

Babylog 8000 plus Infant Care Ventilator

Operating Instructions Software 5.n





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Working with these Operating Instructions

Header line – the title...

of the main chapter

The title of the respective sub-section is printed underneath the main header – to help you find your way quickly from subject to subject.

Page body...

the Operating Instructions

combine text and illustrations. The information is presented in the form of required steps of action, giving the user hands-on experience in learning how to use the ventilator.

Left-hand column... the text

provides explanations and instructs users step-by-step in the practical use of the product, with short, clear

instructions in easy to follow sequences.

Bullet points indicate separate actions. Where several actions are described, numbers are used to refer both to relevant details in the illustrations and to specify the sequence of actions.

Right-hand column... the illustrations

provide the visual reference for the text and make it easier to locate the various parts of the device. Elements mentioned in the text are highlighted. Unnecessary details are omitted.

Rendering of screen displays guide the user and allow to reconfirm actions performed.

Typing conventions...

Controls are designated as »Control Name« , e.g:

»PEEP/CPAP«

Screen messages are printed in bold, e.g:

Calibrate flow sensor!



WARNING !

Strictly follow this Operator's Instruction Manual

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Use" (see page 18) and in conjunction with appropriate airway monitoring (see page 19). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

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Important Safety Information

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Important Safety Information

Operator's Responsibility for Patient Safety Limitation of Liability

Operator's Responsibility for Patient Safety

WARNING !

Strictly follow this Operator's Instruction Manual.

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Use" (page 18) and in conjunction with appropriate airway monitoring (see page 19). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, largely to the specifics of the Dräger design. This publication excludes references to various hazards which are obvious to a medical professional and operator of this equipment, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. Dräger disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of this product with other products whether supplied by Dräger or by other manufacturers if such a combination is not endorsed by Dräger.

The operators of the ventilator system must recognize their responsibility for choosing appropriate safety monitoring that supplies adequate information on equipment performance and patient condition. Patient safety may be achieved through a wide variety of different means ranging from electronic surveillance of equipment performance and patient condition to simple, direct observation of clinical signs. The responsibility for the selection of the best level of patient monitoring lies solely with the equipment operator (see also page 19, "Mandatory Ventilation Monitoring").

Limitation of Liability

Dräger's liability, whether arising out of or related to manufacture and sale of the goods, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon Dräger's Product Warranty, is subject to and limited to the exclusive terms and conditions as set forth, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to Dräger and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

THE STATED EXPRESSED WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT.

Dräger shall not be liable for, nor shall buyer be entitled to recover any special incidental, or consequential damages or for any liability incurred by buyer to any third party in any way arising out of or relating to the goods.

Warranty

All Dräger products are guaranteed to be free of defects for a period of one year from date of delivery. The following are exceptions to this warranty:

- The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Dräger or its representatives are not covered.
- 2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.
- 3. Oxygen sensors capsules have a six-month limited warranty from the date of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with Dräger holding the option. Dräger is not respon-sible for deterioration, wear, or abuse. In any case, Dräger will not be liable beyond the original selling price. Application of this warranty is subject to the following conditions:

- 1. Dräger or its authorized representative must be promptly notified, in writing, upon detection of the defective material or equipment.
- 2. Defective material or equipment must be returned, shipping prepaid, to Dräger or its authorized representative.
- 3. Examination by Dräger or its authorized representative must confirm that the defect is covered by the terms of this warranty.
- Notification in writing, of defective material or equipment must be received by Dräger or its authorized representative no later than two (2) weeks following expiration of this warranty.

The above is the sole warranty provided by Dräger. No other warranty expressed or implied is intended. Representatives of Dräger are not authorized to modify the terms of this warranty.

Draeger Medical, Inc., Telford, PA

Important Safety Information

Definitions Summary of WARNINGS and CAUTIONS

Definitions

WARNING !

A WARNING statement refers to conditions with a possibility of personal injury if disregarded.

CAUTION !

A CAUTION statement designates the possibility of damage to equipment if disregarded.

NOTE: A NOTE provides additional information intended to avoid inconveniences during operation.

Inspection	=	examination of actual condition
Service	=	measures to maintain specified condition
Repair	=	measures to restore specified condition
Maintenance	=	inspection, service, and repair, where necessary
Preventive Maintenance	=	Maintenance measures at regular intervals

Typing conventions in this manual

Controls (knobs, hard keys and menu keys) are designated as **»Control Name**«, e.g.:

»PEEP/CPAP«

On-screen messages are printed in **bold**, e.g.:

Calibrate flow sensor!

Summary of WARNINGS and CAUTIONS

General Precautions

WARNING !

Strictly follow this Operator's Instruction Manual

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Use" (page 18) and in conjunction with appropriate airway monitoring (see page 19). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

WARNING !

Babylog 8000 plus is solely intended for use by physicians or by allied health care professionals on the order of a physician. All users must be properly trained and completely familiar with these Operating Instructions.

WARNING !

This device is to be used only in rooms with line power installations complying with national safety standards for hospital patient rooms. (e.g., IEC 601.1, "Safety of Medical Equipment).

To maintain grounding integrity, connect only to a"hospital grade" receptacle.

Always disconnect supply before servicing.

WARNING !

DANGER, risk of explosion if used in the presence of flammable anesthetics.

This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures with air or with nitrous oxide are likely.

WARNING !

Mobile telephones must not be used within 10 meters (33 feet) of the equipment. Mobile telephones can interfere with the function of electromedical equipment and therefore endanger the patient!

WARNING !

Do not use ventilator in conjunction with nuclear spin tomography (MRT, NMR, or NMI)!

Equipment malfunction may result.

WARNING !

Sidestream monitors may cause negative pressures in the event of a blocked inspiratory circuit. Always connect monitoring lines of a suctioning sidestream monitor via adapter 84 12 448 with safety valve.

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

WARNING !

Always use independent apnea monitor when the built-in apnea monitoring has been switched off. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute must be provided in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

If a fault is detected in the ventilator and its life-support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O2 concentration where necessary and appropriate. The unit should then be removed from use and serviced by an authorized service technician.

CAUTION !

Restriction of Distribution

Federal Law and Regulations in the United States and Canada restrict this device to sale by or on the order of a physician. Important Safety Information

Precautions During Preparation

WARNING !

Always install expiratory valve that has been cleaned and disinfected.

WARNING !

Treatment of batteries and O2-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O2-sensor capsules.

WARNING !

Always use medical grade oxygen and air that is dry and free from dust and oil. Contaminated gas may cause ventilator malfunction.

WARNING !

Always provide adequate ventilation!

When the equipment is being operated with O₂, ensure that the ambient concentration does not exceed 24% O₂. Otherwise, the risk of fire may be increased.

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

WARNING !

Dräger cannot warrant or endorse the safe performance of third party humidifiers for use with the Babylog 8000 plus infant ventilator. Specifically, combinations of humidifiers not intended for use with infant patients bear risks of delivering breathing gas not maintained at a proper temperature.

Excessive rainout in the inspiratory line of the breathing circuit may disable the flow and volume measuring capabilities of the Babylog 8000 plus ventilator.

Increased pneumatic resistance and compliance in the inspiratory line caused by a humidifier may result in inaccurate airway pressure readings.

We recommend contacting the manufacturers /distributors of heated humidifying devices about compliance of their products with the requested performance characteristics.

WARNING !

Dräger cannot warrant or endorse the safe performance of third party ventilator circuits for use with the Babylog 8000 plus infant ventilator. Increased pneumatic resistance caused by some circuit systems may result in inaccurate airway pressure readings.

Only use circuits with an inner diameter of at least 10 mm (0.4 inch)

We recommend contacting the manufacturers /distributors of infant patient circuits regarding compliance of their products with the requested performance characteristics (see p. 32).

WARNING !

In order to avoid any risk of electric shock in the event of faulty grounding of patient monitoring equipment, do not use antistatic or electrically conductive patient circuits

WARNING !

Note arrows for inspiratory and expiratory connector on ventilator ports. If circuit ends are confused, humidification will not be effective.

Precautions During Operation

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

WARNING !

Always use safety valve when connecting sampling CO₂ or NO monitors. Otherwise negative airway pressures may result in the event of a blocked inspiratory circuit.

WARNING !

The ventilator is ready for operation only when:

- it is completely assembled with all required auxiliary equipment in place,
- all sensors are calibrated (O2, Flow),
- all checks have been completed successfully.

CAUTION !

Do not place containers of liquids on top of the Babylog 8000 plus ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.

CAUTION !

If Air and O₂ supply lines are contaminated with particles or moisture, as is likely during the use with a medical air compressor, use high pressure line filters that retain at least 0.1 micron particles and stop water droplets (e.g. Dräger part no. D 800 130, D 800 132).

CAUTION !

Always hold end cuffs when pulling a circuit from a port. Otherwise damage to the patient circuit will result.

WARNING !

Always use ventilator that has been cleaned and disinfected and has been successfully tested to be ready for operation.

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction. Not any and every critical condition can be expected to cause a ventilator alarm.

WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O2 concentration where necessary and appropriate. The unit should then be removed from use and serviced by an authorized service technician.

WARNING !

In case of malfunction of any of the built-in monitoring, a substitute must be provided in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations. This is particularly important when, during a nebulizer treatment, the Babylog flow sensor has been removed to protect it against contamination.

WARNING !

The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety when switching off flow measurement during nasal CPAP.

Use appropriate external monitoring to assure patient's oxygenation status and to detect apnea.

WARNING !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. It is absolutely essential that the ventilation regime and the oxygen concentration administered is selected on the basis of arterially measured oxygen partial pressure in the blood of the infant. This is the only way of minimizing the risk of both hyperoxemia, which might cause, above all, retrolental fibroplasia, and hypoxemia, which might contribute to intraventricular hemorrhage and damage to the baby's brain.

WARNING !

The accuracy of the concentration of oxygen delivered to the patient must be monitored at all times. If the oxygen analyzer integrated into the Babylog 8000 plus ventilator is not operable, an independent oxygen monitor must be connected to the inspiratory limb of the patient circuit.

WARNING !

- Always use extreme caution when using oxygen!
- Oxygen intensely supports any burning! No smoking, no open fire in areas where oxygen is in use!
- Always provide adequate ventilation in order to maintain ambient O2 concentrations < 24 %.
- Always secure O2 cylinders against tipping, do not expose to extreme heat.
- Do not use oil or grease on O2 equipment such as tank valves or pressure regulators. Do not touch with oily hands. Risk of fire!
- Open and close valves slowly, with smooth turns. Do not use any tools.

WARNING !

Do not block air intake. Ventilator malfunction will result.

Be careful not to cause back pressure when using scavenging systems.

WARNING !

Aerosol medications may clog expiratory valves which can impair ventilation.

Therefore, exchange expiratory valve immediately after nebulizing aerosols.

WARNING !

Aerosol medications may clog bacteria filters which can impair ventilation.

Therefore, do not use bacteria filters at the nebulizer output or in the expiratory side of the patient circuit.

WARNING !

The wires of the Babylog 8000 plus flow sensor operate at a high temperature. If the sensor is left in the patient circuit for an extended period of time while nebulizing without cleaning, residue buildup might result from the pharmaceutical aerosols that would impair flow measurement.

As a worst case, these residues might ignite!

To prevent this, it is not sufficient to remove the electrical connector from the flow sensor.

Therefore, it is mandatory to physically remove the flow sensor from the circuit, (resp. the flow sensor element from the wye) before beginning any nebulizer treatment.

WARNING !

When the flow and volume measuring system of the Babylog 8000 plus ventilator is not operable, detection of spontaneous breathing activity is not possible. Therefore no apnea alarm is provided at that time.

Tidal volumes for ventilated infants are significantly influenced by the compressible volume of the breathing circuit (in addition to parameters of the patients lungs). Adjustment of inspiratory time, expiratory time, pressure limits, and inspiratory flow rate all affect the tidal volume delivered to the patient. Assessment of ventilator settings must be made with special care during periods where no patient flow/volume information is available. Otherwise, lung damage due to excessive tidal volumes and/or pressures may result.

Precautions During Care

WARNING !

Water traps should be used in appropriate locations of the breathing circuit in order to prevent water accumulation in the tubing from being drained toward the patient's airway.

WARNING !

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.

WARNING !

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

WARNING !

Follow all accepted hospital procedures for disinfecting parts contaminated by body fluids (protective clothing, eyewear, etc.).

WARNING !

The alarm silence button is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilator function and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury.

WARNING !

The ventilator is only ready for operation when it has been completely assembled and the flow sensor been calibrated after switching the ventilator on.

CAUTION !

WARNING !

Therapeutic decisions should not be made solely on the basis of the data transmitted via the communications Interface. Always use other diagnostic means in addition.

CAUTION!

Use only dry and clean compressed air and oxy-

gen. Water and/or oil in the air or oxygen supply

CAUTION ! Do not place containers of liquids on top of the Babylog 8000 plus ventilator. Liquids penetrating

the ventilator can cause equipment malfunction

will cause equipment malfunction and damage.

Certain components of the ventilator consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately apparent. Sterilization with ethylene oxide (EtO) is also not recommended.

Do not process flow sensor element in cleaning and disinfection equipment.

CAUTION!

Do not use compressed air, a brush or similar tools to clean the flow sensor element, as this would possibly damage the thin wires in the flow sensor.

CAUTION !

Ensure that no liquid remains in the pressure measuring canal of the expiratory valve, as it might cause malfunction.

and damage.

Precautions During Maintenance

WARNING !

To avoid any risk of infection, clean and disinfect ventilator and accessories before any maintenance according to established hospital procedures - this applies also when returning ventilators or parts for repair.

WARNING !

Preventive Maintenance work on the Babylog 8000 plus ventilator shall be performed by properly trained and factory authorized staff only.

WARNING !

When servicing the ventilator, always use replacement parts that are qualified to Dräger standards.

Dräger cannot warrant or endorse the safe performance of third party replacement parts for use with the Babylog 8000 plus ventilator.

WARNING !

Disconnect power!

Before opening the unit, always disconnect plug at the wall outlet first.

WARNING !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to properly trained and factory authorized service personnel.

For ventilators with liquid crystal displays (LCD):

WARNING !

If, in case of damage to the ventilator, the glass of the LCD screen is broken, a liquid chemical may escape that should not come into contact with the skin. In case of contamination, wash off with soap immediately.

WARNING !

Treatment of batteries and O2-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O₂-sensor capsules.

CAUTION !

The device must be inspected and serviced at regular 6 month intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor.

For repairs of the Babylog 8000 plus infant ventilators, we recommend that you contact DrägerService.

Intended Use

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Intended Use

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Intended Medical Applications Restrictions of Use

Intended Medical Application

WARNING !

Babylog 8000 plus is solely intended for use by physicians or by allied health care professionals on the order of a physician. All users must be properly trained and completely familiar with these Operating Instructions.

Babylog 8000 plus is a long term ventilator to be used in the intensive care of premature and newborn babies and of infants up to 10 kg (22 lbs).

Available Ventilation Modes

- CMV Continuous Mandatory Ventilation, Time-controlled, time-cycled, pressurelimited continuous flow ventilation.
- A/C Assist Control Ventilation Time-controlled, volume triggered, timecycled, pressure-limited continuous flow ventilation that is synchronized with each spontaneous patient breath.
- SIMV Synchronized Intermittent Mandatory Ventilation,

Time-controlled, volume triggered, timecycled, pressure-limited continuous flow ventilation, synchronized with patient's spontaneous breathing at the set ventilation rate.

- PSV Pressure Support Ventilation (available option), Time-controlled, volume-triggered, flow cycled, pressure-limited ventilation synchronized with each spontaneous patient breath.
- CPAP Continuous Positive Airway Pressure, Spontaneous breathing with positive airway pressure.

Ventilation Mode Extensions

- VG Volume Guarantee (available option) Volume controlled ventilation. The ventilator controls inspiratory pressure in order to deliver the preset tidal volume. May be combined with A/C, SIMV, and PSV.
- VIVE Variable Inspiratory, Variable Expiratory Flow Separate continuous flow during expiration in mandatory ventilation modes.

Restrictions of Use

CAUTION !

Restriction of Distribution

Federal Law and Regulations in the United States and Canada restrict this device to sale by or on the order of a physician.

WARNING !

This device is to be used only in rooms with line power installations complying with national safety standards for hospital patient rooms. (e.g., IEC 601.1, "Safety of Medical Equipment).

To maintain grounding integrity, connect only to a"hospital grade" receptacle.

Always disconnect supply before servicing.

WARNING !

DANGER, risk of explosion if used in the presence of flammable anesthetics.

This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures with air or with nitrous oxide are likely.

WARNING !

Mobile telephones must not be used within 10 meters (33 feet) of the equipment. Mobile telephones can interfere with the function of electromedical equipment and therefore endanger the patient*!

WARNING !

Do not use ventilator in conjunction with nuclear spin tomography (MRT, NMR, or NMI)!

Equipment malfunction may result.

Dräger medical equipment conforms to the interference immunity requirements laid down in product-specific standards or in EN 60601-1-2 (IEC 601-1-2). However, depending on the design of a mobile phone and the use situation, field strengths exceeding the values laid down in the specified standards may be generated in the immediate vicinity of mobile phones, thereby causing interference and malfunctions.

