

EvitaXL

Intensive Care Ventilator

Operating Instructions*



* These Operating Instructions apply also to Evita 4 with the XL option



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Working with these Operating Instructions

Header line – the title... of the main chapter

Titles of the respective sub-sections are printed below 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 as sequential 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 the operator step-by-step in the practical use of the product, with short, clear instructions in easy-to-follow sequence.

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

Right-hand column – the illustrations...

provide visual reference for the text and for locating the various parts of the equipment. 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«

Screen pages are indicated as »Screen page«, e.g.

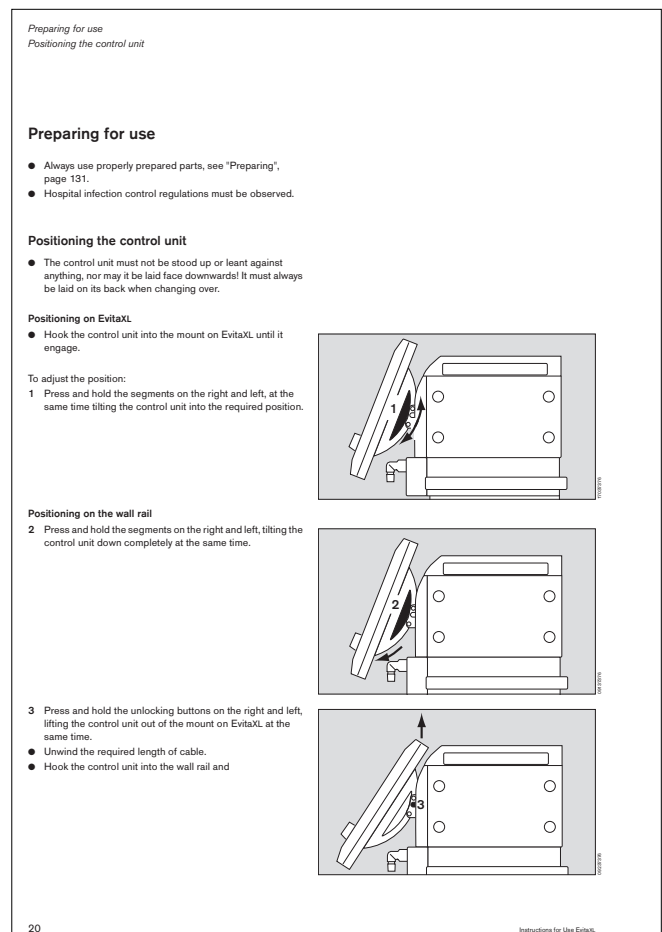
»Measured values«

Screen messages are printed in bold, e.g:

Flow Calibration

Screen messages rendered throughout the text are shown without the exclamation marks indicating their alarm level.

NOTE: If you wish to read these instructions without the ventilator in front of you, you may keep the full page photograph folded out.



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" on page 20 and in conjunction with appropriate airway monitoring (see page 23). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

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Important Safety Information READ THIS FIRST!

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Important Safety Information

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" on page 20 and in conjunction with appropriate airway monitoring (see page 23). 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 Draeger 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. Draeger Medical, Inc. 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 Draeger or by other manufacturers if such a combination is not endorsed by Draeger Medical, Inc.

Patient monitoring

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.

Limitation of Liability

Draeger Medical, Inc.'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 Draeger Medical, Inc.'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 Draeger Medical, Inc. 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.

Draeger Medical, Inc. 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 Draeger 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:

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Draeger Medical, Inc. or its representatives are not covered.
2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with Draeger Medical, Inc. holding the option. Draeger Medical, Inc. is not responsible for deterioration, wear, or abuse. In any case, Draeger Medical, Inc. will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. Draeger Medical, Inc. 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 Draeger or its authorized representative.
3. Examination by Draeger or its authorized representative must confirm that the defect is covered by the terms of this warranty.
4. Notification in writing, of defective material or equipment must be received by Draeger or its authorized representative no later than two (2) weeks following expiration of this warranty.

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

Draeger Medical, Inc., Telford, PA

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

»**PEEP**«

Screen pages are indicated as »Screen page«, e.g.

»Measured values«

Screen messages are printed in bold, e.g:

Flow Calibration

Screen messages rendered throughout the text are shown including the exclamation marks indicating their alarm level,e.g.

Standby activated !!!

Abbreviations and Symbols

Please refer to "Abbreviations" on page 216 and "Symbols" on page 220 for explanations.

Labels on the equipment

Please refer to "Labels" on page 177.

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 Medical Applications" on page 20 and in conjunction with appropriate airway monitoring (see page 23). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

WARNING !

The EvitaXL ventilator must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction.

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 !

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 gases or anesthetics.

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

WARNING !

Never use flammable medications (e.g. on the basis of ethanol) or other substances based on flammable solvents in the patient circuit. Fire hazard!

Always provide adequate ventilation when using flammable substances for disinfection.

WARNING !

Do not use mobile phones within 33 feet (10 m) of the ventilator.

Mobile phones can cause interference with electrical and electronic medical equipment with the risk of patient injury.

WARNING !

Do not use in conjunction with magnetic resonance imaging (MRI)!

Equipment malfunction with the risk of patient injury may result.

WARNING !

Using high frequency electrosurgery equipment, defibrillators, or short-wave treatment equipment in the vicinity of the ventilator may interfere with its operation and pose a risk of patient injury.

WARNING !

Do not use the EvitaXL ventilator in hyperbaric chambers. Equipment malfunction may result, with the risk of patient injury.

WARNING !

Do not place the EvitaXL ventilator on a patient's bed while in motion.

Ensure that the ventilator is properly secured to prevent it from falling or being knocked over.

WARNING !

When using EvitaXL in combination with other products and when using EvitaXL during patient transfers, the person responsible for operating the equipment must ensure that all equipment is adequately secured in accordance with applicable safety standards.

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 system must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

Back-up ventilation with an independent manual ventilation device

If a fault is detected in the EvitaXL ventilator, so that its life-support functions are no longer assured:

- start ventilation using an independent ventilation device (resuscitation bag) without delay, if necessary with PEEP and / or increased inspiratory O₂ concentration.

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.

Device for use in health care facilities only and exclusively by persons with specific training and experience in its use.

Precautions during preparation

WARNING!

Always install components that have been cleaned and disinfected according to approved hospital procedures.

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!

Draeger cannot warrant or endorse the safe performance of heat/moisture exchangers.

The user must verify that the heat/moisture exchanger is covered by a technical safety certificate which guarantees complete suitability for the intended use.

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

WARNING!

The flow resistance of bacteria filters placed in the expiratory side may be substantially increased by nebulized aerosols with the risk of impaired ventilation. If an expiratory filter is used during nebulization, airway pressures and flow should be monitored for any indication of increased expiratory resistance due to filter obstruction.

WARNING!

Draeger cannot warrant or endorse the safe performance of third party humidifiers that are not described in this manual for use with the EvitaXL ventilator.

Specifically, the user must assess the risks of delivery of breathing gas not maintained at a proper temperature associated with different humidifier designs. We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Increased pneumatic resistance in the inspiratory line caused by a humidifier may result in less accurate airway pressure readings.

We recommend contacting the manufacturers/ distributors of third party humidifier devices about compliance of their products with the requested performance characteristics.

WARNING!

Do not place containers of liquids (such as humidifier water reservoirs) on top of or above the EvitaXL ventilator. Liquids getting into the ventilator can cause equipment malfunction with the risk of patient injury.

WARNING!

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!
Risk of increased breathing resistance due to condensation.

WARNING!

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!

We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

WARNING!

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

WARNING!

Connecting other devices to the same extension power strip may cause the leakage current to the patient to increase beyond permissible values in the event of grounding failure.
In this case, the risk of electric shock cannot be safely excluded.

WARNING!

Always use medical grade oxygen and air that is dry and free from dust (filtered to $<1\mu\text{m}$) and oil.
Contaminated gas may cause ventilator malfunction.
Required supply pressures are between 3 and 6 bar (43 to 87 psi).

WARNING!

Installation of the Evita nurse call kit should only be performed by DraegerService or factory trained and authorized service personnel.

WARNING!

The operator of the ventilator must still assume full responsibility for ventilation monitoring via the EvitaXL screen when the nurse call is connected.
Only highest priority alarms (!!!) will activate the nurse call.
● Check screen displays frequently.

WARNING!

A fault in any of the components in the link between nurse call and central hospital alarm system (e.g. in the electronics for nurse call in EvitaXL, in the EvitaXL power supply, or in the enunciator of the central hospital alarm system) may result in failure of the nurse call.

WARNING !

Installation of the Evita 4 Link interface card may be performed by factory trained and authorized service personnel only.

CAUTION !

Do not drop control panel - physical damage to the unit is likely.
Do not allow control panel to lean against any objects in an upright position.
When changing panel, lay it on its back..

CAUTION !

To prevent accidental blockage of air intake, protective cover must always be in place for operation.

CAUTION !

Analog Interface

Do not supply any external voltages to the analog interface outputs of the Evita 4 Link interface card.

Important Safety Information

Summary of WARNINGS and CAUTIONS

Precautions regarding electrical supplies

WARNING!

Only use rechargeable batteries !

Explosion hazard!

Single use batteries may explode when being charged with the DC power pack while ventilator is operating on line power.

WARNING!

Only external batteries may be connected to the DC socket of the ventilator and only using the connecting cable specified in the Ordering Information.

WARNING!

Do not connect any AC-powered equipment to the external battery connection socket of the ventilator..

WARNING!

Leave the ventilator connected to AC power only in well ventilated areas. In sufficient concentrations, the hydrogen generated when charging batteries may otherwise lead to an explosion

WARNING!

It is mandatory and responsibility of the user to ensure sufficient battery capacity. See "Battery Maintenance".

CAUTION !

The capacity of batteries must be checked regularly and the batteries replaced if necessary.

Avoid deep discharges, they lead to premature wear.

CAUTION !

Avoid storing the ventilator for extended periods at temperatures over 50 °C.

The internal battery and O₂ sensors may be damaged, or equipment life may be shortened

Precautions during operation

WARNING !

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

WARNING !

In case of a fault in any of the built-in monitoring a substitute has to 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.

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 !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. Make adjustments to the FiO₂ according to the blood gas values measured.

WARNING !

Do not block air intake. Ventilator malfunction will result.

WARNING!

Do not place containers of liquids (such as infusion bottles) on top of or above the EvitaXL ventilator. Liquids getting into the ventilator can cause equipment malfunction with the risk of patient injury.

WARNING !

Always set the alarm limit »PAW \nearrow « in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.

WARNING !

When using AutoFlow, always set alarm limits MV \nearrow and MV \nearrow in order to avoid excessive or insufficient flow following rapid changes in compliance.

WARNING !

Installation of the EvitaXL NIV option should only be performed by DraegerService or factory trained and authorized service personnel.

WARNING !

Precautions when using mask ventilation.

