Contents

1 Introduction

The SBS 2500 is a portable measuring instrument suited for determining the specific gravity of liquids. The instrument uses the oscillating body method. To fill the measuring cell the built-in sample pump or a syringe may be used.
The results are automatically calculated into specific gravity, the value is then shown on the backlit display.
The results, along with the sample identification, temperature, temperature-coefficient, date and time can be saved. Together with the instrument identification they can then, via the integrated infrared interface, be transferred to the computer or printed out on a printer.

2 Safety measures

Measures for your protection

- Do not work in an explosion-hazardous environment! The instrument housing is not gastight. Otherwise, there is a risk of explosion from sparks and/or risk of corrosion by gasses which can seep in.

- Always hold the end of the sample tube over a waste container! There is a risk of injury when emptying corrosive substances.
- Leave the syringe in the sample intake after injecting a sample! Otherwise, the sample will run out of the measuring cell.

Measures for operational safety

- Never press on the measuring cell window! This can influence the oscillation characteristics of the measuring cell.
- Do not clean the measuring cell with concentrated NaOH (caustic soda) or HF (hydrogen fluoride)! Both substances chemically corrode the measuring cell.
- Use batteries of the specified type only. Otherwise, proper operation cannot be guaranteed.
- Do not submerge the housing in liquid! The instrument is only resistant to splashed water.
- Ensure that the following environmental conditions are met:
  - no strong vibrations present
  - not in direct sunlight
  - no high humidity present
  - no corrosive gasses present
  - temperature between – 20 °C and 70 °C
  - no strong electrical or magnetic fields present

3 Description of the instrument

3.1 SBS 2500

Illustration, see **rear fold-out page**

1	Backlit Display
2	Keypad
3	Drain button
4	Sample pump
5	Cover of sample pump
6	Connector for syringe adapter
7	Fixing screw for sample tube
8	Sample tube
9	Measuring cell
10	Infrared interface
11	Lock button
12	Fill button
13	Battery compartment cover

3.2 Display

Illustration, see **rear fold-out page**

1	Selected unit of measurement
2	Result
3	Sample identification (a…z or space)
4	Sample number, or error number if an error has occurred
5	Appears if `Stability` is set to `Auto`
6	Appears if `Memory in` is set to `Auto`
7	Appears if `Memory out` is set to `Auto`. If a printer or PC is connected, the data are transferred automatically
8	Battery-power indicator
9	Temperature (°C / °F)
10	Appears if delete mode is activated
11	Mark for results For the identification of invalid or incorrect results or for marking a sample change
Δ	Reference temperature

3.3 Keys

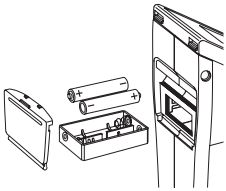
Illustration, see **front fold-out page**
Red symbols: Press key longer than 2 seconds.
Blue symbols: Press key briefly.

No.	Symbol	Short key-press	Long key-press
1		• Move marker to the left • Mark saved results	• Delete saved results
2	 α	• Move marker upward • Select sample number (ascends) • Switch between `Yes` and `No` setting	• Select temperature-compensation coefficient α
3		• Move marker to the right • Display saved results • Transfer one saved result to a printer/PC	• Transfer a series of saved results to a printer/PC
4	cal 	• Move marker downward • Select sample number (descends) • Switch between `Yes` and `No` setting	• Call up adjustment mode
5	**esc**	• Exit the menu	• Switch instrument on or off
6	**ok/meas.**	• Start measurement • Confirm input • Confirm data delete • Confirm data transfer • While pressing and holding key 5: enter the menu	

Only the arrow symbols are used to represent keys 1 – 4 in the following operating instructions

4 Tutorial

4.1 Inserting batteries



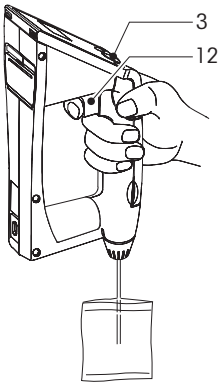
- Open the battery compartment cover on the back of the SBS 2500.
- Remove battery compartment.
- Insert batteries into the battery compartment, observing correct polarity.
- Insert battery compartment, ensuring that the contacts of the battery compartment face the instrument.
- Close battery compartment cover.

The instrument switches on automatically and is immediately ready for operation. With the backlighting switched off the battery lasts about 90 hours.

