Medical–Biological
Research & Technologies

DEN-1B

Densitometer

Suspension turbidity detector

Operating Manual
Certificate

for version
V.2AW

Contents

1. Safety Precautions

The following symbol means:

Caution! Make sure you have fully read and understood the present Manual before using the equipment. Please pay special attention to sections marked by this symbol.

GENERAL SAFETY

- Use only as specified in the Operating Manual provided.
- Save the unit from shocks and falling.
- After transportation or storage and before connecting it to the electric circuit, keep the unit under room temperature for 2-3hrs.
- Before using any cleaning or decontamination methods except those recommended by the manufacturer, check with the manufacturer that the proposed method will not damage the equipment.
- Do not make modifications in design of the unit.

ELECTRICAL SAFETY

- Connect only to an external power supply with voltage corresponding to that on the serial number label.
- Use only the external power supply provided with this product.
- Ensure that the power switch and external power supply are easily accessible during use.
- Disconnect the unit from the external power supply before moving.
- If liquid penetrates into the unit, disconnect it from the external power supply and have it checked by a repair and maintenance technician.
- Do not operate the unit in premises where condensation can form. Operating conditions of the unit are defined in the Specifications section.

Batteries

- Use alkaline (preferred) or rechargeable AA type batteries.

ATTENTION! DANGER! Risk of explosion and burns:

- The batteries must be inserted correctly with respect to polarity by following the diagram in the battery case.
- If one battery is reversed (two + poles or two - poles in contact with each other), a chemical reaction is produced in minutes that releases explosive gasses and extremely corrosive liquid.
- In case of doubt, turn off the unit immediately and check the polarity.
- Protect your eyes in case a leakage is detected. Cover the battery case with a rag before opening it to avoid contact with any discharge.
- In case of contact with liquid from the batteries, rinse the affected area immediately with clear water and get immediate medical attention.

- Do not mix brands of batteries.
- Do not mix new and used batteries.
- Remove the batteries from the unit for prolonged storage.
- Do not recharge alkaline batteries.
- Do not short-circuit the batteries as this can cause burns.
- Do not attempt to open or dismantle batteries.
- Do not put used batteries in a fire.
- Keep batteries out of reach of children.
- Keep water out of the battery case.
- Follow the disposal instructions and properly dispose of the used battery.

DURING OPERATION

- Do not operate the unit in environments with aggressive or explosive chemical mixtures. Please contact manufacturer for possible operation of the unit in specific atmospheres.
- Do not operate the unit if it is faulty or was installed incorrectly.
- Do not use outside laboratory rooms.
- Use the **Select** and **Install** buttons only for calibration of the unit according to p. **3.4**. Do not press the buttons in other cases, as this can cause calibration reset and may require recalibration.

BIOLOGICAL SAFETY

- It is the user's responsibility to carry out appropriate decontamination if hazardous material is spilt on or penetrates into the equipment.

2. General Information

DEN-1B Densitometer is designed for solution turbidity measurement in the range of 0.0 - 6.0 McFarland units (0 cells/ml - $18x10^6$ cells/ml). DEN-1B is capable of measuring solution turbidity in a wider range (6.0 - 15.0 McFarland units) however, it is necessary to remember that in this case the standard deviation values increase.

DEN-1B Densitometer is used for 1) determining concentration of cells (bacterial, yeast cells) in the fermentation process, 2) detection of susceptibility of microorganisms against antibiotics, 3) identification of microorganisms with various test systems, 4) measuring optical density at fixed wavelength and 5) quantitative evaluation of concentration of dyed solutions that absorb green light.

The operation principle is based on optical density measurement with digital result representation in McFarland units.

The unit is calibrated at the factory and saves calibration data when being switched off. However, in can be calibrated by 2-8 points in 0.0 - 6.0 McFarland unit range if necessary. Both commercial standards (e.g. produced by *Prolab, Lachema, BioMerieux,* etc.) and the cell suspensions prepared in the laboratory can be used for calibration.

Table 1. Interpretation of McFarland Standard results into corresponding numeric values of bacterial suspension concentration and their optical density at 550 nm.

