

Digital Hydrometer **SBS-3500**

INSTRUCTION
MANUAL



Storage Battery Systems LLC • Instruction Manual for SBS-3500 Digital Hydrometer • Rev. 09-15

Test Equipment Depot - 800.517.8431 - 99 Washington Street Melrose, MA 02176

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1. About the Instruction Manual

This instruction manual informs you about the installation and the safe handling and use of the product. Pay special attention to the safety instructions and warnings in the manual and on the product.

The instruction manual is a part of the product. Keep this instruction manual for the complete working life of the product and make sure it is easily accessible to all people involved with the product.

Conventions for Safety Messages

The following conventions for safety messages are used in this instruction manual:

	DANGER Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

A notice indicates a situation which, if not avoided, could result in damage to property.

TIP *Tip gives extra information about the situation at hand.*

Typographical Conventions

The following typographical conventions are used in this instruction manual:

Convention	Description
<key>	The names of keys and buttons are written inside angle brackets.
“Menu Level 1 > Menu Level 2”	Menu paths are written in bold, inside straight quotation marks. The menu levels are connected using a closing angle bracket.

2. Safety Instructions

- Read this instruction manual before using the portable density meter SBS-3500.
- Follow all hints and instructions contained in this instruction manual to ensure the correct use and safe functioning of the SBS-3500.

Liability

- This instruction manual does not claim to address all safety issues associated with the use of the instrument and samples. It is your responsibility to establish health and safety practices and determine the applicability of regulatory limitations.
- Storage Battery Systems LLC only warrants the proper functioning of SBS-3500 if no adjustments have been made to the mechanics, electronics, or firmware.
- Only use the SBS-3500 for the purpose described in this instruction manual. Storage Battery Systems LLC is not liable for damages caused by incorrect use of the SBS-3500.

Installation and Use

- The SBS-3500 is **not** an explosion-proof instrument and therefore must not be operated in areas with risk of explosion. The SBS-3500 is not designed for use with petroleum based liquids.
- Never remove the pump lock and battery cover in hazardous areas. Only exchange the batteries outside of hazardous areas.
- The installation procedure shall only be carried out by authorized personnel who are familiar with the installation instructions.
- Do not use any accessories or wearing parts other than those supplied or approved by Storage Battery Systems LLC.
- Make sure all operators are trained to use the instrument safely and correctly before starting any applicable operations.
- In case of damage or malfunction, do not continue operating the SBS-3500. Do not operate the instrument under conditions which could result in damage to goods and/or injuries and loss of life.
- Check the SBS-3500 for chemical resistance to the samples and cleaning liquids.
- Do not expose the instrument to temperatures below 0 °C (32 °F) if water is contained in the measuring cell or pump (freezing water will cause rupture of the measuring cell).
- The SBS-3500 is not insulated against high voltages. Measuring samples under high voltage (e.g. in energized battery banks) bears the risk of an electric shock. Define appropriate testing procedures and safety measures to protect yourself from any electric shock.

Maintenance and Service

- The results delivered by SBS-3500 not only depend on the correct functioning of the instrument, but also on various other factors. We therefore recommend you have the results checked (e.g. plausibility tested) by skilled personnel before consequential actions are taken based on the results.
- Service and repair procedures may only be carried out by authorized personnel or by Storage Battery Systems.
- If your instruments needs repair, contact your local Storage Battery Systems LLC representative.

Disposal

- Observe the legal requirements in your country or state.

Precautions for Highly Flammable Samples and Cleaning Liquids

- Observe and adhere to your national safety regulations for handling the measured samples (e.g. use of safety goggles, gloves, respiratory protection etc.).
- Only store the minimum required amount of sample, cleaning liquids and other inflammable materials near SBS-3500.
- Do not leave sample/rinsing containers uncovered. Clean all spillages immediately.
- Make sure that the setup location is sufficiently ventilated. The environment of SBS-3500 must be kept free of flammable gases and vapors.
- Supply a fire extinguisher.

3. Measuring Principle

Definition of Density

The density ρ of a sample is defined as its mass divided by its volume:

$$\rho = \frac{m}{V}$$

Density is a temperature-dependent measuring unit.

The Oscillating U-Tube Principle

The sample is introduced into a U-shaped borosilicate glass tube that is being excited to vibrate at its characteristic frequency electronically. The characteristic frequency changes depending on the density of the sample. Through determination of the characteristic frequency the density of the sample can be calculated. Due to the temperature dependency of the density value, the temperature of the sample has to be determined precisely.

Concentration Measurement

In binary mixtures, the density of the mixture is a function of its composition. Thus, by using density/concentration tables, the density value of a binary mixture can be used to calculate its composition.

This is also possible with so-called quasi binary mixtures. These are mixtures containing two major components and some additional ones which are present in very small concentrations compared to the two main components. Many decarbonated soft drinks, for example, can be considered to be quasi binary mixtures of sugar in water because the concentration of flavors and acids are very small compared to sugar and water. Thus, the sugar concentration can be measured with a density meter.

4. Overview of SBS-3500 Hydrometer

The portable density meter SBS-3500 measures the density of liquids in g/cm^3 or kg/m^3 according to the oscillating U-tube principle. Apart from density you can select various further measuring units (relative density, density at reference temperature, concentrations). A temperature sensor measures the sample temperature right at the measuring cell. The temperature is displayed and can be used internally for automatic temperature compensation of the density reading if required.

Owing to the lightweight and compact design one can easily perform measurements of usually difficult accessible samples. The backlight of the display ensures clear visibility of results, even in dark surroundings. The backlight of the oscillator at the same time enables to observe the filling process in detail.

Samples are filled into the measuring cell using the built-in pipette-style pump or a syringe. You can allocate sample IDs to your samples for easier identification. You can also define and store different measuring methods allowing acceleration of repeatedly performed standard measurements.

The SBS-3500 is operated via seven keys. 1024 measured data including date, time and sample ID can be stored in the memory of the SBS-3500 density meter and can be recalled, exported to a PC or printed later. The transfer of the stored measured data to a printer or PC is done wireless using an infrared interface (IrDA).

5. Checking the Supplied Parts

The SBS-3500 hydrometer was tested and packed carefully before shipment. However, damage may occur during transport.






- Keep the packaging material (box, foam piece) for possible returns and further questions from the transport company or insurance company.
- Check the delivery for completion by comparing the supplied parts to those given in Table 5.1.
- If a part is missing, contact your Storage Battery Systems representative.
- If a part is damaged, contact the transport company and your Storage Battery Systems representative.



Fig. 5 - 1 Supplied items

- 1 ... SBS-3500 density meter
- 2 ... IrDA USB adapter
- 3 ... Plastic syringes 2 mL
- 4 ... Luer adapter 1/4" UNF (for syringe filling)
- 5 ... Filling tube (standard 180 mm)

Table 5.1: Supplied Parts

Symbol	Pcs.	Description	Part No.
	1	SBS-3500 Portable Density Meter	SBS-3500
	1	Instruction Manual (English)	
	1	Filling Tube (standard 180 mm)	SBS-3500-TUBE
	1	Luer Adapter 1/4" UNF (for syringe filling)	
	10	Plastic Syringes 2 mL	

6. Description of the Instrument

6.1 Front View



Fig. 6 - 1 Front view of SBS-3500





- 1 ... Built-in pump
- 2 ... Screw plug
- 3 ... Measuring cell
- 4 ... Softkeys
- 5 ... Operating keys
- 6 ... Graphical, monochrome LC display



Fig. 6 - 2 Top view of SBS-3500

- 1 ... Built-in pump
- 2 ... Fixing screw of the pump lock
- 3 ... Pump lock
- 4 ... Infrared interface (IrDA)

Keys on the Front of the SBS-3500

	For switching the instrument on and off.
	For deleting measured data, entries and characters during an entry.
	Softkeys for selecting menu items and for navigation. The function of the right softkey can be configured.
	Arrow keys for navigation within the menu and for the entry of characters.