Mandatory Ventilation Monitoring Backup Ventilation With an Independent Manual Ventilation Device (Resuscitation Bag)

WARNING !

Sidestream monitors may cause negative pressures in the event of a blocked inspiratory circuit. Always connect monitoring lines of a suctioning sidestream monitor via adapter 84 12 448 with safety valve.

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

Mandatory Ventilation Monitoring

Babylog 8000 plus includes monitoring for:

- inspiratory O2 concentration
- airway pressure
- flow
- tidal volumes
- respiration rate (tachypnea monitoring)

WARNING !

Always use independent apnea monitor when the built-in apnea monitoring has been switched off. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute must be provided in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

An optional communications interface for the Babylog 8000 plus ventilator is available for communicating measured data and ventilator settings to other devices, such as patient monitors or computers.

For administering pharmaceutical aerosols, the ventilator may be combined with a pneumatic nebulizer.

Backup Ventilation With an Independent Manual Ventilation Device (Resuscitation Bag)

WARNING !

If a fault is detected in the ventilator and its life-support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O2 concentration where necessary and appropriate. The unit should then be removed from use and serviced by an authorized service technician. This page intentionally left blank

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Design of the User Interface

Design of the User Interface



The ventilator front end consists of a **dial panel** and a **display/menu key panel**.

Dial panel

The dial panel contains buttons for the main operating modes and dial knobs for the most important ventilator parameters.

- 1 Green LEDs next to the dials indicate mandatory parameters in the respective operating modes. These LEDs will flash if a parameter has been internally limited or needs to be acknowledged.
- 2 »Vent. Mode« key switches to basic ventilation mode menu
- 3 »Vent. Options« key switches to ventilation mode extensions menu.



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Display/menu key panel

Main components of this panel are the LCD screen and a number of keys with fixed or variable function assignments.

- 1 » \square « key silences audible alarms for 2 minutes.
- 2 »Confirm« key is used for acknowledging alarms or to confirm settings.
- 3 »Man. Insp.« key initiates manual breaths.
- 4 »Cal. Config.« key switches to calibration menu.
- **5** In different screen menus, the 6 menu keys below the screen are used to select monitoring functions and ventilation modes.
- 6 The illuminated bar graph above the screen displays current airway pressure readings.

Screen Layout

- 1 The graphics display window shows pressure or flow waveform or pressure-volume loops.
- 2 The measured values window numerically displays measured values, e.g. for MV, FiO₂, Peak, Mean, PEEP.
- **3** The status window displays the current mode of ventilation and other status information.
- 4 The menu bar shows the respective function of the menu keys as symbols or text labels.

In some instances, text and measured values are shown together in one larger window.

Messages are displayed as overlay windows on top of the current screen:

Display (example):

Apnea







Screen Menus

Screen Menus

Ventilation Menus



Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed.

Operating Concept

Screen Menus

Monitoring Menus



Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed.

Operating Concept

Screen Menus

Calibration/Configuration Menus



Preparation

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Preparation

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Mounting Babylog 8000 plus on Mobile Stand

• Turn stand until the two lockable casters are to the right.

NOTE: The following mounting instructions for Babylog assume the stand is in this position:



- 1 Tilt Babylog forward approximately 45°.
- 2 Insert front latches into slots in platform.
- 3 Lower ventilator inserting back latches into slots in platform. Secure at the back using knurled screws.



• Place tray on the ventilator - the two latches fit into the back slots in the enclosure.

CAUTION !

Do not place containers of liquids on top of the Babylog 8000 plus ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.



Mounting the Expiratory Valve

WARNING !

Always install expiratory valve that has been cleaned and disinfected.

- **1** Flip lever in release position = upwards.
- Push expiratory valve onto guide rod as far as it will go.
- **2** Lock expiratory valve = flip lever down.
- **3** Connect silencer to exhaust nozzle on expiratory valve.

Installing an O2 Sensor Capsule

Installing an O2 Sensor Capsule

- before first use
- when calibration can no longer be performed.
- Unscrew the two screws in cover on the right and remove cover lid.
- Pull used O₂ sensor capsule.
- Insert new capsule into opening circular contacts must point towards cover lid.
- Press down cover and re-tighten the two screws.



After installation:

- Wait for 15 minutes for sensor to warm up before calibration.
- Calibrate sensor manually, see page 39.
- Dispose of the used sensor, see page 104.

WARNING !

Treatment of batteries and O2-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O2-sensor capsules.

Connecting Supplies

Gas Supply

WARNING !

Always use medical grade oxygen and air that is dry and free from dust and oil. Contaminated gas may cause ventilator malfunction.

Supply pressures must be between 43.5 and 87 psi (3 to 6 bar)

 Screw high pressure air and oxygen hoses to sockets on the back panel of Babylog and insert probes into wall terminals.



CAUTION !

If Air and O_2 supply lines are contaminated with particles or moisture, as is likely during the use with a medical air compressor, use high pressure line filters that retain at least 0.1 micron particles and stop water droplets (e.g. Dräger part no. D 800 130, D 800 132).



WARNING !

Always provide adequate ventilation!

When the equipment is being operated with O₂, ensure that the ambient concentration does not exceed 24% O₂. Otherwise, the risk of fire may be increased.

Electrical Supply

Line voltage must correspond to voltage range of ventilator (see rating plate on back):

either : 220 V to 240 V or : 100 V to 127 V

• Insert Babylog power plug into wall outlet.

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing. Connecting a Humidifer

Connecting a Humidifier

WARNING !

Dräger cannot warrant or endorse the safe performance of third party humidifiers for use with the Babylog 8000 plus infant ventilator. Specifically, combinations of humidifiers not intended for use with infant patients bear risks of delivering breathing gas not maintained at a proper temperature.

Excessive rainout in the inspiratory line of the breathing circuit may disable the flow and volume measuring capabilities of the Babylog 8000 plus ventilator.

Increased pneumatic resistance and compliance in the inspiratory line caused by a humidifier may result in inaccurate airway pressure readings.

We recommend contacting the manufacturers /distributors of heated humidifying devices about compliance of their products with the requested performance characteristics.

Humidifiers for use with the Babylog 8000 plus ventilator:

- Humidifiers must conform to ISO 8185.
- The total resistance of the patient circuit must be less than 20 cmH2O/L/s, inspiratory resistance ≤ 12 cmH2O/L/s, expiratory resistance ≤ 8 cmH2O/L/s.
- The combination with the Babylog 8000 plus ventilator may not impair safety and function of either device.
- Prepare humidifier following its operating instructions.

Preparation

Assembling Components

Assembling Components

Connecting a Patient Circuit

WARNING !

Dräger cannot warrant or endorse the safe performance of third party ventilator circuits for use with the Babylog 8000 plus infant ventilator. Increased pneumatic resistance caused by some circuit systems may result in inaccurate airway pressure readings.

Only use circuits with an inner diameter of at least 10 mm (0.4 inch)

We recommend contacting the manufacturers /distributors of infant patient circuits regarding compliance of their products with the requested performance characteristics (see p. 32).

WARNING !

In order to avoid any risk of electric shock in the event of faulty grounding of patient monitoring equipment, do not use antistatic or electrically conductive patient circuits*

- Connect patient circuit to ports on ventilator and humidifier.
- Use segments of appropriate length for the different application environments (see next page, suggested lengths are in meters).

CAUTION !

Always hold end cuffs when pulling a circuit from a port. Otherwise damage to the patient circuit will result.



* IEC 601-2-12 "Lung Ventilators" does not consider the use of antistatic or electrically conductive materials for patient circuits of a lung ventilator a contribution to increased safety. To the contrary, the use of such materials increases the risk of electric shock for the patient and the fire risk associated with oxygen. Assembling Components

Use with open care beds (outside an incubator)

It is recommended to use a hinged circuit support arm with an appropriate circuit holder at the end (part no. 84 09 609).

- Swivel both nozzles on Babylog downwards or in the direction of the patient.
- Attach patient circuit to correct ports on the ventilator. Note suggested segment length (in meters).

WARNING !

Note arrows for inspiratory and expiratory connector on ventilator ports. If circuit ends are confused, humidification will not be effective.

• Install water trap(s) in vertical position at the lowest point of the circuit.

Use with Dräger Series 8000 incubators

- Install water trap(s) in vertical position at the lowest point of the circuit.
- Install flexible circuit support arm (order no. 2M 19630) to hold circuit inside the incubator hood.
- Clip both limbs of the circuit to circuit support arm.
- Push inspiration hose through one of the upper silicone access ports in the incubator hood.

NOTE: Check that humidifier temperature probe is mounted outside the incubator. When mounted inside, the humidifier temperature control might become impaired. Follow respective humidifier operating instructions.

• Push expiratory limb of the circuit through the port immediately below.

Use with third party incubators

When used in combination with other than Dräger Series 8000 incubators, we recommend using flexible circuit support arm (order no. 84 10 080). It can be installed in most incubator models similar to the one for the Dräger Series 8000 incubators.





Installing an Optional Bacteria Filter

A bacteria filter may be used as a protection against contamination of the inspiratory side of the ventilator.

- Use installation kit 84 10 230.
- 1 Push hose segment 0,25 m onto inspiratory port
- 2 Attach adapter Ø15 mm / Ø22 mm to hose.
- 3 Attach bacteria filter to adapter
- 4 Install size II ET-tube connector to bacteria filter.
- Install patient circuit as before.
- Follow instructions for use of bacteria filter.



Installing the Wye and Flow Sensor

- 1 Put sterile wye into breathing circuit.
- Insert flow sensor (ISO connector 15 mm, part no. 84 11 130) into the wye,

or

- **3** use wye with integrated flow sensor (part no. 84 10 185)
- 4 Connect plug on flow sensor cable to wye.
- Route flow sensor cable to ventilator along patient circuit.

NOTE: Positioning of the wye: The connector for the endotracheal tube should be pointing approximately 45° downward to avoid buildup of condensation.



Assembling Components

• Plug flow sensor cable connector into the back panel of the ventilator and tighten securing screws.



• Connect infant size test lung (part no. 84 09 742) to wye. It consists of a small bellow, a 165 mm long endotracheal tube (internal dia 2.5, CH 12), and ET-tube connector.



WARNING !

Always use safety valve when connecting sampling CO₂ or NO monitors. Otherwise negative airway pressures may result in the event of a blocked inspiratory circuit.

 Always connect sampling lines of sidestream monitors via adapter 84 12 448 with safety valve – luer lock connector pointing upwards to avoid condensation buildup.



Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed.
Before Using for the First Time

NOTE: The built-in NiCd battery for power failure alarm is recharged automatically during operation. Before first use, or when the ventilator has been out of service for a long time, the ventilator must be run for half an hour to sufficiently charge the NiCd battery.

Use the following settings to avoid audible alarms during charging:

- 1 Set dial knob »O2-Conc.%« to 21.
- 2 Set dial knob »Insp. Flow V « to 5.
- 3 Set dial knob »Tin« to 0.4, »Tex« to 0.6.
- 4 Set dial knob »Pinsp« to 20.
- 5 Set dial knob »PEEP/CPAP« to 0.
- 6 Press power switch button in as far as it will go = On.





• Display:

The ventilator now tests the internal program memory. All LEDs are lit and both a continuous audible alarm and a tone sequence will sound briefly.

Self test

Afterwards

• Display (Example):

After the self test, the software version and number of operating hours are displayed.

+Lung function +PSV +Communication +VG Hours of operation : 5146	og 8000 plus	(5.00) 📰
Hours of operation : 5146	tion +P9 tion +VG	U I
FIOW Measurement : NIPU,Y	peration wrement	5146 NTPD,Y

Preparation

Before Using for the First Time Calibrations

- 1 Press »Vent. Mode« menu key.
- 2 Press »CMV« menu key. Press »On« menu key.



- Display (example):
- **3** The alarm limit symbol **x**/**•** will be flashing as a request to set alarm limits.

	50	j_cmH2O	ÜΕ		-LZmin	CMV
			Fi02	20	5 %	
		20	P	11	cmH20	<u> </u>
Graph	Meas	List	Tre	nd 📕	$\overline{\mathbf{x}}$	4:1
					3	

Calibrations

Calibration of the built-in oxygen analyzer:

- is performed automatically every 24 hours.
- must be performed manually after replacing a used O2 sensor.
- may be performed manually at any time.

Calibration of the flow sensor:

- is required every time the ventilator is switched on,
- after exchanging a flow sensor.

Calibration of pressure sensors:

- is automatic when ventilator is switched on.

Calibrating the O2-Sensor Manually

After sensor has been replaced, but possible at all times.

1 Press »Cal. Config.« menu key.





- 2 Press »O2-Cal« menu key.
- **3** After approximately 5 minutes, **O2 cal** disappears from the display, calibration is now completed.

 50 cmH20 VE
 -.--L/min
 CMV

 02 calibration
 %
 3

 Meas switched off
 cmH20
 02 cal

 Graph
 Meas
 List
 Trend

To clear the respective text message:

1 Press »Confirm« key.



Calibrations

Calibrating the Flow Sensor

- after ventilator is switched on,
- after cleaning and disinfecting of a sensor,
- after exchanging a flow sensor.
- 1 Press »Cal. Config.« menu key.



For best measurement accuracy:

- Select type of flow sensor (ISO or Y), to fine-tune measuring circuit to the particular type of sensor used.
- 2 Press »Sensor« menu key.
- Mark display line Flow Sensor with menu keys »***, and
- select ISO or Y style sensor with menu keys
 * + « or » «.



Select reference conditions:

NTPD (ambient temperature 20 °C, atmospheric pressure of 1013 mbar, dry gas), or

BTPS (body temperature 37 °C, ambient pressure, water vapor saturated gas).

- 3 Mark display line **Measurement** with menu keys »★★«, and
- 4 select NTPD or BTPS with menu keys » + ∗ or » «.



Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed.

Calibrations

To calibrate:

- 1 Disconnect ET-tube and keep the patient connection of the wye sealed, e.g. using a sterile glove.

NOTE: Gas flow through the wye must be completely blocked for calibration (zero flow condition).



- Display:
- 2 Press »Start« menu key.

After approximately 1 second, the message AFTOW will disappear from the status field, the sensor is now calibrated.

F 1	ow Sen	Sensor calibration E					
					20,00100		
Start							
		2					

• Display:

		50) cmH20	VE	-−L∠min	CMV
	F	low ser	nsor ca	librate	ط [%] ا	
-			- ^{2s}		-crinzo	
Graph	າ	Meas	List	Trend	1 /A	

• Reconnect ET-tube.

If calibration could not be performed successfully:

• Exchange sensor element or cable, see page 42.

NOTE: If the flow sensor needs to be replaced during operation but cannot be calibrated immediately, measuring accuracy may be reduced.

• Calibrate as soon as possible.

NOTE: If flow sensor becomes momentarily disconnected, no calibration is required.

Calibrations

Exchanging a Flow Sensor Element

In case of message:

Flow measurement disturbed Measurement switched off

- **1** Pull plug from flow sensor.
- 2 Pushing buttons on both sides simultaneously, pull flow sensor element from wye.
- **3** Insert new flow sensor element into the wye until it engages. Ovals engraved on flow sensor element and wye should line up.
- 1 Re-insert into the wye. Watch for proper orientation: groove in plug must match tongue in flow sensor.
- Calibrate flow sensor, see page 40.



Checks of Readiness for Operation

Perform each time the ventilator has been cleaned and disinfected.

Completely reassemble ventilator system with accessories, please refer to pages 33 through 36.

Calibrate flow sensors after switching ventilator on, see page 40.

Connecting a Test Lung

The test lung consists of a bellow for simulating compliance (approximately 0.5 mL/cmH2O) and an ET- tube, internal dia. 2.5 CH 12, 165 mm long, with connector, for simulating airway resistance.



Testing Power Failure Alarm

- Disconnect power plug from wall outlet:
- 1 Push power switch button in back of ventilator and engage = ON.

Continuous audible alarm should sound and remain at a constant volume for about 20 seconds; if not, the NiCd battery must be recharged, see page 37, "Before Using for the First Time".

- 2 Flip protective cap on power switch sideways.
- 1 Push button in fully and release = OFF: Continuous tone should now stop.



Reconnect power plug.

Checks of Readiness for Operation

Testing Gas Supply Failure Alarm

 Push power switch button in back of ventilator and engage = ON.



- Switch on CMV, please refer to page 58.
- Set dial knob »**O2-Conc.%** « to 60 %.
- Unplug probe of O2 supply hose from wall terminal.
- Red alarm lamp will start blinking, audible alarm will sound.



Display:

- Re-connect O2 probe.
- Red alarm will stop blinking, audible alarm will stop.
- Unplug probe of air supply hose from wall terminal.
- Red alarm will start blinking, audible alarm will sound.

Display:

- Re-connect air probe.
- Red alarm will stop blinking, audible alarm will stop.



Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed.

Testing CMV

• Switch on CMV, please refer to page 58.

Adjust dial knobs whose green LEDs are lit:

- 1 »O2-Conc. %« to 21.
- 2 »Insp. Flow V « to 10.
- **3** »Tin« to 0.4. »Tex« to 0.6.
- 4 »Pinsp« to 20.
- 5 »PEEP/CPAP« to 0.
- From the monitoring menu, press menu keys »PEEP/CPAP« and »Pressure«.



