CD in your CD- or DVD-drive.
- If the **SVTS Setup** does not start automatically execute the file **SetupMenu.exe** onto the SVTS CD.
- First have a look to the **READ ME** file for latest information about the setup procedure.
- Execute the **Setup SVTS** and follow the advices on the screen. Confirm **uninstall SVTS from this computer** to remove the present SVTS version.
- Now execute again the **Setup SVTS** to install the new SVTS software.

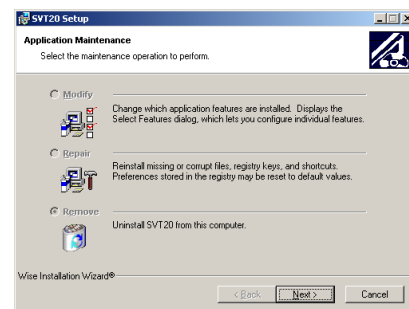


Fig. 38: Remove of SVTS

## 4 OPERATIONAL INSTRUCTIONS

### 4.1 Touch panel

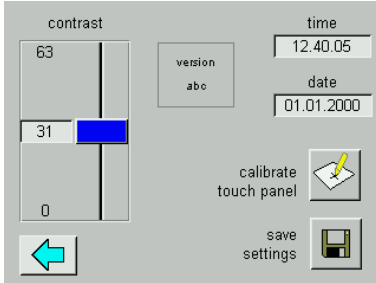




Fig. 39: Touch panel settings

The SVT 20 is equipped with a touch panel. You can fold out the touch panel at the front of the SVT 20. To use the touch panel you need only your finger; tip on the symbols or hold the finger on a symbol and drag by moving your fingertip.

The touch panel has two main functions:

**settings touch panel**  In this dialog you can calibrate the touch panel, set the contrast of the display, and set the time and date.

**quick adjustment menu**  This dialog is a tabbed dialog, this means that the content differs depending on the selected tab.

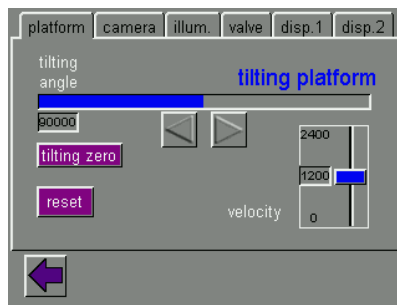




Fig. 40: Touch panel dialog platform

Dialog **platform**:

Press and hold the button  or  to tilt the platform. The tilting speed can be set with the blue slider **velocity**. The button **tilting zero** will set the platform horizontal. The button **reset** will perform a reference run.

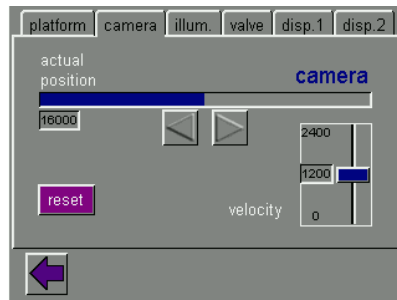




Fig. 41: Touch panel dialog camera

Dialog **camera**:

Press and hold the button  or  to move the camera left or right. The speed of the camera movement can be set with the blue slider **velocity**. The button **reset** will perform a reference run.

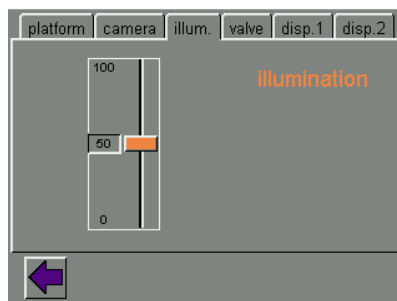


Fig. 42: Touch panel dialog illumination

Dialog **illum.:**

The intensity of the backlight can be set with the orange slider.

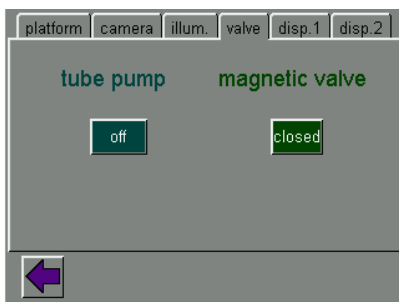


Fig. 43: Touch panel dialog valve

Dialog **valve**:

To switch the **tube pump** between **off** and **on** and the **valve** between **open** and **closed**.

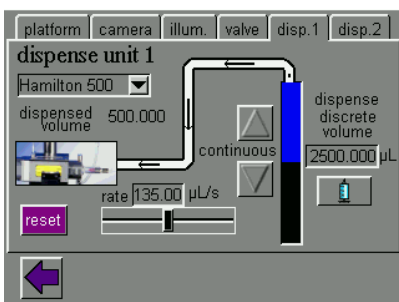


Fig. 44: Touch panel dialog dispense 1

Dialog **disp. 1** and **disp 2**:

Dialogs for controlling the dosing units 1 and 2 installed at the LDU/SVT. The dialog is only available when a LDU/ SVT is present.

Press **Hamilton 500** to select the installed syringe type.

Press and hold the button or for continuous dosing.

The dosing rate can be set with the black slider **rate**.

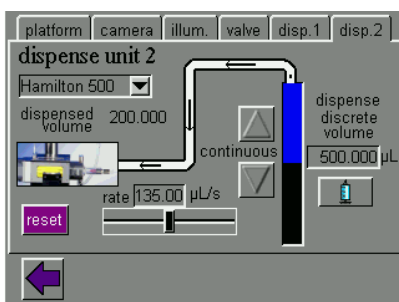


Fig. 45: Touch panel dialog dispense 2

Press the **2500.000 µL** field to open the **Popup Keyboard**, where you can enter the value. The button **reset** will perform a reference run. The button will dose the discrete volume.

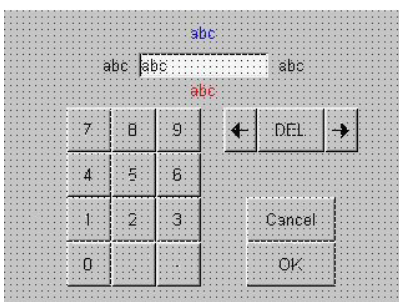


Fig. 46: Touch panel dialog platform

Popup **Keyboard**:

For entering numerical values.

















## 4.2 Software

### 4.2.1 Icons











Fig. 47: Icons — SVTS software

The icons in the main window of the SVTS have the following meaning and function:






	New (Ctrl+N)	Opens the dialog for creating a new single measurement window
	New Result Window	Opens a new result window directly
	Open (Ctrl+O)	Opens a stored file
	Save (Ctrl+S)	Store the actual file. If it was not stored before you will be asked to enter a filename
	Cut (Ctrl+X)	Cut the selection and put it on the clipboard
	Copy (Ctrl+C)	Copy the selection and put it on the clipboard
	Paste (Ctrl+V)	Insert clipboard content
	Print	Print the active document
	About	Display program information, version numbers and copyright
	Calibrate	Calibrates the image size by use of a known diameter (e.g. a needle)
	Single measurement	Manual or automatic measurement of a single drop
	Timed measurement	Measurement in pre-defined intervals
	Extract Profile	Extracts the profile of the actual drop
	Settings image processing	Opens the dialog <b>Preferences — Imageprocessing</b>
	Settings Dropwindow	Opens the dialog <b>Preferences — Drop Window</b>
	Device Control	Opens the dialog <b>Device Control</b>



The icons in the drop image window of the SVTS have the following meaning and function:

	Resize Window	Resizes the drop image window to the size of the image from the camera
	Framegrabber Settings	Opens the dialog <b>Framegrabber Preferences</b>
	reset clock	Set the drop timer to zero (only in live image mode)
	Live image start/stop	Starts or stops the image grabbing
	create snapshot	Creates a snapshot in a new window
	New Sequence	Opens the window <b>New Sequence</b> to record a movie
	Calibrate by camera movement	Opens the dialog <b>Dynamic Calibration</b> to calibrate the image size by movement of the camera
	Hold Drop	Holds the actual founded drop inside the viewable area

The icons in the result window of the SVTS have the following meaning and function:

	Define as active	Defines the actual result window as the active one (where all the data were written to); is active when table part of the result window is selected
	Always Update	Toggles between automatic update of the graph and the rows or no automatic update; is active when table part of the result window is selected
	Update Now	Updates the graph and the rows in the result window once per click when the automatic update is switched off; is active when table part of the result window is selected
	Always Update graph	Toggles between automatic update or no update; is active when graphic part of the result window is selected
	Enable graph	Switch graphic display on or off; is active when graphic part of the result window is selected

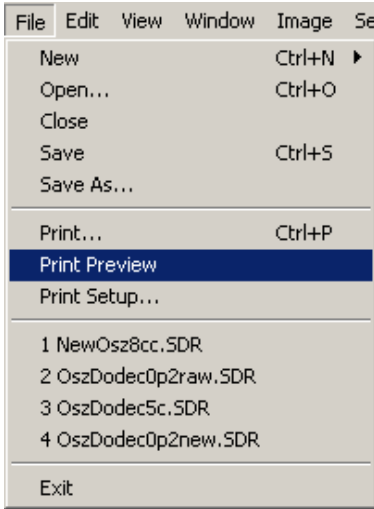


Fig. 48: Menu - File

## 4.2.2 Menus

The appearance of the menu bar depends on the active window.

The Menu **File** is made up of

- **New** – Opens a new **result** or **movie** window if an image window is already open. If no image window is open you have no choice but a new image window will be opened.
- **Open...** – Opens a stored result file **\*.sdr**
- **Close** – Closes the actual window
- **Save...** – Stores the actual active result file (the **Save As...** dialog opens if the file is not stored before)
- **Save As...** – Opens the file save dialog to store the actual active result file under a definable name and into a selectable folder
- **Print...** – Prints the data and graph of the active result file
- **Print Preview** – Prints the data and/or graph of the active result file on the screen
- **Print Setup** – Settings for the printer
- **1-x** – Here you can select one of the last four result files
- **Exit** – Shutdowns the SVTS

The Menu **Edit** is made up of:

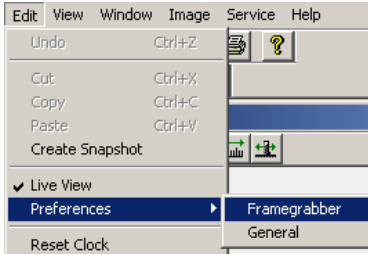


Fig. 49: Menu - Edit

- **Undo** – Cancels the last command (Not implemented yet)
- **Cut** - Cuts the marked data and copies them into the clipboard
- **Copy** - Copies the marked data into the clipboard
- **Paste** - Pastes the data from the clipboard
- **Create Snapshot** - Pastes the data from the clipboard
- **Live View** - Starts or stops the image grabbing
- **Preferences** ► - Opens the framegrabber preferences or the general preferences
- **Reset Clock** – Sets the drop timer in the live image window to zero

The Menu **View** is made up of:

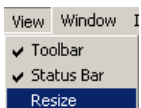


Fig. 50: Menu - View

- **Toolbar** – Switches the toolbar (icons) in the result window on or off
- **Status Bar** - Switches the status bar (information bar in main window) on or off
- **Resize** - Resizes the drop image window to the size of the image from the camera; only active in image window

The Menu **Window** is made up of:

- **New Window** – Opens a new instance of the image window
- **Cascade** - Lays all open windows one on top of the other
- **Tile** - Lays all open windows next to each other
- **Arrange Icons** – Orders all open window to your selection (Cascade, ...)
- **Device Control** – Opens the dialog **Device Control**
- **1-x** – Here you can select one of all open windows; the active is marked with a check

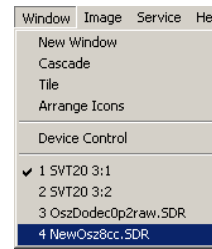


Fig. 51: Menu - Window

The Menu **Image** is made up of:

- **Calibrate** – For calibration of the image window by use of a needle with a known size in the capillary
- **Extract Profile** - Extracts the profile of the actual drop
- **Single Measurement** - Calculates the IFT once
- **Tracking** – Calculates the IFT as fast as possible
- **Hold Drop** – Holds the actual founded drop inside the viewable area
- **Dynamic Calibration** –Calibrates Automatically the image window by camera movement

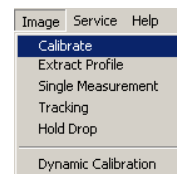


Fig. 52: Menu - Image

The Menu **Service** is made up of:

- **SubSystems** ► – Starts the reference run for the camera or for the tilting table
- **Set communication parameter** – Settings for the serial connection
- **Reconnect** – Restarts the communication with the PC

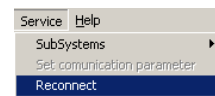


Fig. 53: Menu - Service

The Menu **Help** contains the version information's, the customer information, the Master ID, and the installed modules.

### 4.2.3 Preferences of SVTS

Before you start the **first** measurement check the preferences described in this chapter.

The **Preferences** are divided into two main blocks:

- **Framegrabber** – Settings for the used frame grabber.
- **General** – Preferences of the SVTS software.



Fig. 54: Dialog Preferences

### 4.2.3.1 Framegrabber Preferences

The dialog **Framegrabber Preferences** is structured into four tabbed dialogs. If you do any changes to the pre-defined values and settings you must click to the **Apply** button to accept the changes (it is not enough to click to OK). It is not recommended to change any of the values and settings in these four tabbed dialogs.

**Camera** – In this tabbed dialog you can enter the camera dependent parameters.

**Format** – This dialog area contains the following buttons:

**PAL (CCIR)** – European video norm. This is the video norm of the standard SVT 20 camera.

**NTSC (RS170)** – American video norm. SVT 20 video cameras according to this norm are only available on special request.

**SECAM** – French video norm. SVT 20 video cameras according to this norm are not available.

**AutoDetection** – Click this button to automatically detect the video norm of the build in SVT 20 camera.

**Input Channel** – In this dialog you select on which input channel the SVT 20 is connected to.

Just select to which connector on the frame grabber (in your PC) you have connected the video cable from the SVT; to  **Composite 1** (this is the standard input channel for the SVT 20 camera) or to  **Composite 2**. The input channel  **S-Video** will normally not be used for connecting the SVT 20 camera.

**Sync. level** – In this dialog you can select the synchronization level of the used camera.

Just select between  **75 mV** and  **125 mV** (this is the default value for the SVT 20 camera). The 75 mV is for video signals with poor synchronization.

**Acquisition offset** – In this dialog area you can set the offset for the image acquisition synchronization.

**Horizontal** – To change the horizontal offset for the image synchronization you can enter a value in the edit field or use the   buttons to increase or decrease the value.

**Vertical** – To change the vertical offset for the image synchronization you can enter a value in the edit field or use the   buttons to increase or decrease the value.

**Reset** – Click this button to reset to the default values.

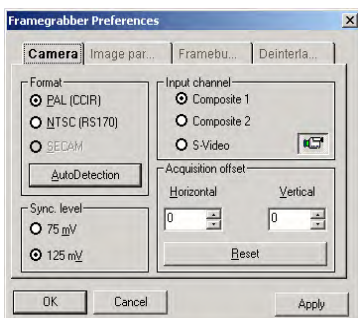


Fig. 55: Tabbed dialog Camera

**Image Par...** – In this tabbed dialog you can change the image parameter.

**Brightness** – To change the value for the brightness you can move the slider left (increase) or right (decrease). The default value for the brightness is 100.

**Contrast** – To change the value for the contrast you can move the slider left (increase) or right (decrease). The default value for the contrast is 216.

**Saturation(U)** – To change the value for the saturation<sup>1</sup> (U) you can move the slider left (increase) or right (decrease). The default value for the saturation is 254. This is only reasonable for color cameras.

**Saturation(V)** – To change the value for the saturation (V) you can move the slider left (increase) or right (decrease). The default value for the saturation (V) is 180. This is only reasonable for color cameras.

**Hue** – To change the value for the hue<sup>2</sup> you can move the slider left (increase) or right (decrease). The default value for the hue is 128. This is only reasonable for color cameras.

**Default** – Click this button to reset to the default values.

**Combine U/V** – Activate this check box to adjust the both saturation sliders simultaneously. This is only reasonable for color cameras.

**Adaptive AGC** – Activate this check box to activate the automatic gain control, which means the frame grabber will control the brightness automatically.

**Color bars** – Activate this check box to show a color bar pattern in the image window. This can be used to check the frame grabber.

**Gamma correction** – Activate this check box to compensate the color differences between the image from the camera and the image which is actually displayed. This is only reasonable for color cameras.

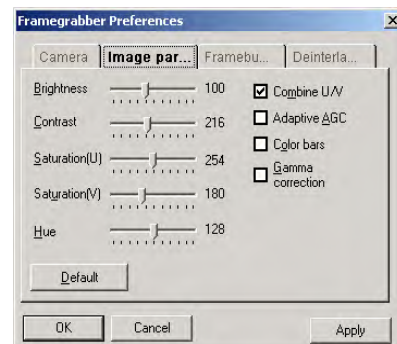


Fig. 56: Tabbed dialog Image par...

**Framebu...** – In this tabbed dialog you can change the size of the frame buffer.

All the images coming from the camera (so called frames) will be stored in a frame buffer, designed as a ring (or circular) buffer. On slow computer systems a bigger frame buffer size increases the number of images that can be stored by the movie functions.

The default value for the **Frame buffer size** is **25** frames.

You can select whether you want define the buffer size in frames  **frames** or in bytes  **bytes**.

A click to the button **reserve maximum** will set the buffer to the maximum number of frames.

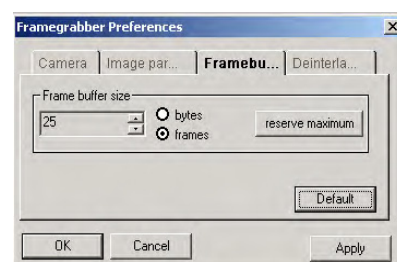


Fig. 57: Tabbed dialog Framebu...

<sup>1</sup> The saturation of a color is determined by a combination of light intensity and how much it is distributed across the spectrum of different wavelengths.

<sup>2</sup> A hue refers to the gradation of color within the optical spectrum.



Fig. 58: Tabbed dialog Camera

**Deinterla...** – In this tabbed dialog you can select interlaced and non-interlaced camera mode.

Ⓐ **none (25 fps – full image information)** – This is the default setting. It gives better images which are more valuable. The frame grabber will send to the software every even and odd half line (with pixels) from the camera. All even and odd lines together will give a **full image**.