TIP For faster up and down navigation, keep the arrow keys pressed.


6.2 Rear View



Fig. 6 - 3 Rear view of SBS-3500

- 1 ... Data storage key
- 2 ... Type plate with serial number
- 3 ... Custom functions (optional)
- 4 ... Mark for the correct battery insertion
- 5 ... Calibration number (optional)

Key on the Back of the SBS-3500

	For starting a measurement and storing results in the memory
---	--

6.3 Display

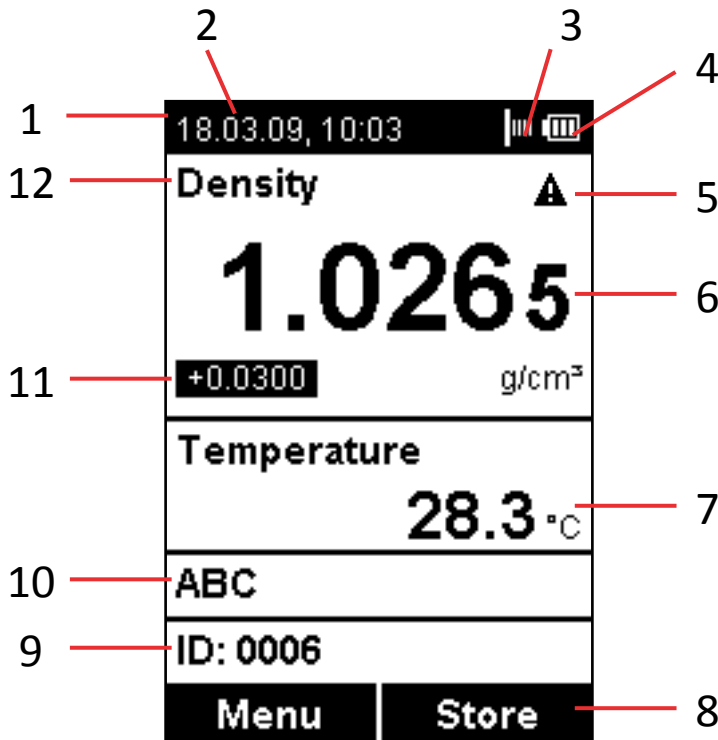





Fig. 6 - 4 Display of SBS-3500

- 1 ... Information header
- 2 ... Date and time
- 3 ... Symbol for infrared data transfer
- 4 ... Symbol for battery charge status
- 5 ... Warning sign
- 6 ... Measuring value
- 7 ... Sample temperature °C/°F
- 8 ... Softkey configuration
- 9 ... Sample ID
- 10 ... Method
- 11 ... Custom offset
- 12 ... Measuring unit

Symbols on the Display

	<p>The infrared data transfer symbol is shown on the information header when data is imported or exported via the IrDA interface.</p>
	<p>The battery charge status symbol informs you about the battery charge status of your instrument. For further information on difference charge status symbols and their meanings, see Chapter 12.1.</p>
	<p>The warning sign indicates that a measured value is outside range specifications. The warning sign is always shown together with an information (press the right softkey) stating the warning type (for details about warning types, see Chapter 14).</p>

TIP *You can change between the <Info> softkey which is displayed together with the warning sign and the original softkey configuration by pressing the arrow keys.*

7. Operating the SBS-3500

NOTICE

Standard tolerances in dimensions of AA batteries might result in some rattling noise coming from the battery compartment when moving the instrument. This has no negative influence on the operation of the instrument.

NOTICE

Protect the instrument against any collision or strong shock as this may lead to a malfunction of the instrument and breakage of the measuring cell.

7.1 Connecting the Filling Tube

- Screw in the filling tube by hand until you feel some resistance against turning. Do not use any tools for screwing in the filling tube.




Fig. 7 - 1 Connecting the filling tube


7.2 Attaching the Syringe Adapter

1. Remove the screw plug at the side of the instrument.
2. Screw in the Luer adapter (see Chapter 5) by hand until you feel some resistance against turning. Do not use any tools for screwing in the Luer adapter.

7.3 Switching the Instrument On

- To switch the instrument on, press the  key for approximately two seconds until the instrument beeps and shows the welcome screen. After showing the welcome screen, the SBS-3500 immediately switches to the main screen (measuring mode). Now you can start with the measuring process.

7.4 Switching the Instrument Off

- To switch the instrument off, press the  key until "Power Off" is displayed. If the instrument is in the energy saving mode (see Chapter 8.4), the SBS-3500 switches automatically off after 3, 5 or 10 minutes inactivity (depending on the setting).

8. Defining the Basic Settings

8.1 Language Settings

You can choose between four different menu languages:

1. Press <Menu> and select "Setup > Language".
2. Select the preferred language and press <OK>.

8.2 Units

1. Press <Menu> and select "Setup > Units".
2. Select the preferred density unit (g/cm³, kg/m³ or lb/gal) and press <OK>.
3. Select the preferred temperature unit (°C or °F) and press <Save>.

8.3 Sound Settings

When sound is enabled, the SBS-3500 beeps when it is switched on and off and when a key is pressed.

When sound is disabled, the instrument only beeps when it is switched on and off.

1. Press <Menu> and select "**Setup > Beep**".
2. Select the preferred setting (Beep on/off) and press <Save>.

8.4 Energy Saving Mode

Enabling the energy saving mode lowers the power consumption of the instrument and thus extends battery life. When the energy saving mode is enabled, the instrument will automatically switch itself off after 3, 5 or 10 minutes of inactivity.

When the energy saving mode is disabled, the instrument will remain switched on until it is turned off using the



key.

1. Press <Menu> and select "**Setup > Energy Saving**".
2. Select the preferred setting (Off, 3, 5 or 10 minutes) and press <Save>.

8.5 Backlight

The LCD display and the oscillator are equipped with a backlight. The backlight ensures that even under bad lighting conditions the measuring results and menu options are easily readable. The backlight of the oscillator enables you to observe the filling process.

You can choose between "Auto", "Off" and "On":

Auto	The backlight automatically turns on when a key is pressed or when a new sample is filled into the measuring cell. To activate the backlight without accessing the menu, press an arrow key. The backlight switches off automatically after 30 seconds.
Off	The backlight is permanently off.
On	The backlight is permanently on.

TIP *Having the backlight turned on permanently will shorten battery life.*

1. Press <Menu> and select "**Setup > Backlight**".
2. Select the preferred setting (Auto, Off, On) and press <Save>.

8.6 Contrast Settings


The display contrast can be freely adjusted to suit your preference.

Press <Menu> and select **"Setup > Display Contrast"**.
Select the preferred setting (-8 to +8) and press <Save>.