Display (example):

• Values displayed should be in acceptable range:

PIP	18 to 22 cmH2O
Ē	6 to 10 cmH2O
PEEP	–1.5 to 1.5 cmH2O

	25	cmH2Q	Ρ _{aw}	cmH20	CMV
			PIP	19	
			Ē	7.4	
		<u>1</u> ≦	PEEP	0.0	
Graph	Meas	List	Trend	\sqrt{x}	A : 1

Testing PEEP

6 Set knob for »PEEP/CPAP« to 10.

Confirm setting:

7 Press »Confirm« key.



Display (example):

• Values displayed should be in acceptable range:

PIP	18 to 22 cmH2O
P	12 to 16 cmH2O
PEEP	8 to 12 cmH2O

Checks of Readiness for Operation

Testing Alarm Limits

Apnea alarm limits

- 1 Switch on CPAP, please refer to page 64.
 - Make sure that apnea alarm is enabled, please refer to page 68.



After 30 seconds (max.):

2 Red alarm will start blinking, audible alarm will sound.

Display (example):			5 cmH20	Paω	cmH20	CPAP
Apnea		r	<u> </u>	JIP .		
or			нрпеа	ĿĿ	4.4	
MV low) îs	PEEP		
	Graeh	Meas	list.	Trend	T	

Airway pressure alarm limits

- 3 Switch on CMV, please refer to page 58.
- 4 Block expiratory limb of the circuit (pinch).
- 2 Red alarm will start blinking, audible alarm will sound.

Display (example):

Hose kinked ? or Airway pressure high Inspiration cancelled

		cmH20	Paw	cmH20	CPAP
	Hose	kink	ed ?]	
		<u>1.c</u> ,	PEEP		
Graph	Meas	List	Trend	$\overline{\mathbf{x}}$	

• Release circuit again. Remove ET-tube connector from wye:



• Red alarm will start blinking, audible alarm will sound.

Display (example):

Airway pressure low or Leak in hose system? Check setting !

		cmH20	Paω	cmH20	CPAP
	Leak in Check s	hose s etting	ystem 3 !	2	
		- 15	PEEP		
Graph	Meas	List	Trend	\mathbf{x}/\mathbf{x}	1

- Reset knob for »**PEEP/CPAP**« to 0.
- Reconnect test lung.

WARNING !

The ventilator is ready for operation only when:

- it is completely assembled with all required auxiliary equipment in place,
- all sensors are calibrated (O2, Flow),
- all checks have been completed successfully.

Check humidifier according to its operating instructions.

Checks of Readiness for Operation

Ventilator Checklist

Perform before each use of the ventilator. After exchanging a patient circuit, only checkpoints 3 through 7 are required.

A copy of this checklist is provided as a writing board and should be kept attached to the ventilator.

• Check off each item on the check list using a pencil. Date and initial.

Dräger	Babylog 8000 plus Checklist Always read Operating Manual first and observe 	Date
Babylog 8000 plus	all instructions.	
Serial No	° Use chain to attach this checklist to ventilator	Signature

Operational verification procedure before each use.

What	How	Requirement
1 Gas Supply	Connect high pressure Air and Oxygen hoses at the back, insert probes into wall terminals	Hose fittings: screws tightened Connector probe: firmly inserted
2 Patient System	Expiratory valve Patient circuit Water traps	firmly attached complete vertical position at lowest point
	Flow sensor connector	connected
	Connect test lung with tracheal tube CH 12 (2.5 mm ID) and ET-tube connector to wye.	
3 Leak Test	Switch Babylog 8000 plus ON.	Display: Calibrate flow sensor!
	Press »Confirm « key, Set ventilation mode CPAP : Press keys »Vent. Mode «, »CPAP « and »On «. Dial knobs »Pinsp « to 80, »Insp. Flow ¹/₄ « to 2, Press »Confirm « key, Keep »man. Insp. « pressed:	Bar graph pressure display: (80 +2) cmH2O

What	How	Requirement
4 Function Test		
Flow Calibration	Calibrate flow sensor.	Display: Flow sensor calibrated
Airway Pressure	Set ventilation mode CMV, Set dial knobs: »Pinsp« to 20, »Insp. Flow V « to 10, »Tin« to 0.4, »Tex« to 0.6, »PEEP/CPAP« to 0, then »PEEP/CPAP« to 10, PEEP/CPAP« to 10,	Ventilation in rhythm of set inspiratory and expiratory time. Bar graph pressure display: insp. (20 ± 4) cmH ₂ O exp. (0 ± 2) cmH ₂ O exp. (10 ± 2) cmH ₂ O
5 Apnea Monitoring	Set ventilation mode CPAP:	Display after max. 30 s: Apnea
		and audible alarm.
6 Minute Volume Monitoring	Set ventilation mode CMV : set lower alarm threshold for MV to 1 L/min.	Display after max. 30 s: MV low and audible alarm
	Reset lower alarm limit for MV:	
7 Airway Pressure Monitoring	Kink expiratory limb of patient circuit:	Display: Airway pressure high inspiration cancelled or Hose kinked ? and audible alarm.
		Ventilation will be interrupted, pressure will drop below 5 cmH2O (pressure bar graph). After approximately 5 seconds, ventilation will start again, but will be interrupted im- mediately again. This sequence will repeat.
	Release expiratory limb of patient circuit, Disconnect ET-tube connector at wye:	Display: Airway pressure low or Leak in patient circuit? Check setting! and audible alarm. Pressure bar graph: ≤ 4 cmH2O
	Reset dial knob » PEEP/CPAP « to 0, Reconnect wye.	

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Contents

Operation

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Precautions During Operation

WARNING !

Always use ventilator that has been cleaned and disinfected and has been successfully tested to be ready for operation.

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction. Not any and every critical condition can be expected to cause a ventilator alarm.

WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O2 concentration where necessary and appropriate. The unit should then be removed from use and serviced by an authorized service technician.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute must be provided in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations. This is particularly important when, during a nebulizer treatment, the Babylog flow sensor has been removed to protect it against contamination.

WARNING !

The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety when switching off flow measurement during nasal CPAP.

Use appropriate external monitoring to assure patient's oxygenation status and to detect apnea.

WARNING !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. It is absolutely essential that the ventilation regime and the oxygen concentration administered is selected on the basis of arterially measured oxygen partial pressure in the blood of the infant. This is the only way of minimizing the risk of both hyperoxemia, which might cause, above all, retrolental fibroplasia, and hypoxemia, which might contribute to intraventricular hemorrhage and damage to the baby's brain.

WARNING !

The accuracy of the concentration of oxygen delivered to the patient must be monitored at all times. If the oxygen analyzer integrated into the Babylog 8000 plus ventilator is not operable, an independent oxygen monitor must be connected to the inspiratory limb of the patient circuit.

WARNING !

- Always use extreme caution when using oxygen!
- Oxygen intensely supports any burning! No smoking, no open fire in areas where oxygen is in use!
- Always provide adequate ventilation in order to maintain ambient O₂ concentrations < 24 %.
- Always secure O₂ cylinders against tipping, do not expose to extreme heat.
- Do not use oil or grease on O2 equipment such as tank valves or pressure regulators. Do not touch with oily hands. Risk of fire!
- Open and close valves slowly, with smooth turns. Do not use any tools.

WARNING !

Do not block air intake. Ventilator malfunction will result.

Be careful not to cause back pressure when using scavenging systems.

WARNING !

Aerosol medications may clog expiratory valves which can impair ventilation.

Therefore, exchange expiratory valve immediately after nebulizing aerosols.

WARNING !

Aerosol medications may clog bacteria filters which can impair ventilation.

Therefore, do not use bacteria filters at the nebulizer output or in the expiratory side of the patient circuit.

WARNING !

The wires of the Babylog 8000 plus flow sensor operate at a high temperature. If the sensor is left in the patient circuit for an extended period of time while nebulizing without cleaning, residue buildup might result from the medicated aerosols that would impair flow measurement.

As a worst case, these residues might ignite!

To prevent this, it is not sufficient to remove the electrical connector from the flow sensor.

Therefore, it is mandatory to physically remove the flow sensor from the circuit, (resp. the flow sensor element from the wye) before beginning any nebulizer treatment.

WARNING !

When the flow and volume measuring system of the Babylog 8000 plus ventilator is not operable, detection of spontaneous breathing activity is not possible. Therefore no apnea alarm is provided at that time.

Tidal volumes for ventilated infants are significantly influenced by the compressible volume of the breathing circuit (in addition to parameters of the patients lungs). Adjustment of inspiratory time, expiratory time, pressure limits, and inspiratory flow rate all affect the tidal volume delivered to the patient. Assessment of ventilator settings must be made with special care during periods where no patient flow/volume information is available. Otherwise, lung damage due to excessive tidal volumes and/or pressures may result.

WARNING !

Water traps should be used in appropriate locations of the breathing circuit in order to prevent water accumulation in the tubing from being drained toward the patient's airway.

WARNING !

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.

WARNING !

The alarm silence button is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilator function and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury.

WARNING !

Therapeutical decisions should not be made solely on the basis of the data transmitted via the communications Interface. Always use other diagnostic means in addition.

CAUTION !

Use only dry and clean compressed air and oxygen. Water and/or oil in the air or oxygen supply will cause equipment malfunction and damage.

CAUTION !

Do not place containers of liquids on top of the Babylog 8000 plus ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.

Routine Checks During Operation

- About every hour, check inspiratory gas temperature.
- About every 2 hours, empty water traps in patient circuit. Follow hospital protocols.
- Periodically inspect O₂ and Air inlet water traps. Drain water from bowls when necessary.

Starting Up

Starting Up

- Flip protective cap on power switch clockwise
- Push power switch button until it engages = On
- Calibrate flow sensor, see page 40.



- Before connecting a patient, adjust dial knobs to meet anticipated patient needs:
 - 1 »Insp. Flow V «,
 - 2 »Pinsp«,
 - 3 »PEEP«,
 - 4 »O2-Conc. %«,
 - 5 »Tin«,
 - 6 »Tex«.
- Connect patient.
- Estimate required tidal volume. Recommended: approximately 5 to 6 mL/kg body weight.



Ventilation Modes Overview

Babylog 8000 plus features five main modes of ventilation that each may be modified through extensions. Some extensions are mutually exclusive while others may be combined with one another.

Ventilation modes

- CMV Continuous Mandatory Ventilation/ Mandatory (controlled) ventilation with fixed pattern and rate without recognition of patient's spontanous breathing
- CPAP Continuous Positive Airway Pressure Spontaneous patient breathing with positive airway pressure
- A/C Assist Control Ventilation Mandatory (controlled) ventilation with fixed pattern or tidal volume but synchronized with each spontaneous patient breath.
- SIMV Synchronized Intermittent Mandatory Ventilation Mandatory (controlled) ventilation with fixed pattern or tidal volume and rate but synchronized with spontaneous patient breathing. The patient breathes spontaneously between synchronized mandatory ventilator breaths.
- **PSV** Pressure Support Ventilation Synchronized ventilation with preset inspiratory pressure or tidal volume. The patient determines duration and rate of inspirations.

Extensions

- VG Volume Guarantee Volume controlled ventilation. The ventilator automatically controls inspiratory pressure to deliver the preset tidal volume. May be used with A/C, SIMV, and PSV.
- CMV
 A/C
 SIMV
 PSV
 CPAP

 VG
 •
 •
 •

 VIVE
 •
 •
 •
- VIVE Variable Inspiratory and Variable Expiratory Flow Separate Continuous Flow during the expiratory

cycle of mandatory ventilation.

The table on the right shows all possible combinations of extensions with ventilation modes: Setting Ventilation Modes and Extensions

Setting Ventilation Modes and Extensions

Example: To switch from CMV to SIMV with guaranteed volume VG:

1 Press »Vent. Mode« key.



 Press »SIMV« menu key. Babylog 8000 plus continues to ventilate with CMV/IMV.



- Set trigger volume with menu keys » + « or » «.
- Press »On« menu key. Babylog 8000 plus now ventilates with SIMV.
- Press» VG« menu key.
- Set desired inspiratory tidal volume VTset with menu keys » + « or » − «.



• Press »**On**« menu key.

Babylog 8000 plus now ventilates with guaranteed tidal volume in SIMV mode.

 50 cmH20
 VG
 SIMU

 VT
 13.2 mL

 Peak
 31 cmH20

 2s
 VTset

 910 mL

To switch off VG extension:

1 Press »Vent. Options« key.

• Press menu keys »VG« and »Off«.

Leave menu:

● Press » ◄ _ _ « menu key.

Setting Trigger Volume (Trigger Sensitivity)

The trigger volume is the volume that a patient must inspire in order to trigger a ventilator breath. It is set in the ventilation modes menu or in the extensions menu.

Example: Setting trigger volume in the SIMV menu.

- Press » + « menu key for increased trigger volume (= less sensitive).
- Press » « menu key for decreased trigger volume (= more sensitive).

Recommended:

Start with small trigger volume (= high sensitivity).

Increase trigger volume if ventilator starts autotriggering: range approximately 0.02 to 3 mL.

• The **»Trigger**« LED will be lit briefly for each triggered ventilator breath.







Setting Ventilation Modes and Extensions

CMV / IMV

Continuous Mandatory Ventilation Intermittent Mandatory Ventilation

Time cycled, pressure limited ventilation for patients without spontaneous breathing, fixed pattern - with or without pressure plateau.

Switching on CMV/IMV:

• Press (menu) keys »Vent. Mode«, »CMV«, »On«.

CMV may be combined with:

- Separate expiratory flow VIVE, see page 69.

Ventilation with a pressure plateau

Inspiratory pressure is limited to Pinsp. Whenever the plateau is long enough for the flow to drop to zero at the end of inspiration, tidal volume VT is proportional to inspiratory pressure.

 $VT = (Pinsp - PEEP) \cdot C$

C = Compliance of patient's respiratory system

Tidal volume VT is controlled by the pressure differential Pinsp – PEEP.

The limitation of pressure to Pinsp prevents damaging pressures, e.g. in cases of decreasing compliance. The pressure plateau facilitates diffusion of breathing gas inside the lung.



Displaying the pressure waveform:

Press »Graph« and »Paw« menu keys.

Display (example):

The dotted line in the pressure waveform represents the setting of pressure limit Pinsp.

To leave this menu:





Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed

Displaying the flow waveform:

- Press »Graph« and »Flow« menu keys.
 To leave this menu:
- Press » a key.

Displaying measured pressure values:

- Press »Meas« and »Paw« menu keys.
- Set the desired ventilation pattern using dial knobs »Pinsp«, »PEEP«, »Tin«, »Tex« and »Vinsp«.







- Displaying the measured values for volume:
- Press »Vol« menu key.
- Set dial knobs »**Pinsp**« and »**PEEP**« in such a way that the required tidal volume VT is delivered.
- For setting of alarm limits for minute ventilation, please refer to page 70, 71.

Ventilation without a pressure plateau

This represents volume controlled ventilation. Peak inspiratory pressure results from settings of Tin and \dot{V} insp.

Tidal volume VT is approximately:

$$VT = Tin \cdot \dot{V}insp \cdot \frac{Crs}{Crs + Cc}$$

Tin = inspiratory time,

 V_{insp} = continuous inspiratory flow, Crs = compliance of patient's respiratory

Crs = compliance of patient's respiratory system, Cc = compliance of patient circuit system.

Tidal volume is controlled via flow and inspiratory time.



Operation

Setting Ventilation Modes and Extensions

Displaying the pressure waveform:

- Press »Graph« and »Paw« menu keys.
- Press » « key.
- Set the desired ventilation pattern using dial knobs »PEEP«, »Tin«, »Tex« and »Vinsp«.

	50) cmH20	VE 0.	48 L∕min	CMU
·····			Fi02 :	26 %	
		2s	F 8.	4 cmH20	
			-		
Graph	Meas	T List	l Trend	<u>_</u> /	

Displaying the flow waveform:

- Press »Graph« and »Flow« menu keys.

Displaying measured pressure values:

Displaying the measured values for volume:

• Press »Meas« and »Paw« menu keys.

• Press »Meas« and »Vol« menu keys.

To leave this menu:

Press » 🗲 🗖 « key.

	10	L/min	$\mathbf{P}_{a\omega}$	cmH20	CMV
			PIP	29	
			Ē	8.3	
*		2s	PEEP	4.1	

2s

List

RC

ÜΕ

Fi02

Trend

MV O₂ P HFVol

0.46L/mmn

26 %

8.3 cmH20

10 L/min

Meas

Paw

Graph

Vol



- Set dial knobs »Vinsp« and »Tin« in such a way that the required tidal volume VT is delivered.
- Set dial knob »**Pinsp**« to a threshold value that is not to be exceeded.
- For setting of alarm limits, please refer to page 68, 69.

Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed

CMU

4.1

- 6

A/C

Assist Control Ventilation

Ventilation with a preset pattern that is synchronous with patient's spontaneous breathing. The patient determines the ventilation rate.

If a patient becomes apneic, ventilation will be performed using a rate determined by Tin and Tex settings.



Switching on Assist Control:

• Press (menu) keys »Vent. Mode«, »A/C«, »On«.