- Never ventilate an intubated patient in »Mask/NIV« mode
- In MASK/NIV« mode, the alarm system is adapted to mask ventilation. Make sure that only patients are ventilated in this mode who can breathe sufficiently on their own, especially when alarms have been manually disabled.
- When masks are used, dead space increases.
- Always follow the mask manufacturer's directions to properly deal with the increased dead space caused by the mask.
- Apnea cannot always be detected reliably. SpO₂ monitoring must be use if available.
- Avoid high airway pressures. Risk of aspiration.
- After changing from »Mask« mode to »Tube« mode, always check and adjust alarm limits and ventilator settings if necessary to ensure that ventilation is monitored comprehensively.

WARNING !

Only switch off alarms if the safety of the patient will not be compromised by the absence of an alarm. The operator of the ventilator system must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

Always check and restore alarm limits and ventilator settings after changing from »Mask« to »Tube« mode in order to ensure comprehensive ventilation monitoring.

WARNING !

For breath rates below 12 bpm, deviations from set oxygen concentration may be significantly higher in extreme cases. These deviations cannot be monitored by the internal O₂ analyzer of the ventilator.

WARNING !

The integrated nebulizer function of EvitaXL is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause considerable deviations in tidal volume and inspiratory O₂ concentration!

WARNING !

Consider effects of aerosols on sensors, filters, and heat and moisture exchangers (HMEs)! The measuring function of the flow sensor may be impaired. The flow resistance of filters is liable to increase and may impair ventilation. Do not put a microbial filter on the nebulizer outlet when in use!

WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier! Risk of increased breathing resistance due to condensation.

Important Safety Information

Summary of WARNINGS and CAUTIONS

WARNING !

The hot wire in the flow sensors is heated well above its normal operating temperature during the cleaning process. Therefore, avoid flammable gases (e.g. ethanol vapors) after disinfection.

Vent flow sensors after disinfection with ethanol for at least 30 minutes.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute has to 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 when sensors and their respective alarm functions are deactivated.

WARNING !

All data transmitted via Evita 4 Link is for supplemental information purposes only. It may not be used as the sole basis of therapeutic decisions.

Precautions during configuration

WARNING !

Always adjust audible alarm volume to a level that ensures the operator will be alerted when alarms occur. Failure to identify and correct alarm situations may result in patient injury

Precautions during care procedures

WARNING !

To avoid risks to hospital staff and patients, disinfect and clean ventilator after use.

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

WARNING !

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

WARNING !

Sterilization of parts in ethylene oxide (EtO) may lead to a patient health risk:

Patients may become exposed to EtO that may have diffused into components.

WARNING !

To avoid any risk of infection for hospital staff or other patients, clean and disinfect ventilator after use.

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

WARNING !

Vent flow sensor after disinfection with ethanol for at least 30 minutes or rinse with sterile water. Otherwise, residual ethanol vapors might ignite and destroy the sensor during calibration.

CAUTION !

The temperature sensor is not designed for disinfection in an automatic parts washer or for bath disinfection.

CAUTION !

When removing a reusable patient circuit, always grasp hoses by their sleeve, never by the hose itself, to avoid possibly tearing the hose at the sleeve or ripping it out of the sleeve.

CAUTION !

Flow sensor is not compatible with parts washer equipment and may not be autoclaved or steam-sterilized. It cannot withstand high temperatures and would be destroyed.

CAUTION !

Do not disassemble expiratory valve beyond removing diaphragm!

CAUTION !

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

CAUTION !

The surface of the EvitaXL screen is made of Plexiglas® (polyacrylate).
Exposure to alcohol or agents containing alcohol will likely cause fissure cracks.

CAUTION !

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

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 !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly.
We recommend that you contact DraegerService for maintenance service for the EvitaXL Ventilator.

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 !

Both breathing and cooling air are drawn in through the filter cover.
Do not block air intake, do not place ventilator immediately against a wall – risk of overheating the ventilator.

WARNING !

When servicing the ventilator, always use replacement parts that are qualified to Draeger standards.
Draeger cannot warrant or endorse the safe performance of third party replacement parts for use with the EvitaXL ventilator.

CAUTION !**Maintenance**

This device must be inspected and serviced at regular intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DraegerService through your vendor.
For repairs we recommend that you contact DraegerService.

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Intended Use

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Intended Use

NOTE: These Operating Instructions apply also to Evita 4 when equipped with the XL option

Intended Medical Applications

EvitaXL

Long-term ventilator for intensive care.

For adults, children, and infants with a body weight of at least 3 kg (6.6 lbs).

May be used for ventilation of premature infants with "NeoFlow" option.

With the following ventilation modes

CMV (Continuous Mandatory Ventilation)

controlled and assisted constant-volume ventilation with intermittent (IPPV) or continuous (CPPV) positive airway pressure.

With the options:

- CPPV (Continuous Positive Pressure Ventilation)
- PLV (Pressure Limited Ventilation)
- AutoFlow®*
for automatic control of "Insp.Flow" and "P_{insp}".
- IRV (Inversed Ratio Ventilation).

SIMV (Synchronized Intermittent Mandatory Ventilation)

Combines mechanical (volume-controlled) ventilation with spontaneous breathing.

With the options:

- PLV (Pressure Limited Ventilation)
- AutoFlow®
for automatic control of "Insp.Flow" and "P_{insp}".

MMV (Mandatory Minute Volume Ventilation)

spontaneous breathing with automatic adjustment of mandatory ventilation to the patient's minute volume requirement.

With the options:

- PLV (Pressure Limited Ventilation)
- AutoFlow®
for automatic control of "Insp.Flow" and "P_{insp}".

SB (Spontaneous Breathing)

Spontaneous breathing at ambient pressure.

CPAP (Continuous Positive Airway Pressure)

Spontaneous breathing with positive airway pressure.

PSV (Pressure Support Ventilation)

Pressure-assisted spontaneous breathing.

PCV+ (Pressure Controlled Ventilation plus) (BIPAP*)

Pressure-controlled ventilation combined with free spontaneous breathing during the whole breathing cycle, and with an adjustable pressure assist starting on CPAP level.

PCV+Assist (Pressure Controlled Ventilation plus, Assisted) (BIPAPAssist)

Pressure controlled, assisted ventilation.

APRV (Airway Pressure Release Ventilation)

Spontaneous breathing on two pressure levels with long time ranges – independently adjustable.

Special modes/ventilation mode extensions

Automatic Tube Compensation ATC (optional)

Can be used with all ventilation modes.

Provides targeted reduction of the work of breathing attributable to an endotracheal or tracheostomy tube.

Apnea Ventilation

For automatically switching over to volume-controlled mandatory ventilation if breathing stops.

If apnea occurs, EvitaXL sounds an alarm after the preset alarm period (T_{Apnea} ✓) and starts volume-controlled ventilation.

NIV mask ventilation (optional)

(Non-Invasive Ventilation)

For ventilation with a nasal or facial mask to support non-invasive ventilation of patients with spontaneous breathing. Choice between mask ventilation and tracheal ventilation of intubated patients.

ILV (Independent Lung Ventilation)

Separate, differentiated, synchronised ventilation with two Evita units, independently ventilating each lung.

* Licensed trade mark

Diagnostic functions**Intrinsic PEEP-measurement**

For determining intrinsic PEEP and measuring trapped volume.

Occlusion pressure measurement

For evaluating a patient's breathing drive during spontaneous breathing.

Negative Inspiratory Force NIF

For measuring the patient's maximum inspiratory effort following expiration.

Other features include:

DC power pack

Internal DC power pack supplying EvitaXL with power from two DC sources:

- via two 12 V lead-acid gel batteries integrated into the internal DC power pack,
- and
- (optionally) via additional external 12 V or 24 V lead-acid gel batteries.

For uninterrupted operation following failure of the AC line power supply, EvitaXL automatically switches to the external or internal battery.

For supplying power from the internal batteries or additionally from external batteries during transfer within the hospital.

Evita 4 Link (optional)

Interface card

For output of measured values, status messages and alarm messages to on-line equipment for monitoring, documentation or processing.

Automatic gas switch-over:

In the event of a gas failure, EvitaXL automatically changes over to the other gas supply available.

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.

Device for use in health care facilities only and exclusively by persons with specific training and experience in its use.

WARNING !

The EvitaXL ventilator must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction.

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 !

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 gases or anesthetics.

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

WARNING !

Do not use mobile phones within 33 feet (10 m) of the ventilator.

Mobile phones can cause interference with electrical and electronic medical equipment with the risk of patient injury*

WARNING !

Do not use in conjunction with magnetic resonance imaging (MRI)!

Equipment malfunction with the risk of patient injury may result.

WARNING !

Using high frequency electrosurgery equipment, defibrillators, or short-wave treatment equipment in the vicinity of the ventilator may interfere with its operation and pose a risk of patient injury.

WARNING !

Do not use the EvitaXL ventilator in hyperbaric chambers. Equipment malfunction may result, with the risk of patient injury.

WARNING !

Never use flammable medications (e.g. on the basis of ethanol) or other substances based on flammable solvents in the patient circuit. Fire hazard!

Always provide adequate ventilation when using flammable substances for disinfection.

Ventilation Monitoring

The built-in monitoring features of the EvitaXL ventilator ensure appropriate monitoring of ventilation therapy and therefore detect any undesirable changes in the following ventilation parameters:

- airway pressure, PAW
- expiratory minute volume, MV
- inspiratory tidal volume, VTi
- inspiratory O₂ concentration, FiO₂
- inspiratory breathing gas temperature, T
- apnea time
- breath rate
- expiratory CO₂ concentration, etCO₂ (optional)

Changes in these parameters may be caused by:

- acute changes in the patient's condition
- incorrect settings and user error
- equipment fault conditions
- failure of power and gas supplies

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 system must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

Back-up ventilation with an independent manual ventilation device

If a fault is detected in the EvitaXL ventilator, so that its life-support functions are no longer assured:

- start ventilation using an independent ventilation device (resuscitation bag) without delay, if necessary with PEEP and / or increased inspiratory O₂ concentration.

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Operating Concept

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Operating Concept

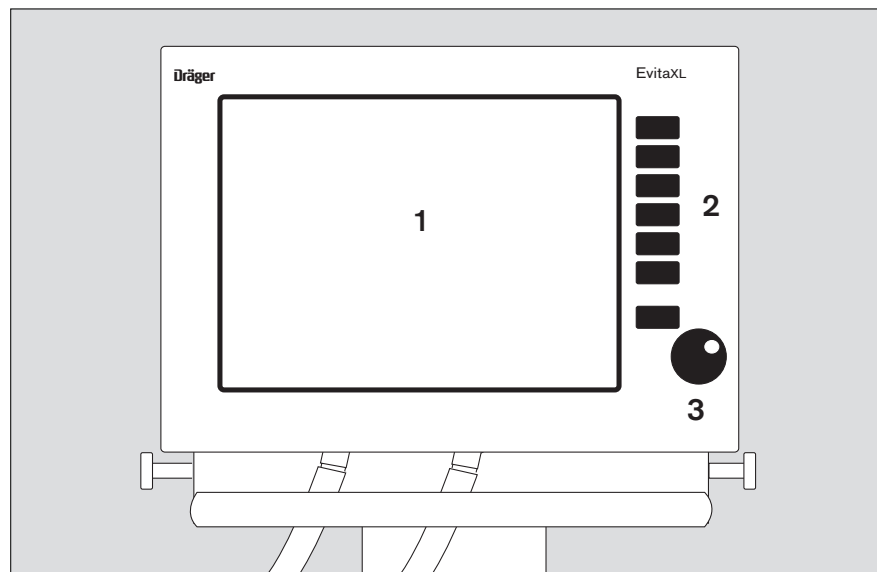
Control Panel



The control unit is characterized by its small number of operating elements, its clear layout and easy operation.