McFarland Standard	Composition	Interpretation	
	Concentration $BaSO_4$	Bacterial concentration*	Theoretical optical density at 550 nm**
0.5	$2.40x10^{-5}$ mol/l	$150x10^6$ cells/ml	0.125
1	$4.80x10^{-5}$ mol/l	$300x10^6$ cells/ml	0.25
2	$9.60x10^{-5}$ mol/l	$600x10^6$ cells/ml	0.50
3	$1.44x10^{-4}$ mol/l	$900x10^6$ cells/ml	0.75
4	$1.92x10^{-4}$ mol/l	$1200x10^6$ cells/ml	1.00
5	$2.40x10^{-4}$ mol/l	$1500x10^6$ cells/ml	1.25

* Bacterial concentration depends on microorganism size. The numbers represent an average value valid for bacteria. For yeasts, which are larger in size, these numbers should be divided by about 30.

** Values correspond to optical densities of bacterial suspensions. The $BaSO_4$ solutions optical density values differ, because the particle size and form differ from those of bacteria and light is diffracted differently.

3. Getting started

3.1. Unpacking

Remove packing materials carefully and retain them for future shipment or storage of the unit.

Examine the unit carefully for any damage incurred during transit. The warranty does not cover in-transit damage.

Warranty covers only the units transported in the original package.

3.2. Complete set. Package contents:

Standard set

- DEN-1B Densitometer suspension turbidity detector..... 1 piece
- AA type battery .....3 pieces
- external power supply ..... 1 piece
- Operating Manual, Certificate ..... 1 copy
- A-16 adapter for tubes..... 1 piece

Optional accessories

- CKG16 calibration kit for glass tubes 16 mm in diameter ..... on request
- CKG1802 calibration kit for glass tubes 18 mm in diameter ..... on request

3.3. Battery set up:

- Insert a flat sharp pin into the small socket according to the fig.1/1 on the underside and open the battery compartment.
- Insert the batteries inside as shown on the installation scheme in the battery compartment.
- Place the unit on the horizontal even working surface;
- Alternatively, connect the external power supply to the socket (fig.2/2) on the rear side of the unit.

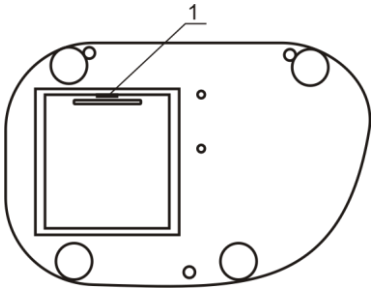

Fig.1 Bottom panel

3.4. **Calibration.**

The device is pre-calibrated at the factory for operation with the glass tubes 16 mm in external diameter (see the label on the bottom side of the unit) at temperature range from +15°C to +25°C and saves calibration data when being switched off.

Note! To work with other type tubes (e.g. with different outer diameter, bottom shape or different material such as transparent plastic tubes), it is necessary to perform calibration in the specified tubes, using adapters, if necessary.

Perform calibration in the following sequence from the lower calibration value to the higher values: 0.00, 0.50, 1.00, 2.00, 3.00, 4.00, 5.00 and 6.00. Use at least 2 points for calibration.

3.4.1. If the external power supply is used, connect it to electric circuit.

3.4.2. Switch ON the unit using the **Power** switch (Fig.2/1) on the rear panel (position I).

Attention! Make sure that the tube socket is empty!

Note! Use a thin pin of maximum diameter 2 mm for pressing the **Select** and **Install** buttons.

3.4.3. Press the **Select** button (fig.2/3) on the backside of the unit. A flashing "**-.--**" indication will be shown on the display, showing that the unit is ready to save calibrations value of the first calibration point - the empty socket.

3.4.4. Press the **Install** button (fig.2/4), the empty socket calibration value will be saved in the unit memory and the next calibration value is displayed (flashing figure "0.00").

Note! It is required to calibrate the 0.00 value and recommended to calibrate as many points as possible to obtain precise results. The minimum requirement is to calibrate 2 points closest to the working range limits (e.g. 0.00 and 6.00 for operation in 0.00 - 6.00 McF unit range).