If nothing appears in the display

- Check polarity of the batteries and battery compartment.

4.2 Test measurement



- Push drain button (3) downward completely.
- Ensure that the sample tube is located in the accompanying density standard or in distilled water.
- Press the fill button (12) slowly to fill the measuring cell.
- Ensure that no air bubbles are contained within the measuring cell.

The instrument automatically executes a measurement and the result appears in the display.
The result for water must be 1.000 in the selected measurement unit SG (t/t).

If the deviation is ≤ 0.0005

Adjustment is ok, the instrument is ready for measurement.

If the deviation is > 0.0005

Adjust instrument, see Chapter 4.4.

4.3 Adjustment

Warning: you must be in the "expert" mode to perform a water calibration

Initializing adjustment

- Press and hold the ↓ key until `CALIB (Water)` appears on the display.

The instrument adjusts automatically (duration: approx. 1 minute). After adjustment is completed, the measured deviation from the theoretical value and `Execute?` (`No`) appears.

- Press the ↑ or ↓ key. `Execute?` (`Yes`) appears.
- Press the **ok/meas.** key to confirm.

The adjustment is confirmed.

4.4 Cleaning

The built-in sample pump or an external syringe can be used to fill the measuring cell with cleaning liquid.

- Empty the measuring cell completely before cleaning. Press the drain button downward completely.
- Clean the measuring cell daily with a suitable cleaning liquid.
- For very dirty measuring cells, let the inside of the cell soak in the cleaning liquid.
- Repeat cleaning if necessary.
- If the housing is soiled, clean with a cleaning tissue.

4.5 Switching off and on

Switching off

- Press and hold the **esc** key until the display is turned off.

The instrument is now turned off.

Switching on

- Press and hold the **esc** key until the display appears.

The instrument is ready for operation.

5 Measurement (meas)

5.1 Procedure for proper measurement

- Test the instrument for accuracy with distilled water before beginning any measurements (see Chapter 4.3).
- Ensure that the measuring cell is clean before each measurement. Insufficient cleaning leads to remaining residue in the measuring cell and, therefore, incorrect results.
- Check the sample for chemical resistance of the instrument materials.
  - Sample tube: PTFE (polytetrafluorethylene)
  - Measuring cell: Borosilicate glass
  - Measuring cell holder: PPS (polyphenylene sulphide)
  - Sample pump: PP (polypropylene)
- Ensure that the samples to be measured:
  - are liquid enough to be sucked up or injected;
  - can be dissolved with a solvent suitable for cleaning the measuring cell;
  - are homogeneous (no emulsions or suspended particles, no air bubbles);
  - have reached ambient temperature in the measuring cell.

For samples which are 20 °C colder than the ambient temperature:

- Heat the sample before beginning the sampling procedure.

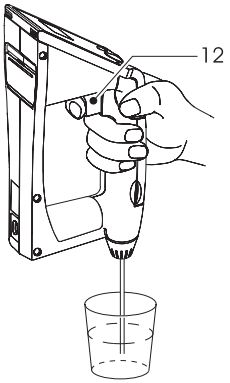
Note

The unit display flashes when the difference in temperature between the sample and the ambient air is greater than ±5 °C.

For samples of high viscosity (> 2000 mPa•s):

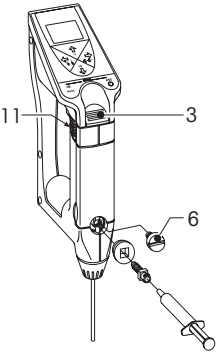
- Use an external syringe to fill the measuring cell.

5.2 Filling the measuring cell using the built-in sample pump



- Ensure that the sample tube is in the sample.
- Press the fill button (12) slowly to fill the measuring cell.
- Ensure that there are no air bubbles in the measuring cell.

5.3 Filling the measuring cell using an external syringe



- Press the drain button (3).
- Slide up the lock button (11).
- Remove the screw stopper (6) with a coin.
- Screw in the adapter for the external syringe.
- Hold the sample tube over a waste container.
- Slowly inject the sample into the measuring cell.
- Ensure that there are no air bubbles in the measuring cell.
- Do not remove the syringe while measuring.

5.4 Measuring

The ≋ symbol appears in the display: Measuring with automatic stability control

- Press the **ok/meas.** key to start measuring.