Assist Control may be combined with:

- Guaranteed volume delivery VG, see page 66.
- Separate expiratory flow VIVE, see page 69.
- Set the desired ventilation pattern using dial knobs »Pinsp«, »PEEP«, »Tin«, »Tex« and »¥insp« - with or without a plateau, as with CMV.
- For setting a trigger volume, please refer to page 56.
- Adjust inspiratory time **»Tin**« according to patient's spontaneous breathing pattern.
- Adjust rate of background (backup) ventilation with expiratory time **»Tex**«.
- In case of auto triggering, increase trigger volume.
- For setting of alarm limits, please refer to page 68, 69.



Setting Ventilation Modes and Extensions

SIMV

Synchronized Intermittent Mandatory Ventilation

Ventilation with fixed pattern and rate but synchronized with patient's spontaneous breathing. Patients are allowed to breathe spontaneously between ventilator breaths, but will not receive pressure support.

Used for weaning patients from ventilator.

If a patient becomes apneic, ventilation will be performed using a rate determined by Tin and Tex settings.



Switching on SIMV:

• Press (menu) keys »Vent. Mode«, »SIMV«, »On«.

SIMV may be combined with:

- Guaranteed volume delivery VG, see page 66.
- Separate expiratory flow VIVE, see page 69.
- Set the desired ventilation pattern using dial knobs »Pinsp«, »PEEP«, »Tin«, »Tex« and »Vinsp«

 with or without a plateau, as with CMV and the set ventilator rate.
- For setting a trigger volume, please refer to page 56.
- Adjust inspiratory time »Tin« according to patient's spontaneous breathing pattern.
- In case of auto triggering, increase trigger volume.
- For setting of alarm limits, please refer to page 68, 69.



PSV (available option)

Pressure Support Ventilation

Pressure supported ventilation synchronous to patient's own spontaneous breathing. Patient determines both rate and duration of inspiration. A ventilator breath is terminated when inspiratory flow has dropped to approximately 15% of peak flow, at the latest after Tin.

Used for spontaneously breathing patients with sufficient respiratory control, who are to be supported with an adjustable inspiratory pressure. Particularly suited for weaning.

If a patient becomes apneic, ventilation will be performed using a rate determined by Tin and Tex settings.



Switching on PSV:

• Press (menu) keys »Vent. Mode«, »PSV«, »On«.

PSV may be combined with:

- Guaranteed volume delivery VG, see page 66.
- Separate expiratory flow VIVE, see page 67.
- Set the desired ventilation pattern using dial knobs »Pinsp«, »PEEP«, and »Vinsp« - with a plateau, as with CMV.

Actual inspiratory time and tidal volume are displayed.

- Limit inspiratory time with »Tin«.
- Set background (backup) ventilation rate with »Tex«.
- For setting a trigger volume, please refer to page 56.
- In case of auto triggering, increase trigger volume.
- For setting of alarm limits please refer to page 68, 69.
 - **NOTE:** PSV is recommended only for patients with leakage rates up to 40 %



Operation

Setting Ventilation Modes and Extensions

CPAP

Continuous Positive Airway Pressure

Babylog 8000 plus applies a continuous flow with an airway pressure at PEEP/CPAP level.

Switching on CPAP:

Press (menu) keys »Vent. Mode«, »CPAP«, »On«.

CPAP may be combined with:

- Separate expiratory flow VIVE, see page 67.
- Set desired CPAP level using dial knob »PEEP/CPAP«.
 Adjust flow according to patient needs.

Displaying the flow waveform:

• Press »Graph« and »Flow« menu keys.

To leave this menu:

● Press »◄ _ « key.

Displaying measured pressure values:

• Press »Meas.« and »Paw« menu keys.

To leave this menu:

• Press » - « key.

Mean airway pressure should agree with the set value for PEEP/CPAP.

Peak pressure and PEEP are not displayed while in CPAP mode.

• Set dial knob »**Pinsp**« approximately 5 cmH2O higher than PEEP/CPAP.

Displaying the measured values for volume:

• Press »Meas.« and »Vol« menu key.

To leave this menu:

- Press » → → « key.
- Check spontaneously inspired volume.

For setting of alarm limits, please refer to page 68, 69.





Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed

Nasal CPAP

Monitoring of minute ventilation and for apnea is not possible due to leakage through patient's mouth. Therefore, switch off flow measurement:

• Unplug flow sensor cable at the wye.



- Display:
- Press »Confirm« key. Flow measurement is now switched off.

WARNING !

The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety when switching off flow measurement during nasal CPAP.

Use appropriate external monitoring to assure patient's oxygenation status and to detect apnea.

		2	L/min	VE	- L Z min	CPAP
_Flow measurement disturbed [%]						
	Mea	suremer	nt swite	ched of	f %	A FIOL
			15	UT	mL	
Gr	aph	Meas	List	Trend	<u>z/</u> *	

Setting Ventilation Modes and Extensions

Volume Guarantee (Available Option)

May be combined with ventilation modes CMV, SIMV, and CPAP.

VG controls inspiratory plateau pressure in such a fashion between Pinsp and PEEP that the set tidal volume VTset is delivered.

NOTE: VG requires that a ventilation pattern with plateau is used.

Used for patients who are to be ventilated with a constant tidal volume.

Switching VG on:

• Press key »Vent. Options«.





- Press» VG« menu key and use menu keys » + « or » - « to set desired tidal volume VTset.
- Press »On« menu key. Tidal volume and peak pressure of mandatory breaths will now be displayed.
- Set ventilation pattern with a plateau using dial knobs »Tin«, »Tex«, »PEEP«, and »V insp«.
- Set dial knob »**Pinsp**« to a threshold value that is not to be exceeded.

To leave this menu:

• Press » - « key.



Independent Expiratory Flow VIVE

VIVE (Variable Inspiratory and Variable Expiratory Flow)

Expiratory continuous flow $\forall exp$ may be set independently from inspiratory flow $\forall insp$. During mandatory breaths, inspiratory flow is applied. During spontaneous breathing and during CPAP, the expiratory flow is in effect.

An increased inspiratory flow Vinsp may be used

- to supply a higher flow for spontaneous breathing than the one scheduled for ventilator breaths.
- to improve gas washout in the wye by increasing turbulence in the circuit system.
- to allow for separate shaping of manually triggered breath in CPAP.

A reduced expiratory flow \dot{V}_{exp} may be used to conserve oxygen and, thereby, reduce cost of ventilation.

1 Press »Vent. Options« key



 Press »VIVE« menu key and use menu keys » + « or » - « for setting expiratory flow.

Press »On« menu key and return with »



Setting Alarm Limits

Setting Alarm Limits

The alarm limits for the following parameters are adjusted automatically:

Airway pressure

Upper alarm limit for ventilator breaths:	Pinsp + 5 cmH2O
Upper alarm limit for expiration or CPAP:	PEEP/CPAP + 4 cmH2O
Lower alarm limit:	PEEP/CPAP - 2 cmH2O
Lower alarm threshold for disconnection:	<u>Pinsp – PEEP</u> + PEEP 4



Upper alarm limit:	» O2-Conc.% « + 4 Vol.%
Lower alarm limi:	» 02-Conc.% « – 4 Vol.%

For a detailed description of alarm criteria, please refer to "Technical Data", page 126.

Manual setting of alarm limits

is required for minute ventilation MV, apnea, and breathing rate:

Lower alarm limit MV X : 0 to upper alarm limit

to 15 L/min

0 to 30 seconds

Upper alarm limit MV 🛣 : from lower alarm limit

Alarm delay »Alarm delay«: (delays alarms for "MV low" and "VT low")

Apnea time:

5 to 20 seconds above 20 seconds = Off when very small patients are ventilated, apnea monitoring may be switched off to avoid false alarms.

Use separate apnea monitoring in this case!

Breathing rate (Tachypnea alarm) »Tachypnea«:

20 to 200 bpm below 20 bpm = OFF



Press menu key » ***/*** « in the Monitoring menu.

• Display (example):



- Select alarm parameter with » * * « menu key.
- Adjust alarm threshold with menu keys » + « or » «.

Repeatedly pressing key briefly: adjustments in increments

Keeping key pressed down: rapid changes.

Recommendation for setting MV alarm limits.

When the measured value for minute ventilation MV has reached steady state:

 Press »±30% « menu key. The lower alarm limit is set to 30% below actual minute volume, the upper alarm limit to 30% above actual minute volume, but it will not exceed 15 L/min.

To leave menu:

• Press » - « menu key.

Special Functions

Special Functions

Manual Inspiration / Inspiration Hold

Applicable to all modes of operation, independent of $\mathsf{T}\mathsf{in}$ and $\mathsf{T}\mathsf{ex}$ settings.

All other parameter settings apply.

- 1 Limit inspiratory pressure with dial knob »Pinsp«.
- 2 Keep button pressed for the duration of desired inspiration time. Inspiration is stopped after a maximum of 5 seconds.

NOTE: In this case, the next manual cycle is possible only after a delay of 5 seconds.



• Display (example):



Special Functions

Nebulizing Aerosols (Available Option)

Applicable in all modes of ventilation.

Prerequisites:

Nebulizer output port on the back panel of the ventilator and nebulizer kit 84 11 025.

WARNING !

Aerosol medications may clog expiratory valves which can impair ventilation.

Therefore, exchange expiratory valve immediately after nebulizing aerosols.

WARNING !

Aerosol medications may clog bacteria filters which can impair ventilation.

Therefore, do not use bacteria filters at the nebulizer output or in the expiratory side of the patient circuit.

Before using a nebulizer

- 1 Remove plug from flow sensor,
- acknowledge Flow sensor inop alarm on the ventilator.



When using the detachable ISO 15 flow sensor (part no. 84 11 130):

- 2 Pull flow sensor from the wye and
- **3** attach tapered tube connector directly to the wye.

When using the wye with integrated flow sensor (part no. 84 10 185)

- 4 Remove flow sensor element.
- **5** Insert sealing plug (order no. 84 11 024, part of nebulizer kit).



Special Functions

WARNING !

The wires of the Babylog 8000 plus flow sensor operate at a high temperature. If the sensor is left in the patient circuit for an extended period of time while nebulizing without cleaning, residue buildup might result from the medicated aerosols that would impair flow measurement.

As a worst case, these residues might ignite!

To prevent this, it is not sufficient to remove the electrical connector from the flow sensor.

Therefore, it is mandatory to physically remove the flow sensor from the circuit, (resp. the flow sensor element from the flow sensor housing) before beginning any nebulizer treatment.

WARNING !

When the flow and volume measuring system of the Babylog 8000 plus ventilator is not operable, detection of spontaneous breathing activity is not possible. Therefore no apnea alarm is provided at that time.

Tidal volumes for ventilated infants are significantly influenced by the compressible volume of the breathing circuit (in addition to parameters of the patients lungs). Adjustment of inspiratory time, expiratory time, pressure limits, and inspiratory flow rate all affect the tidal volume delivered to the patient. Assessment of ventilator settings must be made with special care during periods where no patient flow/volume information is available. Otherwise, lung damage due to excessive tidal volumes and/or pressures may result.

Preparation

Installing the nebulizer output port connector:

- 1 Remove lower enclosure mounting screw on the left side of the ventilator enclosure with a coin. Attach female port connector with mounting screw.
- 2 Insert plug into female port in the back of the ventilator until it engages securely.
- Prepare nebulizer following its Instructions for Use, open patient circuit, and install nebulizer.
- **3** Attach corrugated patient circuit to expiratory port of nebulizer

and

4 Attach corrugated patient circuit to inspiratory port of nebulizer.

Using nebulizer with incubator patients





Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed.
Place nebulizer output port into one of the U-grommets available on most incubators for routing hoses and cables (upper location preferred if several available).



Using nebulizer with patients in open beds

 Place nebulizer output port into circuit holder of hinged circuit support arm.



• Position nebulizer upright and fill.

Starting nebulizer treatment

1 Connect nebulizer gas supply line to outlet port until it engages.

NOTE: The nebulizer operates continuously. However, aerosol that is produced during expiration will not be transported into the patient's lungs.

NOTE: The inspired O₂-concentration FiO₂ will be reduced since the nebulizer operates with pressurized air (2 L/min).



Special Functions

In order to maintain constant FiO2 :

 Increase O₂-concentration for the duration of the aerosol treatment with the dial knob »O₂-Conc. %« using a value from the nomogram.

Example:

During aerosol application, set dial knob »**O**2**-Conc.** %« to approximately 90 Vol.-%.



Ending nebulizer treatment

- 1 Retract ring on output port, connector will disengage.
- Remove residual medication from nebulizer, unmount nebulizer and process according to its Instructions for Use.
- Re-insert flow sensor element into flow sensor housing,
- re-attach connector plug to flow sensor.
- Install a cleaned and sterilized expiratory valve, see page 29.



Displaying Waveforms and Measured Values

Pressure Waveform Paw

 From the Monitoring menu, press menu keys »Graph« and »Paw«.

Display (example):

- 1 pressure scale
- 2 pressure limit »Pinsp«
- 3 time scale
- 4 end of Tex

To leave menu:

• Press » - « menu key.



• From the Monitoring menu, press menu keys »Graph« and »Flow«.

Display (example):

- 1 flow scale
- 2 baseline
- 3 time scale
- 4 end of Tex

To leave menu:

ed.

•	1 10 2 -	L/min VE Fi(4 2s 3	0.49L∕min)2 26 % 10 cmH20	CMV
Paω	Flow	Freeze		-



ա	Freeze		-	_

Displaying Waveforms and Measured Values

Freezing Waveforms

• From the »Graph« sub-menu, press »Freeze« menu key.

To cancel the freeze:

 Press »Freeze« menu key again and the current waveform will be displayed.

To leave menu:

● Press » → → « menu key.



Displaying Measured Pressure Values

• From the Monitoring menu, press menu keys »Meas.« and »Paw«.

CMU 50 cmH20 \mathbf{P}_{aw} cmH20 PIP 31 Ē 10 2s PEEP 4.2 HFV01 Vol Paw RC MV O₂

Display (example):

- PIP = Peak pressure of previous breath cycle
- **P** = mean value of previous breath cycle
- PEEP = end expiratory pressure of previous breath cycle

To leave menu:

• Press » - « menu key.

Displaying Measured Values of Lung Mechanics

Babylog 8000 plus calculates a patient's resistance and compliance using linear regression.

- From the Monitoring menu, press menu keys »Menu« and »RC«.
 - R = airway resistance (incl. ET-tube)
 - C = dynamic compliance of the respiratory system
 - TC = time constant of the respiratory system
 - C20/C = index hinting an overdistension of the lung: C20/C < 0.8: lung may be overdistended. (only if there is no marked pressure plateau, see page 141.)
 - r = correlation coefficient of linear regression

Please refer to pages 140, 141 for a description of the calculations of above parameters.

NOTE: The display of ventilation waveforms is interrupted automatically for one minute after a manual inspiration. Waveforms and respective measured values may be evaluated together.

See page 75 for switching between waveforms.

See page 76 for cancelling a screen freeze.

If the "Attention" symbol \triangle is showing next to the value for r, the measured values may be unreliable, e.g. due to a leak.

To leave menu:

● Press » ▲ □ « menu key.



	50	jcmH20	С	0.52	CMU
			R	157	
			C20/C	2.63	
			To	82	
		<u>2</u> 5	r 🛆	0.98	
Vol	Paw	RC	MU Ó₂ P	HFV01	-

Displaying Waveforms and Measured Values

Displaying Measured Volume Parameters

• From the Monitoring menu, press menu keys »Meas.« and »Paw«.

Display (example):

- VE = expiratory minute ventilation
- spont. = percentage spontaneous breathing of total minute ventilation
- Leak = ET-tube leak (see description on page 138)

VT = expiratory tidal volume of previous breath cycle

- To leave menu:
- Press » < コ « menu key.

Displaying Combination of Measured Values

• From the Monitoring menu, press menu keys »Meas.« and »MV O2 P«.

Display (example):

- VE = expiratory minute ventilation
- FiO2 = measured inspiratory O2 concentration
- Mean = Mean value of airway pressure of previous breath cycle

To leave menu:

• Press » - a « menu key.

	50) cmH20	VE 0.4	l7L∕min	CMV
Á		2s	FiO2 2 7 8.1	26 % L cmH20	
Vol	Paw	RC	MV O ₂ P	HFV01	-

Displaying All Set Values

• From the Monitoring menu, press menu key »List«. All set values are displayed.

Display (example):



For more set values:

• Press menu key »Set2«.

HF-Ampl. HF-Freq.	100 10	% VTs Hz	.et	11 mL	CMV
Set1	Set2	Meas1	Meas2		ţ

Displaying all Measured Values

• Press menu keys »Meas1« or »Meas2«. All measured values are displayed.

Display (example):

PIP ₱ PEEP FiO2 ftot	30 8.1 4.2 26 37	cmH20 cmH20 cmH20 % bpm	VE VT Leak spon	0.45 12.5 t 0	L/min mL % %	CMV
Set1	Set	2 Mea	si M	eas2		-
MVim	0.62L	zmin C	0	.59 mL	∕cmH₂0	CMU
DCO ₂	M	lL²∕s R		137 cm	H₂0/L/s	
UTim 👘	15.9 m	iL C ₂	₀∕C 0	.90		
VTHf	m	iL To	5	81 ms		
TISPO	s	RU RU	ЛR	3.0bp	m∕mL	
Set1	Set	2 Mea	s1 🚺	eas2		-

Displaying Trends

Displaying Trends

Trends for some measured values over the previous 24 hours are stored in memory.