Its main elements are:

- 1 A large screen with all the information and controls needed for ventilation.
- 2 Fixed function keys ("hard" keys) beside the screen – for rapid access to major functions.
- 3 Central rotary dial knob for selecting and confirming settings on-screen.

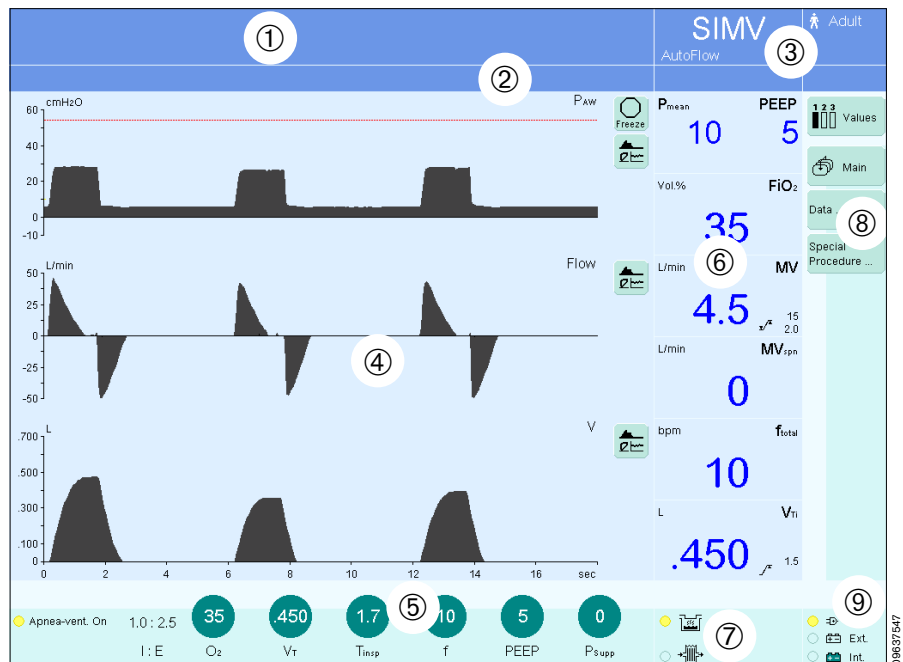


The Screen...

displays all the most important ventilation data at a glance.

The various screen pages use the same layout, with specific data being presented always in the same place.

- 1 Alarm messages
- 2 Operator prompts
- 3 Therapy status with ventilation mode, e.g. SIMV, ventilation mode supplements, e.g. AutoFlow®, patient mode, e.g. "Adult" for adults.
- 4 Waveforms, loops, and trends visualizing ventilation, e.g. the real-time waveforms of PAW(t), Flow(t), VT(t) (parameters displayed can be configured).
- 5 Presentation of set ventilation parameters for the active ventilation mode and its extensions.
- 6 Essential, measured values of ventilation (can be configured).
- 7 Humidification type and status.
- 8 Touch-sensitive screen keys for the specific screen pages (can be configured).
- 9 Power supply indicator.



To select a screen page:

- Touch the respective screen key:
 - » **Main**« to select the main screen.
 - » **Values**« to select a different group of measured values in the field for numerical values.
 - »**Data...**« to display all measured values, the logbook or trends on an additional screen ("card").
 - »**Special Procedure...**« to select additional functions, e.g. nebulization of pharmaceutical aerosols and oxygenation for bronchial suction.

Other on-screen function keys can be configured individually, see "Configuration", page 134.

Operating Concept

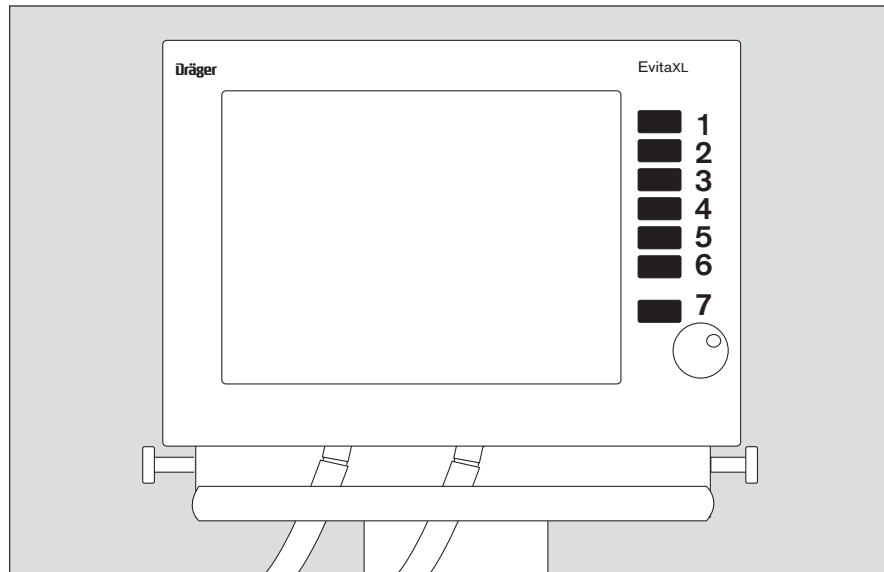
Fixed Function Keys...

On-screen Controls

Fixed Function Keys...

provide immediate access to major on-screen functions, such as selection of the ventilation mode, setting of ventilation parameters, or adjusting of alarm limits:

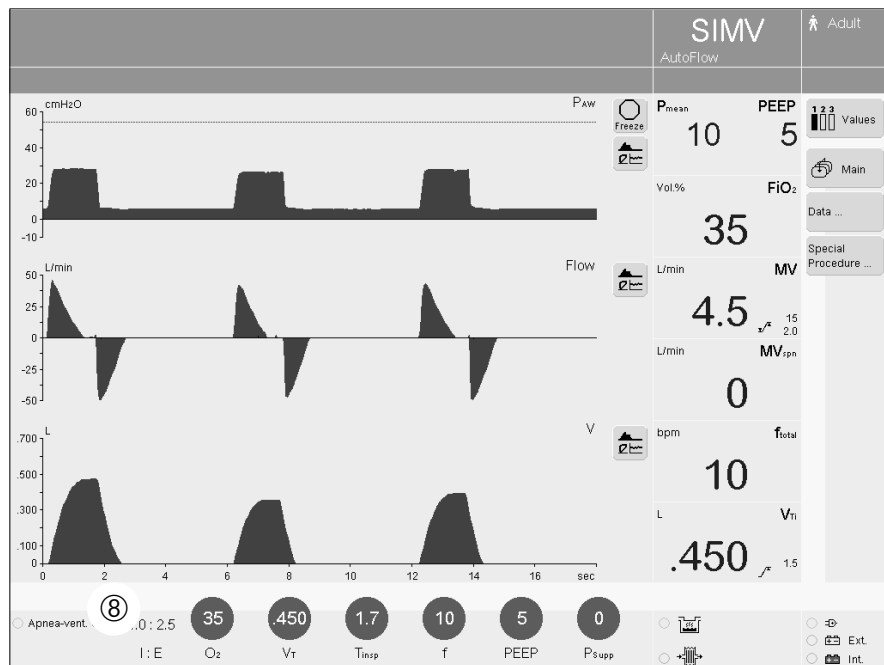
- 1 » **Alarm Silence**« for silencing the audible alarm for two minutes.
- 2 » **Alarm Limits**« for adjusting alarm limits.
- 3 » **Ventilator Settings**« for setting ventilation mode and ventilation parameters.
- 4 Unassigned key for future functions.
- 5 » **Sensor Parameter**« for calibrating sensors and for activating/deactivating monitoring functions.
- 6 » **System Setup**« for configuring system functions.
- 7 » **Start/Standby**« for selecting standby mode or normal operation.



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On-Screen Controls

- 8 In a separate field at the bottom of the main screen, EvitaXL displays the ventilation parameters required for the active ventilation mode in the form of virtual screen knobs for the respective settings.



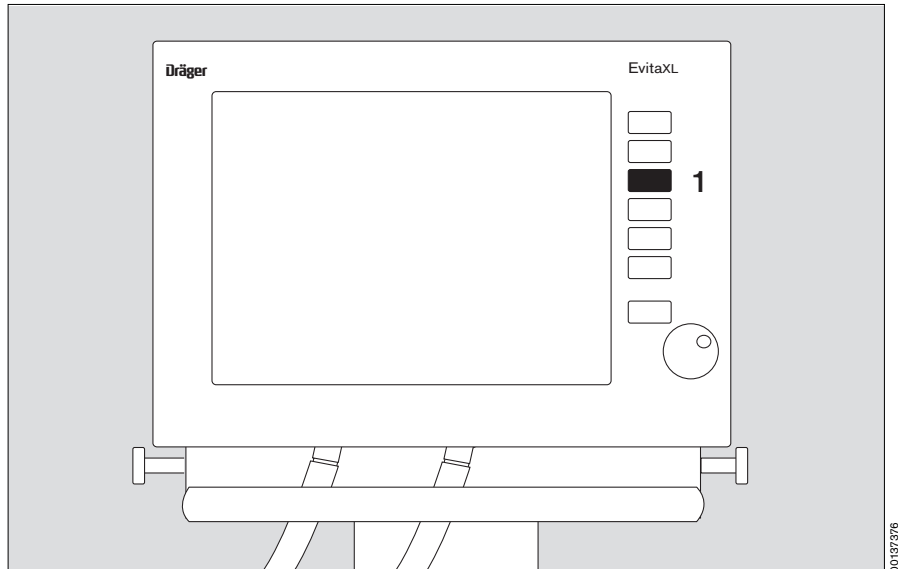
09637547

To set the ventilation mode and ventilation parameters:

1 Press » Ventilator Settings«

or

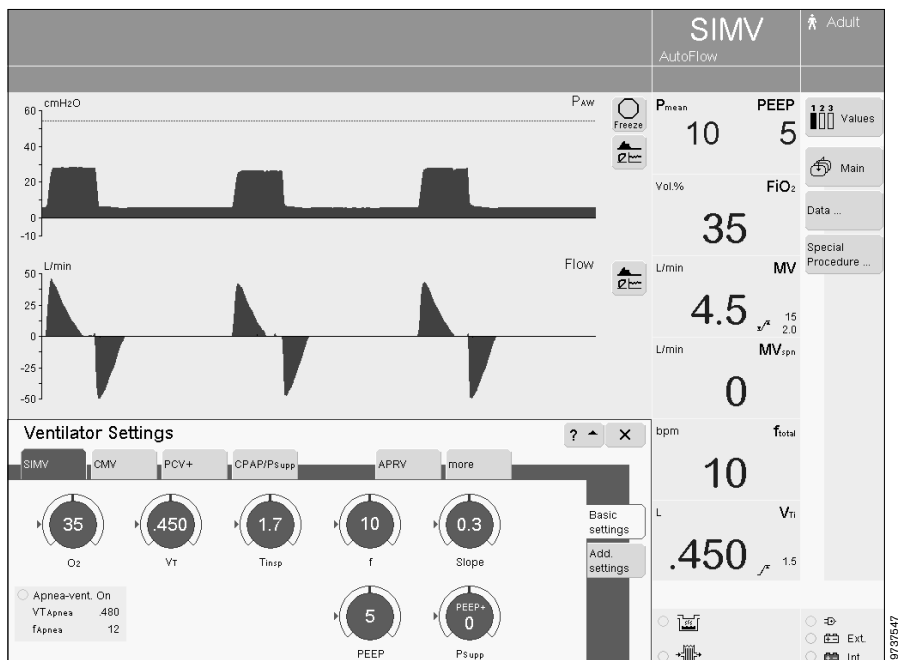
- touch one of the virtual screen knobs at the bottom of the screen.