Ⓑ **progressive scan (50 fps – half image information)** – This setting is only recommended to use if you need more images per second. From the frame grabber only the even lines will be read (which is double the fast than to read all lines). To display a complete image the software interpolates the 'missing' lines.

### 4.2.3.2 General preferences

Fill out all the parameters in the Preferences and the parameters in the **SVT2o 1** window.

The preferences are structured in the tabbed dialogs:

- + ... **Results**
- + ... **Graph**
- + ... **Imageprocessing**
- + ... **Drop Window**
- + ... **Devices**

The left part of this edit control is similar to the directory structure of the windows explorer. A click to the **+** icon opens the particular tree. You can select a tabbed dialog in this tree or in the right part of this control dialog by use of the tabs.

Please note that changes in the preferences will not change the view at an actual measurement, only for a new window. To change the view in actual windows use the dialogs with the right mouse button in the same way.

The **Result** dialog is structured into the following tabbed dialogs:

**Text Defaults** – In this tabbed dialog you can enter the default entries of the text fields for new result windows, like title, test name, sample name, device used, customers name, operator name and the footer.

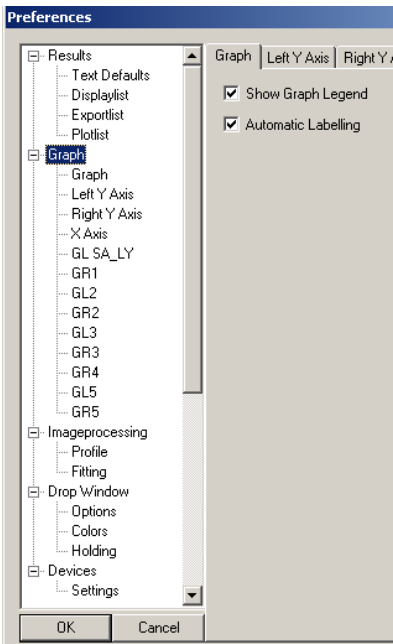


Fig. 59: Dialog Preferences

**Displaylist** – In this tabbed dialog you can select the parameters which will be displayed in the table field of the result window.

Only the items in the **Display Items** box will be shown in the table field of the result window.

**==>** Copy the marked item to the **Display Items** box. You can mark different items by holding the <Ctrl> button when click to the next item, or you can mark a row of items by click to the first item of the row and holding the <Shift> button when click to the last item of the row.

**<==** Deletes the marked item from the **Display Items** box. You can mark and delete only one item each.

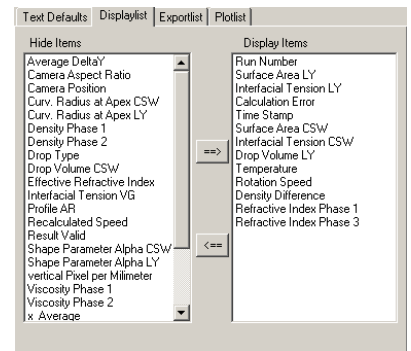


Fig. 60: Preferences – Result – Displaylist

**Exportlist** – This tabbed dialog is not yet implemented.

**Plotlist** – In this tabbed dialog you can select the curves which will be displayed in the graph curve of the result window.

Only the items in the **Plot Items Left** box, the **Plot Items Right** box, and the **X-Axis** box will be shown in the graph field of the result window.

**==>** Copy the marked item to the **Plot Items Left** box the **Plot Items Right** box, or the **X-Axis** box. You can mark different items by holding the <Ctrl> button when click to the next item, or you can mark a row of items by click to the first item of the row and holding the <Shift> button when click to the last item of the row. You can add only one item to the **X-Axis** box.

**<==** Deletes the marked item from the **Plot Items Left** box or the **Plot Items Right** box. You can mark and delete only one item each. From the **X-Axis** box the item cannot be deleted.

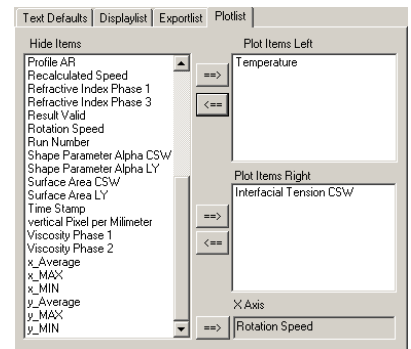


Fig. 61: Preferences – Result –Plotlist

The **Graph** dialog is structured into the following tabbed dialogs:

**Graph** – In this tabbed dialog you can select

**Show Graph Legend** Select to enable the legend of the graph.

**Automatic Labeling** Select to enable automatic labeling according to the **Plotlist**.

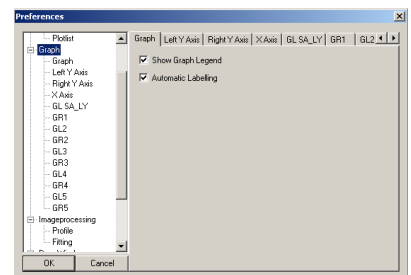


Fig. 62: Dialog Preferences – Graph

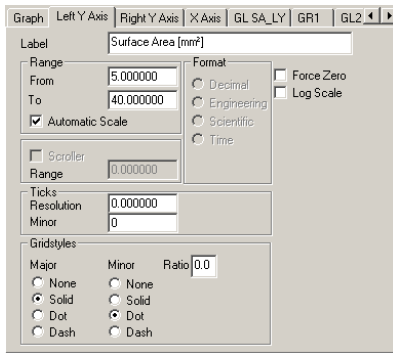


Fig. 63: Preferences – Graph – Y Axis

**Left/Right Y Axis** – In this tabbed dialog you can define the presentation parameters for the left or the right Y axis.

You can define the **Label**, the scaling (in **Range**), the **Ticks**, the **Scroller**, and the **Gridstyles**.

**Force Zero** activate to set the origin of the axis to zero.

**Log Scale** activate for logarithmic scaling of the axis.

**X Axis** – In this tabbed dialog you can define the presentation parameters for X axis.

You can define the **Label**, the scaling (in **Range**), the **Ticks**, the **Scroller**, and the **Gridstyles**.

**Force Zero** activate to set the origin of the axis to zero.

**Log Scale** activate for logarithmic scaling of the axis

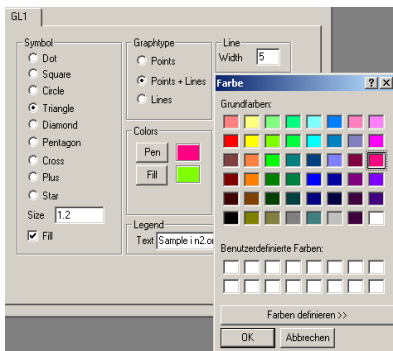


Fig. 64: Preferences – Graph – GL1

**GLxx or GRxx** – In this tabbed dialog you can define the format parameters for the result points inside the graph in the data rows **GL1**, **GR1**, ... **GR5**.

You can define the **Symbol** (the form of the points), the **Graphtype**, the **Line Width**, and the line (**Pen**) and symbol (**Fill**) **Color** and the **Legend** text.

A click to the **Pen** or **Fill** button opens the (standard windows) dialog **Colors** to select the corresponding colors.

The **Imageprocessing** dialog is structured into the following tabbed dialogs:

**Profile** – In this tabbed dialog you can define the parameters for the profile finding and extraction.

**Range for** – this dialog area contains the following edit fields (field to enter a value):

**Initial search** - Maximum distance of left/right drop apex to left/right bonding line in pixel (the default value is 600 pixel).

Only for the measuring mode full drop (  Full  ).

**Track Search** - Maximum distance between profile neighbor points in high contrast regions (the default value is 5)

**Recover Search**- Maximum distance between profile neighbor points in low contrast regions (the default value is 20)

The unnamed dialog area contains the following edit fields (field to enter a value) and check boxes (control to activate  or deactivate  a function):

**Threshold Edge Filter** –With this you define the difference in brightness two neighboring pixels must have to detect an edge (white=255 and black=0). The standard value is 100 and should only be changed when the image is not sharp enough.

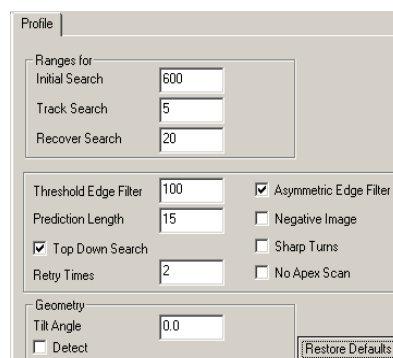


Fig. 65: Preferences – Imageprocessing – Profile



**Prediction Length** - The algorithm estimates the current slope by a weighted average over the last points (choose lower values for poor shaped drops; the default value is 15 pixel)

**Top Down Search** – Searching for the drop in top down direction

**Retry Times** - Number of images used to extract a valid profile (default 2)

**Asymmetric Edge Filter** - With this you define the way the difference in brightness two neighboring pixels must have to detect an edge. Activate this if you encounter problems in profile finding (e.g. when a satellite droplet nearly touches the drop).

**Negative Image** - Changes the contrast from white->black and black -> white.

**Sharp Turns** - Allow irregularities in drop profile. Activate this to allow the profile path finder to follow a knick (sharp angle) in the curve.

**No Apex Scan** - The drop is assumed to be in the middle of the bounding box. Only works on full drops. This is sometimes useful when more than one drop is visible in image window.

**Geometry** – this dialog area contains the following edit field and check box:

**Tilt Angle** - Value of the tilt angle between camera and measuring system, when all is reset.

**Detect** – Detects the tilt angle between camera and measuring system automatically

**Restore Defaults** – Click this button to restore the default values for this dialog.

**Fitting** – In this tabbed dialog you can define the parameters for the profile fitting.

**Number of Profile Points** – This dialog area contains the following edit field (field to enter a value):

**All (up to 4000 points)** - Activate this check box for the maximum number of profile points (the more point the longer time to calculate results).

**Number of profile points** - Set the number of profile points for LY fit (default value is 50 points).

**Calculate total aspect ratio** - Activate this check box to calculate the aspect ratio of the optical system automatically.

**Fitting error limit** - If the fitting error is higher than this limit, the result will not be transferred into the result window.

**Restore Defaults** – Click this button to restore the default values for this dialog.

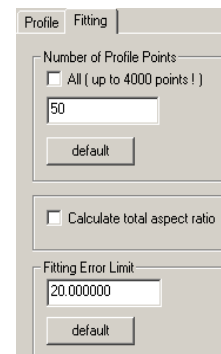


Fig. 66: Preferences – Imageprocessing – Fitting

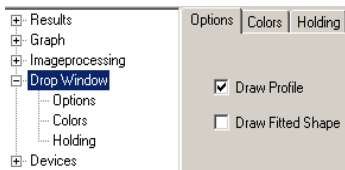


Fig. 67: Preferences – Drop Windows – Options

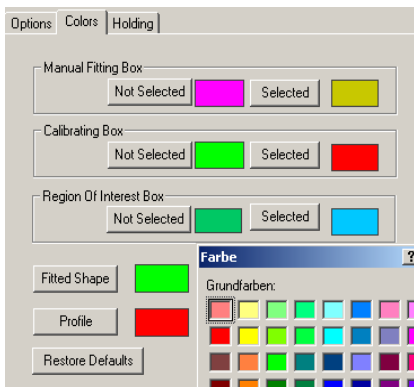


Fig. 68: Preferences – Drop Windows – Colors

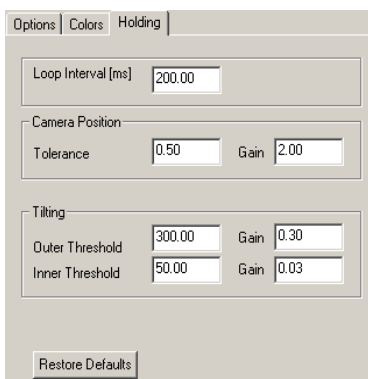


Fig. 69: Preferences – Drop Windows – Holding

The **Drop Window** dialog is structured into the following tabbed dialogs:

**Options** – In this tabbed dialog you can select:

- Draw Profile** - Activate this check box to draw the line for the extracted profile in the result window.
- Draw Fitted Shape** - Activate this check box to draw the line for the fitted shape in the result window.

**Colors** – In this tabbed dialog you can select the colors for the boxes and the lines.

**Manual Fitting Box** – In this dialog area you can select the color for the **Not Selected** and for the **Selected** box. With a click to the button the (standard windows) dialog **Colors** to select the corresponding colors will open.

**Calibrating Box** – In this dialog area you can select the color for the **Not Selected** and for the **Selected** box.

**Region of Interest Box** – In this dialog area you can select the color for the **Not Selected** and for the **Selected** box.

**Fitted Shape** – Click to the button to select the color for the fitted shape line.

**Profile** – Click to the button to select the color for the profile line.

**Restore Defaults** – Click this button to restore the default values for this dialog.

**Holding** – In this tabbed dialog you can define the parameters for the hold drop function.

**Loop Interval [ms]** – Time to refresh the drop holding.

**Camera Position**

**Tolerance** – Sensitivity of the camera reaction (in pixel) to hold the drop.

**Tilting**

**Outer Threshold** - Limit of the tilting table for greater tilt angles.

**Inner Threshold** - Limit of the tilting table of smaller tilt angles.

In the **Devices** dialog you can define the device parameters.

**Settings** – In this tabbed dialog you can set device dependent parameters.

In the dialog area **Temperature** you can select which temperature sensor will be used.

**Use**  **Internal Sensor** – Select this radio button to use the temperature values from the build-in sensor at the measuring cell.

**Use**  **External Sensor** – Select this radio button to use the temperature values from an external PT 100 (optional available) connected to the **T2**.

In the dialog area **Chamber Oil** you have to enter parameters for the liquid in the measuring cell.

**Refractive Index [20]** – Refractive index at 20 °C. The default value (1.3960) is only valid for the delivered silicone oil. If you use any other liquid you have to enter the corresponding value.

**RI coefficient [1/K]** – Temperature coefficient for the refractive index of the cell liquid. The default value (-0.000380) is only valid for the delivered silicone oil. If you use any other liquid you have to enter the corresponding value.

In the dialog area **Rotation** you can enter parameters for the rotational behavior.

**Acceleration Rate** – Enter the value for the acceleration rate (how fast the motor will spin up) (default rate is 3000 rpm/s).

**Deceleration Rate** - Enter the value for the deceleration rate (how fast the motor will spin down) (default rate is 3000 rpm/s).

**Maximum Speed** - Enter the value for the maximum speed. For the SVT 20 the maximum speed is 20000 rpm.

In the dialog area **Camera position** you can enter the speed of the camera movement when used in manual mode.

**Manual motion speed** - Enter the value for the speed of the camera movement when used in manual mode (default value is 1000).

In the dialog area **Tilting table** you can enter parameters for the tilting table.

**Manual motion speed** - Enter the value for the speed of the tilting table movement when used in manual mode (default value is 1000).

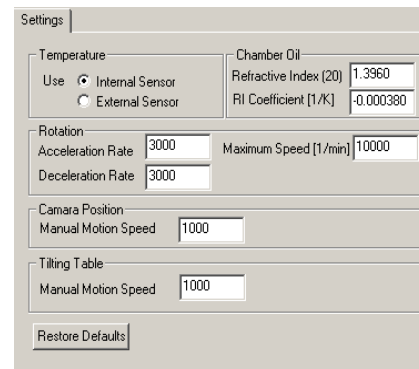


Fig. 70: Preferences – Device Settings

## 4.3 General use

### 4.3.1 Switch on/off the SVT

On the backside of the power supply there is the main power switch, on the backside of the SVT 20 is also a power switch. Because the power supply will consume power even when the SVT 20 is switched off, you should switch off the main power switch on the power supply, when you stop working for a longer time (i.e. over night).

### 4.3.2 Reset of tilting platform and camera carriage



Fig. 71: Menu – Service – Reference Run

The tilting platform and the camera carriage were driven by stepper motors. The position of the platform and the carriage were stored directly at the motor controllers. At a power failure or interruption, or when you move by use of the touch panel while the software is on it could happen that the last stored positions of the motors don't agree with the real positions. In this case (and also when using the SVT 20 the first time) you should carry out a camera reference run and a tilting table reference run.

The reference run can be initiated at the touch panel (*see chapter 4.1 Touch panel page 22*) and in the software (Menu **Service – SubSystems ▶ – Camera Reference Run or Tilting Table Reference Run**). The software will read the positions **only at start-up time**; therefore you should use the reference run at the touch panel only before the software is started.



**Do not initiate the reference run at the touch panel  
while the software is running!**

## 5 MEASUREMENT

In this chapter detailed information of the measuring procedures will be described.

The measuring results do not only depend on the correct use and functioning of the measuring device and the software, but may also be influenced by other factors. It is advised therefore, that the measuring results are **plausibility tested** before consequential actions are taken.

Before you start a measurement have a look to the following points:

- What is the goal of the measuring series?
- How the samples will be prepared?
- How is the set-up of the measuring device?

A precise definition of the problem or the terms relieves the simple-mindedly actions by the practical realization of an experiment.

Before you start to measure some preparations should be done.

### 5.1 Preparation of the SVT 20

The setup of the measuring device is, amongst others, important for reliable and reproducible results. **Before** you switch on the SVT 20 have a look to the following points:

- leveled and vibration-free stand
- correct setting of voltage selector at power supply
- all cabling is in good condition and not buckled
- clean windows at the measuring cell
- bubble and dirt free silicone oil in the cell
- well tempered measuring cell (i.e. tempered by a liquid circulator)
- sufficient cooling liquid flow through the motor (at temperatures over 60 °C **not together** with the circulation through the measuring cell)
- clean prism at the top of the zoom lens (particularly free from oil spots or other dirt which can change the refraction index of the prism)
- clean and functioning backlight

Switch on the SVT 20 and wait until the boot process is completed (wait 10 seconds after the backlight went on) before you start the SVTS software.