8.7 Allocation of the Softkey Function

On the front side of SBS-3500 are two softkeys. When the instrument displays the main screen, the left softkey always takes you to the main menu. The right softkey can be allocated with one out of five predefined functions. The allocated function is only available in the main screen.

The functions available are "ID", "Method", "Store" and "Print".

ID	Opens the sample ID list to select an ID for the following measurement.
Method	Opens the method list to select a method for the following measurement.
Store	Provides the same functionality as the  key on the back of the instrument and starts and stores a measurement.
Print	Enables immediate print-out of the measured value using the IrDA interface.

1. Press <Menu> and select "Setup > Softkey".
2. Select the preferred setting (ID, Method, Store, Print) and press <Save>.

8.8 Password Protection

You can protect your instrument with a password according to your demands. If the password protection is enabled, the password needs to be entered before changing the settings, before performing an adjustment and before selecting a measuring unit.

For performing measurements as well as entering, changing or deleting measuring methods or sample IDs no password entry is required.

You can anytime change the password later on or disable password protection entirely. Keep your password information safe.

To set, change or delete a password

1. Press <Menu> and select **"Setup > Set Password"**.
2. If your instrument is already password protected, enter your current password.
3. Enter your new password using the arrow keys and press <Continue>.
4. If you want to disable the password protection entirely, enter <0000> as the new password and press <Continue>.
5. Enter the password again and press <Save>.

8.9 Date and Time Settings

During operation the information header always displays the current date and time.

To set date and time

1. Press <Menu> and select "**Setup > Date and Time > Set Date and Time**".
2. Enter the current day, month and year using the arrow keys and confirm each of your selections by pressing <OK>. The cursor moves to the next value to be set.
3. Press <Save>. Now the time settings are displayed on the screen.
4. Repeat the procedure to enter the current time and press <Save>.

To set the date format

1. Press <Menu> and select "**Setup > Date and Time > Date Format**".
2. Select the preferred date format and press <OK>.

To set the time format

1. Press <Menu> and select "**Setup > Date and Time > Time Format**".
2. Select the preferred time format and press <OK>.

9. Exchanging Data with a PC

Your SBS-3500 features wireless data transfer from and to a PC via the integrated IrDA interface. You need a PC with an infrared interface or a PC with an IrDA USB adapter installed and connected. Contact your Storage Battery Systems LLC representative if you need an IrDA USB adapter for your PC.

9.1 Establishing a Connection to a PC

1. If your PC has no IrDA interface, install the IrDA USB adapter on your PC.
2. Hold the IrDA interface of SBS-3500 to the IrDA interface of your PC to establish communication between the two instruments.
3. Continue with Chapter 9.2 or Chapter 9.3.

9.2 Exporting Data to a PC

The following data can be exported from your instrument to a PC:

- Measured data (see Chapter 10.9 for further options how to export measured data)
 - Custom functions (custom-specific measuring units)
 - Adjustment data (currently valid adjustment)
 - Device information
 - Sample ID list
 - Method list
 - System settings (backup copy of instrument)
1. Establish a connection between the SBS-3500 and the PC (see Chapter 9.1).
 2. Press <Menu> and select **“Setup > Import / Export > Send to PC”**.
 3. Select the type of data you want to export. A dialog window appears on your PC asking if you want to accept the file.
 4. Click <Yes>. The selected data are transferred and filed on the desktop.

9.3 Importing Data from a PC

The following data can be imported from a PC to your instrument:

- Custom functions
 - Sample ID list
 - Method list
 - Firmware updates
1. Establish a connection between the SBS-3500 and the PC (see Chapter 9.1).
 2. Press <Menu> and select **“Setup > Import / Export > Receive from PC”**.
 3. On the PC, right mouse-click on the file you want to send and select **“Send to > A nearby computer”**.

The selected file is transferred to the instrument.

10. Performing a Measurement

General Instructions for Measuring



WARNING

Handling samples with temperatures of more than 70 °C bears the danger of heavy burns.

- Make sure you wear protective clothes or ensure alternative protection from burns when handling high temperature samples.



WARNING

The SBS-3500 is not insulated against high voltages. Measuring samples under high voltage (e.g. in energized battery banks) bears the risk of an electric shock.

- Define appropriate testing procedures and safety measures to protect yourself from any electric shock.

NOTICE

Before performing a measurement, make sure that the wetted parts are resistant to the sample (see Chapter 16).

NOTICE

Sample containing dissolved CO₂ will cause bubbles within the measuring cell with the effect of invalid measurement results. Make sure your sample is degassed carefully.

Degassing a sample can be done by:

- Boiling the sample for several minutes,
- Stirring the sample for 5 to 15 minutes until no bubbling occurs any more or
- Putting the sample for approximately 5 to 10 minutes into an ultrasonic bath.

-
- Make sure that the measuring cell is filled free from gas bubbles. Possible reasons for gas bubbles in the measuring cell are:
 - Gas bubbles in the sample
 - Leaky connection of the filling tube, the pump or the screw plug
 - Make sure that the measuring cell is fully filled.
 - Make sure that the sample temperature does not deviate too strongly from the ambient temperature.

If the sample measured is outside the temperature specifications (0 to +40 ° C), the display shows the warning sign until the sample has reached a measurable temperature. If the measured value is nevertheless saved, it is shown with an exclamation mark.

- Make sure to carefully clean the instrument after each measurement series to avoid deposits in the measuring cell.
- Make sure that suitable solvents for cleaning are available.

TIP *Your filled sample is continuously measured and the measuring result is displayed. By storing the measuring result, you can print it or export it to a PC later.*

10.1 Selecting the Measuring Unit

For measuring your samples you can choose between a number of predefined measuring units or you can import custom functions into the instrument and select one of them as the measuring unit. Contact your SBS representative to obtain a custom function from Storage Battery Systems LLC.

All measuring units are derived from the density of the sample at the measured temperature.

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1. Press <Menu> and select “**Measuring Units**”. The list of the predefined measuring units is displayed.
2. Select the preferred measuring unit and press <OK>. Some measuring units contain subitems with options to be selected.
3. Select the preferred option and press <OK>.

10.1.1 Categories of Measuring Units

For further details, see Appendix B.

Meas. Units	Options	Description
Density	Density	Density at the displayed measuring temperature in g/cm ³ , kg/m ³ or lb/gal.
	Density @ xx °C: α (g/cm ³ /K)	Density at the chosen reference temperature in g/cm ³ , kg/m ³ or lb/gal. The temperature influence is compensated by the set temperature coefficient α.
	Specific Gravity SG: SG Temp. (°C or °F) α (g/cm ³ /K)	Specific gravity is the density of the sample (at the chosen reference temperature) divided by the density of water (at the chosen reference temperature). The temperature influence is compensated by the set temperature coefficient α (g/cm ³ /K)
Alcohol	Alcohol % v/v @ 20°C	Concentration of an ethanol/water mixture in % by volume at 20°C
	Alcohol % w/w	Concentration of a mixture of alcohol and water in % by weight.
	Alcohol US @ 60°F (°Proof)	Degrees Proof at 60°F
API	API Gravity A API Gravity B API Gravity D	API number for the product group referred to the reference temperature of 15°C, 20°C, 29.5°C or 60°F. Product Group A: Crude Oil Product Group B: Fuels Product Group D: Lubricants
	API SG A API SG B API SG D	Specific gravity for the product group referred to the reference temperature of 15°C, 20°C, 29.5°C or 60°F.
	API Density A API Density B API Density D	Density of the product group in g/cm ³ with regard to the reference temperature of 15°C, 20°C, 29.5°C or 60°F.
Baumé	α (g/cm ³ /K)	Degrees Baumé at 60 °F. Temperature influence is compensated by the set temperature coefficient α. For determining degree Baumé there are two different calculation methods depending on whether the density is above or below the density of water. Depending on the density of the measured liquid, SBS-3500 automatically switches between the two calculation methods.
H2SO4	H2SO4 % w/w	Concentration of sulfuric acid or battery acid in % by weight.
	H2SO4 @ 20°C	Density of sulfuric acid or battery acid at 20°C.
Sugar	Brix	Degrees Brix (sucrose concentration in % by weight).
	Extract (°Plato)	Degrees Plato.
Custom Functions	--	Optional custom functions. Contact your Storage Battery Systems LLC representative to obtain a custom function.
Period	--	Period value of the oscillator at the measuring temperature.
Raw Data	--	Period value and resistance of the temperature sensor (only for service purposes).