EvitaXL displays the menu »Ventilator Settings« in the bottom part of the screen (example):

Screen knobs and screen keys are displayed in the form of horizontal and vertical tabs as on a file catalog card.

- Horizontal screen keys for selecting the ventilation mode.
- Vertical screen keys for selecting supplemental settings.



Operating Concept

On-Screen Controls

The touch-sensitive screen controls are used in the same way as real keys and knobs:

Touching these controls with a fingertip is equivalent to pressing a key or taking hold of a knob.

Settings are made and confirmed by turning and pressing the central rotary dial knob.

The status of the screen controls is indicated by their color:

grey = not available

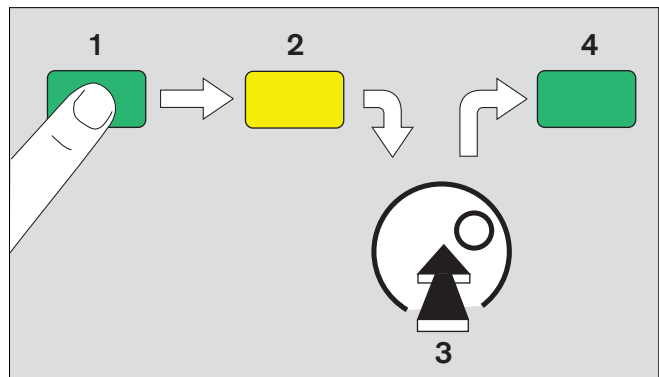
yellow = ready for use

pale green = may be adjusted, but is not active

dark green = may be adjusted and is active

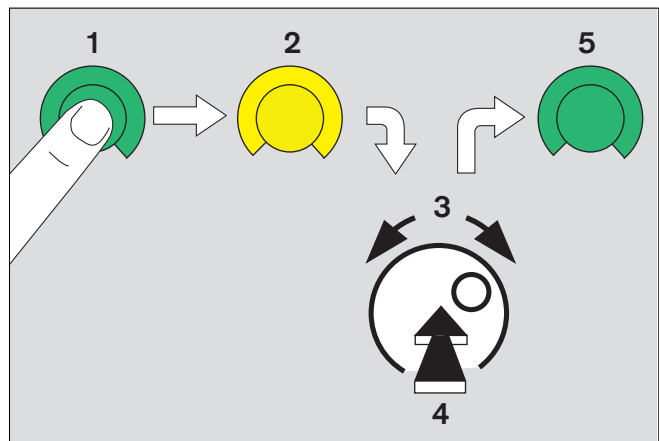
Screen keys:

- 1 Touch a screen key to select it.
- 2 The screen key turns yellow.
- 3 Press dial knob to confirm.
- 4 The screen key turns pale/dark green, respectively.



Screen knobs:

- 1 Touch a screen knob to select it.
- 2 The screen knob turns yellow,
- 3 Turn dial knob to set.
- 4 Press dial knob to confirm,
- 5 The screen knob turns pale/dark green, respectively.



To set ventilation parameters directly:

From the main screen (example):

- Touch the desired screen knob in the row of displayed screen knobs and settings.
- EvitaXL displays the »Ventilator Settings« menu. The selected screen knob is already yellow and may therefore be adjusted immediately.

Display (example):

- Turn dial knob to adjust setting, press dial knob to confirm.

The color of the screen knob changes to dark green – the setting is now in effect.

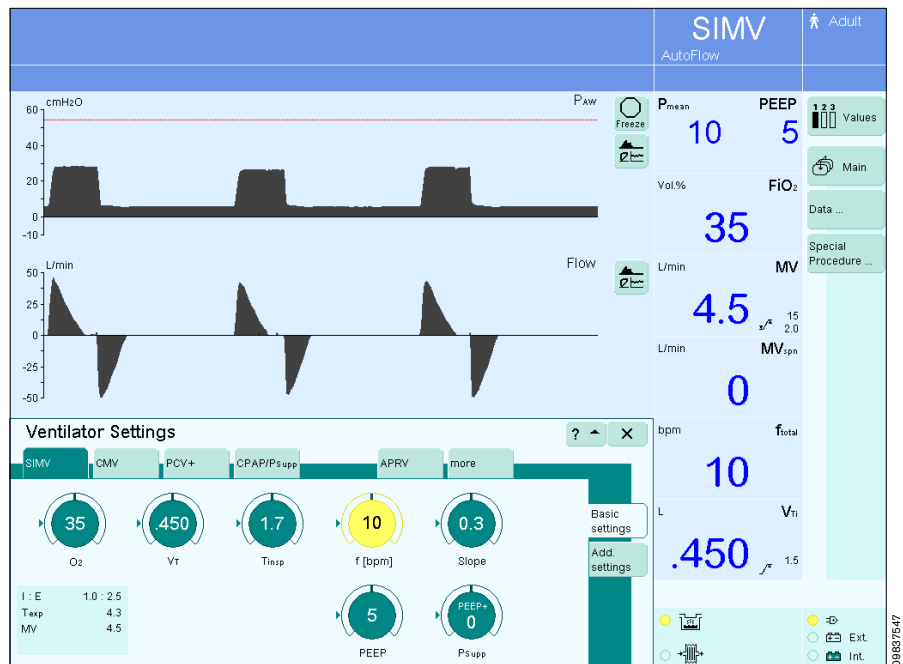
To call up additional information texts:

- Touch »? ▲« screen key.

To quit the menu:

- Press »X« screen key.

Arrows (►) on the dials of screen knobs indicate the initial values in effect when the ventilator is switched on. These defaults can be adjusted to specific hospital requirements, see "Configuration", page 139.



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Preparation

Positioning The Control Panel	34
Assembly of Components	35
Precautions When Using Heat/Moisture Exchangers	37
Potential Hazards from Use of Expiratory Bacteria Filters	38
Installing a Heated Humidifier	39
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Providing Electrical Supplies and Connections	43
Gas Supply	44
Nurse Call (Available Option)	45
Checks of Readiness for Operation	46
Leak Test	50
Entering the Humidifier Type	51
Application Mode Selection Tube / Mask (Optional)	51

Preparation

Positioning The Control Panel

CAUTION !

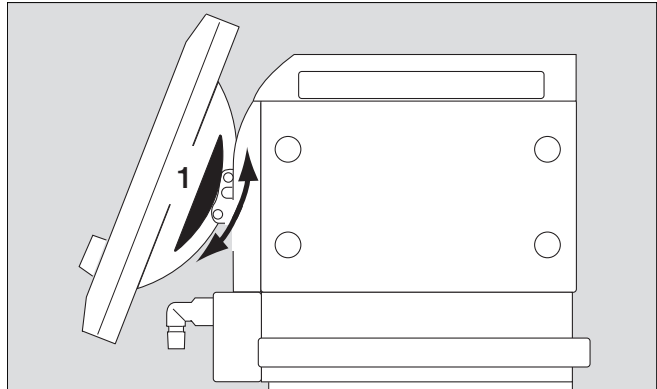
Do not drop control panel - physical damage to the unit is likely.
Do not allow control panel to lean against any objects in an upright position.
When changing panel, lay it on its back..

Mounting the control panel to the ventilator

- Hang control panel into its mounts on the EvitaXL main unit, until it clicks into position.

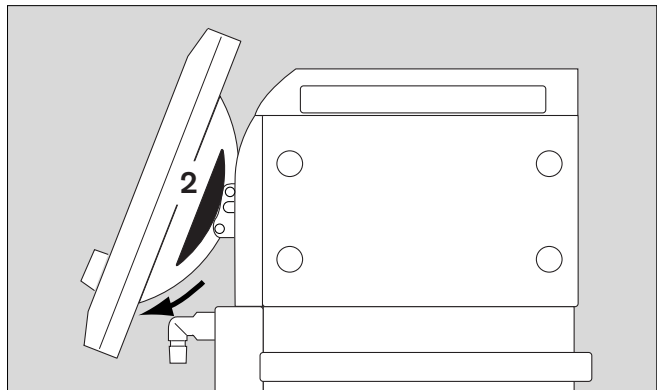
Tilting the Control Panel

- 1 Press segments on the right and left and, at the same time, tilt control panel to the desired position.



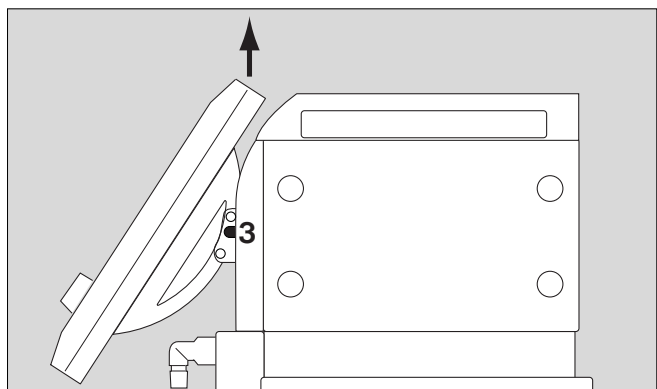
Mounting the Control Panel to a Wall Rail

- 2 Press segments on the right and left, and tilt control panel fully downwards.



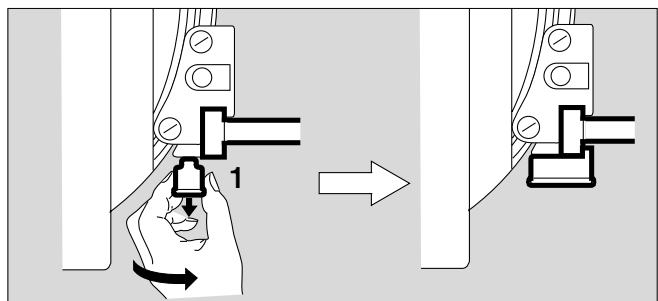
- 3 Hold down release buttons on the left and right, and remove control panel from its mounts on the EvitaXL main unit.