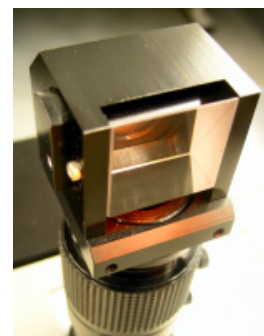


Fig. 72: Prism on top of zoom lens

## 5.2 Start the SVTS 20 software

The SVTS 20 software can be started in three different modes:

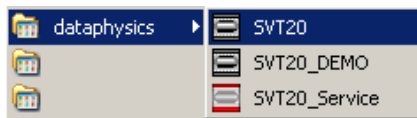


Fig. 73: SVT 20 modes

- Standard mode for device control and measurement (computer icon on the desktop)
- Demo mode to simulate the SVT; can be used to calculate results on a second PC
- Service mode for service personal from Dataphysics or their representatives

## 5.3 Cleaning of the capillary

The capillary should normally not be taken out for cleaning purposes. Between different measurements you should carry out the following cleaning procedure:

- Stop the motor of the SVT 20.
- Remove both plastic protection covers from both side of the measuring cell.
- Take off both septa holder.
- Screw on left and right auxiliary connectors to the capillary.
- Plug in two flushing tubes to the connectors.
- Tilt the measuring cell by means of the software to the right side (motor upturned). If the software is not yet running you can use the touch panel to tilt the cell.
- Depending on the previous measured and the next sample you should flush the capillary several times before you fill it with the next sample. Depending on the previous filling it is recommended to carry out several times a solvent row, for example with n-hexane, acetone and water.
- Flush the capillary at least three times with the next heavier phase (liquid with the higher density), to prevent impurity or a deviation from concentration.
- If the septa are still usable you can re-screw the left septa holder onto the capillary.

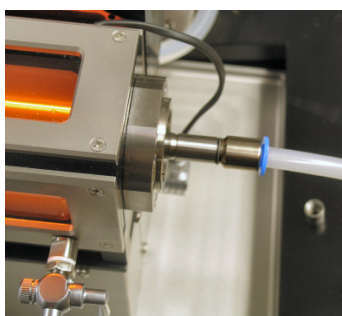
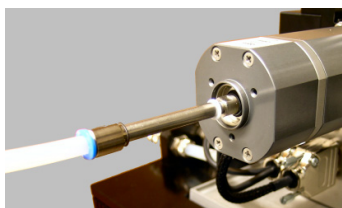


Fig. 74: Auxiliary connectors for cleaning the capillary (CT-SVT)



**The capillary should only be removed for cleaning if the procedure described above is not sufficient, or if you want to insert a different one.**

## 5.4 Preferences and Settings of SVTS

Before you start the **first** measurement check all the preferences described in the chapter 4.2.3 *Preferences of SVTS page 27*. It is not necessary to set all the preferences before a measurement, only the one you want to set different to the last settings.

## 5.5 Preparation of the samples

The preparation of the samples is decisively important for the measuring results. Therefore be sure to treat the samples always the same way, unless you want to measure the different results of different sample treatments.



To avoid systematic errors it is absolutely necessary to prepare the instrument and the sample always the same way.

## 5.6 Fill in liquid with higher density (outer phase)

The selection of the capillary arises from the measuring job as well as according to the compatibility to the sample. Care and cleanliness must be taken in filling the capillary with the liquids, especially if surface active substances will be used. Even smallest contaminations can reduce the surface tension of liquids, and therefore the measuring results.

The filling of the capillary with the liquid with higher density should be carried out bottom-up, so the air can exhaust from the left side.

- Tilt the measuring cell by means of the software to the right side (motor upturned). If the software is not yet running you can use the touch panel to tilt the cell.
- Take off both septa holder.
- Fill the capillary from the right side with a 10 ml syringe (*Part-No.: 6000168*) until the liquid with higher density oozes out the upper end of the capillary (pick up the oozing liquid with an adequate cloth or vessel).
- Close the upper side of the capillary with an entirely septum held in the left septa holder.
- Close the right side of the capillary with a septum **cut in half** and held in the right septa holder.
- Tilt the measuring cell back to the home position (horizontal).
- Mount the plastic protection covers on both side of the measuring cell.



**Never spin the SVT 20 without mounted plastic protection covers!**

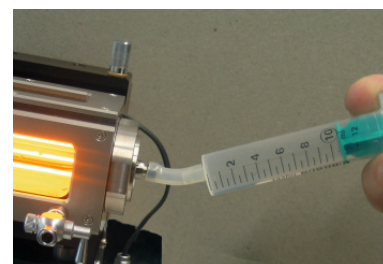


Fig. 75: Filling of capillary with the liquid with higher density

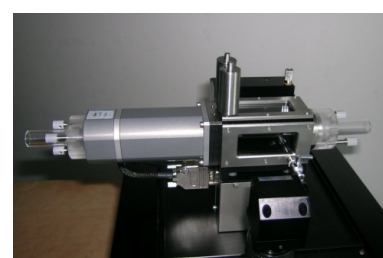


Fig. 76: SVT 20 with plastic protection covers

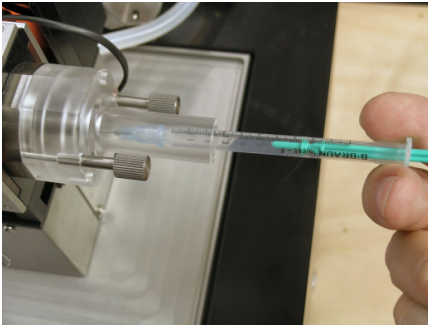


Fig. 77: Injection of second liquid

## 5.7 Inject liquid with lower density (inner phase)

The injection of a drop of the liquid with the lower density (inner phase) into the filled capillary can be done for example by use of the 1 ml syringe (Part-No.: 6000141) and a long needle (Part-No.: 6000145 SNS-D/SV).

The injected drop should not contact the wall of the capillary; to avoid this it is recommended to rotate the capillary with 200 to 500 rpm.

## 5.8 Scaling of image window

To calibrate the absolute image size the software needs a reference value. The system allows two ways of calibrating the image size of the drop window.


If you measure a completely visible drop (ellipsoid) you can use the (more comfortable) function **Calibrate By Camera Movement**.

If you have a cylindrical drop, without seeing the spherical ends, the appropriate way to calibrate the image size is the function **Calibration by use of a needle**.

### 5.8.1 Calibrate by camera movement

To calibrate the absolute image size the software needs a reference value. This reference value can be produced by the SVT 20 itself, if a stable (stable position in the image window) and sharp contoured drop is available, by moving the camera carriage a defined way to the left and to the right.

If you need to adjust the zoom or the focus if the drop is already inside the capillary (during the measurement) you only can use this function to calibrate the image size

You open the dialog **Dynamic Calibration** with a click to the icon  (Calibrate By Camera Movement).

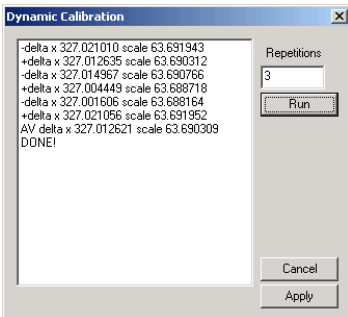



Fig. 78: Dynamic Calibration

Before you start this function with click to the  button ensure that a sharp contoured, and stable image of a drop is visible.




**To get reproducible results you need a stable and sharp drop with a good contrast to his ambient.**

**Repetition** – Enter the number of repetitions you want to be carried out.

**Run** – Starts the defined number of ‘calibration movements.







Every calibration step will be shown in the dialog. One calibration step is consisting of a movement to the left (-delta) and to the right (+delta). The average over all calibration steps will be used as result.

You must click to the  button to accept and transfer the result of the image calibration to the dialog SVT20 1.




## 5.8.2 Calibration by use of a needle

To calibrate the absolute image size the software needs a reference value. For this, the dosing needle could be used.

- Insert the dosing needle into the chamber. Pay attention that the needle is in the middle of the measuring capillary.
- Enter the diameter in mm of the used dosing needle into the edit field **Cal.Obj.Size [mm]** of the **SVT20 1** dialog.
- Click into the drop window and set the **Calibrating Box** (square or rectangle) over the needle to define a region where the will be done. The mouse cursor will change his form depending on the position inside the image window. Inside the image window the cursor form change from  to . Inside the calibrating box it will change to  and also the color of the box line will change. If the cursor is over a line of the box it will change to , , or  depending where on the line it is located.
- Adjust the zoom and the focus to see the image of the needle sharp and in the size you want to use for the measurement.
- Fix the zoom and the focus of the lens by means of the two knurled screws, because the settings of the optics should not be changed after the calibration.



**Calibration of the image size is no longer valid when the zoom or focus settings are changed, or the liquid in the cell or the capillary!**

- Click on the **Calibrate** button  in the **SVT20 1** dialog. The value in the edit field **Scale [pixel/mm]** will change to the new calibrated value. Repeat it several times to get a mean value.

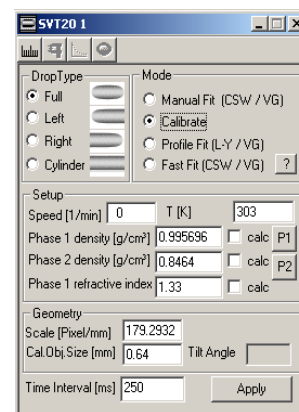


Fig. 79: Calibrating the magnification

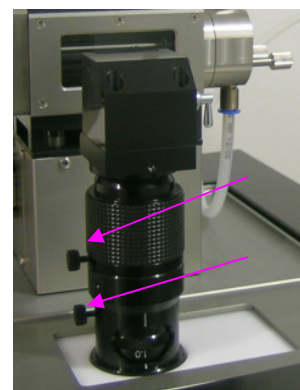


Fig. 80: Knurled screws for fixing zoom and focus at the lens

## 5.9 Hold drop function

In a first step of the measurement you need to catch the image of the drop by moving the camera left or right.

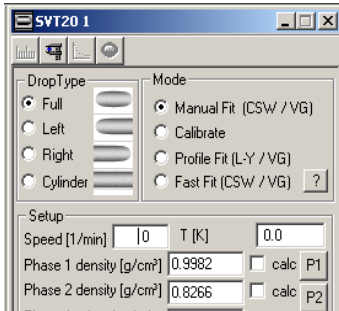
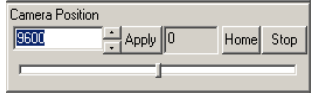



Fig. 81: SVT20 1 dialog

- Select  **Full** in the **Drop Type** area of the dialog **SVT 20 1**.
- Tilt the platform until the droplet is visible approx. in the middle of the image.
- Move the camera to the position of the drop (so you see the image of the drop in the middle of the image window). To select the camera position you can move the slider, enter a value in the edit field or use the  buttons. The movement will be carried out when you click to **Apply**.

- Change the mode to **Profile Fit (L-Y / VG)** or **Fast Fit (L-Y / VG)**.
- If you see the drop in the frame **Fitting Box** of the drop window quite stable you can click on the **Hold drop** button  on the right side of the drop window toolbar. The drop image will be hold automatically inside the frame by moving the camera left or right and the tilting platform up or down.
- To improve the contrast of the drop you can adjust the frame grabber parameter (see chapter 5.8 *Framegrabber Preferences page 28*) and/or the horizontal and vertical faceplate.

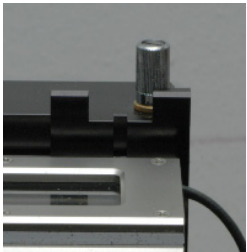
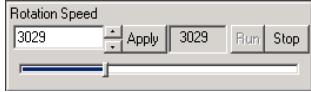


Fig. 82: Horizontal and vertical faceplate

## 5.10 Accelerate the rotational speed

The hold drop function allows the easy acceleration of the rotational speed without losing the droplet out of field of view due to centrifugal forces.

Use moderate steps (of about 200 rpm) until you reached the necessary measuring rotational speed. To select the next **Rotational Speed** you can move the slider, enter a value in the edit field or use the  buttons.

The acceleration up to the next rotational speed will be carried out when you click to **Apply**.

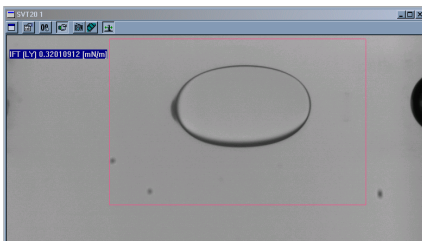


Fig. 83: Caught and held drop inside the Fitting Box



**Apply moderate changes in rotational speed to prevent, that the drop will slip out of the frame!**

If the drop has satellite droplets, the fitting module in the SVTS software will mask out the satellite, if it is clearly definable as a satellite and doesn't deform the profile too much.

If satellites occur, which prevent the automatic fitting of the drop, try to get rid of them by quick increasing and decreasing ( $\pm 500$  rpm) of the rotational speed. If this is not successfully, you have the possibility to analyze the drop shape with the manual fit function.

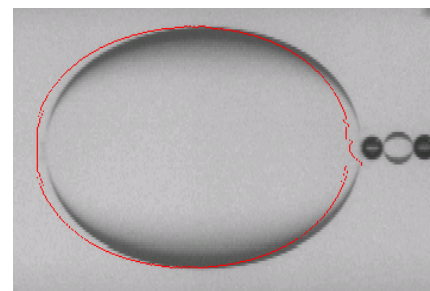


Fig. 84: Drop with satellites, but still measurable

The necessary rotational speed for measuring the Interfacial Tension (IFT) depends on the density difference between the outer and inner phase. The following diagram will help you to find the best rotational speed  $\omega$ :

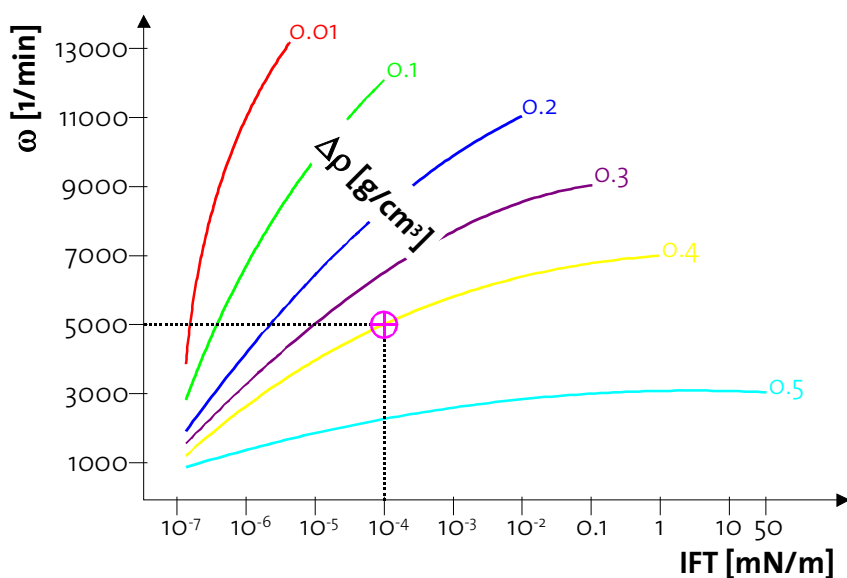


Fig. 85: Rotational speed in dependency of density difference and interfacial tension

**Example:** For a sample with the density difference  $\Delta\rho$  of  $0.4 \text{ g/cm}^3$  to the ambient liquid and an interfacial tension of about  $10^{-4} \text{ mN/m}$  you will need a rotational speed  $\omega$  of about 5000 1/min is recommended.



**In most cases a rotational speed between 3000 and 6000 rpm is the recommended range to measure the interfacial tension.**

The higher the speed, the faster is the mechanical wear of the shaft sealing rings.

## 5.11 Measurement parameters

To get reproducible and correct results take care that all physical data of the used sample liquids are entered in the corresponding **Setup** edit fields.

First you must select the **Drop Type**. The selection of the **Drop Type** relies on the form of the drop you get when rotating the capillary with the measuring speed.

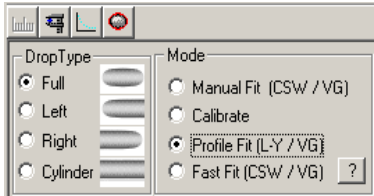


Fig. 86: Selection of Drop Type and Mode

- ⊙ **Full**– Select always full drop type whenever possible, because you will get the most accurate results.
- ⊙ **Left**– Select this drop type if the right end of the drop is not visible.
- ⊙ **Right**– Select this drop type if the left end of the drop is not visible.
- ⊙ **Cylinder**– Select this drop type if whether the left neither the right end of the drop is visible.

The selection of the **Mode** relies on the form of the drop you get (Drop Type) and the availability of the method (only the **VONNEGUT** method is available for a drop with a cylindrical shape with no ends). A click to the **?** icon will open the **Table of available calculation methods**.

Drop Type	Profile Mode	Manual + Fast Mode	Vonnegut (VG)	Cayias Schechter Wade (CSW)	Laplace Young (LY)
Full	YES	YES	YES	YES	YES
Left	YES	YES	YES	YES	YES
Right	YES	YES	YES	YES	YES
Cylinder	YES	NO	YES	NO	NO

Fig. 87: Table of available calculation methods

⊙ **Manual Fit (CSW / VG)** – This mode is used to get single measurement results. The calculation of the IFT will be done according to **CAYIAS, SCHECHTER, WADE (CSW) AND VONNEGUT (VG)**. In the drop window click into **Manual Fitting Box** (square or rectangle frame) and move the frame over the drop. Adjust the frame (by click and pull the lines of the frame) to fit the ellipse inside the frame to the drop. The mouse cursor will change his form depending on the position inside the image window. Inside the image window the cursor form change from to . Inside the frame it will change to and also the color of the box line will change. If the cursor is over a line of the box it will change to , , or depending where on the line it is located.

⊙ **Calibrate** – This mode is only used to calibrate the image size manually (see chapter 5.8 *Scaling of image window page 40*).

⊙ **Profile Fit (L-Y / VG)** – This mode is used to get series of measurement results. The calculation of the IFT will be done according to **LAPLACE YOUNG AND VONNEGUT (VG)**. This fit and calculation is the most complex one, and therefore the most tedious one.



**To reduce the processor load (for the automatic scaling of the graph) and thus increasing the speed of the calculation you can disable the graph in the result window (recommended for slow PC systems).**

⊙ **Fast Fit (CSW / VG)** – This mode is used to get series of measurement results. The calculation of the IFT will be done according to CAYIAS, SCHECHTER, WADE (CSW) AND VONNEGUT (VG).

Before you can get a result you must enter the fields in the **Setup** area of the **SVT20 1** dialog.

**Speed [1/min]** – This field will be filled out automatically with the actual rotational speed if you have a live image.

**T [K]** – This field will be filled out automatically with the actual temperature (in Kelvin) if you have a live image. If you have opened a stored bitmap file you can enter the value manually.

**Phase 1 density [g/cm<sup>3</sup>]** – In this field you have to enter the density value of the liquid with higher density in g/cm<sup>3</sup>. If you had entered the list **P1** for the temperature dependent values of the density, you can activate the automatic calculation by selecting the check box  **calc** behind the edit field (no need for entering a value). If this box is activated the density will be calculated automatically during the measurement (depending on the temperature at each time).