10.1.2 Calculating a Temperature Coefficient

A temperature coefficient α (g/cm³/K) is needed for the calculation of some measuring units at a certain reference temperature.

The temperature coefficient can be calculated as follows:

$$\text{Temperature Coefficient} = \left| \frac{\rho_1 - \rho_2}{T_1 - T_2} \right|$$

ρ_1 ... Density at temperature T_1

ρ_2 ... Density at temperature T_2

Typical temperature coefficients:

Numerous aqueous solutions from 0 to approx. 20 %	0.0003
Numerous aqueous solutions from 10 to approx. 50 %	0.0005
Numerous organic solutions	0.001

10.1.3 Importing Custom Functions

In addition to the predefined measuring units, you can import up to ten custom functions to the instrument and select one of these as the measuring unit.

To do this, the coefficients for the calculation of your measuring unit need to be transferred to the instrument in the correct format. Contact your Storage Battery Systems LLC representative if you want to import one or more additional measuring units to your instrument. You will receive a file with the custom functions in the correct format from Storage Battery Systems LLC.

For how to import custom functions, see Chapter 9.3.

10.2 Selecting Measuring Methods

Application of the method selection

You can define and store measuring methods in your SBS-3500, providing a great contribution to a more efficient organization of your measuring process.

A stored measuring method may contain the following kinds of information:

- Measuring unit
- Offset value
- Temperature coefficient

You can define and name up to 20 different measuring methods.

If you own several SBS-3500 instruments, you can import the same method list to all instruments.

10.2.1 Entering a New Method

1. Select the preferred measuring unit (see Chapter 10.1) and, if necessary, the custom offset (see Chapter 13.4).
2. Press <Menu> and select "**Methods > Enter new Method**".
3. Enter the measuring method's name using the arrow keys.
4. Navigate to the tick symbol using the arrow keys and press <Save>.

TIP *If you keep an arrow key pressed, the cursor automatically stops at the tick symbol.*

10.2.2 Entering Method Lists

If you plan to set up or edit large method lists, you can do so conveniently on the PC and then import the list to SBS-3500. If you own several SBS-3500 instruments, you can import the same method list to all instruments to get several identical instruments.

To gain insight into the format to be used, first define one or two methods on the instrument (see Chapter 10.2.1) and then transfer these to the PC. After doing that you can conveniently enter further methods in the same format and import these into the instrument.

For how to import method lists, see Chapter 9.

TIP Importing a new method list automatically deletes the existing method list.

Entering the data on the PC also allows for using additional characters. The instrument supports the space character and the following characters:

```
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^
_ ` a b c d e f g h i j k l m n o p q r s t u v w x y z { | }
~ ° ² ³ µ Ä Ö Ü ß ä é è ö ü û
```

Method list template

The following table explains the lines of a method list:

<METHODLIST>	
<METHOD>	
<NAME>ALCOHOL</NAME>	Name of the first method: Alcohol
<UNIT>11</UNIT>	Measuring unit: Alcohol % v/v
</METHOD>	
<METHOD>	
<NAME>SG</NAME>	Name of the second method: SG
<UNIT>3</UNIT>	Measuring unit: Specific Gravity SG
<ALPHA>0.00124</ALPHA>	Temperature coefficient: 0.00124
<TEMP1>20</TEMP1>	Temperature 1: 20
<TEMP2>4</TEMP2>	Temperature 2: 4
</METHOD>	
</METHODLIST>	

10.2.3 Editing a Method

1. Press <Menu> and choose “**Methods > Edit Method**”.
2. Select the method you want to edit and press <OK>.
3. For changing a method name, see Chapter 10.2.1.

10.2.4 Deleting Methods

1. Press <Menu> and select “**Methods > Edit Method**”.
2. Select the method to be deleted and press .
3. Select <Delete Selected> to delete only the selected method or <Delete all> to delete all methods.
4. Press <Delete> when asked if you really want to delete the selected method(s).

10.2.5 Selecting a Method

1. Press <Menu> and choose “**Methods > Select Method**”. All stored methods are displayed.
2. Select the preferred method and press <OK>.

10.3 Assigning a Sample ID

You can assign different sample IDs to samples. This function helps to uniquely assign measured data to

- Samples (sample identification)
- Users who performed the measurement (user identification)
- The measuring point where the sample was taken etc.

You can save up to 100 different sample IDs.

10.3.1 Entering the Sample ID

1. Press <Menu> and select **"Sample-ID > Enter new ID"**.
2. Use the arrow keys to enter the sample ID.
3. Browse with the arrow keys to the tick symbol and press <Save>.

TIP *If you keep an arrow key pressed, the cursor automatically stops at the tick symbol.*

TIP *If you enter a new sample ID and only select the tick symbol without entering letters for the ID, the sample ID is automatically given the name <empty>. The 4-digit consecutive number of the measured data is then used as the ID.*

TIP *You can count the measurements performed with one sample ID. By entering one to four "#" signs at any position of your sample ID, you will see the one- to four-digit subcounter of measured values as part of your sample ID on the main screen. The subcounter will be set to (000)1 as soon as you either select another sample ID or select the same sample ID again.*

Example: By naming your sample ID "Tank 1 - ##", you will get "Tank 1 - 01", "Tank 1 - 02", etc. as sample ID on the main screen. By naming your sample "#### - Tank 1", you will get "0001 - Tank 1", "0002 - Tank 1", etc. as sample ID on the main screen.

TIP *If you reset the subcounter within a sample ID by mistake (by selecting the same sample ID anew), switch the instrument off and on again to proceed with the next higher subcounter within this sample ID.*

10.3.2 Entering Sample ID Lists

If you plan to set up or edit large sample ID lists, you can do so conveniently on the PC and then import the list to SBS-3500. If you own several SBS-3500 instruments, you can import the same sample ID list to all instruments to get several identical instruments.

To gain insight into the format to be used, first define one or two sample IDs on the instrument (see Chapter 10.3.1) and then transfer these to the PC. After doing that you can conveniently enter further sample IDs in the same format and import these into the instrument.

For how to import sample ID lists, see Chapter 9.