The ≋ symbol blinks during measurement. The result appears in reverse display.

The ≋ symbol does not appear on the display: Measuring with manual stability control

The instrument measures continuously.
- Wait until the displayed value stabilizes.
- If the result is to be saved: Press the **ok/meas.** key.

The result appears in reverse display.

Emptying the measuring cell

- Hold the sample tube over a waste container.
- Press drain button (3) downward slowly and move it up again with the fill button (12).

5.5 Saving the results

The instrument can save up to 1100 results internally. Each time a result is saved, the number of internally-stored values increases by one.
The procedure for saving the results is dependent upon the settings in the menu (see Chapter 5.4).

The ⭳ symbol appears in the display: Saving all results automatically

The instrument saves all results automatically.

The ⭳ symbol does not appear in the display: Saving selected results manually

Save the result:
- Press the **ok/meas.** key.

Do not save the result:
- Press the **esc** key.

5.6 Displaying and marking saved results

Displaying saved results

- Press the ← key.

The sample number flashes and the symbol ⊠ appears.
- Scroll through the saved results using the ↑ and ↓ keys.

Marking results

For the identification of invalid or incorrect results or for marking a sample change.
- Select the desired sample number using the ↑ and ↓ keys.
- Press the **ok/meas.** key.

The selected sample number is marked with an asterisk.

Note

The marking is removed if the sample has already been marked.

5.7 Printing and transferring results

Conditions

- For PRN and RS interfaces, the infrared adapter must be connected to the printer/PC.

Important

To transfer or print results, hold the instrument in the direction of the infrared adapter at a maximum distance of approx. 20 cm.

The ⇪ symbol appears in the display: Printing or transferring results automatically

Every displayed result is transferred automatically.

The ⇪ symbol does not appear in the display: Printing or transferring selected results manually

- Press the → key.
- Select desired result with the ↑ or ↓ key.
- Press the **ok/meas.** key to transfer/print the result.

The ⇪ symbol flashes and the result is transferred.

Printing and transferring results of a series of samples manually

- Press and hold the → key until Memory out , Execute? (All) appears in the display.
- Press the ↑ or ↓ key.
  Execute? (Range) appears.
- Press the **ok/meas.** key to confirm.
- Enter the desired series of samples (from ... to ...) using the arrow keys.

To transfer the series of samples:

- Press the **ok/meas.** key.

The sample series (from ... to ...) is confirmed. The ⇪ symbol flashes and the results of the selected series of samples are transferred.

To print or transfer all results manually

- Press and hold the → key until Memory out , Execute? (All) appears in the display.
- Press the **ok/meas.** key.

The ⇪ symbol in the display flashes and all results are transferred.

After a successful transfer, the user is asked whether he/she would like to delete the transferred results: Memory All Clear Execute? (No).

Leaving transferred results in tact

- Confirm Memory All Clear Execute (No) by pressing the **ok/meas.** button.

Deleting transferred results

- Press the ↑ or ↓ key.
  Execute? (Yes) appears.
- Press the **ok/meas.** key to confirm.

All results are deleted.

5.8 Deleting results

It is not possible to delete indiidual results with the SBS 2500.

Deleting all results

- Ptess and hold the ← key until `Memory All Clear` `Execute? (No)` appears in the display.
- Press the ↑ or ↓ key.
  `Execute? (Yes)` appears.
- Press the **ok/meas.** key to confirm.

All results are deleted.

6 Adjustment (cal)

Warning: you must be in the "expert" mode to perform calibrations

Before adjusting

- Carry out a test measurement before adjusting the measuring cell, see Chap. 4.3.

Test measurement result < 0.9995 or > 1.0005

- Check if the measuring cell is dirty, clean if necessary and repeat the test measurement.

Test measurement result once again < 0.9995 or > 1.0005

- Readjust instrument.

6.1 Adjusting the measuring cell with water

Settings in the menu

- `Calib. Mode: off`

Adjusting

- Ensure that the measuring cell and sample tube are clean.
- Fill the clean measuring cell with the accompanying density standard or distilled water and ensure that no air bubbles are allowed to enter.
- Press and hold the ↓ key until `CALIB (Water)` appears in the display.

The instrument adjusts automatically (duration: approx. 1 minute). After adjustment is completed, the measured deviation from the theoretical value and `Execute? (No)` appears.