**Phase 2 density [g/cm<sup>3</sup>]** – In this field you have to enter the density value of the drop liquid (with the lower density) in g/cm<sup>3</sup>. If you had entered the list **P2** for the temperature dependent values of the density, you can activate the automatic calculation by selecting the check box  **calc** behind the edit field (no need for entering a value). If this box is activated the density will be calculated automatically during the measurement (depending on the temperature at each time).

**Phase 1 refractive index** – In this field you have to enter the refractive index value of the liquid with higher density. If you had entered the list **P1** for the temperature dependent values of the refractive index, you can activate the automatic calculation by selecting the check box  **calc** behind the edit field (no need for entering a value). If this box is activated the refractive index will be calculated automatically during the measurement (depending on the temperature at each time).

**calc** – Activates the automatic calculation depending on the table **Substances**.

With a click to the button **P1** or **P2** you open the tabbed dialog **Substances** where you can enter the temperature dependent values of the density and the refractive index.

Setup			
Speed [1/min]	3600	T [K]	275.4
Phase 1 density [g/cm <sup>3</sup> ]	0.9982	<input checked="" type="checkbox"/> calc	P1
Phase 2 density [g/cm <sup>3</sup> ]	0.8266	<input type="checkbox"/> calc	P2
Phase 1 refractive index	1.33	<input checked="" type="checkbox"/> calc	

Fig. 88: Setup parameters for the measurement

In the tabbed dialog **Substances** you can enter the public (valid for both tabs) values:

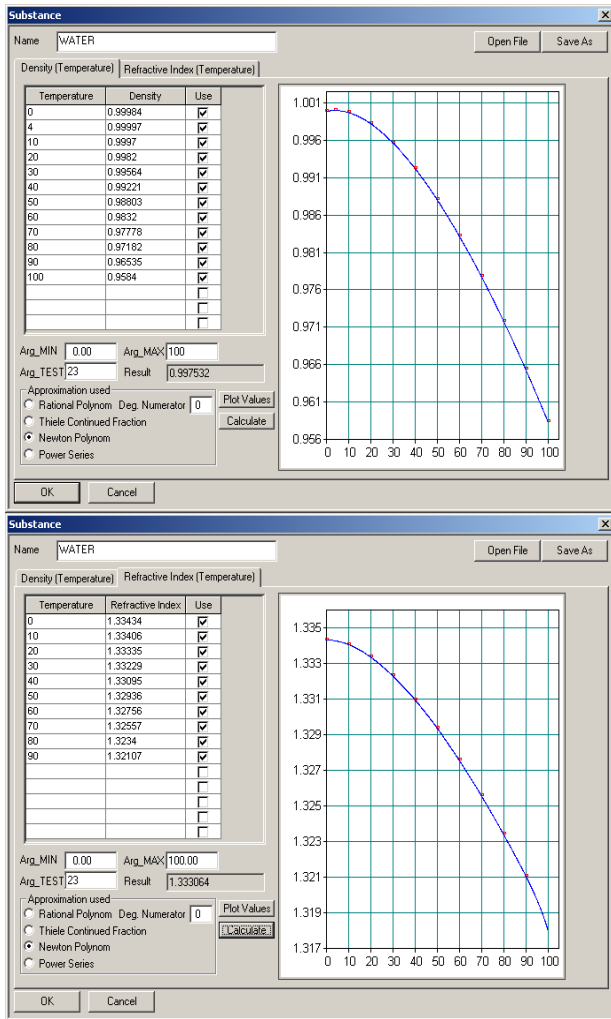


Fig. 89: Temperature dependent values of the density and the refractive index of water

**Name** – In this field you can enter the name of the substance you want to define. The name, under which the file will be stored, will be entered when you save the file.

**Open File** – Click this button to open a file stored before.

**Save As** – Click this button to save the file under a –to be entered- file name.

Depending which tab you have selected you can enter the temperature and the density or the temperature and refractive index into the table, by just clicking into the field you want to fill in. The check box behind the values defines if these values will be used for calculation or not.

**Arg\_MIN** – Defines the value of the origin of the x-axis (temperature) in the graph.

**Arg\_MAX** – Defines the end value of the x-axis (temperature) in the graph.

**Arg\_TEST** – Defines the temperature value you calculate the **Result**.

**Result** – Density or refractive index at the entered temperature value (**Arg\_TEST**).

**Plot Values** – Click this button to plot the values in the graph.

**Calculate** – Click this button to calculate and plot the interpolated values in the graph, and to calculate the **Result** at the entered temperature value (**Arg\_TEST**).

**Approximation used** – In this dialog area you select the way the interpolated values in the graph will be calculated. You can select between **Rational Polynom** (with the **Deg. Numerator**), **Thiele Continued Fraction**, **Newton Polynom** (mostly used), and **Power Series**.

**Continued Fraction, Newton Polynom** (mostly used), and **Power Series**.

The **Geometry** area of the **SVT2o 1** dialog is for the scale values of the image size.

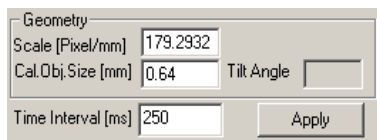


Fig. 90: Geometry parameters for the measurement

**Scale [Pixel/mm]** – In this field the calibrated value for the image size will be entered automatically after the calibration (by needle or camera movement).

**Cal.Obj.Size [mm]** – In this field you must enter the size (diameter of the needle) of the object used for calibration of the image size (only if you do a **Calibration by use of a needle** chapter 5.8.2 page 41).


**Tilt Angle** – This field will be automatically filled with the value (entered in preferences or detected automatically) of the tilting deviation between camera and measuring system.


**Time Interval [ms]** – In this field you can enter the time interval between two consecutive measurements when using the function **Timed Measurement**.


## 5.12 Result window


The result window is used to display besides the results also the parameters of the measurement in numerical and graphical form.


The icons in the result window of the SVTS have the following meaning and function:

 **Define as active** — Defines the actual result window as the active one (where all the data were written to); is active when table part of the result window is selected.

 **Always Update** —Toggles between automatic update of the graph and the rows or no automatic update; is active when table part of the result window is selected.

 **Update Now** — Updates the graph and the rows in the result window once per click when the automatic update is switched off; is active when table part of the result window is selected.

 **Always Update graph** — Toggles between automatic update or no update; is active when graphic part of the result window is selected.

 **Enable graph** — Switch graphic display on or off; is active when graphic part of the result window is selected.

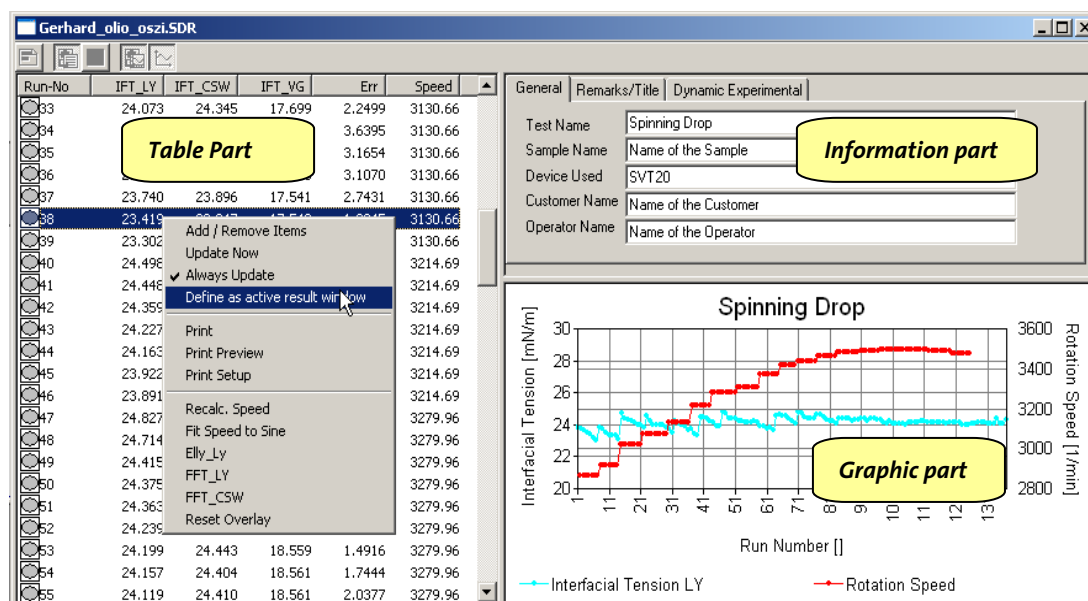


Fig. 91: Result window with table, information, and graphic part.

In the **table part** of the result window you have the following items in the context menu (open with a right mouse click):

**Add/Remove Items** — Opens the dialog **Display List** to select the items to be shown in the table. Only the items in the **Display Items** box will be shown in the table field of the result window.

Table 1: List of available items

Item	Meaning	Unit
<b>Average DeltaY</b>	Drop diameter (only VG mode)*	pixel
<b>Calculation error</b>	Fitting error	pixel
<b>Camera Aspect Ratio</b>	Width of a pixel divided by the height	—
<b>Camera Position</b>	Position of the camera carriage	
<b>Curv. Radius at Apex CSW</b>	$R_o$ in a Adams-Bashforth system	pixel
<b>Curv. Radius at Apex LY</b>	$R_o$ in a Adams-Bashforth system	pixel
<b>Density Difference</b>	Density difference between outer and inner Phase	$g/cm^3$
<b>Density Phase 1</b>	Density of outer Phase	$g/cm^3$
<b>Density Phase 2</b>	Density of inner Phase	$g/cm^3$
<b>Drop Type</b>	F = Full shape, L = Left side, R = Right side, C = Cylindrical part	—
<b>Drop Volume CSW</b>	Calculated drop volume according to CSW*	$\mu l$
<b>Drop Volume LY</b>	Calculated drop volume according to LY*	$\mu l$
<b>Effective Refractive Index</b>	$n_1/n_2$	—
<b>Interfacial Tension CSW</b>	Calculated Interfacial Tension according to CSW*	mN/m
<b>Interfacial Tension LY</b>	Calculated Interfacial Tension according to LY*	mN/m
<b>Interfacial Tension VG</b>	Calculated Interfacial Tension according to VG*	mN/m
<b>Profile AR</b>	Aspect ratio calculated by LY-fit*	—
<b>Recalculated Speed</b>	Rotation speed after fitting and phase shift	1/min
<b>Refractive Index Phase 1</b>	Refractive Index $n_1$ of outer Phase	—
<b>Refractive Index Phase 3</b>	Refractive Index $n_3$ of cell liquid	—
<b>Result Valid</b>	Boolean variable (0 or 1) depending on error limit	—
<b>Rotation speed</b>	Rotational speed	1/min
<b>Run Number</b>	Sequential number of measuring row	—
<b>Shape Parameter Alpha CSW</b>	Property of the profile (shape)	—
<b>Shape Parameter Alpha LY</b>	Property of the profile (shape)	—
<b>Surface Area CSW</b>	Surface area of drop calculated according to CSW*	$mm^2$
<b>Surface Area LY</b>	Surface area of drop calculated according to LY*	$mm^2$
<b>Temperature</b>	Temperature at selected sensor	K
<b>Time Stamp</b>	Time since start or <b>Reset Timer</b>	s
<b>Vertical Pixel per Millimeter</b>	Magnification	mm
<b>Viscosity Phase 1</b>	Viscosity of outer Phase	mPas
<b>Viscosity Phase 2</b>	Viscosity of inner Phase	mPas
<b>x_Average</b>	Property of the profile (shape)	pixel
<b>x_MAX</b>	Property of the profile (shape)	pixel
<b>x_MIN</b>	Property of the profile (shape)	pixel
<b>y_Average</b>	Property of the profile (shape)	pixel
<b>y_MAX</b>	Property of the profile (shape)	pixel
<b>y_MIN</b>	Property of the profile (shape)	pixel

\* CSW =Cayas Schechter Wade; LY = Laplace Young; VG = Vonnegut



**==>** Copy the marked item to the **Display Items** box. You can mark different items by holding the <Ctrl> button when click to the next item, or you can mark a row of items by click to the first item of the row and holding the <Shift> button when click to the last item of the row.

**<==** Deletes the marked item from the **Display Items** box. You can mark and delete only one item each.

**Update Now** — Updates the graph and the rows in the result window once per click when the automatic update is switched off; is active when table part of the result window is selected.

**Always Update** —Toggles between automatic update of the graph and the rows or no automatic update; is active when table part of the result window is selected.

**Define as active** — Defines the actual result window as the active one (where all the data were written to); is active when table part of the result window is selected.

**Print** — Prints the table directly to the standard printer.

**Print Preview** — Shows the table directly on the screen, as it would be printed on the standard printer.

**Print Setup** — Opens the dialog printer setup, where you can select the printer and his settings.

**Recalc. Speed** — The values of the rotational speed will be approximated (first fitted and then phase shifted) to a polynomial curve.

**Fit Speed to Sine** — The values of the rotational speed will be approximated (first fitted and then phase shifted) to a sinusoidal curve. This is recommended for oscillation measurements.

**Elly\_Ly** — Fits an ellipse on the oscillation results (best displayed as Surface Area over Interfacial Tension). With the ellipse fitting the real part ( $E'$ ) and imaginary part ( $E''$ ) of the surface dilatation module can be calculated. The values of  $E'$  and  $E''$  are shown in **Dynamic Experimental**.

**FFT\_LY** — Computes a Fast Fourier Transform<sup>1</sup> on the values according to LY. With the FFT\_LY the real part ( $E'$ ) and imaginary part ( $E''$ ) for higher harmonic oscillations of the surface dilatation module can be calculated. The results are shown in **Dynamic Experimental**.

**FFT\_CSW** — Computes a Fast Fourier Transform on the values according to CSW. With the FFT\_LY the real part ( $E'$ ) and imaginary part ( $E''$ ) for higher harmonic oscillations of the surface dilatation module can be calculated. The results are shown in **Dynamic Experimental**.

**Reset Overlay** — Deletes all overlays in the graph part.

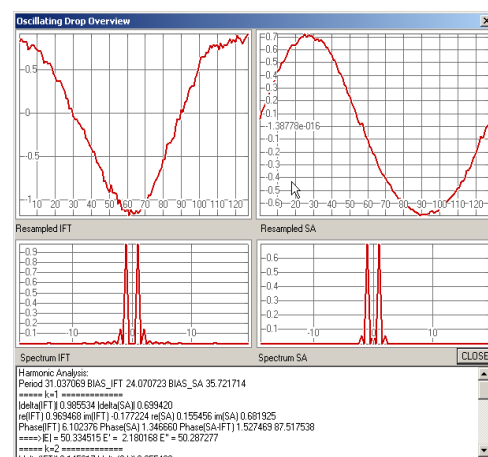


Fig. 92: Fourier analysis for oscillation measurement

<sup>1</sup> A **fast Fourier transform (FFT)** is an efficient algorithm to compute the discrete Fourier transform (DFT) and its inverse, used to analyze the frequencies contained in a sampled signal.

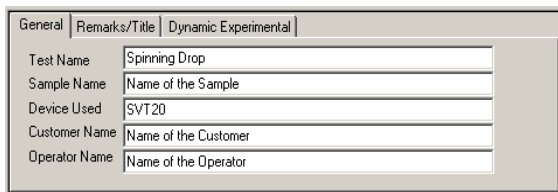


Fig. 93: Information part of the result window

In the **information part** of the result window you can enter additional information to the test. Also some special information about an oscillatory test will be written in.

In the tabbed dialog **General** you can enter additional text dedicated to the test.

In the tabbed dialog **Remarks/Title** you can enter additional text dedicated to the test.

In the tabbed dialog **Dynamic Experimental** special information about an oscillatory test will be written in.

In the **graphic part** of the result window you have the following items in the context menu (open with a right mouse click):

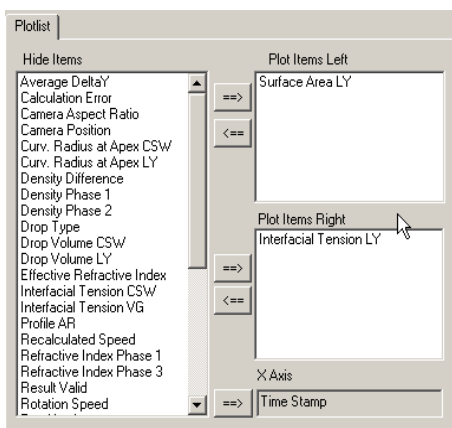


Fig. 94: Plotlist in graphic part of the result window

**Add/Remove Items** — Opens the dialog **Plot List** to select the items you want to be shown in the table. Only the items in the **Plot Items** box will be shown in the graph part of the result window.

**Graph Properties** — Opens the tabbed dialog **Graph** to define the presentation parameters for the graph.

**Show Graph** — Switch graphic display on or off.

**Always Update** —Toggles between automatic update of the graph and the rows and no automatic update; is active when table part of the result window is selected.

**Print** — Prints the table directly to the standard printer.

**Print Preview** — Shows the table directly on the screen, as it would be printed on the standard printer.

**Print Setup** — Opens the dialog printer setup, where you can select the printer and his settings.

## 5.13 Single measurement

The first step of a single measurement is to check if the drop profile can be detected correctly by the profile path finder.

- Select the measuring mode  **Profile Fit (L-Y / VG)** or  **Fast Fit (CSW / VG)**.
- Click to the button (Extract Profile) to detect the profile of the drop.
- Verify that the profile can be detected correctly.

If the drop profile can be detected correctly by the profile path finder you can use the single automatic measurement, otherwise you have the possibility to use the single manual measurement instead.

### 5.13.1 Single manual measurement

use the manual profile setting if the drop profile can not be detected correctly by the profile path finder.

After you have carried out all above procedures and set all necessary parameters, you can start a single manual measurement by selecting the mode  **Manual Fit (CSW / VG)**.

In the drop window click into the frame **Manual Fitting Box** and move the frame over the drop. Adjust the frame (by clicking and pulling the lines of the frame) so that the **ellipse drawn inside the frame** fits to the drop. The mouse cursor will change his form depending on the position inside the image window. Inside the image window the cursor form change from to . Inside the frame it will changes to and the color of the box line will change, too. If the cursor is over a line of the box it will change to , , or depending where on the line it is located.

The IFT will be automatically recalculated and displayed in the image window (**IFT (CSW) 7.6673029 [mN/m]**) after releasing the mouse key.