- Uncoil the cable as far as necessary.
- Mount the control panel to the wall rail and



- 1 Lock in place by pulling down the latch (located beneath the bracket) and turning it in the direction of the wall rail.

NOTE: The control panel rail clamps are designed for use with 25 x10 mm wall rails.



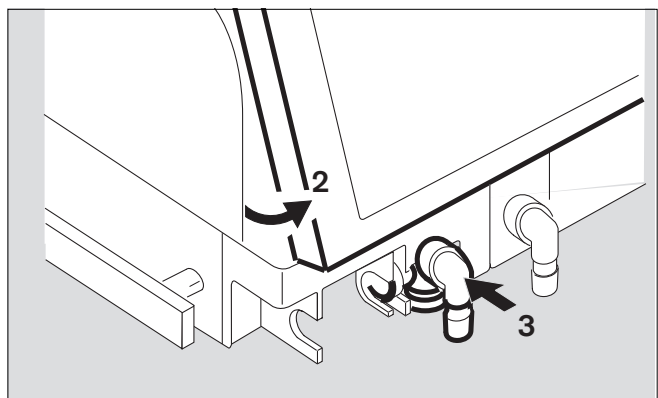
Assembly of Components

WARNING!

Always install components that have been cleaned and disinfected according to approved hospital procedures.

Installing the expiratory valve

- 2 Tilt control panel upwards, pressing the segments on the right and left at the same time.
- 3 Push patient block fully into mounting receptacle. Check that it is properly engaged by gently pulling on the port. It should stay securely attached.

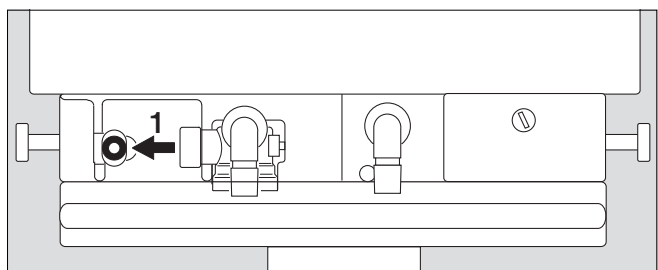


Preparation

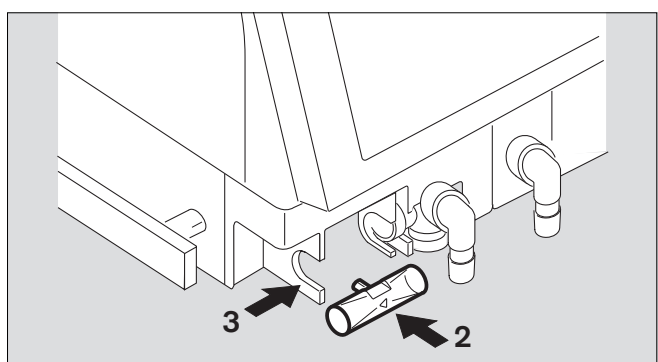
Assembly of Components

Mounting a flow sensor

- 1 Push connector socket all the way to the left.

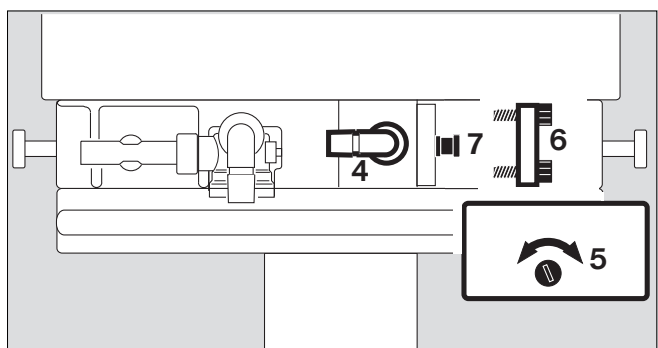


- 2 Gently push flow sensor into its mount – with the connector facing towards the ventilator – and into the socket, as far as it will go.
Then:
- 3 Push flow sensor to the right and into the rubber lip seal of the expiratory valve, as far as it will go.



Installing an O2 sensor capsule

- when using the system for the first time
 - when the display reads:
O2 measurement inop
 - when calibration can no longer be performed.
- Ensure ventilator is placed in standby or is switched off completely.
 - Tilt control panel upwards.
- 4 Turn port downwards or to the left.
 - 5 Use coin to loosen screw and remove protective cover.
 - 6 Loosen the two knurled screws and remove lid from the sensor chamber.
 - 7 Insert new sensor capsule.
- NOTE:** The sensor end with the circular contacts must be visible.
- 6 Close the sensor chamber securely with the two knurled screws.
 - 5 Screw protective cover back in place.



CAUTION !

To prevent accidental blockage of air intake, protective cover must always be in place for operation.

- Dispose of the used O₂ sensor capsule, see page 161.

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.

Precautions When Using Heat/Moisture Exchangers

The use of a heat/moisture exchanger (HME) in the patient circuit can increase breathing resistance considerably.

An increase in breathing resistance will lead to increased work of spontaneous breathing and will require a greater trigger effort during assisted ventilation. Under unfavorable conditions, an increase in breathing resistance can also lead to intrinsic PEEP.

The operator must be aware that this breathing resistance in the patient circuit cannot be monitored by the ventilator.

- Therefore, you should regularly check the condition of the patient as well as the ventilator's measured values for volume and resistance.

WARNING!

Draeger cannot warrant or endorse the safe performance of heat/moisture exchangers.

The user must verify that the heat/moisture exchanger is covered by a technical safety certificate which guarantees complete suitability for the intended use.

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

- Follow Instructions for Use of the heat/moisture exchanger (HME)!

When using a heat and moisture exchanger:

- Set ventilator to HME, see page 51.

Potential Hazards from Use of Expiratory Bacteria Filters

The use of an expiratory bacteria filter is not mandatory. Use of bacteria filters in the expiratory side of the patient circuit can cause an undesirable increase in breathing resistance.

Particularly when nebulizing aerosols or humidifying the breathing gas, resistance caused by a bacteria filter may slowly increase, leading to increased work of breathing and to intrinsic PEEP.

WARNING!

The flow resistance of bacteria filters placed in the expiratory side may be substantially increased by nebulized aerosols with the risk of impaired ventilation. If an expiratory filter is used during nebulization, airway pressures and flow should be monitored for any indication of increased expiratory resistance due to filter obstruction.

Intrinsic PEEP may be recognized by the fact that expiratory flow has not returned to "0" at the end of expiration.

In case of unacceptably high PEEP, the ventilator will issue the alarm message:

PEEP high !!!

- Check bacteria filter and exchange, if it proves to be the cause of high PEEP.

Installing a Heated Humidifier

WARNING!

Draeger cannot warrant or endorse the safe performance of third party humidifiers that are not described in this manual for use with the EvitaXL ventilator.

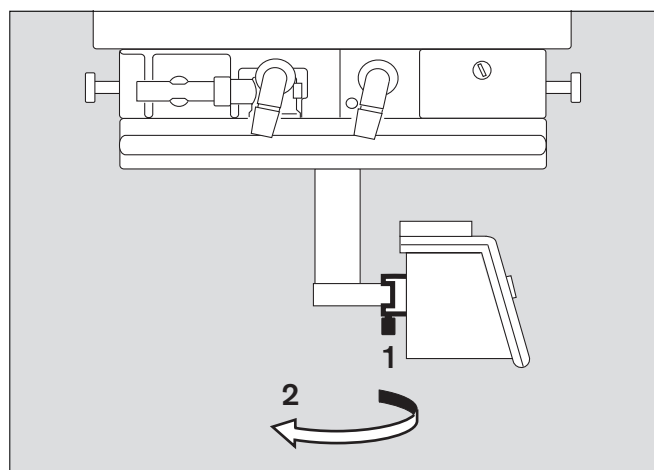
Specifically, the user must assess the risks of delivery of breathing gas not maintained at a proper temperature associated with different humidifier designs. We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Increased pneumatic resistance in the inspiratory line caused by a humidifier may result in less accurate airway pressure readings.

We recommend contacting the manufacturers/distributors of third party humidifier devices about compliance of their products with the requested performance characteristics.

- 1 Attach humidifier to mount below ventilator with rail clamp and secure clamp mechanism (screws, lever).
- 2 Swivel humidifier into desired position.
- Prepare humidifier following its Operating Instructions.

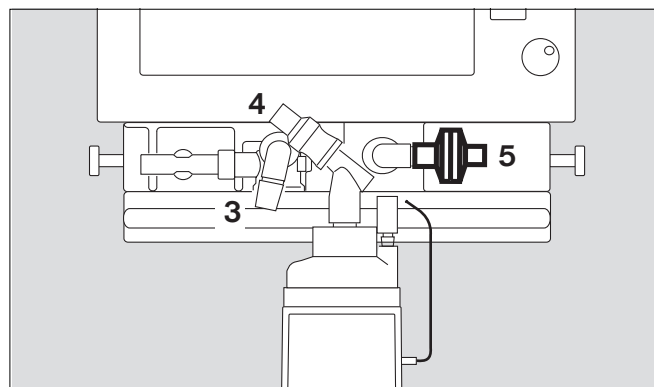
Depending on the position of the ventilator in relation to the patient bed, the hinged circuit support arm can be mounted to either side of the ventilator.



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- 3 Turn expiratory port to the left or right, respectively (left showing).
- 4 Attach angled circuit connector of humidifier pointing into the direction desired (left showing).
- 5 Turn inspiratory port to the right and install a bacteria filter to the port.

NOTE: For the following descriptions it is assumed that the patient circuit has been attached on the left-hand side



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WARNING!

Do not place containers of liquids (such as humidifier water reservoirs) on top of or above the EvitaXL ventilator. Liquids getting into the ventilator can cause equipment malfunction with the risk of patient injury.

Ventilating Adults and Children

- Set the ventilator to breathing gas humidifier, see page 51.

Upward from 100 mL tidal volume VT

Patient mode: »Adults«

WARNING!

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

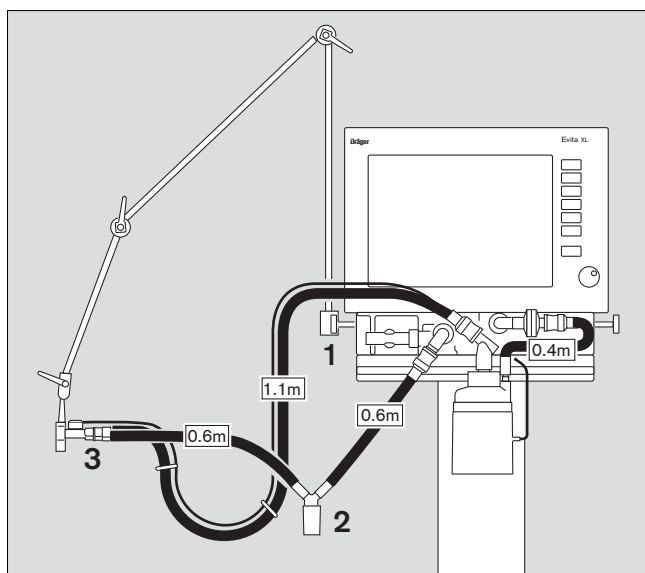
Risk of increased breathing resistance due to condensation.