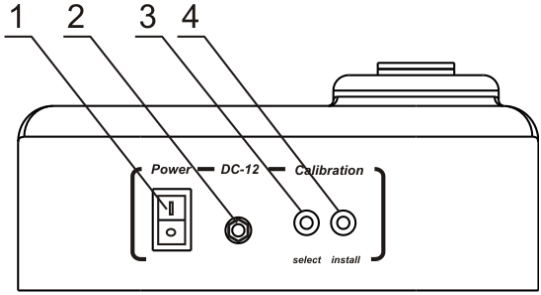

Fig.2 Rear panel

Note! If the standard for 0.00 value is not available, fill the tube (of the kind that is used for operations and standards) with distilled water; use the tube as the 0.00 value standard.

3.4.5. Insert the tube with the standard solution, corresponding to the calibration point value, into the socket (fig.3/1) of Densitometer.

Note! Shake the tube with the standard solution, if necessary. It is recommended to use a vortex, e.g. Personal Vortex V-1 plus, for shaking.

3.4.6. Press the **Install** button. This calibration curve value will be saved in the memory and the next calibration value will be displayed.

Note! If pressing the Install button during the calibration process does not cause switching to the next standard value, it means that the currently inserted in the densitometer socket standard has lower turbidity value than the previous standard. The reason is that the inserted standard solution turbidity does not correspond to the required value (the standard is to be shaken or replaced).

3.4.7. Repeat steps 3.4.5.-3.4.6. until the calibration is complete (1-7 times, i.e. as many times as many points the chosen calibration curve has).

3.4.8. If a standard is not available, press the **Select** button for the next calibration value to be displayed.

3.4.9. After installing the last standard value 6.00, or skipping it (by pressing the **Select** button), the will exit the calibration mode automatically. The unit is ready for operation.

3.5. **Reset to factory calibration.** To reset the calibration of the unit to factory settings, ensure that you are in the working mode and the socket of the unit is empty. Press and hold **Install** key for 5 seconds. The unit displays a dot " . ", then changes it to "0.00". The unit is now reset.

3.6. Switch off the unit using the **Power** switch (position **O**). If an external power supply is used, disconnect the external power supply from electric circuit.

4. Operation

Recommendations during operation

- Remove the tube with the solution being measured before switching the unit on or off.
- It is recommended to keep the unit switched on for 15 min before starting the operation in order to stabilize it in the working mode.
- If flat-bottomed tubes are used, the solution level should be higher than 7 mm from a tube bottom; if round-bottomed tubes are used, the level should be higher than 12 mm from a tube bottom.
- The display goes off if there is no tube in the socket during one minute. Press the **On** key (fig.3/3) to activate the unit.
- Check if the **A-16** adapter is in the socket (Fig. 3/1). The device is calibrated for operation with the glass tubes 16 mm in external diameter. Refer to p. 3.4. when using different tubes.

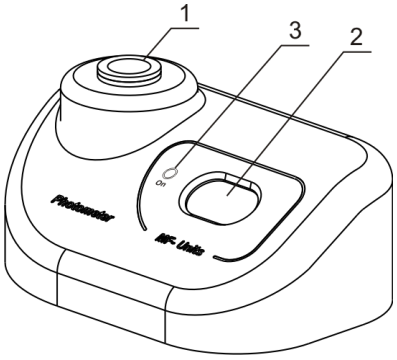

Fig.3 General view

4.1. If an external power supply is used, connect it to electric circuit.

4.2. Switch ON the unit using the **Power** switch (Fig.2/1) on the rear panel (position I).

4.3. The following indication may be shown on the display (fig.3/2):

- "0.00" the unit is calibrated and ready for operation (if no tube inserted);
- "LO BAT" Low Battery: when operating on batteries, replace the batteries following the instructions of the Safety Pre-cautions section concerning batteries.

4.4. Shake the tube with the solution. It is recommended to use a vortex for shaking, e.g. V-1 plus personal vortex. Insert the tube into the socket of densitometer (fig.3/1). The McFarland value for the solution will be shown on the display (fig.3/2).