The calculation of the IFT will be done according to CAYIAS, SCHECHTER, WADE (CSW) AND VONNEGUT (VG).

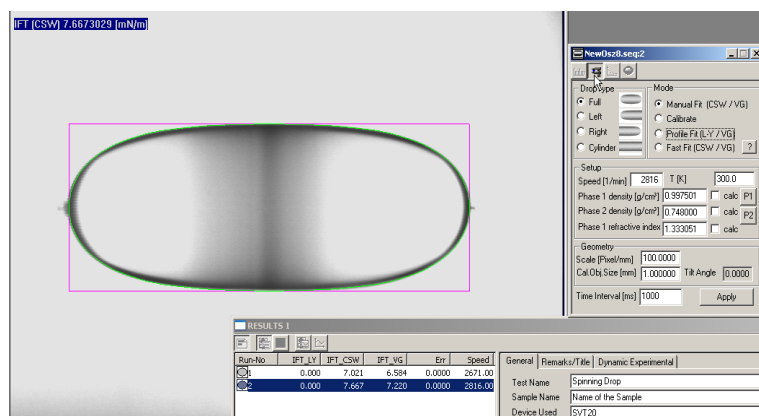


Fig. 97: Single manual measurement

With a click on the button (**Single Measurement**) the IFT will be recalculated and all available results will be transferred into an active result window.

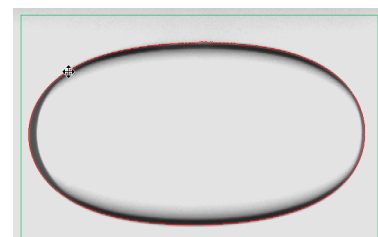


Fig. 95: Sharp contour with correct fit

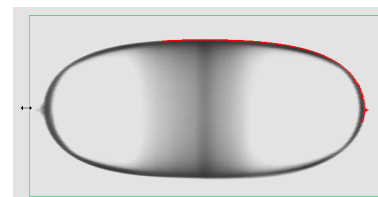









Fig. 96: Unsharp contour with incomplete fit

### 5.13.2 Single automatic measurement

If the drop profile can be detected correctly by the profile path finder you can use the automatic profile setting.

After you have carried out all the above described procedures and have set all necessary parameters, you can now begin to perform a single automatic measurement.

In the drop window click into the frame **Fitting Box** and move the frame over the drop. Adjust the frame (by clicking and pulling the lines of the frame) over the complete drop. It is recommended to pull the frame as wide as possible (enclosing only one drop), because sometimes the drop will move slightly left or right due to drift or movements caused by the hold drop function. The mouse cursor will change his form depending on the position inside the image window. Inside the image window the cursor form change from  to . Inside the frame it will changes to  and the color of the box line will change, too. If the cursor is over a line of the box it will change to , , or  depending where on the line it is located.

- Select the measuring mode  **Profile Fit (L-Y / VG)** or  **Fast Fit (CSW / VG)**.
- Click to the button  (Extract Profile) to detect the profile of the drop.
- Verify that the profile is detected correctly.

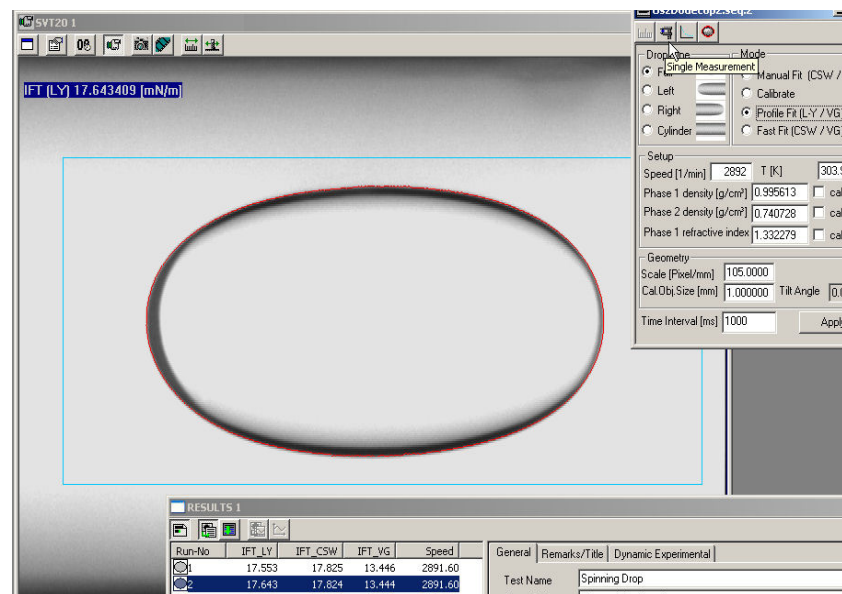



Fig. 98: Single automatic measurement

With a click on the button  (**Single Measurement**) the IFT will be calculated according to the pre-defined measuring method and all available results will be transferred into an active result window.

The IFT will be also automatically displayed in the image window (**IFT [LY] 17.643409 [mN/m]**).

## 5.14 Timed measurement

For measurements with pre-defined time intervals you can use the **Timed Measurement** mode.

A timed measurement is an automatic series of measurements (profile finding, calculation of IFT and transferring of the result).

In the drop window click into the frame **Fitting Box** and move the frame over the drop. Adjust the frame (by clicking and pulling the lines of the frame) so that the complete drop fits into the frame. It is recommended to pull the frame as wide as possible (enclosing only one drop), because sometimes the drop will move slightly left or right due to drift or movements caused by the hold drop function.

- Select the measuring mode  **Profile Fit (L-Y / VG)** or  **Fast Fit (CSW / VG)**.
- Click to the button (Extract Profile) to detect the profile of the drop.
- Verify that the profile is detected correctly.
- Set the **Time Interval [ms]** (interval between two consecutive measurements). The time interval should be chosen long enough to carry out the profile finding, calculation of IFT and transferring of the result.
- Open a result window to save the measuring values.
- Click to the button (Timed Measurement) to start the measurement of the IFT according to the pre-defined measuring method.

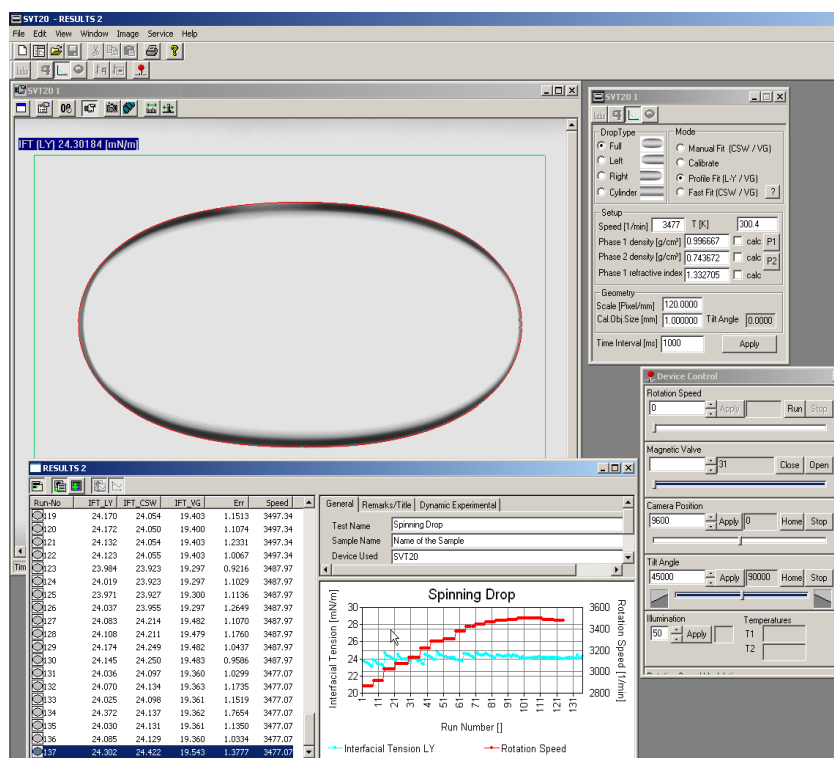


Fig. 99: Timed Measurement

- Click to the button again to stop the Timed Measurement.

## 5.15 Movie — recording and analyzing

The movie function is useful if you want to measure interfacial tensions with a high time resolution, as the saving of the pictures is much faster than the picture analysis. The second important application for the movie function is the dynamic (i.e. oscillating rotational speed) analysis. You can record the whole measurement and evaluate the whole or only the interesting pictures afterwards by single measurement or timed measurement.


The maximum time duration of a video sequence, which can be recorded is limited by the size of the hard disk.

The control of the movie function will be made with the icons in the movie icon bar. The icons are available only if the movie window is active.

A new record deletes the previous one independent from the record time.



**Store every record you want to keep or evaluate immediately.**

Open a new movie windows with a click to the button .

On the top of the movie windows you will find several icons similar to the buttons of a video or tape recorder.

On a new movie window only two of the icons are active.

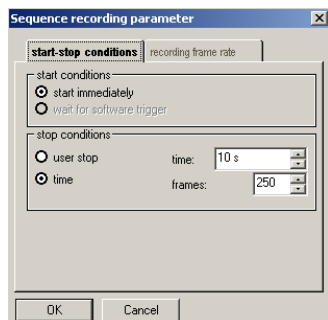








Fig. 100: Sequence recording parameter






-  Recording Settings Opens the tabbed dialog **Sequence recording parameter**, where you can set the stop conditions (all the other function in this dialog are not yet implemented)
-  Start Recording Starts the recording of a movie sequence

In a recorded movie these two icons are inactive, the following other 7 icons are active.



-  First Image Moves the movie sequence back to the first image (active when movie is stopped)
-  Previous Image Moves in the movie sequence one image back, to see singular pictures of the movie (active when movie is stopped)
-  Play Reverse Plays the movie sequence in reverse direction
-  Stop Stops playing the movie sequence

- |   |            |  |
|---|------------|--|
|  | Play       | Plays the movie sequence in forward direction  |
|  | Next Image | Moves in the movie sequence one image back, to see singular pictures of the movie (active when movie is stopped) |
|  | Last Image | Moves the movie sequence forward to the first image (active when movie is stopped)                               |

To analyze a single image you use the **Single Measurement** mode.

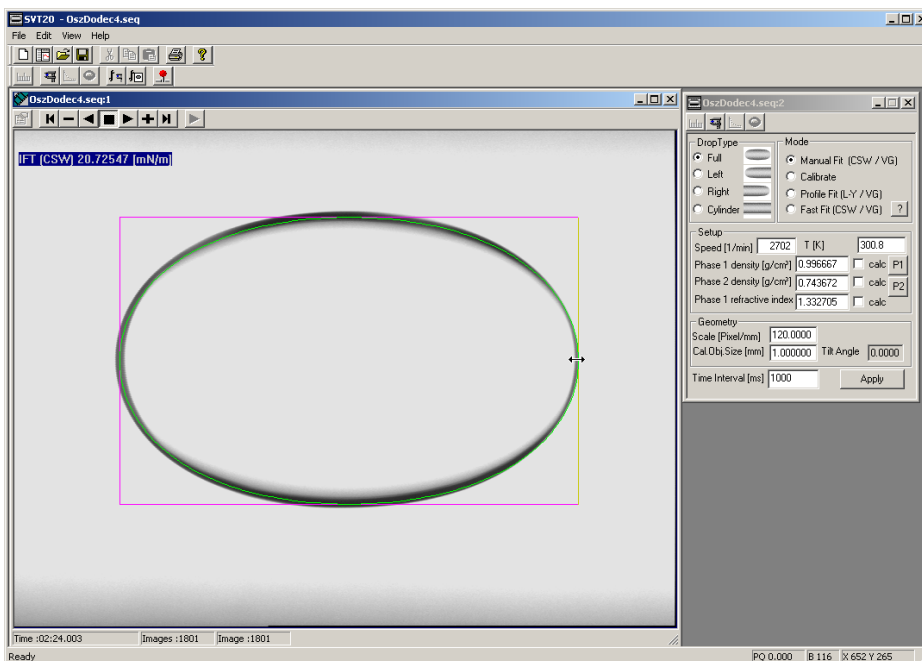





Fig. 101: Movie window analyzed by Single Manual Measurement

- Select the measuring mode  **Manual Fit (CSW / VG)**,  **Profile Fit (L-Y / VG)** or  **Fast Fit (CSW / VG)**.
- Click to the button  (Extract Profile) to detect the profile of the drop.
- Verify that the profile is detected correctly.
- Click to the button  (Single Measurement) to calculate the IFT according to the pre-defined measuring method.
- With a click to the button  (**Single Measurement**) the IFT will be calculated and all available results will be transferred into an active result window (the IFT will be also displayed in the image window).

To perform an automatic evaluation of the whole movie, you use the **Timed Measurement** (see chapter 5.14 page 53).

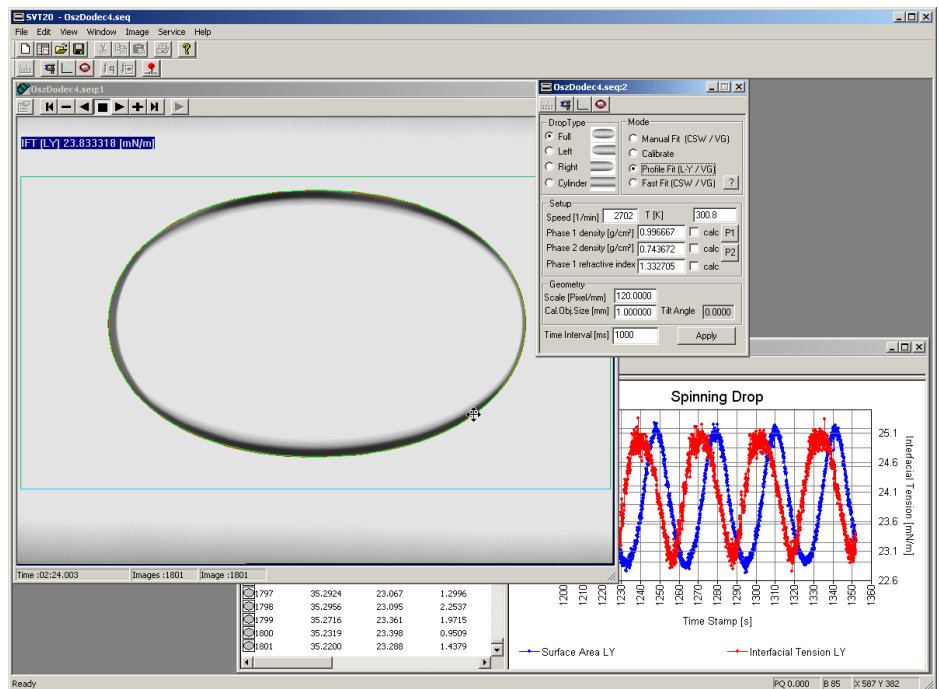





Fig. 102: Movie window analyzed by Timed Measurement

- Select the measuring mode  **Profile Fit (L-Y / VG)** or  **Fast Fit (CSW / VG)**.
- Click to the button  (Extract Profile) to detect the profile of the drop.
- Verify that the profile is detected correctly.
- Set the **Time Interval [ms]** (interval between two consecutive measurements). The time interval should be chosen appropriate to carry out the profile finding, calculation of IFT and transferring of the result.
- Open a result window to save the measuring values.
- Click to the button  (Timed Measurement) to start the measurement of the IFT according to the pre-defined measuring method.
- Click to the button  again to stop the analysis of the movie.



## 5.16 Oscillating the rotational speed

The fitting of the profile and the calculation of the results according to Young-Laplace can take about half a second per image (depending on the performance of the used PC). Therefore it is recommended to record the measurement with oscillating rotational speed as a movie and to analyze the results afterwards.

For oscillating measurements set the parameters at the **Rotation Speed Modulation** area in the dialog **Device Control**.

**Amplitude**— Enter the value for the amplitude of the oscillating rotational speed.

**Period**— Enter the value for the period (thus defining the frequency) of the oscillating rotational speed.

The **Frequency** field displays the resulting frequency of the oscillating rotational speed.

For example with a base speed of 3000 rpm, an amplitude of 200 rpm, and a period of 30 the SVT 20 will create a sinusoidal rotational speed between 2900 rpm and 3100 rpm at a frequency of 0.05 Hz.

The results must be recalculated with **Fit speed to Sine** (click right mouse button in the result window). The values of the rotational speed will be approximated to a sinusoidal curve.

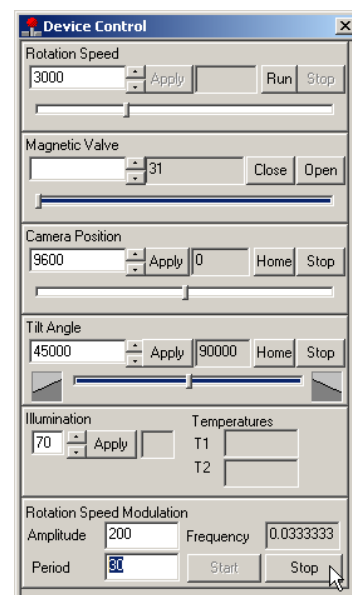


Fig. 103: Device control

After you have carried out all the above described procedures and have set all necessary parameters, you start now recording a movie of the oscillating test.

First start the **Rotation Speed Modulation** by a click to the **Start** Button in the dialog **Device Control**.

When the oscillation is running click to the button to record the movie.



**You should record at least one complete period of the oscillation.**

You can stop the movie recording with a click to the stop button at the movie window and the rotation speed modulation by a click to the **Stop** Button in the dialog **Device Control**.

Store the new record immediately with a click to the save button (or hit at the keyboard the **Ctrl** and the **s** key together). If it was not stored before you will be asked automatically to enter a filename (dialog **Save As**).

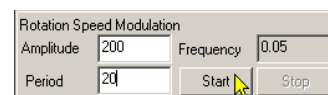


Fig. 104: Rotation speed modulation

To perform an automatic evaluation you use the same method described in **Timed Measurement** (see chapter 5.14 page 53).