Connecting the patient circuit

WARNING!

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.

- 1 Attach circuit support arm to the rail on the left-hand side of the ventilator and tighten screws.
- Connect ventilator circuit segments of appropriate lengths (lengths suggested are in meters)
- 2 Install water trap(s) in vertical position.
- 3 Connect Y-piece, with the rubber sleeve of the Y-piece on the inspiratory side (reusable silicone circuit).

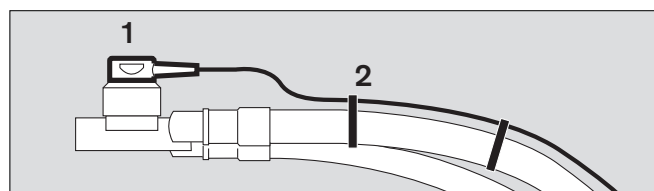


Installing a temperature sensor

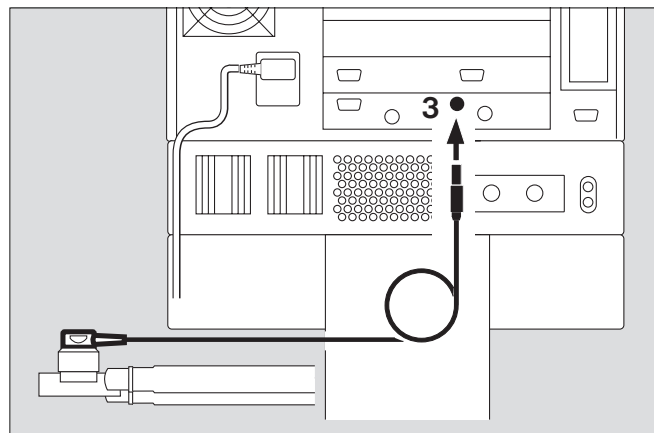
WARNING!

We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

- 1 Push sensor as far as it will go into the rubber sleeve on the inspiratory side of the Y-piece. Align Y-piece so that the sensor is at the top.
- 2 Attach sensor cable with hose clips.

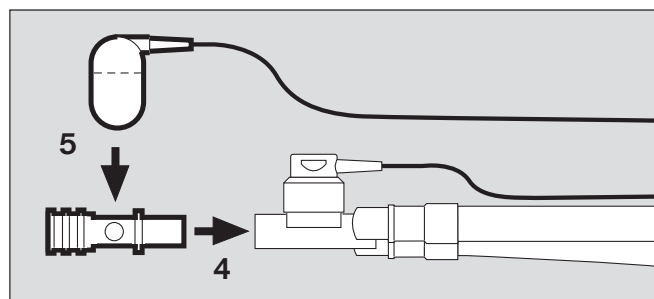


- 3 Insert plug of the temperature sensor into the socket at the rear of the unit.



Installing a CO2 cuvette and CO2 sensor (available option) (CapnoPlus)

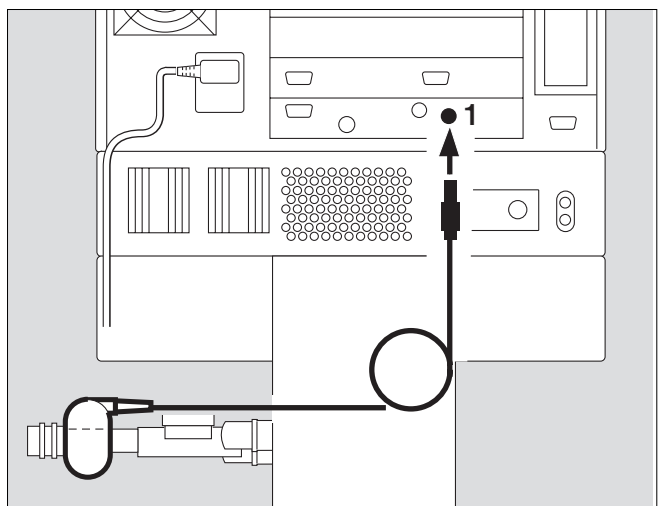
- 4 Fit the cuvette to the patient connection of the Y-piece, with the cuvette windows facing the side.
- 5 Push the CO2 sensor on to the cuvette, with the cable trailing towards the ventilator.



Preparation

Ventilating Infants and Small Children

- 1 Insert the plug of the CO₂ sensor in the CO₂ socket on the rear panel of the EvitaXL.



Ventilating Infants and Small Children

Up to 300 mL tidal volume VT

Patient mode »Pediatrics«

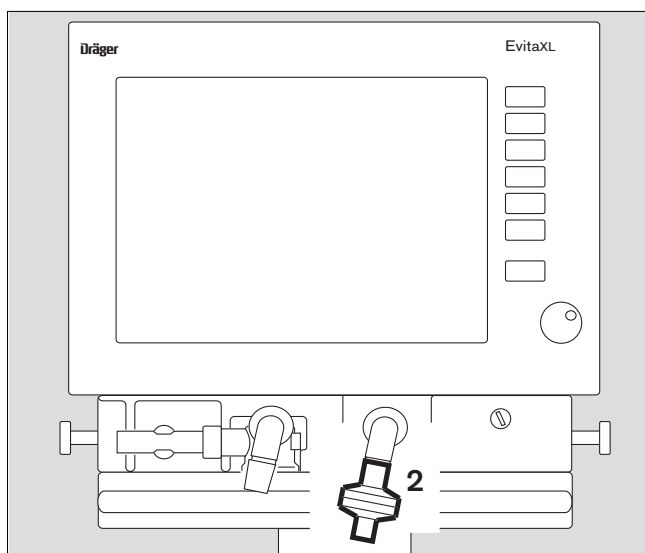
WARNING!

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

Installing an inspiratory bacteria filter

- 2 Place bacteria filter on inspiratory port.

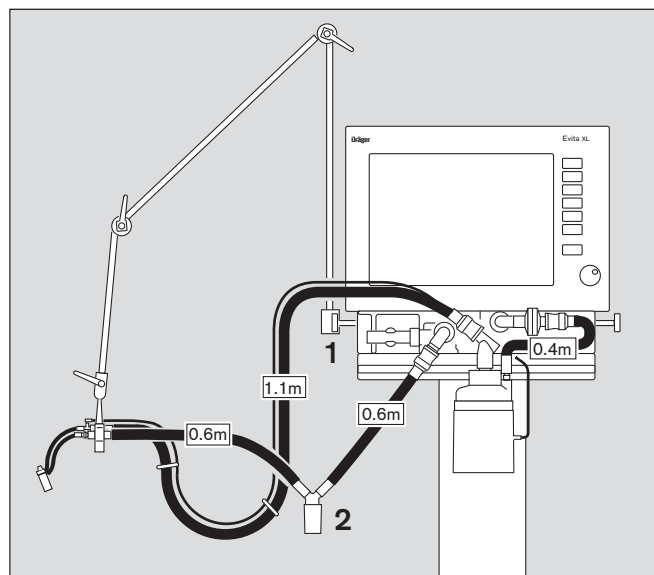


Installing an infant patient circuit

WARNING!

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.

- Prepare the humidifier following its Operating Instructions, using infant size patient circuit connectors
- 1 Clamp hinged circuit support arm to rail on the left-hand side and tighten screws.
- Connect ventilator circuit segments of appropriate lengths (lengths suggested are in meters)
- 2 Install water trap(s) in vertical position.



Providing Electrical Supplies and Connections

AC line power supply

The ventilator is designed for a line voltage of:

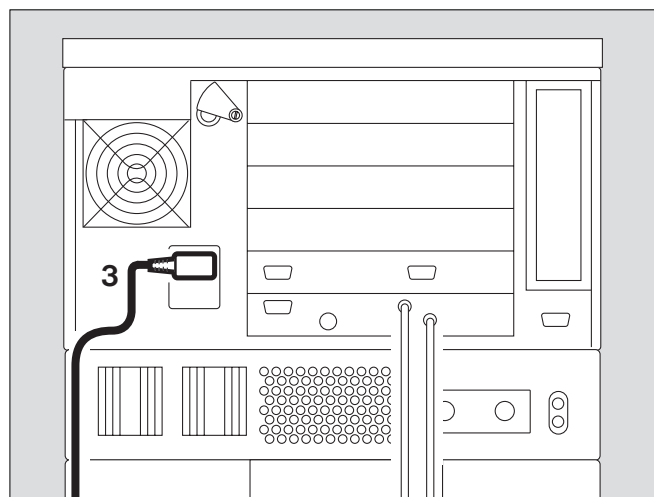
either : 220 V to 240 V

or : 100 V to 127 V

- Insert plug into the power outlet, the yellow "LED" will light up in the power source display on-screen.

WARNING!

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



For operation with DC power unit and external battery (available option)

either : 12 V

or : 24 V

- 3 Connect the external battery with cable, see "Connecting an External Battery (Optional)" on page 57.

Preparation

Gas Supply

Precautions When Using a Power Strip for Auxiliary Equipment.

WARNING!

Connecting other devices to the same extension power strip may cause the leakage current to the patient to increase beyond permissible values in the event of grounding failure.

In this case, the risk of electric shock cannot be safely excluded.

Temporary Interruption of Power Supply

e.g. when hospital backup power supply is activated.

With a discharged 12/24 V DC power supply:

During a power-out EvitaXL will trigger a continuous audible alarm of 2 minutes maximum. If EvitaXL has been operating for less than 15 minutes, this time might be shorter.

Operation continues without interruption, even if the power is interrupted for longer than 10 milliseconds.

The capacity of the internal batteries of the DC power supply can bridge a power failure of at least 10 minutes, provided the charging time since the last use of the internal batteries was sufficient.

Gas Supply

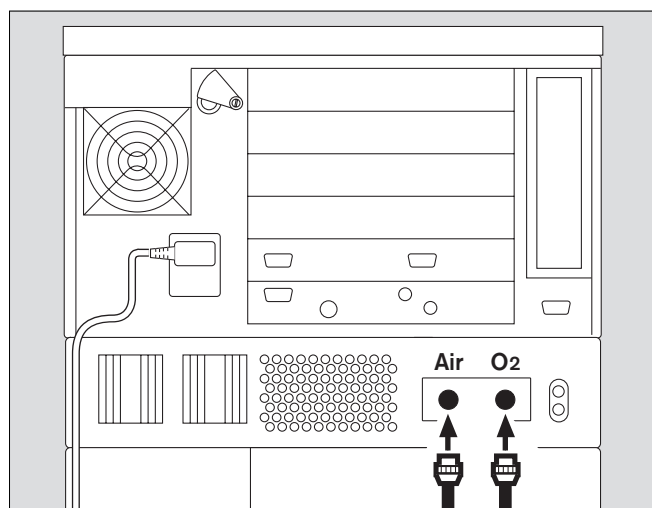
- Screw high pressure air and oxygen hoses to sockets on the back panel of EvitaXL and insert their probes into wall terminals.