Sample ID list


The following table explains each line of a sample ID list:

<IDLIST>	
<ID>	
<NAME>ETHANOL</NAME>	Name of the first ID: <Ethanol>
</ID>	
<ID>	
<NAME>WATER</NAME>	Name of the second ID: <Water>
</ID>	
</IDLIST>	

10.3.3 Editing Sample IDs

1. Press <Menu> and select **"Sample-ID > Edit ID"**.
2. Select the ID you want to change and press <OK>.
3. For changing the sample ID, see Chapter 10.3.1.

10.3.4 Deleting Sample IDs

1. Press <Menu> and select **"Sample-ID > Edit ID"**.
2. Select the sample ID you want to delete and press .
3. Select <Delete selected ID> to delete only the selected sample ID or <Delete all IDs> to delete all sample IDs.
4. Press <Delete> when asked if you really want to delete the selected ID(s).

10.3.5 Selecting a Sample ID

1. Press <Menu> and select **"Sample-ID > Select ID"**. All saved sample IDs are displayed.
2. Select the required sample ID and press <OK>.

10.4 Selecting the Measurement Mode

The SBS-3500 provides three different measurement modes - "Precise", "Fast" and "Manual". According to the measurement mode selected, different stability criteria have to be fulfilled before the result is stored. The stability criterion is always related to the temperature:

- When the measurement mode "Precise" is selected, the result is stored as soon as the measured temperature value stays within 0.2 K for 10 seconds. This measurement mode delivers the most accurate results, but may take a longer time in case the sample temperature differs greatly from the ambient temperature.
- When the measurement mode "Fast" is selected, the result is stored as soon as the measured temperature value stays within 0.4 K for 10 seconds. This measurement mode delivers quicker results than the "Precise" mode, but as the density is highly temperature dependent, the measured result is not that accurate.
- The measurement mode "Manual" enables you to decide yourself when to store your measurement result. The result is stored immediately after pressing the <Store> key on the backside of the instrument.

1. Press <Menu> and select **"Measurement Mode"**.
2. Select the preferred setting (Precise, Fast, Manual) and press <Save>.

10.5 Filling Sample

Depending on the viscosity of the sample, you can fill the measuring cell using the filling tube or the plastic syringe. When filling highly viscous samples, we recommend using the plastic syringe.

10.5.1 Filling Using the Filling Tube

1. Press down the pump lever as far as it will go (see Fig. 10 - 1).
2. Submerge the filling tube in the sample.
3. Slowly release the pump lever.

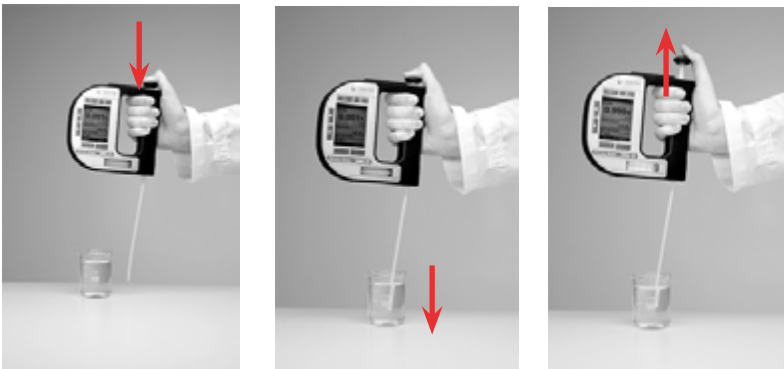


Fig. 10 - 1 Filling sample using the filling tube

10.5.2 Filling with the Plastic Syringe

NOTICE

Do not remove the pump when filling with the plastic syringe. Otherwise, the system is leaky.

1. Fill the plastic syringe with the sample.
2. Fill the measuring cell through the Luer adapter using the plastic syringe.




Fig. 10 - 2 Filling sample using the plastic syringe


10.6 Performing a Measurement

1. Select the measuring unit (see Chapter 10.1) or measuring method (see Chapter 10.2).
2. Define a sample ID (see Chapter 10.3).
3. Fill the measuring cell with the sample.



4. Press the  key on the back of SBS-3500. The measured value is displayed as soon as the result has stabilized. The measured value with all corresponding data is now saved in the results list.
5. Press <OK> to return to the measuring mode.

10.6.1 Deleting the Measured Value

- Press  instead of <OK> when the measured value appears on the display. The measured value is deleted and the instrument returns to the measuring mode.

10.6.2 Printing the Measured Value

You can transfer the measured value to a printer via the IrDA interface. For a compatible printer, contact your Storage Battery Systems LLC representative.

1. Allocate the softkey the command <Print> (see Chapter 8.7).
2. Switch on the printer with the IrDA interface.
3. Press the <Print> key when the measured value appears on the display.
4. Hold the IrDA interface of SBS-3500 to the IrDA interface of the printer to establish communication between the printer and density meter. The measured value is printed.

You can also print out all or only the last measured data (see Chapter 10.9).

10.6.3 Emptying the Measuring Cell

1. Place the filling tube in a vessel which is suitable for sample disposal.
2. Empty the measuring cell by pressing the pump lever.

10.7 Accessing Saved Measured Data

You can save up to 1024 measured data directly in the instrument’s memory. If the memory contains 1024 saved values, further values will overwrite the oldest saved values. Each saved value is given a consecutive 4-digit number. Using this number you can see whether the instrument has overwritten old entries. This is the case if the consecutive number is larger than 1024. If you delete all measured data, the counter starts again at 0001.

1. Press <Menu> and select “**Measured Data**”. The list of results is displayed (see Fig. 10 - 3).

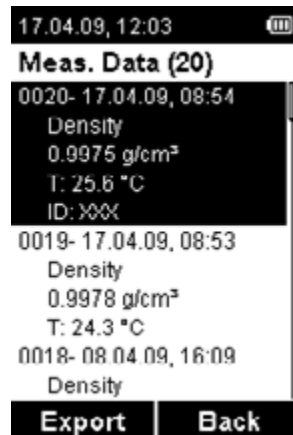


Fig. 10 - 3 Measured Data

10.8 Exporting Measured Data to a PC

For how to export measured data, see Chapter 9.

To set the data export format

1. Press <Menu> and select “**Setup > Import / Export > Data Format**”. You can choose between different format options.
2. Choose the data format, <CSV> or <TXT>, and press <OK>.
3. Choose the delimiter, <,> [comma], <:> [semi-colon] or </> [slash], and press <OK>.
4. Choose the decimal point, <.> [point] or <,> [comma], and press <OK>.

Your changes are accepted and used for the following data export. The settings for delimiter and decimal point are only applied with CSV data exports.

To export a single measured value

1. Establish a connection between the SBS-3500 and the PC as described in Chapter 9.1.
2. Press <Menu> and select **"Measured Data"**.
3. Select the measured value required for export using the arrow keys.
4. Press <Export>.
5. Select <Export Selected> to export the selected measured value to the PC. A dialog window appears on the PC asking if you want to accept the file.
6. Click <Yes>. The measured value is transferred and filed on the desktop.

To export all measured data

1. Establish a connection between the SBS-3500 and the PC as described in Chapter 9.1.
2. Press <Menu> and select **"Measured Data"**.
3. Press <Export>.
4. Select <Export All> to export the whole list of measured data to the PC. A dialog window appears on the PC asking if you want to accept the file.
5. Click <Yes>. The measured data are transferred and filed on the desktop.

10.9 Printing the Saved Measured Data


You can transfer the saved measured data to a printer via the IrDA interface. For a compatible printer, contact your Storage Battery Systems LLC representative.