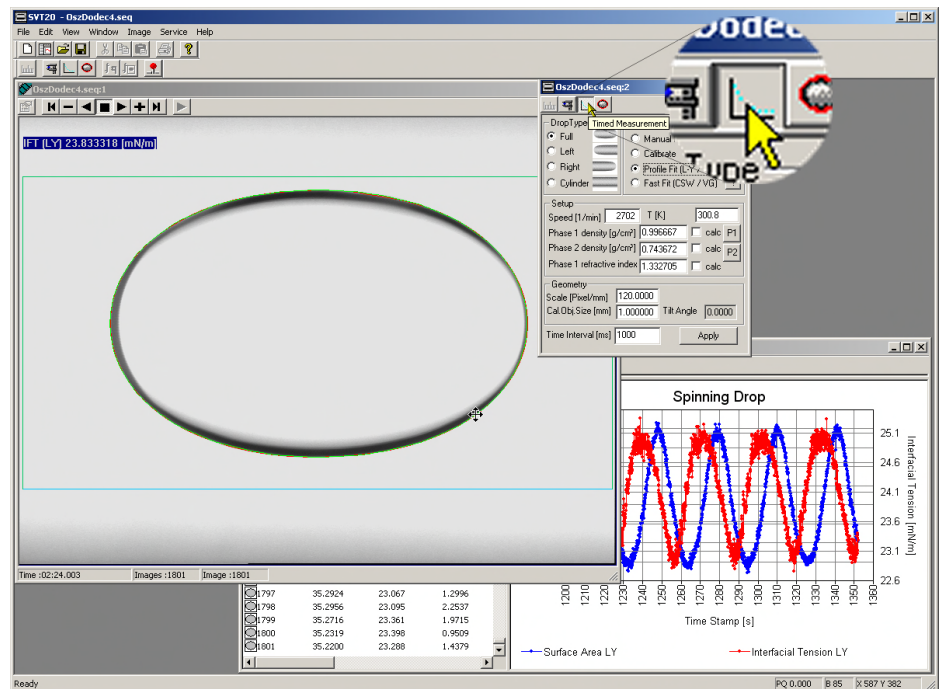


Fig. 105: Analyzing movie by Timed Measurement

- Select the measuring mode  **Profile Fit (L-Y / VG)** (the recommended one) or  **Fast Fit (CSW / VG)**.
- Click to the button (Extract Profile) to detect the profile of the drop.
- Verify that the profile is detected correctly.
- Set the **Time Interval [ms]** (interval between two consecutive measurements). The time interval should be chosen long enough to carry out the profile finding, calculation of IFT and transferring of the result.
- Open a result window to save the measuring values.
- Open the dialog **Display List** by selecting **Add/Remove Items** from the context menu (right mouse click) in the table part of the result window to select the items you want to be shown in the table. Only the items in the **Display Items** box will be shown in the table field of the result window.
- Click to the button (Timed Measurement) to start the evaluation of the IFT according to the pre-defined measuring method.
- Click to the button again to stop the analysis of the movie.

MaharFan

In the software SVTS 21 three ways to calculate the values of the surface dilatation module are implemented.

The **first step** in getting results from the oscillation test must be the approximation of the rotational speed (first fit and then phase shift) to a sinusoidal curve. Select **Fit speed to Sine** (click right mouse button in the result window).

**i** – Select **FFT\_LY** from the context menu (right mouse click) in the table part of the result window to compute a FFT on the values according to LY. The results are shown in an extra window (**Oscillating Drop Overview**) and also as plain text in the tab **Dynamic Experimental** in the information part of the result window.

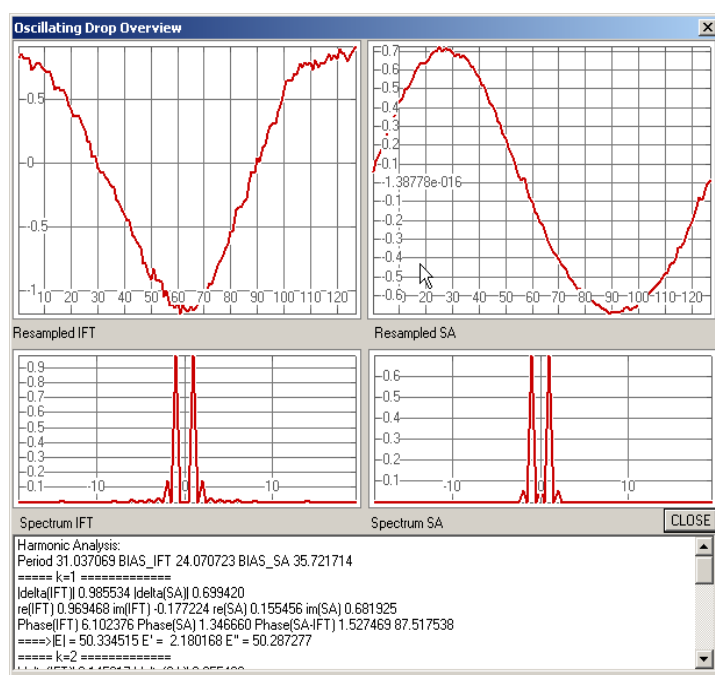


Fig. 108: Fourier analysis for oscillation measurement

**ii** – Select **FFT\_CSW** to compute a FFT on the values according to CSW. The results are shown in the tab **Dynamic Experimental** in the information part of the result window.

The results of the harmonic analysis (FFT) are in detail:

For the complete wave:

**Period** — Period of the analyzed harmonic wave

**BIAS\_IFT** — Mean value of the IFT harmonic wave

**BIAS\_SA** — Mean value of the SA harmonic wave

For the harmonics **k = 1** to **5**:

**|delta(IFIT)|** — Amplitude of the IFT

**|delta(SA)|** — Amplitude of the SA

**re(IFIT)** — Real part of the IFT

**im(IFIT)** — Imaginary part of the IFT

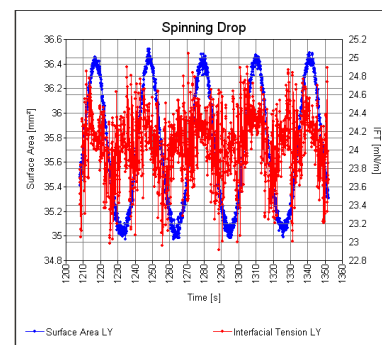


Fig. 106: IFT without speed approximation

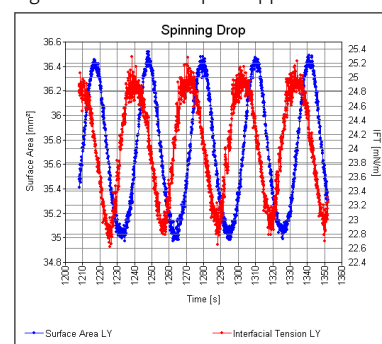


Fig. 107: Same IFT with speed approximation to a sinusoidal curve

- re(SA)** — Real part of the SA
- im(SA)** — Imaginary part of the SA
- Phase(IFT)** — Phasing of the IFT
- Phase(SA)** — Phasing of the SA
- Phase(SA-IFT)** — Phase shift between the SA and IFT wave
- |E|** — Surface dilatation modulus
- E'** — Real part of the surface dilatation modulus (elastic modulus)
- E''** — Imaginary part of the surface dilatation modulus (loss modulus)

**III** – Select **Elly\_Ly** from the context menu (right mouse click) in the table part of the result window to fit an ellipse on the oscillation results (best displayed as Surface Area over Interfacial Tension). With the ellipse fitting the real part **E'** (**elastic modulus**) and imaginary part **E''** (**loss modulus**) of the **surface dilatation module E\*** can be calculated. The values of E' and E'' are shown in the tab **Dynamic Experimental** in the information part of the result window.

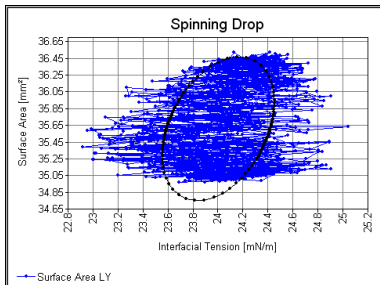


Fig. 109: Ellipse fitting without approximation of speed

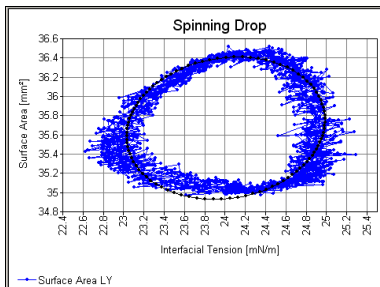


Fig. 110: Ellipse fitting with approximation of speed values to a sinusoidal curve

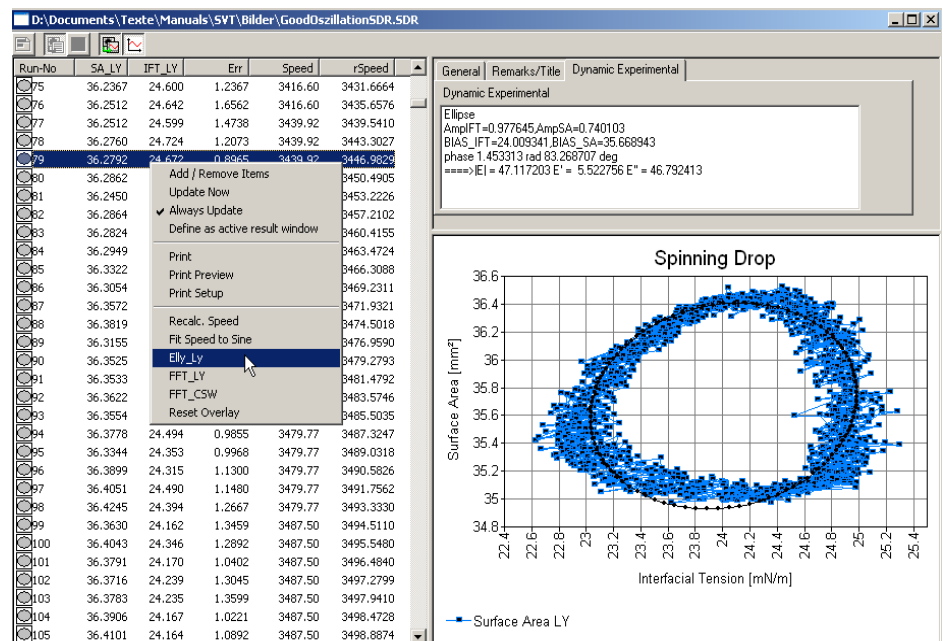


Fig. 111: Oscillation result with ellipse fitting

The results of the ellipse fitting are:

- AmpIFT** — IFT amplitude of the harmonic wave
- AmpSA** — SA amplitude of the harmonic wave
- BIAS\_IFT** — Mean value of the IFT harmonic wave
- BIAS\_SA** — Mean value of the SA harmonic wave
- phase** — Phase shift between the SA and IFT wave
- |E|** — Surface dilatation module
- E'** — Real part of the surface dilatation module (elastic modulus)
- E''** — Imaginary part of the surface dilatation module (loss modulus)



## 6 LIQUID DISPENSE UNIT LDU/SVT

Liquid dosing unit for spinning drop system SVT, motor-driven and software controlled. For the precise dosing of liquid droplets (lighter phase) into the measuring capillary of the SVT, and the automatic rinse and regeneration of the heavier liquid phase in the SVT 20 measuring capillary with an integrated flexible tube pump.

For use with up to two electronic syringe module ES-S.

### Technical data:

- Dosing velocity ES-S: 0.005  $\mu\text{l/s}$ ... ca. 100  $\mu\text{l/s}$  dependent on the used syringe
- Dosing velocity flexible-tube pump: 2 ml/min ... ca. 290 ml/min, electronically controlled

### Consisting of:

- Housing for up to two electronic syringe module ES-S, with interface to the SVT 20
- One electronic syringe module ES-S, incl. gastight 500  $\mu\text{l}$  precision syringe DS 500/GT and dosing tube DT 400/03, 10 disposable dosing needle SNS-D/SV and luer-lock-adapter LL A
- One integrated flexible-tube pump
- Three dosing tubes (bottle — flexible-tube, pump — SVT, SVT — liquid waste bottle)
- Two glass bottles with PTFE sealing flange
- Left adapter fitting with magnetic valve and quick coupling for waste tube
- Right adapter fitting with quick coupling for pressure tube
- Special parts for mounting on the standard capillary CT-SVT xx to convert it into a flow-through capillary

### Optional available:

- **ES-S** – Electronic syringe module (Part. No. 2000692), for dosing of a second liquid
- **DS 500/GT** - 500  $\mu\text{l}$  precision syringe DS 500/GT (Part. No. 6000005)
- **DT 400/03** - PTFE dosing tube (Part. No. 8001404)
- **LL A** – Luer-lock adapter (Part. No. 8000502)
- **SNS-D/SV** – Disposable dosing needle (Part. No. 6000145)



Fig. 112: LDU/SVT

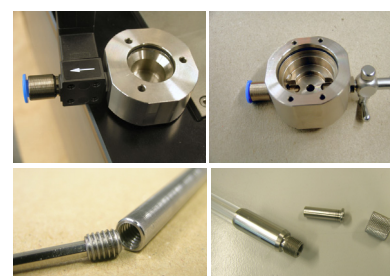


Fig. 113: Special attachments for using the SVT 20 with the LDU/SVT

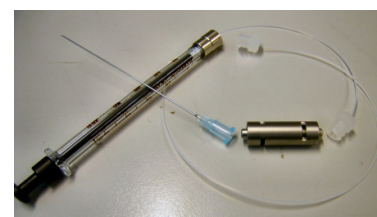


Fig. 114: Accessories of LDU/SVT

## 6.1 LDU/SVT – Preparation of CT-SVT and SVT 20

Before you use the SVT 20 with the LDU/SVT you must convert the standard capillary into a **flow-through** capillary.

- Screw the reducing spout into the capillary by use of the hexagon screw driver.
- Insert the other reducing spout into the capillary and screw on the right septa holder (without any septum).

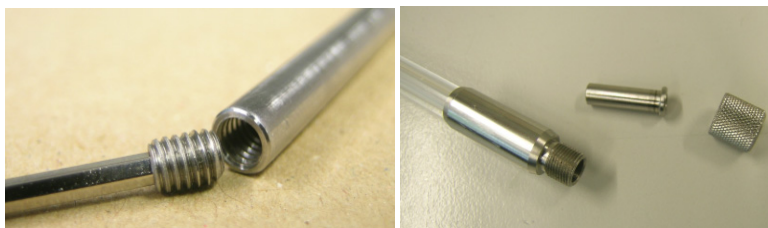


Fig. 115: Reducing spouts to convert a standard capillary into a flow-through capillary

The flow-through capillary can be mounted and removed in the same way as the standard capillary (see chapter 3.3.4 Removal and mounting of Standard Capillary (CT-SVT) page 14) except from inserting any septa.



**Do not use the LDU/SVT if any septum is mounted in the capillary**

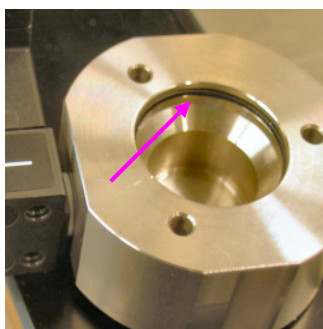


Fig. 116: O-ring in left flow-through adapter

If the flow-through capillary is mounted you can attach the flow-through adapter fittings onto both sides of the measuring cell.

- Check that the O-ring is not worn out and in his correct position.
- Carefully put the left flow-through adapter with the magnetic valve onto the motor and screw it on by use of a hex screw driver (size 2 mm).

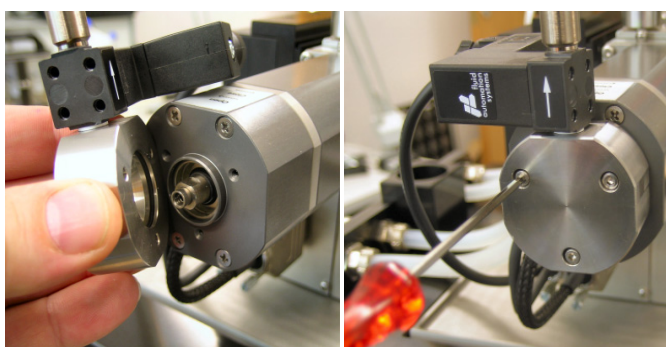


Fig. 117: Mounting of left flow-through adapter

- Check that the O-ring is not worn out and in his correct position.
- Insert a septum into the adapter.
- Mount the plastic protection cover to hold the septum onto the adapter and screw it on by use of a hex screw driver (size 1.5 mm).

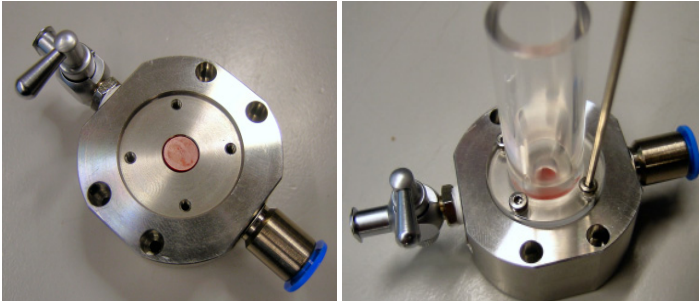


Fig. 119: Preparation of right flow-through adapter

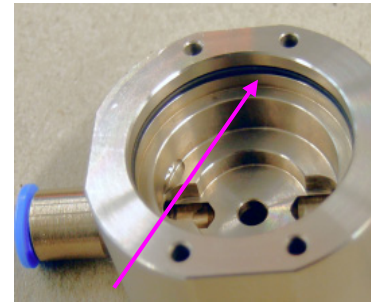


Fig. 118: O-ring in right flow-through adapter

- Carefully put the prepared right flow-through adapter onto the right side of the measuring cell and screw it on by use of the two knurled screws.

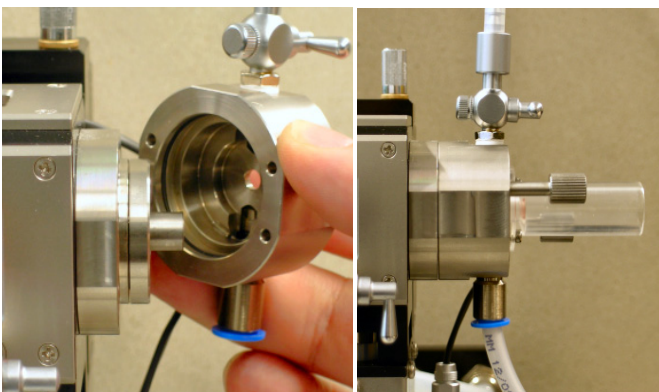


Fig. 120: Mounting of right flow-through adapter

Now fill the measuring cell with the silicone oil (see chapter 3.3.5 Preparing and filling of the measuring cell page 16).