FiO2	Inspiratory O2 concentration
Mean	Mean airway pressure
ΫE	Minute ventilation
С	Dynamic compliance
R	Resistance
RVR*	Rate Volume Ratio

• From the Monitoring menu, press menu key »Trend«.

Display (example):

The diagram displays a window from the previous 24 hour period (if applicable). The size and position of the window within the time period is adjustable.

- Press »Param« menu key to select desired measured value.
- Select the size of the window with menu keys

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- Leftmost position in scroll bar: The displayed time segment is at the beginning of the recorded trend.





2 Rightmost position in scroll bar: The displayed time segment is at the end of the recorded trend.



To leave menu:

• Press » - « menu key.

^{*} RVR may be usd as an indicator for the likelihood of successful weaning

Messages

Messages are displayed according to their urgency in a hierarchical sequence. If two alarm conditions are detected simultaneously, the more urgent one will be communicated first.

Messages appear in a overlay "window" on top of the respective screen image.

At the same time, one of three specific sound patterns will be used to communicate the appropriate level of urgency.

Display (example):

A message will disappear when the causing condition no longer exists.

	2!	5 cmH20	Paw	cmH20	CPAP
		Apnea] IP	 4.3	
		i isi	PEEP		
Graph	Meas	List	Trend	1 / A	A T T

Alarm Categories

Warning (top priority message)

blinking red alarm light, intermittent audible alarm.

Warning messages require immediate action to prevent a life threatening condition, e.g. when a circuit is kinked.

Caution

blinking red alarm LED, repetitive three tone sequence.

Caution messages require short term action to prevent development of a condition with the possibility of patient injury. Respond appropriately and complete the action within 2 minutes at the most.

WARNING !

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.

Advisory

individual three tone sequence.

Advisory messages are reminders for special functions or may highlight a particular setting.



Messages

In the Event of an Alarm

To mute message and audible alarm for 30 seconds:

1 Press »Confirm« key.

Each message is recorded automatically in the ventilator message log.

Silencing audible alarm for 2 minutes

2 Press » A « key.

NOTE: New messages are displayed without their associated audible alarm tone during the 2-minute silencing period.

To re-arm audible alarm:

2 Press » A « key again.

WARNING !

The alarm silence button is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilator function and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury.

NOTE: A troubleshooting list can be found on pages 106 to 109.

Message Log

Every warning, caution, and advisory message is registered in a message log. Log entries include their time of occurrence, text of the message, and an indication of whether the message had been acknowledged (normal display of message in log) or not (display of message highlighted).

- From the monitoring menu, press »
 Log.
- The » and » menu keys allow to scroll forward and backward within the log.

Display (example):

To leave menu:

• Press » 🗲 🗖 « menu key.





Configuration

Displaying and Setting Date and Time

- Press »Cal. Config.« key, then menu keys »Config« and »Clock«.
- Select parameter to adjust with menu keys » Selected parameter will be highlighted (inverse). (example: 05)

Display (example):



To leave menu:

• Press » - « menu key.

Setting Volume of Audible Alarms

 Press »Cal. Config.« key, then menu keys »Config« and » q «.

Display (example):

Adjust volume with keys » A and » A and » A test sound with the current volume level is generated for each increment.
 The vertical bar graph symbolizes the set volume.



To leave menu:

Press » 🗕 🔤 « menu key.

Configuration

Adjusting Screen Contrast

NOTE: Applicable only for ventilators equipped with LCD-type screen:

Screen contrast can be optimized for the (vertical) viewing angle of the operator.

 Press »Cal. Config.« key, then menu keys »Config« and »Contr«.

Display (example):

The display will show a test pattern

Set optimum contrast using menu keys

 — « and » + «.



To leave menu:

• Press » - « menu key.

NOTE: The setting will be retained after the ventilator is switched off.

Setting Language for Screen Messages

Available languages are: American English, German, English (UK), Spanish, French, Italian, Dutch, Japanese, Swedish.

 Press »Cal. Config.« key, then menu keys »Config« and »Lang«.

Display (example):



To leave menu:

• Press » - « menu key.

NOTE: The setting will be retained after the ventilator is switched off.

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Analog and Digital Interface (Available Option)

Interface provides analog output of measured values, output of data reports, communication with patient monitors or personal computers, e.g. with EvitaView PC software, allowing graphic and numeric display of ventilation parameters.

WARNING !

Therapeutical decisions should not be made solely on the basis of the data transmitted via the communications interface. Always use other diagnostic means in addition.

Place connected devices in the same room with the Babylog 8000 plus ventilator, but at a distance of at least 1.5 m (5 ft) from the patient.*

The two **analog outputs** supply each one of the available measured values.

The **RS 232 serial interface** outputs information to a printer:

- reports
- trend information
- waveform data

or transmits data to a patient monitor or a personal computer.

The **marker output** _____ indicates certain events:

- triggered mandatory breath
- mandatory breath
- alarm.

Analog Data Output

The two analog outputs **Analog 1** and **Analog 2** each provide one measured value, e.g. VT, Paw, Flow Voltage range: 0 to 10 V.

 Connect recorder (impedance ≥ 1 MΩ) with interface cable 83 06 487 (see also Technical Data, page 127).



• Select signal and range, see page 92.

^{*} Requirement pursuant EN 60601-1-1

Analog and Digital Interface

Marker Signal Output

The logic pulse at the marker output indicates events during ventilation, e.g. each mandatory breath or triggered mandatory breath. The voltage output is always either H(igh) or L(ow). (Please refer also to Technical Data, page127.)

Depending on the configuration, the pulses are issued as follows:

Mandatory breath

High signal during mandatory breaths, Low signal otherwise.

Triggered mandatory breath:

High signal during triggered mandatory breaths only, Low signal otherwise.

Alarm conditions:

Low signal during an alarm condition, **H**igh signal otherwise.



- Connect recorder (impedance ≥ 1 MΩ) with interface cable 83 06 487.
- Select signal, please refer to "Configuring Marker Output", page 93.



Printing

NOTE: The printer driver for the serial interface is designed for use with HP Thinkjet compatible printers. For use with other printers please consult Dräger first.

• Connect printer with interface cable 83 06 489.

NOTE: For proper function, configuration of RS 232 interfaces of printer and Babylog 8000 plus must match.

• Configure RS 232 interface, please refer to page 93.



• Press »Cal. Config.« key.

E Ca	librati	on/Conf	igurat	ion 💻	CMV
U-Cal	0 ₂ -Cal	Sensor	Print	Config	-
oTrend o30 min. report oGraphics oAll oBabyLink					CMV

Start

Select

Display (example):

• Press »Print« menu key

Printing Reports

For documenting measured, set, and status values.

Example:

+			
7:51	2.08.1997		CMV Babylog 8000 plus
Settings:			Measurements:
TI: 0,82 s	Pinsp: 33,0 cmH20		FiO2: 21 % Mean: 15,0 cmH20
TE: 1,59 s	PEEP: 6,1 cmH20		Leak: 0 % PIP : 33,5 cmH20
I:E: 1: 2,0	FiO2: 21 %		spont: 0 % PEEP: 6,0 cmH20
fset: 24,9 bpm			f: 25,0 bpm
	Flow in: 8,4 L/min		VT: 24 mL
	Flow ex: 8,4 L/min		MV: 0,58 L/min TIspont: -, s
+		-+-	
VG:			LFT:
VTset:,- mL			C: 1,22 mL/mbar R: 408 cmH2O/L/s
1			C20/C: 3,37 TC: 499 ms
+		-+-	
VIVE: off	Trigger: 1,3		Flow measurement:
1			NTPD Y FiO2-compensated
+			

For printing a **single report**:

- Press **»Select**« menu key, until **»Report**« is highlighted.
- Press **»Start**« button. The function of the button changes to **»Stop**«.

NOTE: While a report is being printed, the functions »Print all« and »BabyLink« are not available. However, any of the other functions can be started. Babylog will execute them after finishing the report.



To abort printing:

• Press »Stop« button.

Analog and Digital Interface

To print a report automatically every 30 minutes:

- Press »Select« button until »30 min. report« is highlighted.
- Press **»Start**« button. The function of the button changes to **»Stop**«.



Printing trend information

For graphical printing of trend memory contents. The currently active window (size and position within the 24 hour range) is used.

- Press **»Select**« button repeatedly, until **»Trend**« is highlighted.
- Press **»Start**« button. The function of the button changes to **»Stop**«.



Example:



Operating Instructions Babylog 8000 plus SW 5, USA, 3rd. ed



To abort printing:

• Press »**Stop**« button.

Printing waveforms

For graphics printout of the three waveforms:

Airway pressure Flow Volume

- Press **»Select**« button repeatedly, until **»Graphics**« is highlighted.
- Press »Start« button. The function of the button changes to »Stop«.



To abort printing:

• Press »**Stop**« button.

Example:



Analog and Digital Interface



Printing all

For printing report, trend information, and waveforms.

- Press »Select« button repeatedly, until »All« is highlighted.
- Press **»Start**« button. The function of the button changes to **»Stop**«.



To abort printing:

• Press »Stop« button.

Transmitting Digital Data

For connecting digital data recording devices (patient monitor, PC), using the Dräger "BabyLink" data transmission protocol.

Connect device with interface cable 83 06 488.

- Press **»Select**« button repeatedly, until **»BabyLink**« is highlighted.
- Press »Start« button. The function of the button changes to »Stop«.

o Trend o Graphi o Report	o Trend o 30 nin. report o Graphics o All o Report ∎ <u>BabyLink</u>					
		Select	Stop			

To abort data transmission:

• Press »**Stop**« button.

Configuring Analog and Digital Interfaces

For configuring the RS232 interface, the analog outputs, and the marker output.

 Press »Cal. Config.« key, then menu keys »Config« and »Com«.

Display (Example):

Baudrate: 9600 Parity: NONE Analog1: Flow -2020 L/min Analog2: Paw -1090 cmH20 JL : Inspiration	CMV
V/P 🗣 🛧 Param	-

Selecting signals and ranges for Analog1 and Analog2

- Press »Param« menu key repeatedly, until »Analog1« is highlighted.
- Select desired signal for analog output with menu keys » .
- Press menu key »**Param**« to highlight range selection, then select parameter range with menu keys

Proceed in the same way for Analog2.

NOTE: The setting will be retained after the ventilator is switched off.

Baudrate: 9600 Parity: NONE Analog1: Flow -2020 L∕min Analog2: Paw -1090 cmH20 ♪L : Inspiration			CMV		
U/P		+	÷	Param	-

Analog and Digital Interface

The following signals and ranges are available:

Airway pressure	- 1090 cmH2O	-> 010 V
Airway pressure	- 545 cmH2O	-> 010 V
Mean airway pressure	– 1090 cmH2O	-> 010 V
Mean airway pressure	– 545 cmH2O	-> 010 V
FiO ₂	0100 Vol%	-> 010 V
Flow	- 4040 L/min	-> 010 V
Flow	- 2020 L/min	-> 010 V
Flow	- 1010 L/min	-> 010 V
Flow	- 55 L/min	-> 010 V
Volume	0 500 mL	-> 010 V
Volume	0 100 mL	-> 010 V
Volume	0 50 mL	-> 010 V
Volume	0 25 mL	-> 010 V
Tidal Volume	0 500 mL	-> 010 V
Tidal Volume	0 100 mL	-> 010 V
Tidal Volume	0 50 mL	-> 010 V
Tidal Volume	0 25 mL	-> 010 V
Minute Ventilation VE	0 10 L/min	-> 010 V
Minute Ventilation VE	0 5 L/min	-> 010 V
Minute Ventilation VE	0 1 L/min	-> 010 V
Minute Ventilation VE	00.5 L/min	-> 010 V
MVim	0 10 L/min	-> 010 V
MVim	0 5 L/min	-> 010 V
MVim	0 1 L/min	-> 010 V
MVim	00.05 L/min	-> 010 V
Vtim	0 500 mL	-> 010 V
Vtim	0 100 mL	-> 010 V
Vtim	0 50 mL	-> 010 V
Vtim	0 25 mL	-> 010 V
Vthf	025 mL	-> 010 V
Vthf	0 5 mL	-> 010 V
Dco2	0 200 mL ² /s	-> 010 V
Dco2	0 50 mL ² /s	-> 010 V
Continuous Flow (set value)	0 125 L/min	-> 010 V
Leak	0100 %	-> 010 V
Spontaneous fraction of VE	0 100%	–> 010 V

Default settings:

Analog1: Flow	– 20 20 L/min
Analog2: Airway pressure	– 10 90 cmH ₂ O

To select default settings during operation:

• Press »V /P« menu key.

NOTE: If a measured value exceeds the set range, the output voltage will be clipped.

NOTE: The setting will be retained after the ventilator is switched off.

Baudrat Analogi Analog2	e: 960) : Flow : Paw : Insp:	0 Par -20 -10 iration	ity: NC 20 90 ()NE _∕min ∋mH2O	CMV
U/P		+	+	Param	-

Configuring the marker output

- Press »Param« menu key repeatedly, until » highlighted.

triggered mandatory breath	or
mandatory breath	or
alarm condition.	

Default setting: mandatory breath.

NOTE: The setting will be retained after the ventilator is switched off.

Baudrate: 9600 Parity: NONE Analog1: Flow -20...20 L/min Analog2: Paw -10...90 cmH20 IL : Inspiration

Configuring RS232 interface

To select data transmission rate (baud rate) and parity check mode.

- Press »Param« menu key repeatedly, until »Baud rate« is highlighted.
- Select the baud rate with menu keys

» 📢 « or » 👘 «:

9600, 2400, or 1200

• Select »Parity» using »Param« menu key.



Analog and Digital Interface

Select parity check mode using » select or » select or
 NONE or
 EVEN or
 ODD.

NOTE: When using a printer, select **NONE**.

Factory default settings:			
Baud rate:	9600		
Parity:	NONE		
Stop bits	1 (fixed)		
Data bits	8 (fixed)		

To leave menu:

• Press » - « menu key.

NOTE: The setting will be retained after the ventilator is switched off.

Configuring the printer

If a HP ThinkJet[®] printer is used, it must be configured as follows (see Owner's Manual for HP ThinkJet):

Baud rate:	same as Babylog 8000 plus
Parity:	NONE
Data bits:	8
Handshake mode:	XON/XOFF
	Alternate Control Sequence Mode

Shut Down

Shut-Down

After disconnecting patient

At the back panel:

- 1 Flip protective cap on power switch clockwise.
- **2** Push button in fully and release = OFF.
- Switch off humidifier.
- Disconnect all electrical and pneumatic supplies.
- Empty water traps in gas supply lines.



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Care

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Disassembly

Disassembly

Clean and process ventilator after each patient.

WARNING !

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

Patient breathing circuit

Note: The following description refers to a disposable circuit system. Refer to humidifier operating instructions for disassembly of humidifier components.

- Empty water trap in expiratory limb, if necessary.
- Unplug connector of flow sensor at the wye and at the back of ventilator.
- Remove breathing circuits from flexible circuit support arm in the incubator or from hinged arm.
- Detach circuit from ports on ventilator.
- Detach flow senor.
- Detach temperature sensor(s) from circuit, disconnect cable from humidifier unit.

Remove sensor element from flow sensor:

• Press buttons on both sides of flow sensor element and gently remove insert from wye.

Removing the Expiratory Valve

- 1 Push lever upward (release position).
- 2 Pull expiration valve out (forward).



Disinfecting/Cleaning/Sterilizing

CAUTION !

Certain components of the ventilator consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately apparent. Sterilization with ethylene oxide (EtO) is also not recommended.

To prevent any damage, we recommend that only detergents and disinfectants are used that are compatible with the device, e.g. surface disinfectants on the basis of aldehydes or quarternary ammonium compounds for disinfection.

Ensure that all disinfectants are registered with the U.S. Environmental Protection Agency for use as intended. Always follow the instruction labels specifically with respect to prescribed concentrations and the necessary exposure times.

Disinfectants often contain – besides their main active agents – additives that can also damage materials. When in doubt, ask the supplier/manufacturer of the disinfectant/ cleaning agent.

For a list of materials used in the ventilator, please refer to page 128.

WARNING !

Follow all accepted hospital procedures for disinfecting parts contaminated by body fluids (protective clothing, eyewear, etc.).

Babylog 8000 plus ventilator, mobile stand, cables

• Disinfection procedure: Wipe disinfection

Disinfecting/Cleaning/Sterilizing

Flow sensor element

Disinfection procedure: Bath disinfection

CAUTION !

Do not process flow sensor element in cleaning and disinfection equipment.

Do not use compressed air, a brush or similar tools to clean flow sensor element as this would possibly damage the thin wires in the flow sensor.

NOTE: Residual mucus dried in the wye shortens life of the flow sensor, therefore proceed with bath disinfection immediately after use.

- Rinse flow sensor element in distilled water. Thoroughly shake off residual water.
- After disinfection, autoclave at 134°C (273°F).

Expiratory valve, flow sensor (without sensor element)

- Disinfection procedure: Bath disinfection
- Rinse with clear water preferably soft running water shake off residual water.
- After disinfection, dry expiratory valve completely. We recommend drying by sterilizing in an autoclave at 134°C (273°F).

CAUTION !

Ensure that no liquid remains in the control and measuring canals of the expiratory valve, as it might cause malfunction.