WARNING!

Always use medical grade oxygen and air that is dry and free from dust (filtered to $<1\mu\text{m}$) and oil.

Contaminated gas may cause ventilator malfunction.

Required supply pressures are between 3 and 6 bar (43 to 87 psi).



Nurse Call (Available Option)


Connection on the rear panel of EvitaXL intended for the transmission of alarm signals to a central hospital alarm system.

WARNING!

Installation of the Evita nurse call kit should only be performed by DraegerService or factory trained and authorized service personnel.

- Have a qualified electrician perform the installation of the round 6-way DIN female connector to the line of the central alarm system.

EvitaXL activates the nurse call by closing contacts 3-5 whenever a WARNING level alarm (3 exclamation marks !!!) is displayed.

- 1 Connect plug to the receptacle marked »  « and secure with screws.

WARNING!

The operator of the ventilator must still assume full responsibility for ventilation monitoring via the EvitaXL screen when the nurse call is connected.

Only highest priority alarms (!!!) will activate the nurse call.

- Check screen displays frequently.

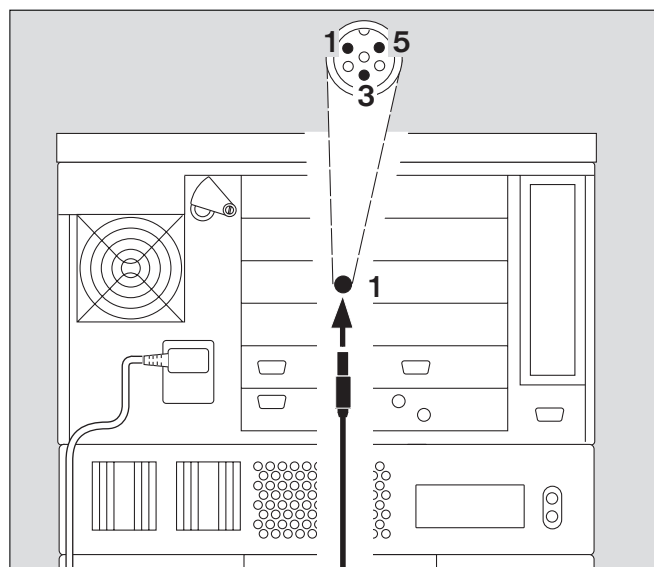
Alarm messages that are transmitted via nurse call are those indicated in red and with three exclamation marks in the top field of the EvitaXL screen. Caution and Advisory level messages are not transmitted. The nurse call is activated also when the original enunciator in the ventilator is faulty or when power is interrupted while the ventilator is in use.

- Check correct operation of connected nurse call system.

WARNING!

A fault in any of the components in the link between nurse call and central hospital alarm system (e.g. in the electronics for nurse call in EvitaXL, in the EvitaXL power supply, or in the enunciator of the central hospital alarm system) may result in failure of the nurse call.

The hospital connections to the central alarm typically use only one channel. The ventilator electronics for the nurse call consequently also use only one channel.



Preparation

Checks of Readiness for Operation

Checks of Readiness for Operation

To be performed before using on a patient, to confirm that the ventilator is working properly and is ready for operation.

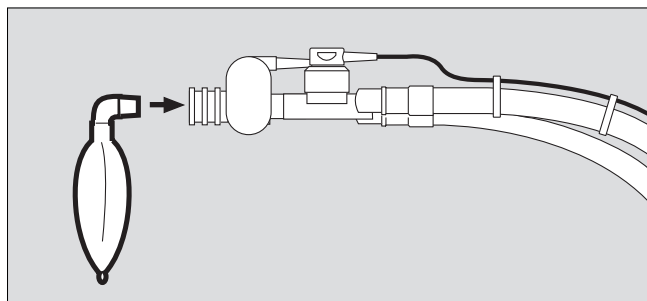
Preparing the adult test lung 84 03 201

for the adult patient circuit

The test lung assembly consists of an elbow connector for connection to the Y-piece, a 7 mm diameter ET-tube connector for simulating airway resistance and a 2 liter breathing bag to simulate compliance.

NOTE: Do not use permanently stretched breathing bags, these might cause artifacts during the check procedures.

- Insert the elbow connector into the Y-piece only when EvitaXL advises you to do so.

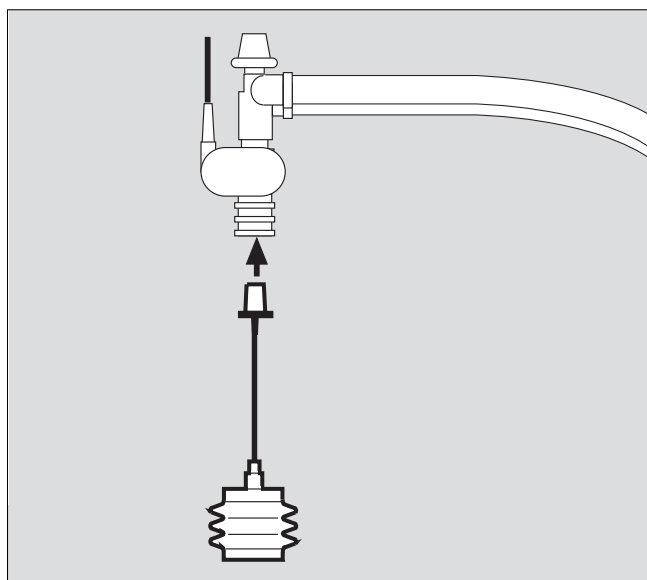


Preparing the infant test lung 84 09 742

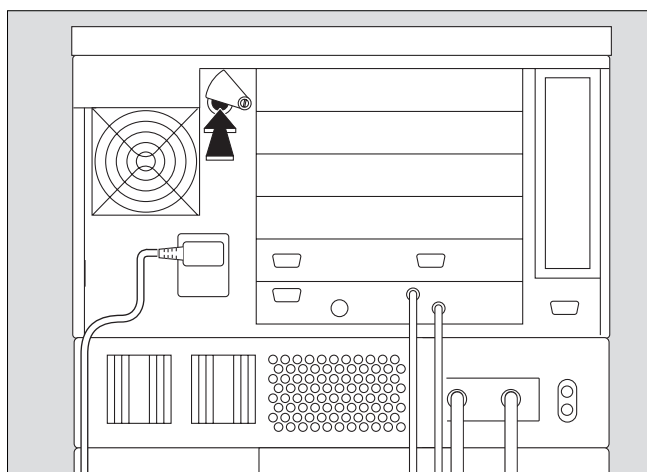
for use with the infant patient circuit

The test lung consists of a tracheal tube CH 12 to simulate airway resistance and a small bellow to simulate compliance.

- Insert the connector into the Y-piece only when EvitaXL advises you to do so.



Switch ventilator on by pressing power switch on the back panel until it clicks into position.



The self-test screen with version no., date, and part no. of the software used is then displayed on EvitaXL.

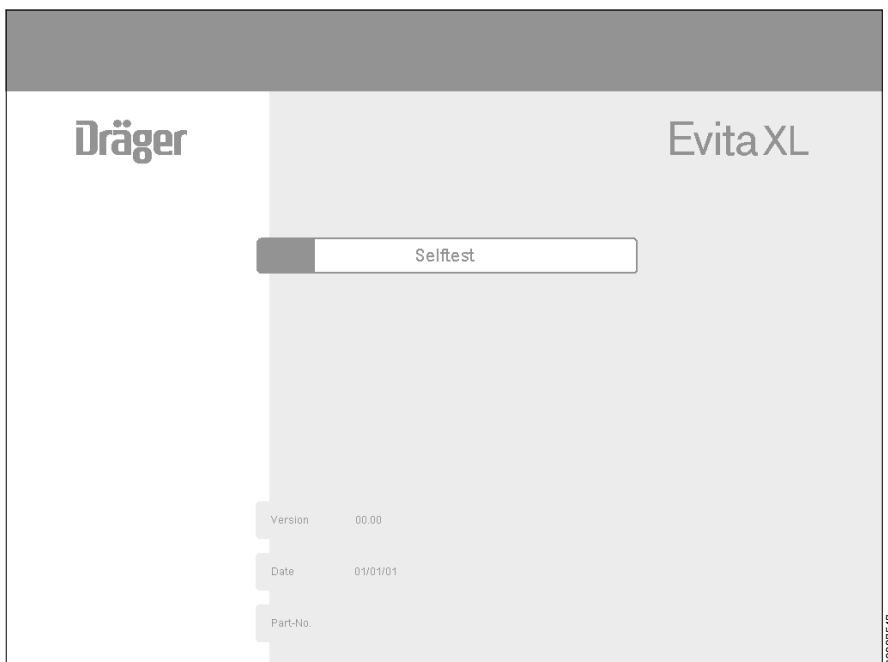
The self-test is performed automatically.

- Wait for this test phase to be completed.

The bargraph indicates the time elapsed for the self-test.

Afterwards, EvitaXL will display an opening screen.

- EvitaXL will start ventilation with the pre-configured settings unless values are changed or standby mode is activated within 30 seconds.



On the opening screen (example):

- Touch »Standby« screen key within 30 seconds and press dial knob to confirm.

Standby activated !!!

appears in the line for alarm messages.

To reset this message:

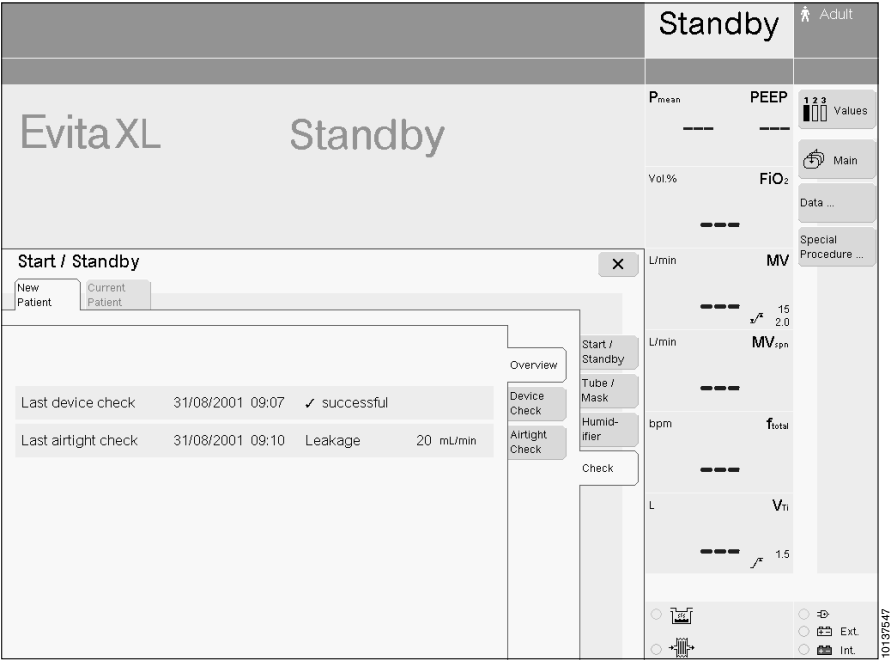
- Touch »Alarm Reset« screen key to the right of the message and press dial knob to confirm.