Measured deviation < 0.001

- Press the ↑ or ↓ key.
  `Execute? (Yes)` appears.
- Press the **ok/meas.** key to confirm.

The adjustment is confirmed.

Measured deviation ≥ 0.001

- Check whether the measuring cell is dirty and if there are air bubbles.

Measuring cell is clean and contains no air bubbles:

- Press the ↑ or ↓ key.
  `Execute (Yes)` appears.
- Press the **ok/meas.** key.

Measuring cell is dirty and/or contains air bubbles:

- `Execute? (No)` is confirmed by pressing the **ok/meas.** button.
- Clean the cell if necessary and readjust.

6.2 Adjusting the measuring cell with a density standard

If a different density range is to be used, the measuring cell can be adjusted using a density standard of your choice (e.g. toluene from the NIST, National Institute of Standards and Technology) instead of distilled water.

Setting in the menu

- `Calib. Mode:  On`
- Enter the following density standard values into the menu:
  Density Density of the density standard (g/cm³) at the reference temperature
  Temp Reference temperature
  α x 1000 Temperature-compensation coefficient of the density standard • 1000

Adjusting

- Ensure that the measuring cell and sample tube are clean.
- Fill the clean measuring cell with the density standard (e.g. Toluene) nsuring that no bubbles are allowed to enter.
- Press and hold the up and down keys simultaneously until **CALIB (STD)** appears in the display.

The instrument adjusts automatically (duration: approx. 1 minute). After adjustment is completed, the measured deviation from the theoretical value and `Execute?` (**No**) appears.

Measured deviation < 0.001

- Press the ↑ or ↓ key.
  `Execute?` (**Yes**) appears.
- Press the **ok/meas.** key.

The adjustment is confirmed.

Measured deviation ≥ 0.001

- Check whether the measuring cell is dirty and if there re air bubbles.

Measuring cell is clean and contains no air bubbles:

- Press the ↑ or ↓ key.
  `Execute` (**Yes**) appears.
- Press the **ok/meas.** key.

Measuring cell is dirty and/or contains air bubbles:

- `Execute?` (**No**) is confirmed by pressing the **ok/meas.** button.
- Clean the cell and readjust if necessary.

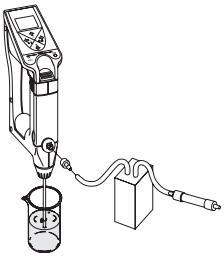
6.3 Adjusting the measuring cell with air

The SBS 2500 measures with the specified accuracy if the measuring cell is correctly adjusted with the accompanying density standard or distilled water. Additional adjustment with air is generally not necessary, but is recommended when:

- the measuring cell is replaced,
- the displayed density of air is < 0.0007 g/cm³ or > 0.0015 g/cm³.

Setting in the menu

`Calib. Mode:  Off.`



Preparing the measuring cell

- Clean the measuring cell with a suitable solvent and rinse with ethanol.
- Hold the sample tube over a waste container.
- Connect a tube from the connection of the external syringe to an air pump (volume flow 1…2 l/min) connected to dry tube filled with 5…10 g silica gel.
- Dry measuring cell for approx. 5…10 min.
- Wait approx. 30 min. until the measuring cell has reached the ambient temperature.

Adjusting

- Press the ↑ and ↓ keys simultaneously.

CALIB (Air) appears in the display. The instrument adjusts the measuring cell automatically.

Adjustment is complete when **CALIB (Air)** disappears (after approx. 2 min.).

- Adjust measuring cell with water or a density standard of your choice.

7 Error messages and malfunctions

Error	Possible causes	What to do
E-01	Adjustment error:	
	• Measuring cell not filled with water	- Fill measuring cell with water
	• Air bubbles in measuring cell	- Use bubble-free, distilled water
	• Sample tube defective	- Replace sample tube
	• Measuring cell is dirty	- Clean measuring cell
	• Measuring cell defective	- Call SBS Service
E-02	Measuring cell fault	
	• Measuring cell is dirty	- Clean measuring cell
	• Measuring cell defective	- Call SBS Service
E-03	Sample temperature not measured correctly	- Call SBS Service
E-04	Error in ambient temperature measurement	- Call SBS Service
E-05	`Full` appears instead of a sample number: Data memory full	- Delete data from memory