Humidifier components

Follow respective operating instructions for cleaning and disinfection of these items.



Reassembly

Assembling the Flow Sensor

- 1 Insert flow sensor element into wye or flow sensor until it engages. The oval marks must line up.
- Connect plug to flow sensor, note orientation (tongue and groove).



 Assemble equipment as described starting on page 29, "Preparation".

After switching on:

- Calibrate flow sensor, see page 40.
- Check readiness for operation, see page 43.

WARNING !

The ventilator is only ready for operation when it has been completely assembled and the flow sensor been calibrated after switching the ventilator on.

Maintenance

Maintenance Intervals

CAUTION ! The device must be inspected and serviced at regular 6 month intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor. For repairs of the Babylog 8000 plus infant venti- lators, we recommend that you contact DrägerService.	O2 sensor capsule Cooling-air intake filter	Replace sensor capsule in event of display message: O2 measurement inop , see page 30. For disposal of sensor capsule, see page 104. Clean or replace after 4 weeks, see page 103. Replace at least every year. Disposal with normal domestic waste.
WARNING !	Lip seals of patient block receptacle plate	To be replaced by trained service personnel every 2 years
To avoid any risk of infection, clean and disin- fect ventilator and accessories before any maintenance according to established hospital procedures - this applies also when	Lithium battery for data backup	To be replaced by trained service personnel every 2 years. For disposal, see page 104.
returning ventilators or parts for repair.	Pressure reducer	Complete overhaul every 6 years by DrägerService.
WARNING !	Preventive maintenance and service	Every 6 months by trained service personnel.

Preventive Maintenance work on the Babylog 8000 plus ventilator shall be performed by trained and factory authorized staff only.

WARNING !

Disconnect power!

Before opening the unit, always disconnect plug at the wall outlet first.

In Case of Ventilator Malfunction

WARNING !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to properly trained and factory authorized service personnel.

For ventilators with liquid crystal displays (LCD):

WARNING !

If, in case of damage to the ventilator, the glass of the LCD screen is broken, a liquid chemical may escape that should not come into contact with the skin. In case of contamination, wash off with soap immediately.

User-Replaceable Parts

Replacing cooling air intake filter

- Clean or replace after 4 weeks. Replace after 1 year at the latest.
- Remove air intake filter from its holder in the back of the ventilator.
- Replace or clean in warm water with detergent added. Dry well.
- Re-insert cooling-air filter into holder. Verify that it is fit properly.
- Dispose of used cooling-air filter with domestic waste.



User Replaceable Parts

Disposal of batteries and O2 sensors

WARNING !

Treatment of batteries and O₂-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O₂-sensor capsules.

• Batteries must be disposed of as special waste.

Dispose of O2 sensors in the same way as batteries. Information may be obtained from local environmental and public health authorities or from approved waste disposal companies.

Troubleshooting

Contents

Troubleshooting

Contents

Troubleshooting

Babylog 8000 plus displays alarm messages at 3 levels of priority:

Warning = Message with top priority

Caution = Message with medium priority

Advisory = Message with low priority

In the table below, the messages are listed in alphabetical order.

The table should help you to identify the cause of an alarm and to ensure rapid remedy of the problem.

Message	Cause	Remedy
Airway pressure high Exp. valve opened	Pressure increase in patient circuit. Expiratory valve has been opened to relieve pressure from system.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
	Ventilator faulty.	Take ventilator out of service.
Airway pressure high Inspiration cancelled	Pressure increase in patient circuit. Ventilator breath has been cancelled to relieve pressure from system.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
	Ventilator faulty.	Take ventilator out of service.
Airway pressure low	Leak or disconnection.	Check patient circuit for leaks.
	Inspiratory or expiratory flow set too low.	Increase flow.
Apnea	Patient's spontaneous breathing has stopped.	Apply controlled ventilation.
Calibrate flow sensor!	After switching ventilator on or after a power out, the ventilator will ask for flow	Press »Confirm « key and calibrate flow sensor, page 40.
	sensor calibration. Without calibration, no flow is measured!	Simply press »Confirm « if ventilator is to be used without flow measurement.
		WARNING It remains the responsibility of the operator to maintain adequate minute ventilation and other parameters.
Dirty flow sensor Please clean sensor!	Liquid in flow sensor.	Exchange sensor insert.
Fault in rotary knob	Ventilator faulty.	Take ventilator out of service.
FiO2 high	O2 measurement faulty.	Calibrate O2 sensor manually, page 39.
	Blender faulty.	Take ventilator out of service.

Message	Cause	Remedy
FiO2 low	O2 sensor not calibrated.	Calibrate O2 sensor manually, page 39.
	Blender faulty.	Take ventilator out of service.
Flow measurement disturbed Meas. switched off	Flow sensor faulty or disconnected.	Connect flow sensor or cable, calibrate flow sensor, page 40.
	Flow measurement faulty.	Exchange flow sensor.
	Faulty cable.	Exchange cable.
Flow measurement disturbed VG uses Pinsp, Check settings!	Due to faulty or disconnected flow sensor, VG is disabled.	Connect flow sensor or cable,calibrate flow sensor, page 40. Exchange flow sensor.
	Flow measurement faulty.	
Frequency high!	Hyperventilation	Adjust ventilator rate
Hose kinked?	Kink in patient circuit. Blockage or condensation in circuit.	Check patient circuit. Clear passage.
	ID of patient circuit too small.	Use circuit with less resistance.
I:E maximum 3:1!	With knobs for Tin and Tex, an I:E ratio > 3:1 was set. The range of settings is limited to 3:1.	Check setting of Tin and Tex, and change to obtain an acceptable ratio.
IRV!	With knobs for Tin and Tex, an I:E ratio of \geq 1:1 was set (Inverse R atio V entilation).	Press »Confirm « key to acknowledge or check settings of Tin and Tex, and change as necessary.
Leak in hose system? Check setting !	Leak or disconnection.	Check patient circuit for leaks.
	Set value for Pinsp too high.	Check set value for Pinsp.
Loss of stored data	Ventilator malfunction.	Take ventilator out of service.
Max. frequency 150 bpm	Ventilation rate set via Tin and Tex exceeds 150 bpm.	Check Tin and Tex settings.
Medical air pressure low	Air supply pressure too low.	Make sure pressure is greater than 3 bar (43.5 psi).
Medical air supply pressure measurement out of range	Faulty pressure sensor. Faulty pressure regulator.	Take ventilator out of service.

Message	Cause	Remedy
MV high	Lung compliance has increased. Resistance has decreased. Hyperventilation.	Check ventilation settings and adjust as necessary.
	Ventilator malfunction.	Take ventilator out of service.
MV low	Lung compliance has decreased. Resistance has increased. Low spontaneous breathing. Large ET-tube leak.	Check ventilation settings and adjust as necessary
	Ventilator malfunction	Take ventilator out of service.
O2 calibration Meas. switched off	Calibration in progress.	Press »Confirm« key to acknowledge.
O2 calibration unstable Check supply pressures	Fault during calibration.	Repeat manual calibration of O2 sensor page 39. Take ventilator out of service.
O2 measurement disturbed	Faulty FiO2 measurement.	Exchange O2 sensor, page 30. Take ventilator out of service.
O2 measurement out of range Exchange sensor!	O2 sensor faulty or used up.	Exchange O2 sensor, page 30.
O2 supply pressure low	O2 supply pressure to low.	Make sure pressure is greater than 3 bar (45 psi).
O2 supply pressure measurement out of range	Faulty pressure sensor. Faulty pressure regulator .	Take ventilator out of service.
PEEP > 8 cmH2O? Press Confirm!	Knob for Pinsp was set at a value above 8 cmH2O, while setting was limited to 8 cmH2O.	Press » Confirm « key. The limitation of 8 cmH2O is cancelled
PEEP minimum 3 cmH2O!	A PEEP lower than 3 cmH2O has been set during high frequency ventilation. PEEP/CPAP is limited to the 3 cmH2O minimum.	Set PEEP to value of at least 3 cmH2O.
Pinsp > 40 cmH2O? Press Confirm!	knob for Pinsp was set at a value above 40 cmH2O, while setting was limited to 40 cmH2O.	Press » Confirm « key. The limitation of 40 cmH2O is cancelled.
Pinsp/PEEP Check set values!	Pinsp setting less than 5 cmH2O above set PEEP. PEEP would be limited by Pinsp	Increase Pinsp and/or reduce PEEP.
Message	Cause	Remedy
---	---	--
Pressure measurement out of range	Liquid in patient block.	Replace patient block
	Condensation in patient circuit.	Remove condensation.
	Fault in pressure measurement function.	Take ventilator out of service.
	ID of patient circuit too small	Use circuit with less resistance.
Printing cancelled Check printer!	Printer switched off.	Switch on printer.
	No paper.	Load paper.
	Faulty cable.	Replace cable.
	RS232 interface of ventilator or printer not properly configured.	Configure RS232 interface, see page 93, 94.
Re-calibrate flow sensor if exchanged!	During operation: Flow sensor has been exchanged	Press » Confirm « key. Calibrate flow sensor, page 40.
	Cable was disconnected and re-connected.	Press » Confirm « key.
VT low Check settings!	Set tidal volume VTset has not been delivered.	Increase inspiratory flow Vinsp, increase inspiratory time, increase Pinsp if necessary.
Tube obstructed?	Kinked or blocked tube.	Clear passage.
	Auto-triggering	Correct trigger sensitivity.
Ventilator malfunction Error code: xxx	Ventilator faulty.	Take ventilator out of service.

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Contents

What's What

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What'sWhat

Dial Panel



1 Dial Panel

- 1.1 Dial knob for inspiratory O2-concentration »O2-Conc.%«
- 1.2 Dial knob »Insp. Flow V «
- 1.3 Dial knob for inspiratory time »Tin«
- 1.4 Dial knob for limiting inspiratory pressure »Pinsp«
- 1.5 Dial knob for expiratory time »Tex«
- 1.6 Dial knob »PEEP/CPAP«
- 1.7 »Vent. Options« key for ventilation mode extensions
- 1.8 »Vent. Mode« key for ventilation modes
- **1.9 »man. Insp.**« key for starting or extending a manual inspiration

Display and Menu Key Panel



2.8

2 Display and Menu Key Panel

- 2.1 Key for selecting »Cal. Config.« menu
- 2.2 Yellow »Trigger« LED lights when inspiration is started by trigger.
- 2.3 Screen for numeric and waveform displays
- 2.4 Bargraph display for airway pressure Paw
- **2.5** Red alarm light flashes for "Warning/Caution" messages to direct attention to the screen.
- **2.6** » \cancel{A} « key for silencing audible alarm for about 2 min
- 2.7 »Confirm« key for acknowledging messages and for checking LEDs and audible alarms
- 2.8 Menu keys

What'sWhat

Front Connections



3 Front Connections

- 3.1 Silencer (for ejector)
- 3.2 Lever for locking expiratory valve (patient block)
- 3.3 Expiratory port
- 3.4 Inspiratory port

Back Panel



4 Back Panel

- 4.1 Power switch
- 4.2 Line power fuses (2x)
- 4.3 Grounding pin
- 4.4 DISS O2 inlet
- 4.5 DISS Air inlet
- 4.6 Connector for flow sensor
- 4.7 Cooling fan air filter
- 4.8 Communications Interface connections (available option)

Labels

5 Labels

5.1 Main CAUTION/WARNING label

DANGER !

RISK OF EXPLOSION IF USED IN THE PRESENCE OF FLAMMABLE ANESTHETICS

WARNING !

DISCONNECT SUPPLY BEFORE SERVICING

REPAIRS ON THIS EQUIPMENT TO BE PERFORMED ONLY BY DrägerService OR ITS AUTHORIZED SERVICE CENTERS

CAUTION !

TO MAINTAIN GROUNDING INTEGRITY, CONNECT ONLY TO A "HOSPITAL GRADE" RECEPTACLE

TO REDUCE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER

USE ONLY DRY AND CLEAN COMPRESSED AIR AND OXYGEN. WATER IN GAS SUPPLY CAN CAUSE EQUIPMENT MALFUNCTION

FEDERAL LAW AND REGULATIONS IN THE USA AND CANADA RESTRICT THIS DEVICE TO SALE BY OR ON THE ORDER OF A PHYSICIAN



5.2 Air Intake CAUTION label





ed

Abbreviations and Symbols

Abbreviation	Explanation		
A/C	Assist Control	PIP	Peak Inspiratory Pressure
С	Compliance	PEEP	Positive End-Expiratory Pressure
Cc	Compliance of the patient circuit	PMean	Mean airway pressure
Crs	Compliance of the respiratory system	Pinsp	Inspiratory pressure limit
CMV	Controlled Mandatory Ventilation	R	Resistance
CPAP	Continuous Positive Airway Pressure,	RVR	Rate Volume Ratio
	ventilator-assisted spontaneous breathing	SIMV	Synchronized Mandatory Ventilation
DCO ₂	Transport coefficient describing	TC	Time Constant of the respiratory system
	the transport of CO2 out of the lungs	Tin	Set inspiratory time
ELD	Electroluminescent Display	TIspo	Actual inspiratory time
f	Breathing frequency	Tex	Set expiratory time
FiO2	Fraction of inspiratory O2	TE	Actual expiratory time
fset	Breathing frequency set by Tin, Tex	TRT	Trigger response time
ftot	Patient breathing frequency	Ϋ́	Flow, insp. or exp.
I:E	Ratio of inspiratory time to expiratory time	۷ı	Insp. Minute Volume
		ΫE	Expired minute ventilation
IRV	Inverse R atio V entilation, where Tin > Tex	V Tin	Continuous flow during set insp. time
ISO 5369	International Standard for medical	V Tex	Continuous flow during set exp. time
	ventilation equipment - lung ventilators	VIVE	Continuous flow ventilation with Variable
KG	Body weight in kilograms		Inspiratory and (independently) Variable Expiratory flow
LCD	Liquid Crystal Display	Vт	Tidal volume
LED	Light Emitting Diode	VTset	Set tidal volume
MV	Minute volume	Vtrig	Trigger volume
O2-conc	Set oxygen concentration	VG	Volume Guarantee
PSV	Pressure Support Ventilation		
Paw	Airway pressure		

What's What

Abbreviations and Symbols

Symbols

- Menu for setting of minute volume alarm limits
- Upper alarm limit
- Lower alarm limit
- Event log menu
- Decrease, page backward
- Increase, page forward
- + Shrink time window
- + Enlarge time window
- Move time window, select parameter
- Move time window, select parameter
- Silence audible alarm for 2 minutes
- C Enunciator/audible alarm
- Pulse signal for marking events during ventilation
- Return to main menu
- ➡ Increase
- Decrease

Cal. Config

Vent. Mode

Vent. Option

- Select parameter
 - Switch to calibration/configuration menu
 - Switch to ventilation menu

Switch to option menu (ventilation extensions)

Contents

Technical Data

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Technical Data

Environmental Conditions Settings - Range, Resolution, and Accuracy

Note: Specifications are given conforming to ISO 5369.

Environmental Conditions

During operation:

Temperature	10 to 40 °C
Atmospheric pressure	780 to 1060 hPa
Rel. humidity	30 to 90 % (no condensation)
For storage:	
Temperature	–20 to 60 °C
Atmospheric pressure	500 to 1060 hPa
Rel. humidity	10 to 95 % (no condensation)

Settings - Range, Resolution, and Accuracy

Parameter	Range	Resolution	Accuracy
Inspiratory time Tin	0.1 to 2 s	0.1 s to 1 s: 0.01 s 1 s to 2 s: 0.1 s	±10 ms
Expiratory time Tex	0.2 to 30 s	0.2 s to 1 s: 0.01 s 1 s to 10 s: 0.1 s 10 s to 30 s: 1 s	±10 ms
O2 Conc.%	21 to 100 %	1 %	±3 %
Inspiratory flow Vinsp	1 to 30 L/min	1 to 10 L/min: 0.1 L/min 10 to 30 L/min: 1 L/min	±10 %
Expiratory flow Vexp	1 to 30 L/min	1 to 10 L/min: 0.1 L/min 10 to 30 L/min: 1 L/min	±10 %
Pinsp	10 to 80 cmH2O	1 cmH2O	1 cmH2O ±3 % (measuring function)
PEEP	0 to 25 cmH2O	to 10 cmH2O: 0.1 cmH2O >10 cmH2O: 1 cmH2O	1 cmH ₂ O \pm 3 % (measuring function)
ΫE alarm limits	0 to 15 L/min	1<1 L/min: 0.01 L/min 1 to 10 L/min: 0.1 L/min	±10 % (measuring function)
Delay for lower alarm limit VE	0 to 30 s	1 s	±10 ms
Apnea time	5 to 20 s	1 s	±10 ms
Tachypnea	20 to 200 bpm	5 bpm	1 bpm
Tidal volume VTSet	2 to 100 mL	2 to 9.9 mL: 0.1 mL 10 to 19.5 mL: 0.5 mL 20 to 100 mL: 1 mL	up to 5 mL: ±0.5 mL > 5 mL: ±10 %

Performance Data

Principle of operation	Babylog 8000 plus operates as a continuous flow ventilator, time cycled or volume controlled and pressure limited. An integrated Air/O2 blender dispenses oxygen.
Control principle	Continuous Flow, expiratory valve pressure limited, time-cycled inspiratory time
Trigger threshold	1 to 10 (corresponds to approximately 0.02 to 3 mL)
Trigger response time (Time from the beginning of a spontaneous inspiration until the outset of the synchronized mechanical breath.)	40 to 60 ms typical (see description, page 139)
Positive endexpiratory pressure PEEP or continuous positive airway pressure CPAP	0 to 25 cmH₂O
System compliance with reusable circuit, without humidifier	<0.6 mL/cmH2O
System resistance at 30 L/min or 5 L/min inspiratory resistance expiratory resistance	<12 cmH₂O; <2 cmH₂O <8 cmH₂O; <1.3 cmH₂O

WARNING !