To print saved measured data


1. Switch on the printer with the IrDA interface.
2. Press <Menu> and select **"Measured Data"**.
3. Select the measured value required for printing using the arrow keys.
4. Press <Export>.
5. Select <Print Selected> to print the selected measured value or <Print All> to print the whole list of measured data.
6. Hold the IrDA interface of SBS-3500 to the IrDA interface of the printer to allow communication between the printer and the density meter.

10.10 Deleting the Saved Measured Data

To delete the last measured value

1. Press <Menu> and select **"Measured Data"**.
2. Select a measured value and press .
3. Select <Delete Last> and press <OK>.
4. Press <Delete> when asked if you really want to delete the last measured value.

To delete all measured data

1. Press <Menu> and select **"Measured Data"**.
2. Select a measured value and press .
3. Select <Delete All> and press <OK>.
4. Press <Delete> when asked if you really want to delete all measured data.

11. Cleaning and Storing the Instrument

11.1 Cleaning the Measuring Cell

Clean the measuring cell with a suitable solvent regularly before and after each measurement series to ensure the long-term accuracy of your results. If the measuring cell is not sufficiently cleaned, residue may form in the measuring cell and lead to inaccurate measurement results. Depending on the application, also cleaning between measurements may be required.

NOTICE

Make sure the solvent you use for cleaning is suitable. The SBS-3500 pump cylinder is not resistant to aggressive cleaning liquids such as acetone or methyl ethyl ketone (MEK).

NOTICE

Do not use any mechanical action for cleaning the measuring cell.

-
1. Empty the measuring cell (see Chapter 10.6.3).
 2. Fill the measuring cell with a suitable solvent.
 3. Pump the solvent through the whole measuring system several times.
 4. Empty the measuring cell.

11.2 Cleaning the Filling Pump

Clean the filling pump regularly, depending on your application. If you measure aggressive samples, e.g. battery acid, clean the filling pump more often.

1. Open the pump lock and remove the pump.
2. Rinse the pump under running tap water while moving the pump piston up and down.
3. Dry the pump with a lint-free cloth.
4. Insert the pump and close the pump lock.
5. Empty the measuring cell (see Chapter 10.6.3).

11.3 Cleaning the Pump Housing

The SBS-3500 is completely sealed against the outside and the pump. Therefore, you can rinse the pump housing with running tap water if the housing is dirty.

1. Open the pump lock and remove the pump.
2. Hold the pump housing under running water and rinse it thoroughly.
3. Insert the pump and close the pump lock.
4. Empty the measuring cell (see Chapter 10.6.3).

11.4 Cleaning the Housing and Display

To clean the housing and display, use a soft cloth dipped in ethanol or warm water. If necessary, you can use a mild solvent (pH < 10).

11.5 Storing the Instrument

Before storing the instrument for a longer period of time, clean the measuring cell as described in Chapter 11.1. This prevents any liquid residues freezing or drying in the measuring cell, which could destroy the cell or lead to measuring inaccuracies.





For storage lasting less than one day, fill the measuring cell with deionized water or solvent. If you have filled the liquid via the plastic syringe, leave the syringe in the adapter to stop the liquid running out.

12. Maintenance

12.1 Changing the Batteries

You can see the status of the battery by looking at the battery symbol in the top right hand corner of the display.

The following status are possible:

Battery is full	
Battery is a little low	
Battery is low	
Battery is empty	

When the batteries are almost empty, the warning “Low Battery” is displayed. After the second warning “Battery Empty”, the instrument switches itself off.

If the batteries are flat, you can easily replace them.



WARNING

When opening the battery compartment or exchanging batteries, sparks may be generated which can cause an explosion or fire in hazardous areas. Serious injuries are possible.

- Never open the battery cover in hazardous areas.
- Only replace the batteries outside hazardous areas.

NOTICE

- Always observe the correct polarity when replacing the batteries.
- Only use batteries of the same type and with the same level of battery charge.

1. Empty the measuring cell (see Chapter 10.6.3).
2. Open the pump lock and remove the pump.



Fig. 12 - 1 Removing the pump

3. Screw out the screw of the pump lock using an Allen key size 2.5 and remove the screw.



Fig. 12 - 2 Removing the pump lock screw

4. Remove the pump lock by sliding it outwards.



Fig. 12 - 3 Removing the pump lock

5. Use an Allen key size 2.5 to open the battery cover.
6. Remove the flat batteries by turning the instrument upside down.
7. Insert the new batteries. The picture on the back of the instrument shows the correct positioning of the batteries.
8. Close the battery cover using the Allen key.
9. Insert the pump lock again and slide it back to the original position. Make sure you slide the pump lock in the correct direction.
10. Close the pump lock again using the Allen screw.
11. Insert the pump again.
12. Close the pump lock. The instrument is ready for operation.
13. Check that the instrument is working properly by switching it on and checking the display.

12.2 Device Information

Information about the instrument is saved in the instrument and can be accessed or exported at any time. This information includes the following:

- Manufacturer
- Instrument name
- Serial number
- Instrument status:
 - Measured data: xxxx/1024
 - IDs: xxx/100
 - Methods: xx/20
- Firmware version
- Date of the firmware version
- Bootloader version
- Date of the bootloader version
- Hardware status

Press <Menu> and select “**Setup > Device Information**”. The device information is displayed.

See Chapter 9.2 for how to export the device information to a PC.

13. Readjustment

If the measuring cell is not sufficiently cleaned, residue can form in the measuring cell. This can be noticed if the density values for deionized water begin to deviate. Therefore, perform regularly check measurements with deionized water. If the density values for water deviate by more than $\pm 0.001 \text{ g/cm}^3$ at the given temperature from the table values (see Appendix A), then a readjustment is required. A readjustment is only possible if the calculated difference between the measured and the theoretical value is smaller than 0.01 g/cm^3 and the temperature of the water is between 15 and 25°C.

13.1 Check Measurement

1. Clean the measuring cell as described in Chapter 11.1 and rinse the measuring cell until no more solvent residues are present.
2. Select the measuring unit "Density" (see Chapter 10.1).
3. Fill the measuring cell with deionized water and perform a measurement (see Chapter 10.6 and 10.7).
4. Compare the measured density value with the table values (see Appendix A).
5. If the measured density value deviates more than $\pm 0.001 \text{ g/cm}^3$ from the table value, perform a readjustment.

13.2 Water Adjustment

One option is to readjust using deionized water.

1. Clean the measuring cell as described in Chapter 11.1 and rinse the measuring cell until no more solvent residues are present.
2. Press <Menu> and select "**Adjustment > Water Adjustment**".
3. Fill the measuring cell with deionized water at approx. 20°C (15 to 25°C) without bubbles.
4. Confirm with <OK> that the measuring cell is filled with deionized water. The density value of the filled deionized water is now measured and compared with the adjustment data. The display shows the calculated deviation (Delta) in g/cm^3 .
5. Press <OK> to activate the new adjustment.

13.3 Custom Adjustment

You can also use any other reference liquid with a known density at 20°C and known temperature coefficient for your readjustment.

We recommend using the customer adjustment, e.g. if you measure only liquids in a specific density range (e.g. high density) and want to yield more accurate results in this range.