E-06	Memory fault	- Call SBS Service
E-07	Measuring time of 10 minutes exceeded	- Switch instrument off and on again - Measure using bubble-free, distilled water If error appears again: - Call SBS Service
BATT	Batteries empty	- Replace batteries (see Chapter 4.1)
	Result = 0.0000 or strongly negative results: Menu setting incorrect	- Set `Calib. Mode` to `off`

8 Cleaning and maintenance

8.1 Cleaning the measuring cell

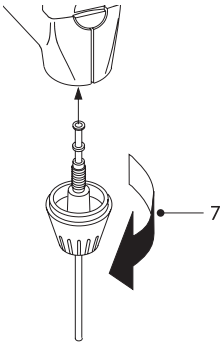
The built-in sample pump or an external syringe can be used to fill the measuring cell with cleaning liquid.

- Clean measuring cell daily with a suitable cleaning liquid.
- For a very dirty measuring cell let the inside of the cell soak with cleaning liquid.
- Repeat cleaning if necessary.

8.2 Cleaning the housing

- Never use aggressive liquids or solvents to clean the housing of the SBS 2500
- We recommend that you use the cleaning tissues which come with the instrument.

8.3 Replacing the sample tube



- Loosen fixing screw (7) of sample tube in the direction of the arrow and remove old sample tube.
- Insert new sample tube with washer into screw gland of sample tube.
- Tighten screw gland of sample tube to instrument by hand.
- Check sample tube for secure seating.

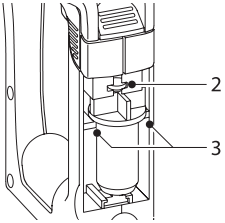
8.4 Replacing the sample pump

Removing cover of sample pump

- Slightly press together cover of sample pump on grip recesses and detach it.
- Pull sample pump out of guide system.

Inserting sample pump

- Insert new sample pump into guide system.



Ensure that the pump plunger (2) and pump body (3) are situated in the corresponding guides when inserting the sample pump.

- Check for proper functioning of sample pump.
- Put the cover of the sample pump back in its place.

9 Standard and optional equipment

Each part identified by an order number can be ordered from SBS.

9.1 Standard equipment

The instrument is delivered pre-assembled.

		Order No.	
1	SBS 2500 Specific Gravity Meter with carrying case, includes:	SBS 2500	
2	AAA-type batteries (LR03, 1.5 V)		
1	Operating instructions	51710073	

9.2 Optional equipment

	Order No.	
Sample tube (with washer)	51324641	
Sample pump, compl.	51324405	
O-ring for sample pump	51524506	

10 Technical data

Measurement principle	Density measurement using the oscillating body method
Sample intake	Using the built-in sample pump or an external syringe
Range of density measurement	0.0000…2.0000 g/cm^3
Accuracy	±0.001 g/cm^3
Resolution	0.0001 g/cm^3
Working temperature	5…35 °C
Storage temperature	– 20…70 °C
Temperature accuracy	±0.2 °C
Materials	
Housing	PBT (polyester)
Measuring cell	Borosilicate glass
Materials which contact the product	PTFE (polytetrafluorethylene) Borosilicate glass PPS (polyphenylene sulfide) PP (polypropylene)
Weight	approx. 360 g
Measuring time per sample	1…10 minutes
Data memory	1100 results
Interface	Infrared for printer and PC
Battery operation	2 x 1.5 V batteries (LR03); type AAA
Battery lifetime	approximately 90 hours (with backlighting off)

Subject to technical changes.

11 Appendix

11.1 Density of pure water (0…40 °C)

Temperature [°C]	Density [g/cm³]	Temperature [°C]	Density [g/cm³]
0	0.99984		
1	0.99990	21	0.99799
2	0.99994	22	0.99777
3	0.99996	23	0.99754
4	0.99997	24	0.99730
5	0.99996	25	0.99705
6	0.99994	26	0.99679
7	0.99990	27	0.99652
8	0.99985	28	0.99624
9	0.99978	29	0.99595
10	0.99970	30	0.99565
11	0.99961	31	0.99534
12	0.99950	32	0.99503
13	0.99938	33	0.99471
14	0.99925	34	0.99438
15	0.99910	35	0.99404
16	0.99894	36	0.99369
17	0.99878	37	0.99333
18	0.99860	38	0.99297
19	0.99841	39	0.99260
20	0.99821	40	0.99222

[Chemical Handbook Fundamental Version, Rev. 3, Table 5.2 (1984)]