## 6.2 LDU/SVT – Connection and Installation

- Connect the electronic syringe module ES-S (or both) to the front side of the LDU/SVT.
- Connect the LDU/SVT with the delivered cable (marked LDU) to the socket **SERIAL AUX 2** on the back of the SVT 20.



**All cable connections must only be closed or opened when the SVT 20 is switched off.**

- Attach the tube from the connector SUCTION on the pump of the LDU/SVT to the bottle with the fresh liquid with the lower density (out of this bottle the capillary will be flushed and filled).



Fig. 121: Pump of LDU/SVT

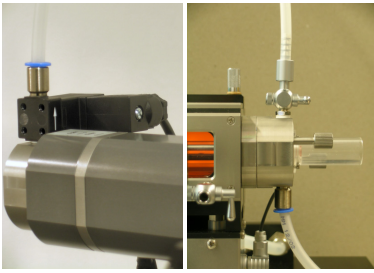
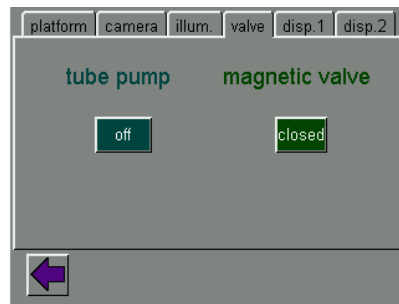


Fig. 122: Connections to the SVT 20

- Attach the tube from the connector PRESSURE on the pump of the LDU/SVT to the quick coupling on the right flow-through adapter fitting.
- Attach the tube from the quick coupling on the left flow-through adapter fitting to the waste bottle.
- Attach the tube with the luer-lock connector to the stopcock on the right flow-through adapter fitting and the other side of the tube to the waste bottle.
- Insert the dosing syringe (e.g. DS 500/GT) already filled with the liquid with the higher density.
- Attach one of the both luer-lock end of the dosing tube (e.g. DT 400/03) to the dosing syringe and the other end to a luer-lock adapter (LL-A).
- Connect the dosing needle to the luer-lock adapter.

## 6.3 LDU/SVT – Control

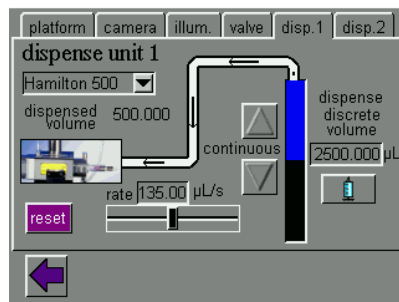
The control of the LDU/SVT will be done by use of the touch panel display integrated in the SVT 20.



Dialog **valve**:

To switch the **tube pump** between **off** and **on** and the **valve** between **open** and **closed**.



If you start the pump, the valve will automatically open.




Dialog **disp. 1** and **disp 2**:

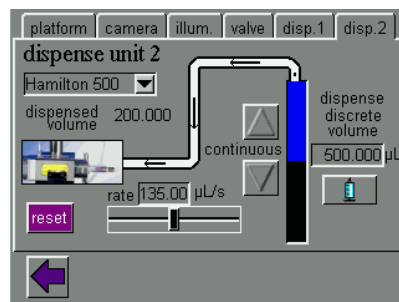
Dialogs for controlling the dosing units 1 and 2 installed in the LDU/SVT. The dialog is only available when a LDU/SVT is present.

Press **Hamilton 500** to select the installed syringe type.

Press and hold the button  or  for continuous dosing.

The dosing rate can be set with the black slider **rate**.

Press the **2500.000 µL** field to open a keyboard, where you can enter the value. The button **reset** will perform a reference run. The button  will dose the discrete volume.





## 6.4 Measurement using a LDU/SVT



If all the installations and preparations, described in the chapters before, were done you can start with the measurement.

The measurement with the aid of the LDU/SVT will be done nearly in the same way than without, except the filling and the cleaning of the capillary.



**Close the software SVTS 20 until the capillary is filled and ready to measure, because the LDU/SVT is controllable only by the touch panel,.**

### 6.4.1 Preparation and filling of CT-SVT

- Open the stopcock on top of the right flow-through adapter.
- Press the button **tube pump** on the touch panel to start the flushing of the liquid with the lower density and close the **magnetic valve** immediately. Now the liquid with the lower density will pump through the right adapter only; this is an approved way to get air bubbles out of the tube and the right flow-through adapter.
- Stop the **tube pump**.
- Tilt the cell completely to the right side by pressing the  button on the touch panel. If the cell is tilted to the right side the air is getting out of the capillary easier.
- Start the **tube pump** again to fill the capillary. Be sure that the **magnetic valve** is open.
- Close the stopcock on top of the right flow-through adapter.
- Let the liquid completely fill the capillary until the liquid drops (over the waste tube) into the waste bottle.
- Stop the filling by pressing the button **tube pump** again.
- Carry out a reference run for the platform by pressing the  button on the touch panel.
- Start now the software SVTS 20.
- Set all required preferences in the software.

### 6.4.2 Measuring the interfacial tension

The measuring of the interfacial tension will be carried out according to the chapter 5 **Measurement page 37 et seq.**

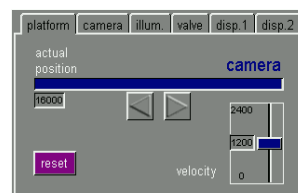


Fig. 123: Tilting of cell

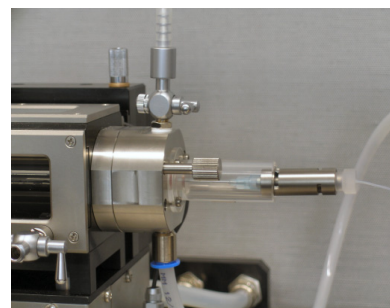


Fig. 124: Insertion of the liquid with the higher density by use of the dosing needle

## 7 OPTIONAL ACCESSORIES AND SPARE PARTS

### 7.1 ET SSR



Fig. 125: ET SSR

**ET SSR** Exchanging Tool for Shaft Sealing Ring of SVT 20 **Part.No: 9000054**

Consisting of:

- Exchanging tool to press the rings out
- 4 shaft sealing rings

### 7.2 SSR



Fig. 126: SSR

**SSR** Shaft Sealing Ring of SVT **Part.No: 8001857**

Set of 4 rings.

To build in the shaft sealing ring you will need an exchanging tool.

### 7.3 Septa, Diameter 7mm

**Septa, Diameter 7mm Part.No: 6000107**

Set of 10 pieces

### 7.4 SNS-D/SV

**SNS-D/SV** Disposable dosing needle for SVT **Part.No: 6000145**

D=0.60 L=80.00 mm

Set of 100 pieces

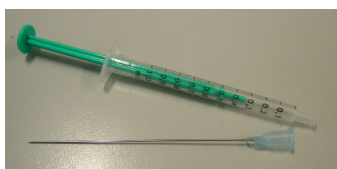


Fig. 127: DS-D 1000 SF and SNS-D/SV

### 7.5 DS-D 1000 SF

**DS-D 1000 SF** Disposable dosing syringe (silicone free) **Part.No: 6000141**

Volume 1000 µl

Set of 100 pieces

### 7.6 DS-D 10000 SF

**DS-D 10000 SF** Disposable dosing syringe (silicone free) **Part.No: 6000168**

Volume 10000 µl

Set of 100 pieces



Fig. 128: DS-D 10000 SF

## 7.7 CT-SVT 1200/800

Ready to use measuring **capillary tube** assembly

- Made of borosilicate glass
- Outer diameter: 12 mm
- Inner diameter: 8 mm
- Length: 229 mm
- Visible length: 54 mm
- Temperature range: up to 130 °C



Fig. 129: Measuring capillary CT-SVT 1200/800

## 7.8 CT-SVT 625/245

Ready to use measuring **capillary tube** assembly

- Made of borosilicate glass
- Outer diameter: 6.25 mm
- Inner diameter: 2.45 mm
- Length: 229 mm
- Visible length: 61 mm
- Temperature range: up to 130 °C



Fig. 130: Measuring capillary CT-SVT 625/245

## 7.9 ECC 1200/800

**ECC 1200/800** Pre-finished **easy clean** measuring capillary assembly

- Made of Borosilicate glass
- Outer diameter: 12 mm
- Inner diameter: 8 mm
- Length: 229 mm
- Visible length: 54 mm
- Temperature range: up to 100 °C

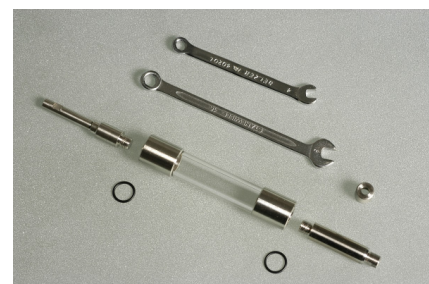


Fig. 131: Easy-clean measuring capillary ECC 1200/800



Fig. 132: Septum and holder for right side of an ECC



Fig. 134: Hollow shaft of ECC with spanner flat on the right side



Fig. 135: O-ring seals in capillary

The ECC will be sealed on the right side by a septum. The septum must be inserted into the holder.

#### Required tools for assembling/disassembling an ECC:

- ✂ Open-ended spanner **G** size 4 mm
- ✂ Open-ended spanner **F** size 5 mm

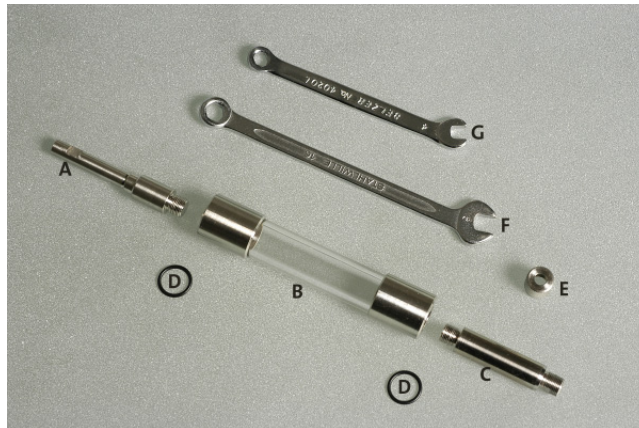


Fig. 133: ECC 1200/800

#### Disassembling of an ECC

The ECC is assembled at delivery. For the easier cleaning the capillary can be taken apart as shown in the figure above.

- Unscrew the drive shaft **A** with the spanner **G**.
- Unscrew the hollow shaft **C** with the spanner **F**.
- Take out the both O-ring seals **D** from the capillary **B**.

#### Assembling of an ECC

After the cleaning of the capillary and of the driving and hollow shaft you can assemble the ECC together.

- Install the both O-ring seals **D** at both sides of the capillary (see figure beside for the post-assembly position of the o-ring).
- Screw in the drive shaft **A** with the spanner **G**.
- Screw in the hollow shaft **C** with the spanner **F**. Please take into account that the side without the spanner flat will fit into the capillary.

The both O-ring seals **D** have an high temperature stability and a strong chemical resistance and have to be replaced only by the original part No. 8003086.

## 8 MAINTENANCE

### 8.1 General

The SVT 20 is continuously rated.



**Internal work on the unit must only be done when the power supply is disconnected and the mains cable has been pulled out!**

**If the unit has a fault, please turn to the service departments of our representatives or to ourselves directly at:**

**Dataphysics** Instruments GmbH

Raiffeisenstraße 34

D-70794 Filderstadt

Tel. ++49 (711) 770556-0

Fax ++49 (711) 770556-99

email [info@Dataphysics.de](mailto:info@Dataphysics.de)

### 8.2 Cleaning of instrument

The coat of varnish of the SVT 20 is resistant to the most common solvents and weak acids.

To clean the housing, use a dry, clean, soft, and fluffiness cloth. With heavy dirt on the housing, use a neutral cleaning liquid on a soft cloth.



**Do not use any chemical products like strong solvents or acids to clean the housing.**

**Make sure that no liquids get into the inside of the housing. This leads to the destruction of the unit and can lead to a hazardous short circuit.**

**The windows are made of special glass and must be handled carefully.**

## 8.3 Trouble shooting

If case that the SVT 20 has a fault please check the following points in table 2:

Table 2: Trouble shooting

Fault / error	Fault repair
SVT 20 without power and LED on power supply off	<ul style="list-style-type: none"> <li>• Check the power source and line.</li> <li>• Check the fuses at the power supply (only with de-connected cables).</li> <li>• Check the correct setting of the voltage selector.</li> </ul>
SVT 20 without power	<ul style="list-style-type: none"> <li>• Switch the SVT 20 on.</li> <li>• Check the power supply cable from power supply to SVT 20.</li> </ul>
SVT 20 camera or tilting position is not the same as shown in software	<ul style="list-style-type: none"> <li>• Carry out a <b>Reset</b> (reference run of camera and tilting table) by use of the touch panel or the software SVTS.</li> </ul>
SVT 20 camera or tilting position is working	<ul style="list-style-type: none"> <li>• Carry out a <b>Reset</b> (reference run of camera and tilting table) by use of the touch panel or the software.</li> </ul>
Chamber's leaking	<ul style="list-style-type: none"> <li>• Exchange the shaft sealing rings.</li> </ul>
Motor blocks	<ul style="list-style-type: none"> <li>• Remove the lock pins.</li> <li>• Adjust the ECC capillary correct.</li> </ul>
Failed to create device (when starting SVTS)	<ul style="list-style-type: none"> <li>• Check both serial cable connections</li> <li>• Switch the SVT 20 off and on again.</li> </ul>
Couldn't detect camera	<ul style="list-style-type: none"> <li>• Check video cable connections</li> <li>• Switch the SVT 20 and the PC off and on again.</li> </ul>

If the SVT 20 doesn't react at all, please consult your sales partner or directly DataPhysics.

## 8.4 Exchange of shaft sealing rings

If the chambers liquid is drop out the cell (at the capillary or motor side) you need to exchange the shaft sealing rings. You should exchange all four rings together, because they wear out equally. The following diagram will show the dependency between the mechanical wear of the shaft sealing rings and the rotational speed.

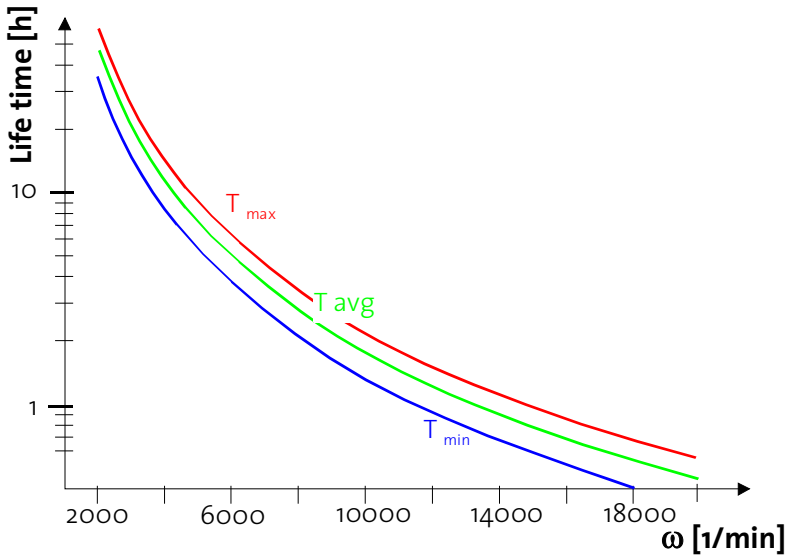


Fig. 136: Lifetime of shaft sealing ring depending on rotational speed

### Required tools for exchanging the shaft sealing rings:

- ✂ Hexagon screwdriver wrench size 2.5 mm and 1.5 mm
- ✂ Phillips screwdriver size 1
- ✂ Open-ended spanner size 7 mm
- ✂ Two lock pins
- ✂ Three **Shaft Sealing Ring for SVT**  
(**Part.No: 8001857**) (4 SSR with a LDU/SVT)
- ✂ **ET SSR** (Exchanging Tool for Shaft Sealing Ring of SVT **Part.No: 9000054**)



**Protect the inside of the SVT 20 with a cloth while working on it.**

**Carry out the following procedure to exchange the shaft sealing rings.**

- Drain the measuring cell (see chapter 3.3.6 Draining of the measuring cell page 16)
- Take off the plastic protection covers from both side of the cell.
- Screw off the holder for the septa from both side of the capillary.
- Take out the bearing flange (holds **Ring 1**) from the right side of the cell.

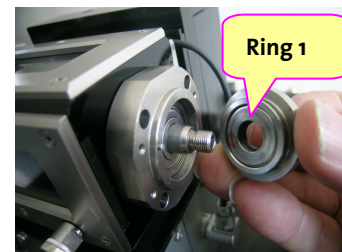
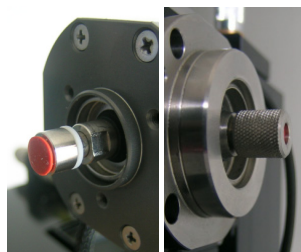
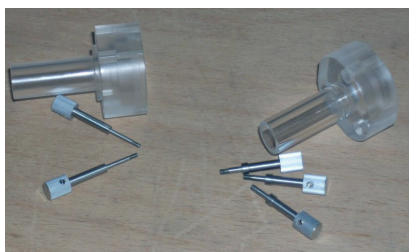


Fig. 142: Protection covers for left and right side    Fig. 143: Septa holder left and right    Fig. 144: Shaft Sealing ring right side

- Insert the both lock pins into the holes beside the funnels; if they do not get in smoothly you must turn the capillary until the pins will slip in by oneself.
- Loosen the capillary by turning the spanner (open-ended spanner size 7 mm) anti-clockwise about **one turn**.
- Unscrew the four screws of the right bearing (Hexagon screwdriver size 1.5 mm).
- Remove the right bearing flange (holds **Ring 2**) carefully without bending the capillary.

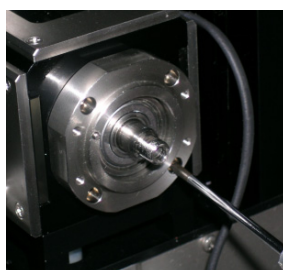
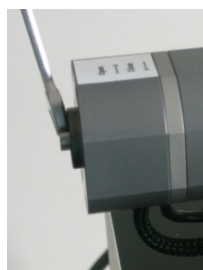


Fig. 137: Lock pins    Fig. 138: Loosening capillary    Fig. 139: Right bearing flange    Fig. 140: Remove bearing flange    Fig. 141: Shaft Sealing ring



- Push on the capillary at the left side (motor housing) and pull out the capillary carefully (avoid any cross forces) from the right side. Please handle the capillary very carefully and bear in mind that it can be very lubricious (from the silicone oil which was in the cell).
- Drain the tubes for cooling the motor.
- Take off the cooling tubes from the back of the motor. For this press the blue ring towards the motor and pull out the tube simultaneously.
- Take off both Sub-D connectors from the cell (below motor housing).
- Unscrew the left quick coupling for the cooling tube from the motor (Hexagon screwdriver size 2.5 mm).