Circuit systems with an inspiratory resistance exceeding 12 cmH2O/L/s or an expiratory resistance exceeding 8 cmH2O/L/s may affect accuracy of airway pressure monitoring. ID of circuits no less than10 mm.

Measuring Functions - Range and Accuracy

Airway pressure

Sensor	Two differential pressure sensors within the ventilator measure pressure in the patient circuit relative to atmospheric pressure at the inspiratory and expiratory port, respectively. Pressure at the wye is calculated from these measured values, see description page 137.
Measuring range	–10 to 100 cmH2O
Zero offset	±1.0 cmH2O
Linearity	± 3 % of measured value
These values are representative for reusable p	patient circuit 84 11 041

Measuring Functions - Range and Accuracy

Parameter	Range	Resolution
Peak	0 to 99 cmH2O	0 to 9.9 cmH2O: 0.1 cmH2O 10 to 99 cmH2O: 1 cmH2O
PEEP	0 to 99 cmH2O	0 to 9.9 cmH2O: 0.1 cmH2O 10 to 99 cmH2O: 1 cmH2O
Pmean	0 to 99 cmH2O	0 to 9.9 cmH2O: 0.1 cmH2O 10 to 99 cmH2O: 1 cmH2O
Paw (t) bargraph display	-10 to 80 cmH2O	0.2 cmH2O
Paw (t) screen display	–10 to 100 cmH2O	-2.5 to 25 cmH2O: 0.5 cmH2O -5 to 50 cmH2O: 1 cmH2O -10 to 100 cmH2O: 2 cmH2O

Flow and Volume

Sensor

Hot wire anemometer between wye and ET-tube connector

Sensor type		Deadspace (without ET-tube)	Resistance at 30 L/min
Wye with flow sensor	84 10 185	1.7 mL	≤ 12 cmH2O
Flow sensor ISO 15	84 11 130	0.9 mL	≤11 cmH2O
Gas composition		Breathing gas with set O2-cond	centration
Reference		switchable between – NTPD (normal temperature 1013 hPa, dry gas) – BTPS (body temperature 3' saturated gas)	20 °C, barometric pressure 7 °C, ambient pressure, water vapor
Measuring conditions pu	ursuant prEN 79	94-1	
Flow measuring range 3dB-bandwidth		0.2 L/min to 30 L/min 28 Hz	
Measuring accuracy for volume (without expirato Measuring range Accuracy to 5 mL Accuracy beyond 5 mL	expiratory tidal ry leak)	0 to 999 mL 0.5 mL 10 % of measured value	
Displayed parameters			

All parameters are displayed numerically or as graphics on the ventilator screen.

Parameter	Range	Resolution
VT	0 to 999 mL	0 to 9.9 mL: 0.1 mL 10 to 99 mL: 1 mL
MV	0 to 30 L/min	0 to 0.99 L/min: 0.01 L/min 1 to 9.9 L/min: 0.1 L/min 10 to 30 L/min: 1 L/min
Leak	0 to 100 %	0 to 10 %: 10 % 10 to 100 %: 1 %
DCO ₂	0 to 999 mL ² /s	1 mL²/s
Spontaneous MV	0 to 100 %	1 %
Flow waveform	–20 to 20 L/min	–2.5 to 2.5 L/min: 0.1 L/min –5 to 5 L/min: 0.2 L/min –10 to 10 L/min: 0.4 L/min –20 to 20 L/min: 0.8 L/min
Breathing rate	0 to 9.9 /bpm 10 to 999 /bpm	0.1 bpm 1 bpm
RVR	0 to 1000 bpm/mL	0.1 bpm/mL

Inspiratory oxygen concentration

Sensor	Fuel cell inside ventilator exposed to inspiratory flow
Measuring range	18 to 100 Vol.%
Measuring acuracy	± 3 Vol.% of pressurized gases O2 and Air When calibrating, Babylog 8000 plus uses 20.9 Vol.% O2 or 100 Vol.% O2 respectively, for calculation.

The measured value is displayed numerically on screen.

Parameter	Range	Resolution
FiO2	18 to 100 Vol.%	1 Vol.%
Compliance C of respiratory system	0.2 to 10 mL/cmH2O	0.1 mL/cmH2O
Resistance R	10 to 10000 cmH2O/L/s	1 cmH2O/L/s
Time constant TC of respiratory system	0.1 to 5 s	0.01 s
Overdistension index C20/C	0 to 5	0.1

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Alarm Criteria

Alarm Criteria

Inspiratory O2 concentration	An alarm is generated when the measured inspiratory O2 concen- tration FiO2 is more than 4 vol% above or below the set value for more than 25 seconds.
Disconnection	A disconnection or a considerable leak in the patient circuit will result in inadequate pressure building up. Therefore, this condition is detected by checking whether a minimum pressure has been reached, depending on the mode of ventilation and set values of PEEP and Pinsp. An alarm is generated when airway pressure does not reach the minimum pressure PEEP + (Pinsp-PEEP)/4 for at least 0.025 s for each breathing cycle during CMV, A/C, PSV and SIMV.
High inspiratory pressure	Airway pressure should not exceed the set pressure limit during man- datory breaths. A maximum of 5 cmH2O is tolerated, thus avoiding immediate alarms in the event of coughs etc. Beyond the alarm threshold of $P_{insp} + 5$ cmH2O, the pressure-time integral of the viola- tion is calculated. An alarm is generated when this integral exceeds a value of 0.33 cmH2O·s. At that time, a mandatory breath is interrup- ted.
	Example: Airway pressure rising to 6 cmH2O beyond the pressure limit and remaining constant. An alarm will then be generated after 0.33 s. If, after the alarm, the pressure-time integral should continue to increase, ventilation would be interrupted and pressure from the patient circuit be relieved to ambient.
High CPAP pressure	An alarm is generated during CPAP and in the expiratory phase of mandatory ventilation modes when airway pressure is continuously beyond the threshold of PEEP/CPAP+4 for more than 5 s. At that time, pressure from the patient circuit is relieved to ambient. If, however, airway pressure exceeds PEEP/CPAP+25 cmH2O, an alarm will be generated already after 0.3 s.
Low CPAP pressure	An alarm is generated when airway pressure is below PEEP/CPAP -2 cmH2O and the pressure-time integral exceeds 6 cmH2O·s.
Blocked ET-tube	A blocked or kinked ET-tube will not allow the passage of breathing gas. This situation is detected via flow measurement. An alarm is generated when no flow is measured in a mandatory mode of ventilation during the whole ventilatory cycle.
Kinked patient circuit	This situation is detected via measurement of airway pressure at the inspiratory and expiratory connection ports of the ventilator. With a blocked or kinked patient circuit, pressure will rise at the inspiratory side. The pressure difference between the two ports is much greater in this situation than under normal operating conditions. An alarm is generated when a pressure difference of 8 cmH2O+0.6xinsp. flow (in L/min) is exceeded. At that time, pressure from the patient circuit is relieved to ambient.

Technical Data

Low tidal volume VT	 In case volume control VG cannot deliver the set tidal volume: An alarm is generated if VT remains below either 90% of VTset or VTset - 0.5 mL (whichever is smaller). Reasons for this condition might be: 1. Pinsp has been set too low. Ventilatory pressure is not sufficient for the intended VT. 2. No plateau during inspiration, because either inspiratory flow is set too low or Tin is set too short. Any alarm will be delayed for the set alarm delay.
Minute ventilation MV	An alarm is generated when the measured minute ventilation is out- side the range defined by alarm limits. However, the alarm for low minute ventilation is delayed for a time that can be set between 0 and 30 s. This makes it possible to tolerate short pauses in ventila- tion without immediately generating an alarm. Both alarm limits may be set between 0 and 15 L/min with the condition that the upper threshold always be higher than the lower limit.
Apnea	An alarm is generated when the ventilator does not recognize ventila- tion for the time set as apnea time. Ventilation, in this context, means a minimum tidal volume of at least 0.6 mL for mandatory breaths, and 0.4 mL for spontaneous breaths. Apnea time may be set between 5 and 20 s.
Tachnypnea	An alarm is generated when the breathing rate exceeds the alarm limit set for tachypnea.

Operating Data

Electrical power Range:

Current consumption at 230 V at110 V

Power consumption

Fuses

Range 100 V to 127 V Range 230 V to 240 V 100/110/127 V ±10 % 230/240 V ±10 % switchable 47 to 63 Hz

0.6 A 1.3 A about 140 W

Refer to fuse ratings on back panel

Technical Data

Operating Data

Gas supply

Supply pressure O2	45 psi - 10 % to 90 psi +10 %
	O2 connection: DISS O2 (male)
Supply pressure Air	45 psi - 10 % to 90 psi +10 %
	Air connection: DISS Air (male)

Gases must be dry and free from oil and dust (medical grade).

Gas consumption for pneumatic control
Gas consumption for ejector
Max. gas consumption

Noise level (free field measurement over a reflecting surface)

Protection against electric shock:

ust (medical grade). about 3 L/min Air only about 10 L/min Air or O2 about 43 L/min Air or O2

max. 55 dB (A)



type BF body floating, pursuant DIN IEC 60601 clause 19 Tab. 4: maximum permissible ground leakage current: 0.5 mA

Dimensions (W x H x D) Ventilator only Ventilator with stand

Weight Ventilator only

approximately 14.5 kg (32 lbs)

Electromagnetic compatibility EMC

(conforming to Directive 89/336/EWG)

tested pursuant DIN IEC 60601-1-2

212 x 280 x 390 mm (8.3 x 11 x 15.4 inches)

700 x 1335 x 700 mm (27.6 x 52.6 x 27.6 inches)

Performance Standards

Babylog 8000 plus is designed to comply with DIN 13254 'Ventilators' and ISO 5369 'International Standard for Medical Ventilation Equipment - Lung Ventilators' as well as ASTM F 1100 'Standard Specification for Ventilators Intended for Use in Critical Care'.

Communication Interface (Available Option)

NOTE: All in- and outputs of the combined analog/digital interface are electrically isolated from the ventilaor electronics. The isolation voltage is 2.5 kV.

Analog1 und Analog2

Outputs are short-circuit protected. Voltages are communicated via a 12 bit DA converter with low pass filter			
Connector type	SMB Subclic		
Signal delay	Electronic filters inside the Baylog 8000 ventilator delay the signals for airway pressure and flow approximately 15 ms compared to the original sensor signals. This delay must be taken into account when comparing signals measured with an independent measuring device with the analog output of the Babylog 8000 plus ventilator.		
Output impedance	\approx 10 k Ω		
Event marker output			
Output is short-circuit protected.			

H-level voltage	5 V \pm 0.5 V, no load
L-level voltage	0 V ± 0.5 V, no load
Output impedance	< 5 k Ω
Connector type	SMB Subclic





Operating Instructions Babylog 8000 plus SW 5, USA 3rd. ed.

Monitor cable 83 06 488 Wiring diagram Materials Used

Materials Used

Part	Appearance	Material	
Ventilation circuit (reusable)	milky, transparent	silicone rubber	
Water traps	yellow, transparent	polysulphone	
Wye, flow sensor adapter with	yellow, transparent	polysulphone	
seal for flow sensor element	milky, transparent	silicone rubber	
Expiratory valve housing, closure	grey	aluminum	
Diaphragm	whitish	silicone rubber	
flow sensor element with	yellow, transparent	polysulphone	
hot wire	pewter	platinum	
Temperature sensor / cable	milky / green	silicone rubber	

Contents

Theory of Operation

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Functional Description of Pneumatics



Functional Description of Pneumatics (Simplified)

- 1 Sintered filter
- 2 Non-return valve
- 3 Pressure regulator
- 4 Absolute pressure sensor
- 5 Solenoid valve of blender and flow unit
- 6 Flow restrictor for blender and flow unit
- 7 Solenoid switching valve
- 8 Solenoid valve
- 9 Solenoid valve
- 10 Non-return valve
- 11 Filter
- 12 Pneumatic control valve
- 13 Flow restrictor
- 14 O2 measuring system
- 15 Pneumatic control valve
- 16 Pneumatic safety valve
- 17 Relative pressure sensor
- 18 Electrical PEEP control valve
- 19 Safety valve
- 20 Expiratory valve
- 21 Bactericidal labyrinth
- 22 Relative pressure sensor
- 23 Solenoid valve
- 24 Ejector

Gas Supply

Compressed gases Air and O2 flow through filter **1** and the non-return valves **2** to the pressure regulators **3**, which produce a constant system pressure for both gases.

Non-return valves **2** prevent gas from flowing back into the central supply.

Absolute pressure sensors **4** measure and monitor system pressure. Flows of Air and O2 are taken to solenoid valve **7** past pressure regulators **3**. This valve controls flow of air or calibration gas through solenoid valve **8** to solenoid valve **9**, to solenoid valve **23**, to safety valve **16**, to PEEP control valve **18**, and expiration valve **20**.

Past pressure regulators **3**, the two gases flow to solenoid valves **5** and flow restrictors **6**. These mix and control the flow of the two gases.

This gas mixture flows through the inspiratory circuit to the patient.

If the gas supply or electric power fails, ambient air can be drawn in through filter **11** and non-return valve **10**; the non-return valve **10** prevents a return flow to ambient air.

Controlled Ventilation

There is a continuous flow through the inspiratory circuit to the wye. O2 sensor **14** measures inspiratory oxygen concentration of the gas flow controlled by pneumatic valve **12**. Safety valve **16** prevents excessive pressure in the patient circuit if, for instance, the expiratory limb of the circuit were blocked and all other pressure releasing mechanisms had failed.

Inspiration

Expiratory valve **20** is controlled by PEEP control valve **18** and closes the expiratory side of the circuit. A continuous flow is then delivered to the patient's lungs.

Airway pressure is measured with two relative pressure sensors **17** and **22**. Inspiratory pressure is controlled by expiratory valve **20**.

Expiration

The PEEP control valve **18** sets the control pressure on the expiratory valve **20**, which opens the breathing system. Expiration is through the open expiratory valve **20**. The ejector **24** is driven by the open solenoid valve **23** and assists with expiration.

PEEP

PEEP control valve **18** generates a control pressure on the control side of expiratory valve **20**, which regulates PEEP in the patient circuit.

СРАР

The control pressure generated by PEEP control valve **18** controls expiratory valve **20** and builds up a continuous, positive airway pressure in the breathing circuit.

This continuous flow is delivered through the wye and expiratory valve **20**.

Measurement of Ventilation Parameters

O2-Measurement

O2 sensor **14** continuously measures inspiratory O2 concentration of a gas flow controlled by the open pneumatic valve **12**.

An automatic two-point calibration is carried out every 24 hours using the following procedure:

Air initially flows to pneumatic valve **12** through solenoid valve **7**, solenoid valve **8** and solenoid valve **9**. Pneumatic valve **12** makes the connection from O2 sensor **14** to the inspiratory limb of the circuit. Pneumatic valve **15** is then opened while at the same time O2 sensor **14** is flushed with air for about 2.5 minutes through flow controller **13**. Thereafter, flushing is repeated with O2.

After calibration, solenoid valve **7** switches back to air, solenoid valve **9** closes, pneumatic valve **15** closes, and pneumatic valve **12** reconnects O2 sensor to the inspiratory circuit.

Measurement of Airway Pressure

Airway pressure is measured via two relative pressure transducers **17** and **22**. The ventilator then calculates airway pressure at the wye on the basis of the pressure drop due to the continuous flow.

A bactericidal labyrinth **21** prevents the pressure sensor **22** from being contaminated by expiration gas.

Ventilation Modes

Continuous Positive Airway Pressure (CPAP)

Babylog 8000 plus keeps airway pressure at the PEEP/CPAP level. The patient may breathe spontaneously at all times. Inspiratory flow should be set significantly higher than what the patient needs for spontaneous breathing in order to avoid fluctuations of airway pressure or increased work of breathing.

Continuous Mandatory Ventilation (CMV)

Mandatory ventilation with continuous flow regardless of spontaneous breathing. Mandatory breaths are timed according to set values for Tin and Tex.

Between mandatory breaths, Babylog 8000 plus keeps airway pressure at the PEEP/CPAP level. The patient may breathe spontaneously at all times.

The settings for Vinsp, Tin, and Pinsp shape a mandatory breath: The continuous flow determines the pressure rise, Tin the duration of the inspiration, and Pinsp limits inspiratory pressure. When the pressure waveform reaches Pinsp, a pressure plateau will be formed. When Pinsp is not reached, the pressure waveform will exhibit a peak.

The pressure waveform pattern determines the factors for tidal volume VT. In two cases this relationship is straightforward.