1. Clean the measuring cell as described in Chapter 11.1 and rinse the measuring cell until no more solvent residues are present.
2. Press <Menu> and select "**Adjustment > Custom Adjustment**".
3. Fill the measuring cell with reference liquid at approx. 20°C (15 to 25°C) without bubbles.
4. Confirm with <OK> that the measuring cell is filled with reference liquid.
5. Enter the density of your reference liquid at the stated reference temperature using the arrow keys and press <Save>.
6. Enter the temperature coefficient of your reference liquid and press <Save>. The density of the filled reference liquid is now measured and compared with the entered density for the reference liquid at 20°C. The display shows the calculated deviation (Delta) in g/cm^3 .
7. Press <OK> to activate the new adjustment.

13.4 Defining an Offset

You can define an offset for your measurement. This is automatically added to each measured value. The offset value always refers to the current measuring unit and is deleted when you change to another measuring unit. If you have selected a method, the set offset is saved with the method.

1. Press <Menu> and select "**Adjustment > Custom Offset**".
2. Enter your offset value and press <Save>.

TIP *The offset value saved with a method can also be changed later on.*

13.5 Restoring to Factory Adjustment

If you want to undo all your adjustments, you can restore the factory adjustment.

1. Press <Menu> and select **“Adjustment > Factory Adjustment”**. The display shows: “Are you sure that you want to reset to factory adjustment?”
2. Press <OK> to restore the factory adjustment. The factory adjustment is restored.

14. Error Messages and Warnings

Error Message	Cause
Out of Specification	The measured sample temperature is outside the specifications.
Out of Range	The measured value is outside the specified range. Possible reasons: <ul style="list-style-type: none"> • The temperature is too high or too low. • The density is too high or too low. • The measured value is invalid.
Temperature Range	The temperature of the reference liquid for readjustment is outside the temperature specifications (+15 to +25°C).
Density Range	The density of deionized water at 20°C measured during readjustment is outside the allowed limits (tolerance 0.01 g/cm ³).
Criterion	The density of deionized water at 20°C measured during readjustment deviates from factory adjustment by more than 0.01 g/cm ³ .
Low Battery	The battery is almost empty.
Battery Empty	The battery is empty.
Error 01	The temperature is invalid.
Error 02	The period is invalid.
Error 03	The SBS-3500 has no adjustment data.
Error 04	Calculation error.

NOTICE

If the error messages “Error 01” to “Error 04” occur, send in your instrument for service.

15. Technical Data

Measuring range:	
Density:	0 to 3 g/cm ³
Temperature:	0 to 40°C (32 to 104°F)
Viscosity:	0 to approx. 1000 mPa•s
Accuracy:	
Density ^a :	0.001 g/cm ³
Temperature:	0.2°C (0.4°F)
Repeatability, s. d.:	
Density:	0.0005 g/cm ³
Temperature:	0.1 °C (0.2°F)
Resolution:	
Density:	0.0001 g/cm ³
Temperature:	0.1°C (0.1°F)
Sample volume:	approx. 2 mL
Sample temperature:	0 to 100°C (32 to 212°F)
Ambient temperature^b:	-10 to +50°C (14 to 122°F)
Storage temperature^c:	-20 to +70°C (-4 to 158°F)
Humidity:	5 to 90% relative air humidity, noncondensing
Protection class:	IP54 (use in light rain or snow possible)
Display:	LCD monochrome, graphical, 41 x 55 mm, 160 x 240 pixel
Data memory:	1024 measured data
Interface:	IrOBEX/IrLPT
Power supply: Battery type: Battery life:	Alkaline battery 1.5V, type EN91 (LR06, AA) from Energizer Industrial > 100 hours
Dimensions^d:	5.5 x 5.4 x 1.1 inches (140 x 138 x 27 mm)
Weight (incl. batteries):	12.2 ounces (345 g)

a Viscosity < 100 mPa•s, density range 0 to 2 g/cm³.

b The sample must not freeze in the oscillator.

c Empty the measuring cell before storing the instrument.

d Without pump and filling tube.

16. Wetted Parts

The following materials are in contact with samples and cleaning liquids.

Material	Part
Borosilicate glass	Measuring cell, pump cylinder
PP (Polypropylene) Faradex MS002	Housing
PTFE (Polytetrafluoroethylene)	Filling tube, piston for hand pump
PVDF (Polyvinylidene fluoride)	Connection block, bolt
Viton	O-ring

Appendix A: Density of Water¹ (0 °C to 40 °C)

T °C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	.99984	.99985	.99985	.99986	.99987	.99987	.99988	.99988	.99989	.99989
1	.99990	.99990	.99991	.99991	.99992	.99992	.99993	.99993	.99993	.99994
2	.99994	.99994	.99995	.99995	.99995	.99995	.99996	.99996	.99996	.99996
3	.99996	.99997	.99997	.99997	.99997	.99997	.99997	.99997	.99997	.99997
4	.99997	.99997	.99997	.99997	.99997	.99997	.99997	.99997	.99997	.99997
5	.99996	.99996	.99996	.99996	.99996	.99995	.99995	.99995	.99995	.99994
6	.99994	.99994	.99993	.99993	.99993	.99992	.99992	.99991	.99991	.99991
7	.99990	.99990	.99989	.99989	.99988	.99988	.99987	.99987	.99986	.99985
8	.99985	.99984	.99984	.99983	.99982	.99982	.99981	.99980	.99980	.99979
9	.99978	.99977	.99977	.99976	.99975	.99974	.99973	.99973	.99972	.99971
10	.99970	.99969	.99968	.99967	.99966	.99965	.99964	.99963	.99962	.99961
11	.99960	.99959	.99958	.99957	.99956	.99955	.99954	.99953	.99952	.99951
12	.99950	.99949	.99947	.99946	.99945	.99944	.99943	.99941	.99940	.99939
13	.99938	.99936	.99935	.99934	.99933	.99931	.99930	.99929	.99927	.99926
14	.99924	.99923	.99922	.99920	.99919	.99917	.99916	.99914	.99913	.99911
15	.99910	.99908	.99907	.99905	.99904	.99902	.99901	.99899	.99897	.99896
16	.99894	.99893	.99891	.99889	.99888	.99886	.99884	.99883	.99881	.99879
17	.99877	.99876	.99874	.99872	.99870	.99869	.99867	.99865	.99863	.99861
18	.99859	.99858	.99856	.99854	.99852	.99850	.99848	.99846	.99844	.99842
19	.99840	.99838	.99836	.99835	.99833	.99831	.99828	.99826	.99824	.99822
20	.99820	.99818	.99816	.99814	.99812	.99810	.99808	.99806	.99803	.99801
21	.99799	.99797	.99795	.99793	.99790	.99788	.99786	.99784	.99781	.99779
22	.99777	.99775	.99772	.99770	.99768	.99765	.99763	.99761	.99758	.99756
23	.99754	.99751	.99749	.99747	.99744	.99742	.99739	.99737	.99734	.99732
24	.99730	.99727	.99725	.99722	.99720	.99717	.99715	.99712	.99709	.99707
25	.99704	.99702	.99699	.99697	.99694	.99691	.99689	.99686	.99683	.99681
26	.99678	.99676	.99673	.99670	.99667	.99665	.99662	.99659	.99657	.99654
27	.99651	.99648	.99646	.99643	.99640	.99637	.99634	.99632	.99629	.99626
28	.99623	.99620	.99617	.99615	.99612	.99609	.99606	.99603	.99600	.99597
29	.99594	.99591	.99588	.99585	.99582	.99579	.99577	.99574	.99571	.99568
30	.99564	.99561	.99558	.99555	.99552	.99549	.99546	.99543	.99540	.99537
31	.99534	.99531	.99528	.99524	.99521	.99518	.99515	.99512	.99509	.99506
32	.99502	.99499	.99496	.99493	.99490	.99486	.99483	.99480	.99477	.99473
33	.99470	.99467	.99463	.99460	.99457	.99454	.99450	.99447	.99444	.99440
34	.99437	.99433	.99430	.99427	.99423	.99420	.99417	.99413	.99410	.99406
35	.99403	.99399	.99396	.99393	.99389	.99386	.99382	.99379	.99375	.99372
36	.99368	.99365	.99361	.99358	.99354	.99350	.99347	.99343	.99340	.99336
37	.99333	.99329	.99325	.99322	.99318	.99314	.99311	.99307	.99304	.99300
38	.99296	.99292	.99289	.99285	.99281	.99278	.99274	.99270	.99267	.99263
39	.99259	.99255	.99252	.99248	.99244	.99240	.99236	.99233	.99229	.99225
40	.99221	.99217	.99214	.99210	.99206	.99202	.99198	.99194	.99190	.99186