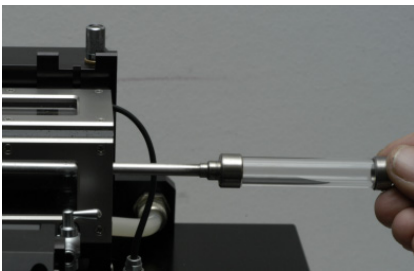


Fig. 145: Removal of capillary

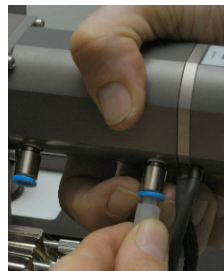


Fig. 146: Pulling out tube

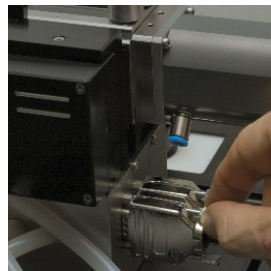


Fig. 147: Sub-D connectors

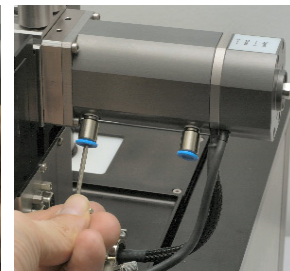


Fig. 148: Left quick coupling

- Unscrew the four screws holding the motor (Hexagon screwdriver size 2.5 mm).
- Take off the motor.
- Unscrew the four screws holding the motor bearing flange (Hexagon screwdriver size 2.0 mm).
- Take off the motor bearing flange (holds **Ring 3**) by simultaneously pulling and twisting.

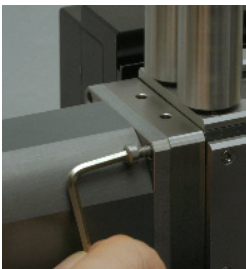


Fig. 149: Motor screws

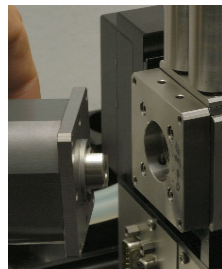


Fig. 150: Take off Motor

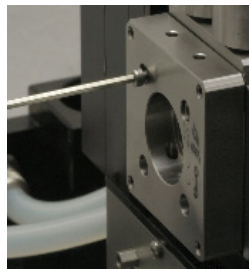


Fig. 151: Bearing cover

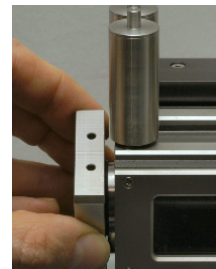


Fig. 152: Twist out cover

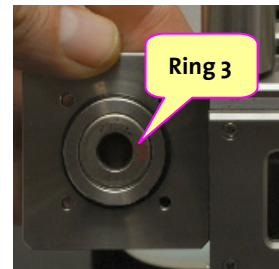


Fig. 153: Bearing cover

- Unscrew the four recessed head screws holding the motor cover (holds **Ring 4**) (Phillips screwdriver size 1) and take it off.
- Now you have four flanges with the built-in shaft sealing rings.

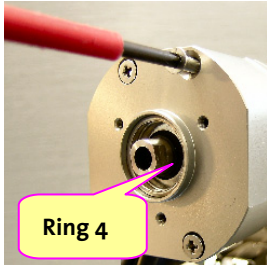


Fig. 154: Motor cap



Fig. 155: Ring 1



Fig. 156: Ring 2

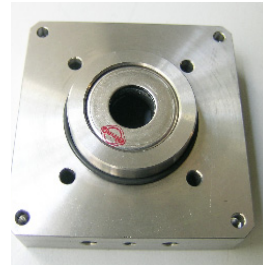


Fig. 157: Ring 3



Fig. 158: Ring 4

- The shaft sealing ring in the motor cap is only necessary when using the flow-through system of the LDU/SVT. Otherwise no liquid must be sealed by this ring; so on a standard SVT 20 it is not necessary to exchange this ring (even though it is wear out).
- Press out the shaft sealing rings from their flanges by use of the **ET SSR** (*Exchanging Tool for Shaft Sealing Ring of SVT*) and a standard hand lever press.
- Position a new shaft sealing ring onto the flange and press it in by use of a standard hand lever press.



Fig. 159: ET SSR + shaft sealing ring



Fig. 160: Pressing out

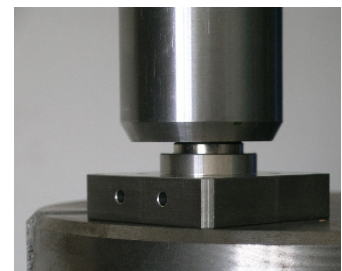


Fig. 161: Pressing in

**To reassemble the measuring cell, the motor, and the capillary please follow the procedure above in reverse order.**

**Please fasten the screws of the bearing cover, the motor and the bearing flange crosswise!**



**Be sure that both lock pins are removed, the capillary is clamped taut and can rotate smoothly before you reconnect the power source.**

**The SVT 20 must never be operated if the capillary is clamped!**

## 9 APPENDIX

### 9.1 Literature

The wealth of experience and knowledge about surface and colloid chemistry can be found in our selection of current standard literature in the internet at

[www.dataphysics.de](http://www.dataphysics.de).

In the following you will find some literature references.

Basic Spinning Drop Science:

B. VONNEGUT, Rotating Bubble Method for the Determination of Surface and Interfacial Tensions, *Rev. Sci. Instrum.* 13 (1942) 6 – 9 (ISSN 0034-6748)

J.L. CAVIAS, R. S. SCHECHTER, W.H. WADE, The measurement of low interfacial tension via the Spinning Drop Technique, in K.L. Mittal (Ed.), *Adsorption at Interfaces*, ACS Symposium Series, 8 (1975) 234 – 247, (ISBN 0-8412-0249-4)

H.M. Prinzen, I.Y.Z. Zia, S.G. Mason, Measurement of Interfacial Tension from the Shape of a Rotating Drop, *J. Colloid Interf. Sci.* 23 (1967) 99 – 107 (ISSN 0021-9797)

A.M. Seifert, Spinning Drop Tensiometry (Review), in D. Mobius and R. Miller (Eds.), *Drops and Bubbles in Interfacial Research*, Amsterdam, 1998 (ISBN 0-444-82894-X)

A.I. Rusanov, V.A. Prokhorov, Methods using Rotation Field (Chapter 7) in: *Interfacial Tensiometry*, Amsterdam, 1996, (ISBN 0-444-82128-7)

C. D. Manning, L. E. Scriven, On interfacial tension measurement with a spinning drop in gyrostatic equilibrium, *Rev. Sci. Instrum.*, 48 (1977), 1699 – 1705 (ISSN 0034-6748)

Application Related:

Y.C. Chiu , P.R. Kuo, An empirical correlation between low interfacial tension and micellar size and solubilization for petroleum sulfonates in enhanced oil recovery, *Colloids and Surfaces A*, 152 (1999) 235 – 244 (ISSN 0927-7757)

L. Cash et al., The Application of Low Interfacial Tension Scaling Rules to Binary Hydrocarbon Mixtures, *J. Colloid Interf. Sci.* 59 (1977) 39 – 44 (ISSN 0021-9797)

J.L. Cayias, R.S. Schechter, W. H. Wade, The Utilization of Petroleum Sulfonates for Producing Low Interfacial Tensions between Hydrocarbons and Water, *J. Colloid Interf. Sci.* 59 (1977) 31 – 38 (ISSN 0021-9797)

P.H. Doe, W. H. Wade, R.S. Schechter, Alkyl Benzene Sulfonates for Producing Low Interfacial Tensions between Hydrocarbons and Water, *J. Colloid Interf. Sci.* 59 (1977) 525 – 531 (ISSN 0021-9797)

R.P. Gee, Oil-in-water microemulsions from association structures of surfactant, water and aminosilicone polymer oil, *Colloids and Surfaces A*, 137 (1998) 91 – 101 (ISSN 0927-7757)

G. Pieper, H. Rehage, D. Barthès-Biesel, Deformation of a Capsule in a Spinning Drop Apparatus, *J. Colloid Interf. Sci.* 202 (1998) 293 – 300 (ISSN 0021-9797)

Husmann, M.; Rehage, H.; Dhenin, E.; Barthes-Biesel, D. Deformation and bursting of nonspherical polysiloxane microcapsules in a spinning-drop apparatus. *J. Colloid Interf. Sci.* 282 (2005) 109 – 119

## 9.2 Technical data

<b>Interfacial tension</b>	<ul style="list-style-type: none"> <li>• <math>1 \cdot 10^{-6} \dots 2 \cdot 10^3</math> mN/m</li> </ul>
<b>Speed range</b>	<ul style="list-style-type: none"> <li>• 0 ... 20 000 rpm; resolution: <math>\pm 0.001</math> rpm</li> <li>• long term stability of the absolute rotational speed: <math>\pm 0.5</math> rpm</li> <li>• Maximum speed step in relaxational tests: max. <math>\pm 2000</math> rpm/s</li> <li>• Oscillation frequency: 0.01 ... 200 Hz at minimum speed of 3000 rpm</li> </ul>
<b>Tilt angle of the capillary block</b>	<ul style="list-style-type: none"> <li>• <math>\pm 10^\circ</math>; resolution: <math>0.0023^\circ</math></li> </ul>
<b>Optics</b>	<ul style="list-style-type: none"> <li>• Six-fold zoom lens (0.7 ... 4.5-fold magnification) with integrated fine focus (<math>\pm 6</math> mm) and high light transmitting capacity</li> <li>• CCD-camera with a resolution of max. 768 x 576 pixels,</li> <li>• Field of view (FOV): 1.9 x 1.4 to 12.1 x 9.1 mm</li> <li>• Optical distortion: <math>&lt; 0.05\%</math></li> </ul>
<b>Video system</b>	<ul style="list-style-type: none"> <li>• Up to 50 images/s digitizing speed</li> <li>• High-performance image processing system with 132 MBytes/s data transfer rate (compatible to European standard CCIR and US standard RS-170)</li> </ul>
<b>Measuring methods</b>	<ul style="list-style-type: none"> <li>• Spinning Drop-Method (SVTS 20)</li> <li>• Oscillating Spinning Drop-Method (SVTS 21)</li> </ul>
<b>Diameter of capillary</b>	<ul style="list-style-type: none"> <li>• outer 12 mm, inner 8 mm (optional: outer 6.25 mm, inner 2.45 mm)</li> </ul>
<b>Temperature measurement and range</b>	<ul style="list-style-type: none"> <li>• 2x Pt100 input for <math>-60 \dots 450</math> °C (Pt100 optional), 0.1 K resolution; 1/3 DIN IEC 751 (<math>\pm 0.03</math> %), class B</li> <li>• Temperature range: <math>-10 \dots 130</math> °C</li> </ul>
<b>Dimensions (L x W x H)</b>	<ul style="list-style-type: none"> <li>• 390 x 390 x 400 mm</li> </ul>
<b>Weight</b>	<ul style="list-style-type: none"> <li>• 35 kg (base unit SVT: 25 kg, power supply module: 10 kg)</li> </ul>
<b>Power supply</b>	<ul style="list-style-type: none"> <li>• 100 ... 240 VAC; 50 ... 60 Hz; 450 VA</li> </ul>

## 9.3 Terms of Guarantee

Dataphysics guarantees the faultless functioning of this unit provided it is used and serviced appropriately and is connected and handled in accordance with these operating instructions.

The guarantee is for two years from the date of delivery.

The place of the guarantee fulfilling is the respective representative or Dataphysics in Filderstadt, Germany

All guarantee and damage claims of the customer are forfeited if he has improperly treated the supplied unit or has supplemented or worked on it or given it to a third party for subsequent reconditioning without our prior approval.

Dataphysics entire liability and your exclusive remedy shall be at Dataphysics option, either **a)** return of the price paid or **b)** repair or replacement of the unit that does not meet Dataphysics limited guarantee and is returned to Dataphysics together with a copy of the receipt. This limited guarantee is void if failure of the unit has resulted from accident, abuse, or misapplication. Any replacement delivery will only be warranted by Dataphysics for the remainder of the original guarantee period or 30 days, whichever is longer.

Dataphysics disclaims all further warranties with respect to the unit, and the accompanying manuals and written materials.

Dataphysics and its suppliers shall not be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising from the use or inability to use this Dataphysics product, even if Dataphysics has been advised of the possibility of such damages. In any case, Dataphysics entire liability shall be limited to the amount actually paid by you for this product. This limitation does not apply to damages which were caused by Dataphysics on intent or by gross negligence. Likewise, claims remain unaffected which are based on mandatory legal rules regarding product liability.

Furthermore, the guarantee conditions of the 'General conditions of supply for products and services of the electrical industry' of the 'Zentralverband Elektrotechnik- und Elektronikindustrie (ZVEI) e. V., Stresemannallee 19, D-60596 Frankfurt am Main' apply.

## 9.4 Requirements of the mains cable

The power supply of the SVT 20 enable operation at a voltage supply with 90 ... 264 Volts Alternating Current (43 ... 60 Hz).

The mains cable delivered with your SVT 20 may not meet the requirements of the country in which you are using the system.



**You must, without fail, use a mains cable which meets the requirements of the relevant country or the local Electricity Board.**

The following information explains the requirements which are to be taken into account when choosing a mains cable.

### General information

- \* The mains cable must be permitted (authorized) for the country in which it is used.
- \* The mains cable should be at least 2 m and at most 3 m long.

### USA and Canada

- \* The mains cable must have the UL release and the CSA certificate
- \* For the cable, the following minimum requirements apply:
  - No. 12 AWG; 3.2 mm<sup>2</sup>; outer 10.9 mm<sup>2</sup>
  - Type SV or comparable
  - 3 phase
- \* The cable must have a nominal current-carrying capacity of at least 20 A.
- \* The mains plug must be shock proof plug of the type NEMA 5-15P (15A, 125V) or NEMA 6-15P (15 A, 250 V).

### Other countries

- \* The connectors of the mains cable must carry the approval certificate of the respective country (see table below):

BSI (Great Britain)	NEMKO (Norway)
CEBEC (Belgian)	OVE (Austria)
DEMKO (Denmark)	SEMKO (Sweden)
EANSW (Australia)	SETI (Finland)
IMQ (Italy)	SEV (Switzerland)
KEMA (Netherlands)	UTE (France)
VDE (Germany)	

- \* The cable must be a three-phase HAR cable of the type HO5VV-F3 with a minimum phase-diameter of 2.5 mm<sup>2</sup>.
- \* The mains cable must have a minimum current-carrying capacity of 20 A and according to the country, have a nominal voltage of 125 V or 250 V Alternating current.

## Japan

In Japan the following cable types and connected loads are required:

- \* All parts of the cable (cable, box, and plug) must have the trademark and the registry number according to the Japanese Dentori Law.
- \* The following minimum requirements apply to the cable:
  - 3.2 mm<sup>2</sup>
  - Type VCT or VCTF
  - 3 phase
- \* The cable must have a nominal current-carrying capacity of at least 20 A
- \* The mains plug must be a 2 pin shock-proof plug according to the Japanese Industrial Standard (15 A, 125 V).



## 9.5 Declaration of conformity

**EG-KONFORMITÄTSERKLÄRUNG**  
**DECLARATION OF CONFORMITY**  
**DÉCLARATION DE CONFORMITÉ**

Wir bestätigen, dass das Produkt / We confirm that the product / Nous confirmons que le produit

**Spinning Drop Tensiometer SVT 20**

den Schutzanforderungen entspricht, die in der EU-Richtlinie 89/336/EWG zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die Elektromagnetische Verträglichkeit festgelegt sind. / is in conformity with the EC directive 89/336/E.E.C. according to the Electromagnetic Compatibility. / est conforme aux obligations de protection définies dans la directive C.E. 89/336/C.E.E. pour une harmonisation des prescriptions des états membres relatives à la compatibilité électromagnétique.

Diese Erklärung gilt für alle Exemplare, die nach den anliegenden technischen Unterlagen - die Bestandteil dieser Erklärung sind - hergestellt werden. / This declaration is valid for all products which are produced in accordance with the technical documentation which is part of this declaration. / Cette déclaration est valable pour tous les exemplaires qui ont été fabriqués selon les documents techniques ci-joints faisant parties intégrantes de cette déclaration.

Zur Beurteilung des Erzeugnisses hinsichtlich der Elektromagnetischen Verträglichkeit wurden die folgenden Vorschriften angewendet: / For verification of conformity with regard to Electromagnetic Compatibility the following standards are applied: / Pour la vérification du produit en regard de la compatibilité électromagnétique, les prescriptions suivantes ont été appliqués:

- EN 50081-1 (1992) Fachgrundnorm Störaussendung (Wohnbereich)  
Generic emission standard, residential environment  
Norme générique émission, environnement résidentiel
- EN 50082-1 (1993) Fachgrundnorm Störfestigkeit (Wohnbereich)  
Generic emission standard, residential environment  
Norme générique émission, environnement résidentiel

Diese Erklärung wird verantwortlich für den Hersteller: / This declaration is given under sole responsibility of: / Cette déclaration engage le constructeur:

**Dataphysics Instruments GmbH**

Raiffeisenstrasse 34


D-70794 Filderstadt

abgegeben durch: / from: / émis par:

Herrn /Mr. /M. Torsten Holz

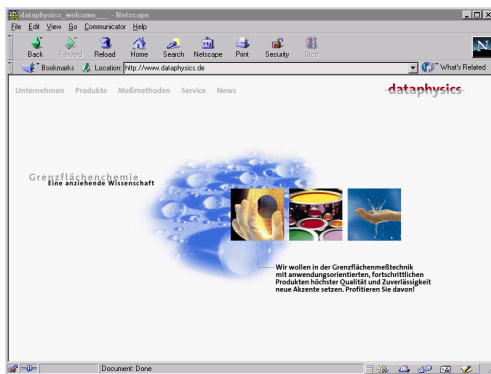
Entwicklungsleiter / Development Manager / Directeur développement

D-70794 Filderstadt 03 - 09 - 2001 Unterschrift / Signature





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