4.5. Glass and transparent plastic tubes (16 or 18 mm in external diameter) can be used for work with densitometer. An **A-16** adapter must be inserted in the socket when working with tubes which have external diameter 16 mm.

Note! The unit must be calibrated each time a tube type, e.g. with different outer diameter, bottom shape or different material transparent plastic tubes), is changed.

4.6. After finishing the operation switch OFF the unit using the **Power** switch (position **O**). If the external power supply is used, disconnect it from electric circuit.

5. Specifications

The unit is designed for operation in cold rooms, incubators and closed laboratory rooms at ambient temperature from +4°C to +40°C in a non-condensing atmosphere and maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.

5.1. Light source ..... LED
5.2. Wavelength..... λ = 565 ±15 nm
5.3. McFarland unit range ..... 0.0 - 15.0
5.4. Display resolution ..... 0.01 McF
5.5. Accuracy, of the full scale ..... ± 3%
5.6. Measurement time ..... 1 s
5.7. Sample volume ..... 2 ml minimum
5.8. Recommended external diameter of tube ..... 16 mm (using **A-16** adapter) or 18 mm
5.9. Display ..... LCD
5.10. Dimensions ..... 165x115x75 mm
5.11. Input current/power consumption ..... 12 V, 7 mA / 0.1 W
5.12. External power supply ..... input AC 100-240 V 50/60 Hz, output DC 12 V
5.13. Battery ..... 3 x batteries AA type
5.14. Weight* ..... 0.7 kg

Replacement parts	Description	Catalogue number
A-16	Adapter for tubes 16 mm in external diameter	BS-050102-AK

Optional accessories	Description	Catalogue number
CKG16	Calibration kit for glass tubes 16 mm in diameter. Latex particles.	BS-050102-BK
CKG1802	Calibration kit for glass tubes 18 mm in diameter. Barium sulphate $BaSO_4$.	BS-050102-GK

Biosan is committed to a continuous program of improvement and reserves the right to alter design and specifications of the equipment without additional notice.

* Accurate within ±10%.

6. Maintenance

6.1. If the unit requires maintenance, disconnect the unit from the electric circuit and contact Biosan or your local Biosan representative.

6.2. All maintenance and repair operations must be performed only by qualified and specially trained personnel.

6.3. Standard ethanol (75%) or other cleaning agents recommended for cleaning of laboratory equipment can be used for cleaning and decontamination of the unit.

7. Warranty. Reclamation information

7.1. The Manufacturer guarantees the compliance of the unit with the requirements of Specifications, provided the Customer follows the operation, storage and transportation instructions.

7.2. The warranted service life of the unit from the date of its delivery to the Customer is 24 months (excluding the consumables, i.e. batteries and calibration kits). Contact your local distributor to check availability of extended warranty.

7.3. Warranty covers only the units transported in the original package.

7.4. If any manufacturing defects are discovered by the Customer, an unsatisfactory equipment claim shall be compiled, certified and sent to the local distributor address. Please visit www.biosan.lv, Technical support section to obtain the claim form.

7.5. The following information will be required in the event that warranty or post-warranty service comes necessary. Complete the table below and retain for your records.

Model	Suspension turbidity detector Densitometer DEN-1B
Serial number	
Date of sale	

8. Declaration of Conformity

Declaration of Conformity

Equipment name:	**DEN-1B**
Type of equipment:	Densitometer
Directive:	EMC Directive 2014/30/EC Low Voltage Directive 2014/35/EC RoHS 2011/65/EC WEEE 2002/96/EC & 2012/19/EU
Manufacturer:	SIA BIOSAN Ratsupites 7, build.2, Riga, LV-1067, Latvia
Applied Standards:	**EN 61326-1:** Electrical equipment for measurement, control and laboratory use EMC requirements. General requirements. **EN 61010-1:** Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements.

We declare that this product conforms to the requirements of the above Directive(s)

Signature

Svetlana Bankovska
Managing director

28.01.2015
Date

Signature

Aleksandr Shevchik
Engineer of R&D

28.01.2015
Date

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