¹ Excerpt from: Spieweck, F. & Bettin, H.: Review: Solid and liquid density determination. Technisches Messen 59 (1992), pp. 285-292

Appendix B: Measuring Unit Details

ID	Measuring unit		Minimum	Maximum	Unit	Format	Offset format
1	Density		0.0000	3.0000	g/cm ³	n.nnnn	0.0nnn
			0000.0	3000.0	kg/m ³	nnnn.n	00nn.n
			00.000	25.000	lb/gal	nn.nnn	0.nnn
2	Density @ xx °C		0.0000	3.0000	g/cm ³	n.nnnn	0.0nnn
			0000.0	3000.0	kg/m ³	nnnn.n	00nn.n
			00.000	25.000	lb/gal	nn.nnn	0.nnn
3	Specific Gravity SG		0.0000	3.0000	--	n.nnnn	0.0nnn
4	Period		0000.00	9999.99	µs	nnnn.nn	No Offset
5	Raw Data	Period	0000.00	9999.99	µs	nnnn.nn	No Offset
		Resistance	1000	200000	Ohm	nnnnn	No Offset
6	Baumé		000.0	100.0	°Baumé	nnn.n	00n.n
7	Brix		-10.0	85.0	°Brix	nnn.n	00n.n
8	Extract		-10.0	85.0	°Plato	nnn.n	00n.n
9	H2SO4 % w/w		000.0	070.0	% w/w	nnn.n	00n.n
10	H2SO4 @ 20 °C		0.8000	2.0000	g/cm ³	n.nnnn	0.0nnn
			0800.0	2000.0	kg/m ³	nnnn.n	00nn.n
11	Alcohol % v/v @ 20 °C		000.0	100.0	% v/v	nnn.n	00n.n
12	Alcohol % w/w		000.0	100.0	% w/w	nnn.n	00n.n
13	Alcohol US @ 60 °F		000.0	200.0	Proof	nnn.n	00n.n
14	API Gravity A		-50.0	100.0	°API	nnn.n	00n.n
15	API Gravity B						
16	API Gravity D						
17	API SG A		0.5000	1.5000	--	n.nnnn	0.0nnn
18	API SG B						
19	API SG D						
20	API Density A		0.5000	1.5000	g/cm ³	nnnn.n	0.0nnn
			0500.0	1500.0	kg/m ³	n.nnnn	00nn.n
21	API Density B		0.5000	1.5000	g/cm ³	nnnn.n	0.0nnn
			0500.0	1500.0	kg/m ³	n.nnnn	00nn.n
22	API Density D		0.5000	1.5000	g/cm ³	nnnn.n	0.0nnn
			0500.0	1500.0	kg/m ³	n.nnnn	00nn.n
23 30 31 32 33 34 35 36 37 38	Custom Functions		--	--	--	--	--

ID	Measuring unit	ρ_{min} [g/cm ³]	ρ_{max} [g/cm ³]	T _{min} [°C]	T _{max} [°C]	T _{min Valid} [°C]	T _{max Valid} [°C]
1	Density	0	3	-20	80	0	40
2	Density @ xx °C	0	3	-20	80	0	40
3	Specific Gravity SG	0	3	-20	80	0	40
4	Period	--	--	--	--	--	--
5	Raw Data	Period	--	--	--	--	--
		Resistance	--	--	--	--	--
6	Baumé	0.5	2	-20	80	0	40
7	Brix	0.8	2	-20	80	0	40
8	Extract	0.8	2	-20	80	0	40
9	H2SO4 % w/w	0.8	2	0	75	10	40
10	H2SO4 @ 20 °C	0.8	2	0	75	10	40
11	Alcohol % v/v @ 20 °C	0.5	1.0	-10	40	0	40
12	Alcohol % w/w						
13	Alcohol US @ 60 °F						
14	API Gravity A	0.5	1.5	-20	80	0	40
15	API Gravity B						
16	API Gravity D						
17	API SG A	0.5	1.5	-20	80	0	40
18	API SG B						
19	API SG D						
20	API Density A	0.5	1.5	-20	80	0	40
21	API Density B						
22	API Density D						
23 30 31 32 33 34 35 36 37 38	Custom Functions	--	--	--	--	--	--

Appendix C: Menu Tree

Measured Data	Export	Export All
		Export Selected
		Print All
		Print Selected
Sample-ID	Select ID	
	Enter new ID	
	Edit ID	
Methods	Select Method	
	Enter new Method	
	Edit Method	
Measuring Units	Density	Density
		Density @ xx °C
		Specific Gravity SG
	Alcohol	Alcohol % v/v @ 20 °C
		Alcohol % w/w
		Alcohol US @ 60°F
	API	API Gravity A
		API Gravity B
		API Gravity D
		API SG A
		API SG B
		API SG D
		API Density A
		API Density B
		API Density D
	Baumé	
	H2SO4	H2SO4 % w/w
		H2SO4 @ 20 °C
	Sugar	Brix
		Extract
	Custom Functions	
	Period	
	Raw Data	
Adjustment	Water Adjustment	
	Custom Adjustment	
	Custom Offset	
	Factory Adjustment	

Setup	Measurement Mode	Precise; Fast; Manual	
	Import / Export	Send to PC	Custom Functions
			Adjustment
			Device Information
			Sample-ID List
			Methods
			System Settings
			Measured Data
		Receive from PC	
		Data Format	Format: CSV; TXT
			Delimiter: . ; /
			Decimalpoint: . ,
	Set Password		
	Date and Time	Set Date and Time	
		Date Format	dd.mm.yy
			dd.mm.yyyy
			yy-mm-dd
			yyyy-mm-dd
			mm/dd/yy
			mm/dd/yyyy
	Time Format	24 hours	
			am/pm
	Softkey	ID; Method; Store; Print	
Display Contrast	-8, ..., +8		
Backlight	On; Auto; Off		
Energy Saving	Off; 3 min; 5 min; 10 min		
Beep	On; Off		
Units	Density: g/cm3; kg/m3; lb/gal		
	Temperature: °C; °F		
Language	English		
	German		
	French		
	Spanish		
Device Information			