Pattern 1, long plateau:

If the pressure plateau is long enough to allow flow to drop to zero by the end of inspiration, lung pressure will have reached equilibrium with airway pressure. Then airway pressure, i.e. the difference between Pinsp and PEEP, will determine tidal volume as

 $VT = (Pinsp - PEEP) \cdot Crs$

where Crs is the compliance of the respiratory system.



Pattern 2, no plateau

Without inspiratory pressure plateau, Pinsp has no influence on VT. A portion of Vinsp fills the patient circuit with each mandatory breath, only the remaining portion actually flows into the lungs. The patient circuit is thus ventilated alongside the patient. Tidal volume may be calculated approximately as

 $VT = Tin \cdot \dot{V}insp \cdot Crs/(Crs + Cc)$

with C_c as the circuit compliance. Especially for very small patients, the influence of the circuit system can be quite considerable, because C_c and C_{rs} are of the same order of magnitude.

Only half of the set continuous flow, e.g., goes into the patient's lungs with values of $C_{rs} = C_c$.

This effect of "co-ventilating" a patient circuit is shared by all ventilators. Babylog 8000 plus therefore features a flow sensor at the wye to measure true inspiratory and expiratory tidal volumes.

Assist Control Ventilation (A/C)

Ventilator breaths are synchronized with a patient's own spontaneous breathing. A breath starts with a spontaneous breathing effort and ends at inspiratory time Tin.

The mandatory breath is shaped by the same settings as in CMV. Babylog 8000 plus detects spontaneous breathing via its flow measuring system. A ventilator breath is triggered if

- inspiratory flow is measured following an expiration, and
- the continuously inspired volume during the spontaneous inspiration (trigger volume Vtrig) reaches the set trigger threshold, and
- Vtrig has been inspired before the end of Tex.

In addition, a ventilator breath may only be started when 0.2 s have elapsed after the end of the previous breath in order to provide sufficient time for expiration.

The patient will control the ventilator rate. It can rise to a maximum of

 $f_{max} = 1/(T_{in} + 0.2 s + T_{RT})$

with TRT as trigger response time, which is the time from the begin of a spontaneous inspiration until the begin of the triggered ventilator breath.

If the patient fails to trigger breaths, ventilation is performed as in CMV.

A/C is suitable for patients with sufficient spontaneous respiration and respiratory control. Weaning may be performed by successively decreasing inspiratory pressure.





Synchronized Intermittent Mandatory Ventilation (SIMV)

SIMV combines synchronized ventilation with spontaneous breathing. Different from A/C, not each and every spontaneous inspiration is supported, but only as many as needed to ventilate a patient with the set ventilator rate. The patient is allowed to breathe between mandatory breaths, however without receiving support.

During a time interval of length Tin+Tex the first spontaneous inspiration will trigger a mandatory breath of length Tin. Any further spontaneous breathing until the end of the time interval is ignored. Ventilator breaths will thus exhibit the irregularity of spontaneous breathing, however, with a time average that corresponds to the set ventilation rate.

The same rules as in A/C mode apply for triggering.

The shape of the mandatory breaths is set in the same fashion as in CMV.

During SIMV, the ventilator rate may be set as during CMV. Triggered, mandatory breaths will alternate with spontaneous breathing without support, during which the patient will have to perform the total work of breathing. Therefore, by extending T_{ex} a successively increasing portion of the total work of breathing can be shifted from the ventilator to the patient.

If the patient fails to trigger breaths, ventilation will be peformed as in CMV.

SIMV is suitable for patients with sufficient spontaneous breathing. Weaning is performed by slowly extending T_{ex} and decreasing inspiratory pressure.



Pressure Support Ventilation (PSV)

PSV works essentially the same as A/C. In addition to ventilator rate, the patient will also control the duration of ventilator breaths via flow: A mandatory inspiration is terminated when flow has decreased to 15 % of maximum inspiratory flow, at the latest after the set inspiratory time Tin.

In order to allow the flow to decrease during a mandatory breath, the pressure pattern must show a plateau (see description of CMV). This is the condition where increased lung pressure due to the filling of the lungs will start to equalize with airway pressure and flow will start to decrease.

The speed of this equalizing process is determined by the time constant TC of the respiratory system. The shorter TC, the faster the lung will be filling. This means that a breath is terminated in PSV when the lung is nearly filled. The resulting inspiratory time is perfectly tuned to the patient.

The same rules as in A/C mode apply for triggering.

The shape of a ventilator breath is set in the same fashion as in CMV, except for inspiratory time. If the plateau is too short, a breath will end after Tin as in A/C.

If the patient fails to trigger breaths, ventilation is performed as in CMV.

PSV is suitable for patients with sufficient spontaneous respiration and respiratory control. Weaning may be performed by successively decreasing support pressure.



Volume Guarantee (VG)

The ventilation mode extension VG allows for the volume control of mandatory breaths. Babylog 8000 plus controls inspiratory plateau pressure automatically, in order to deliver the set tidal volume.

Changes in the mechanical properties of the respiratory system are compensated; tidal volume of delivered mandatory breaths remains constant.

VG may be used with ventilation modes A/C, SIMV, or PSV. The diagram shows an example of SIMV with VG.

The advantage of volume control over time-cycled, pressure-limited ventilation is that changes in resistance or compliance will not have an impact on delivered tidal volumes. If compliance increases, inspiratory pressure is automatically reduced. Reversely, pressure increases for a decrease in compliance: however, only up to the set pressure limit Pinsp. By the same token, fluctuations in spontaneous breathing will be compensated: The more a patient contributes by breathing spontaneously, the less pressure the ventilator will apply. Using VG, Babylog 8000 plus will always apply just the pressure needed to deliver the desired tidal volume. Pressure load for the patient lung is therefore minimized as much as possible.

Without VG, the respiratory therapist must manually readjust inspiratory pressure in order to deliver the desired tidal volume. VG thus also frees the user from routine chores.

Control is performed in the range from +3 cmH2O up to Pinsp. The user determines the pressure the ventilator is allowed to apply via Pinsp.

There are two situations where the ventilator will not be able to deliver the target volume:

- 1. Pinsp is not sufficient.
- 2. The inspiratory pressure pattern does not exhibit a plateau because flow is set too low or Tin set too short.

In both situations, Babylog 8000 plus will display a message, if delivered VT remains below 90% of target volume.

The control operates in a breath-to-breath fashion. Expiratory tidal volume VT is measured, compared to the target volume, and a new plateau pressure is then calculated for the next breath. After a change in target volume, it will take about seven breaths before the corresponding inspiratory pressure has been reached.



In case of a significant ET-tube leak (see description of leak rate calculation on the next page) it may happen - as it may in other modes of ventilation - that expired VT is larger than the one measured. In this case, inspiratory and expiratory tidal volumes will be different. If actual inspiratory VT exceeds VTe of the last breath by an amount that is dependent on the current leak rate, Babylog 8000 plus will terminate an inspiration.

If the flow sensor is inoperable or the patient does not breathe spontaneously, mandatory ventilation (CMV) is started.

Ventilation Monitoring

Airway Pressure Monitoring

Babylog 8000 plus measures airway pressure indirectly, in order to avoid a pressure sensing line connected to the wye. Two piezoresistive pressure transducers measure pressures PI and PE inside the ventilator at the inspiratory and expiratory ports, respectively. From these two values airway pressure PY is calculated.

Due to operation with continuous flow, inspiratory pressure PI is the starting point. The continuous flow \forall_{insp} will cause a pressure drop P in the inspiratory limb of the patient circuit that is dependent on resistance RI of the inspiratory circuit and \forall_{insp} :

 $P = V insp \cdot RI$

P only insignificantly depends on the ventilation pattern, which makes the calculated pressure at the wye approximately equal to pressure P reduced by the amount of PI:

 $PY = PI - P = PI - \dot{V}insp \cdot RI$

Airway pressure at the wye can therefore be calculated if resistance RI is known.

The total resistance of the patient circuit can be measured during ventilation, however, not the inspiratory portion.

Extensive laboratory tests have demonstrated that for all circuits encountered in the field, the inspiratory limb is responsible for approximately 70 % of total circuit resistance. With this estimate, Babylog 8000 plus calculates

PY - 0.7 < PI - PE >

where < PI - PE > represents the time average of the pressure drop across the total patient circuit. If a circuit system shows a distribution of resistance different from the 30 % to 70 % ratio, an inaccuracy is introduced. For circuits encountered in the field, this error is less than 1 cmH₂O. It may be higher for highly resistive systems and simultaneously high continuous flows. Therefore only patient circuits with at least 10 mm ID should be used.

Flow and Volume Measurement

Flow is measured with a hot wire anemometer that is either integrated into the wye or into a separate sensor adapter between wye and ET-tube. Flow direction is detected by using two hot wires, one of which is located in the "shadow" of a flow obstacle from one side.

The smallest flow that can reliably be detected is 0.2 L/min. Smaller flow values are therefore ignored and displayed as zero values.

Two different sensor types are available:

- 1. Wye-sensor, integrated into the wye
- 2. ISO sensor, connected between wye and ET-tube connector

Both designs use the same sensor element. However, they are not completely identical in their flow response. Therefore, in order to optimize measurement results, the sensor type is a parameter to be set in one of the ventilator menus.

Reference conditions

Hot wire anemometers primarily measure gas mass, not volumes or flows. The volume that corresponds to a particular amount of gas depends on environmental parameters such as atmospheric pressure, temperature, and humidity, following the general gas law.

Babylog 8000 plus displays values measured for flow and volume for one of two reference conditions:

- 1. NTPD (temperature at 20 °C, barometric pressure at 1013 mbar, dry air)
- 2. BTPS (body temperature at 37 °C, actual barometric pressure, water vapor saturated air)

The reference conditions desired are set in the menu.

Leak rate

With an uncuffed ET-tube, breathing gas will frequently escape to ambient between trachea wall and tube. The Babylog 8000 plus flow sensor is located in the wye, i.e. before the leak. During inspiration, breathing gas will be lost after measurement, during expiration, it will be lost before being measured. Therefore, tidal volume measured for inspiration will be larger than true tidal volume, tidal volume for expiration will be smaller. On average, the difference between inspiratory and expiratory flow is equal to the leakage flow. The gas volume that did not flow back through the sensor must have escaped through the leak.

Babylog 8000 plus therefore determines the average leak flow from the difference between inspiratory minute ventilation $\forall I$ and expiratory minute volume $\forall E$, the latter being displayed as minute volume. Scaled to $\forall I$, the leakage rate displayed on screen is calculated in percent:

Leak rate = 100 % · (VI- VE) / VI

Trigger function

Babylog 8000 plus detects spontaneous breathing using flow measurement. During a patient's inspiratory effort, the flow signal will increase where it had been negative (= expiration) before. In order to reliably detect an inspiration and to prevent a mandatory breath from being triggered by noise or artifacts, the patient is required to first inspire a certain volume Vtrig. This volume represents a trigger sensitivity which is displayed on a scale from 1 to 10 in the respective menu, where 1 is the highest and 10 the lowest sensitivity.

The diagram shows the relationship between Vtrig and trigger sensitivity.

At the highest sensitivity setting, Vtrig is 0. Then inspiratory flow only needs to reach the minimum value of 0.2 L/min for triggering a breath. But then there is also the possibility of auto-triggering due to artifacts. In cases of auto-triggering, trigger sensitivity should be reduced.

The lower the sensitivity, the longer the delay between spontaneous inspiration and ventilator breaths. Care must be taken to prevent mandatory inspiration from getting in the way of spontaneous expiration. Then the patient would end up "fighting" the ventilator. Selection of the right trigger sensitivity is always a compromise between the shortest possible trigger delay and a reliable protection against auto-triggering.



Measurement of Lung Mechanics Parameters

For each cycle of inspiration and expiration, Babylog 8000 plus calculates the following parameters from the waveforms for pressure, flow, and volume:

-	С	dynamic compliance of the respiratory system
		using linear regression

- R airway and ET-tube resistance using
- r coefficient of correlation
- TC time constant of the respiratory system $(TC = R \cdot C)$
- C20/C lung overdistension index according to [1]

Babylog 8000 plus first saves all measured values for $P_{aw}(t)$, Flow(t), and V(t) for a breath up to a length of 5 s.

120 data points per second are sampled. The data is evaluated and the results are displayed. Subsequently, another cycle is sampled, and so on. Hence, the numeric results on display do not belong to a breath in progress but are normally a few seconds old.

The calculation is based on the equation:

 $Paw = R \cdot Flow + V/C$

which holds true for the single compartment model of the respiratory system at each point in time during a breath. Resistance and compliance are assumed to be constant.

The method of linear regression finds the best matching values of R and C for the pressure flow and volume data set. The correlation coefficient r, a number between 0 and 1, is a measure for this match. The closer r is to 1, the better the match.

Since Babylog 8000 plus only has information about airway pressure, but not about pleural or esophagal pressure, spontaneous breathing cannot be evaluated. Considerable spontaneous breathing superimposed on ventilation will therefore alter the results.

The same is true for a substantial leak. Resistance and compliance displayed will be greater than true values.

An on-screen warning symbol is used to indicate a possible condition of calculated values being affected in such fashion. This means that r is less than 0.95, the leak rate in the breath just evaluated is more than 20 %, or that considerable spontaneous breathing is detected.

For calculation of the overdistension coefficient C₂₀, the volume increase attributable to the last 20 % of the inspiratory pressure is determined and related to the dynamic compliance [1]:

 $C_{20} = (V(T_{in}) - V(t_{80})) / (0.2 \cdot P_{peak})$

An overdistended lung becomes stiffer towards the end of inspiration, resulting in reduced volume increase during the final 20 % of inspiratory pressure. As a consequence, C20/C will be less than 1, indicating overdistention. However, this condition can be detected reliably only if there is no pressure plateau, or only a short plateau. The sooner the plateau sets in during inspiration, the less significant the value of C20/C will be.

The results are displayed until a new evaluation is complete. However, if no new values are obtained within a minute, the display is cancelled.



Rate-Volume Ratio (RVR)

The ratio of breathing frequency and tidal volume,

RVR = f / VT

can help assess the outcome of weaning the patient from mechanical ventilation [1].

Therefore the Babylog 8000 plus calculates and displays RVR.

In clinical practice, tidal volumes often fluctuate considerably between spontaneous breaths and mechanical ventilation cycles. To avoid breath-to-breath variations in the measurement of RVR, the formula

$RVR = f^2 / MV$

is used. The measured parameters, frequency f, and minute ventilation MV are both values averaged over about 10 to 15 seconds, which in turn yields a stable RVR display.

[1] A prospective study of indexes predicting the outcome of trials of weaning from mechanical ventilation; by Karl L. Yang, Martin J. Tobin, The New England Journal of Medicine, Vol 324, 21, 1991

Name and Description	Order no.	Name and Description	Order no.
Babylog 8000 ventilator, supply 100 – 127 V or 220 V – 240 V	84 11 163	 Side-mounting platform for use with Dräger Series 8000 incubators 	2M 19 460
Babylog 8000 ventilator, supply 100 – 127V or 220 V – 240 V including BabyLink interface	84 11 162	Circuit support systems	
Babylog 8000 ventilator, supply 100 – 127 V or 220 – 240 V including PSV/VG kit	84 18 003	with Dräger Series 8000 incubators	84 11 075
Babylog 8000 ventilator, supply 100 – 127 V or 220 – 240 V including Babylink interface,		 Flexible circuit support arm for third-party incubators or 	84 10 080
including PSV/VG kit	84 18 002	 Hinged arm for use of ventilator without incubator 	84 09 609
Options			
BabyLink Communication interface board	84 11 108	Kits for sterilization / disinfection	
Nebulizer kit	84 11 025	when used with disposable circuits and humidifier chambers	
Kit PSV/VG	84 11 473	Reusable flow sensor adapter ISO 15	84 11 130
		Expiratory valve (block)	
Accessories required for operation		Babylog 8000 plus	84 08 950
O2 sensor capsule	68 50 645	Infant size test lung (infant size bellows)	84 09 742
DISS O2 gas supply	45 00 907	alternatively,	
	45 20 807	• Reusable (silicone) circuit	94 11 041
hose with filter	45 20 808	(IOI use with Fisher ar ayker humidiner)	04 11 041
High pressure O2 filter	D 800130	Replacement Parts	
High pressure Air filter	D 800132	Expiratory valve (block) Babylog 8000 plus	84 08 950
Circuits		Y-piece with flow sensor (use for reusable circuits)	84 10 185
Disposable circuit	see your hospital supplier	Reusable flow sensor adapter ISO 15 with flow sensor (use for disposable circuits)	84 11 130
 Reusable (silicone) circuit (for use with Fisher&Paykel humidified) 	er) 84 11 041	Flow sensor element, 5 pack	84 10 179
Bacteria filter installation kit	84 10 230	Flow sensor cable	84 09 626
Adapter with safety valve	84 12 448	O2 sensor capsule	68 50 645
		Air intake filter fleece	84 09 108
Mounting systems		Cooling fan air filter fleece	83 05 367
Mobile stand (narrow)	84 09 280		
or			
Mobile stand for compressor	84 18 097		

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Operating Instructions Babylog 8000 plus SW 5, USA 3rd. ed.

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These Instructions for Use apply only to **Babylog 8000 plus 5.n** with Serial No.:

If no Serial No. has been filled in by Dräger these Instructions for Use are provided for general information only and are not intended for use with any specific machine or device.

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