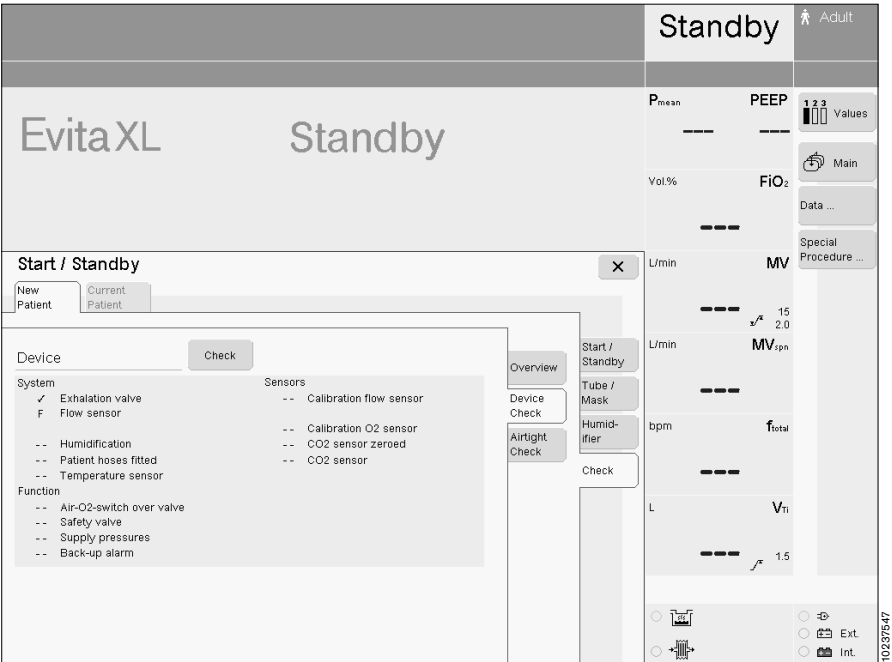
Preparation

Checks of Readiness for Operation

- Touch »Check« screen key.



- Touch »Device Check« screen key: EvitaXL displays the date of the last device check performed and a list of the individual checks. The scope of this list depends on the options available on the ventilator.



EvitaXL guides the user through each test procedure in a dialog format. Questions are displayed in the information line below the "Alarms" field and must be answered by touching the screen keys »Yes« and »No«. Alternatively, instructions for performing tests may also be displayed.

The ventilator indicates a correct result with a checkmark (✓). Faulty results are marked F.

Two dashes (– –) appear if a test is not performed.

In the event of deficient results (F):

- Eliminate the cause of the problem and
- touch the »Repeat« screen key.

NOTE: Checks may also be skipped by touching the »next test« screen key if this is in accordance with accepted hospital procedures.

To start the test procedure:

- Touch »Check« screen key displayed in the checklist.

The ventilator performs each test, line by line.

NOTE: Results obtained during these tests of readiness for operation as well as the calibration values for the sensors are saved until the next calibration run - even when the ventilator was switched off in the meantime.

After the test procedure:

- Perform a leak test, see page 50.

Preparation

Leak Test

Leak Test

Perform this test:

- after the tests of readiness for operation,
- after changing the patient circuit,
- after changing the humidifier.

In the checklist:

- Touch »Airtight Check« screen key.

The result of the last leak test is displayed together with the following values:

- Leakage
- Compliance
- Insp. resistance
- Exp. resistance

To start the leak test:

- Touch »Check« screen key.

The actual leakage flow is displayed continuously throughout the test. A leakage flow of 300 mL/min at a pressure of 60 cmH₂O is acceptable.

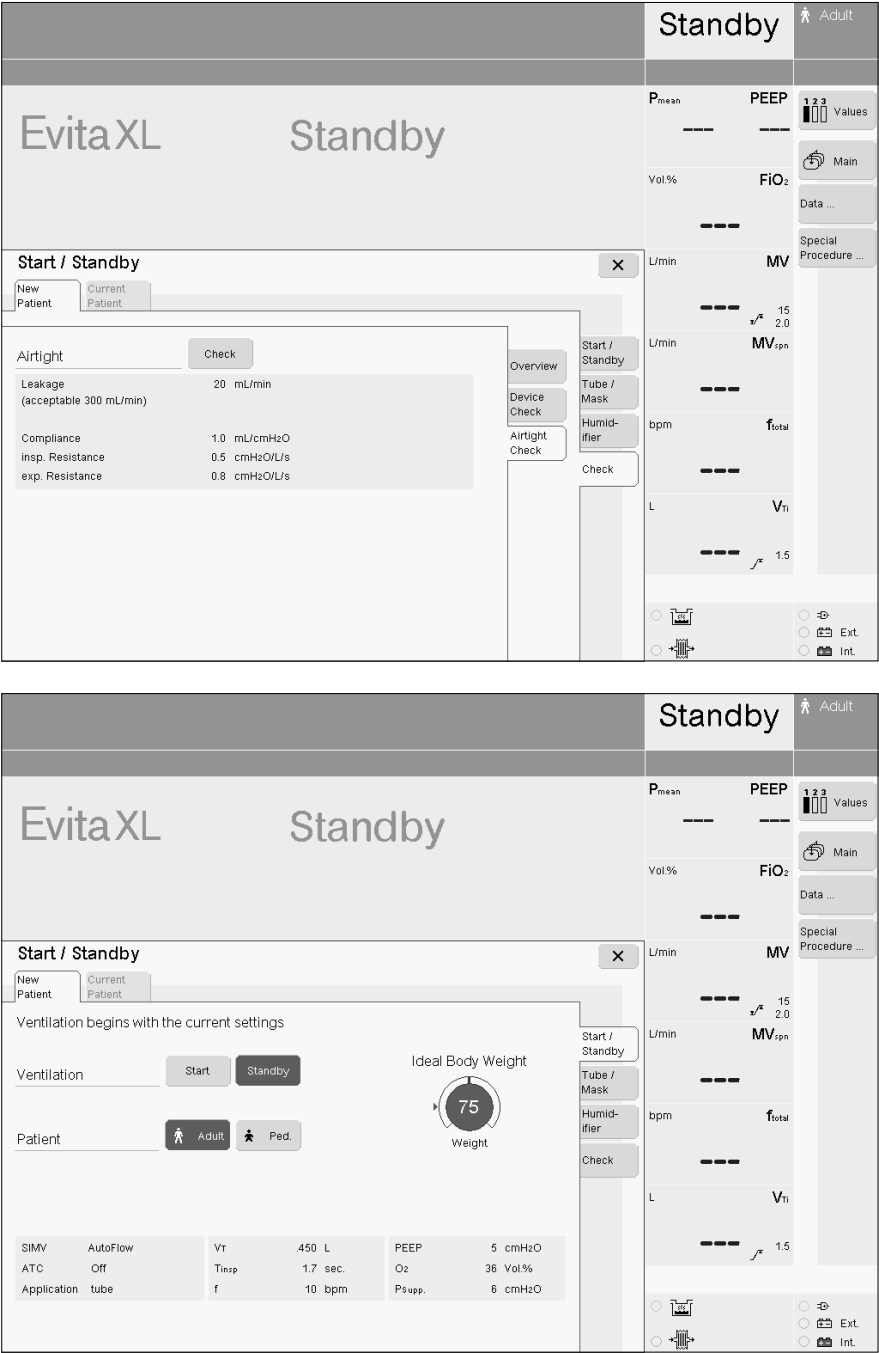
After the leak test, the ventilator determines the compliance and the inspiratory and expiratory resistance of the patient circuit.

EvitaXL uses the calculated patient circuit compliance to automatically correct both volume controlled ventilator breaths, as well as values measured as part of flow monitoring, see page 207.

NOTE: When changing the patient mode or type of humidifier, the ventilator automatically resets the values for circuit compliance and resistance to the default values.





To return to the start screen:

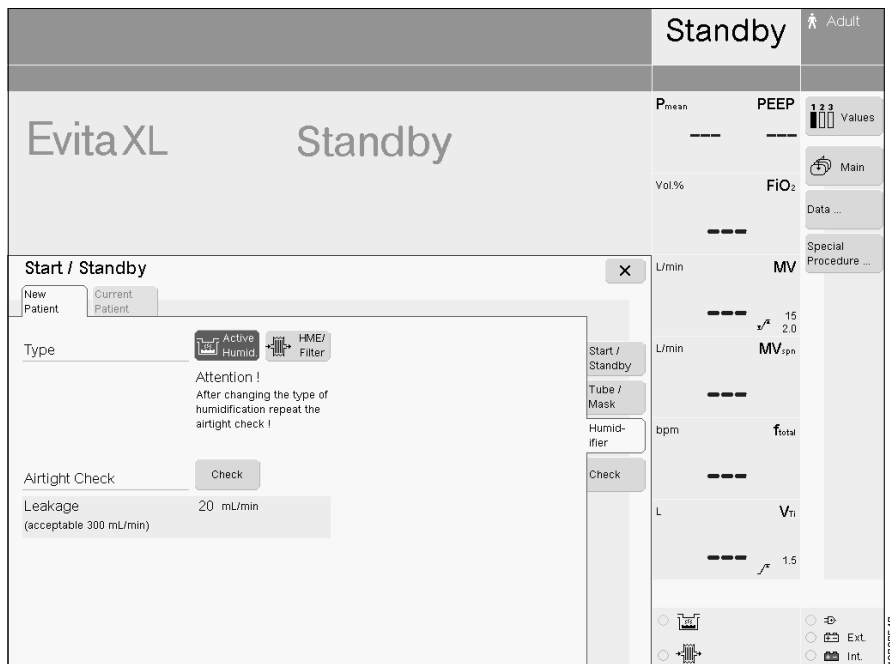
- Touch »Start/Standby« screen key in the »Start/Standby« menu.



Entering the Humidifer Type

In standby mode:

- Touch the screen key »Humidifier«. EvitaXL displays the menu for entering the humidifier type used:
 -  Active Humid. = heated breathing gas humidifier
 -  HME/Filter = heat and moisture exchanger
- Touch screen key corresponding to the type of humidifier used. The key will turn yellow.
- Press dial knob to confirm, the key turns green. EvitaXL will include the selected humidifier in its calculation of circuit compliance. The yellow LED in front of the symbol for the selected humidifier lights up in the status field.
 -  Heated humidifier
 -  HME/filter





After changing the humidifier:

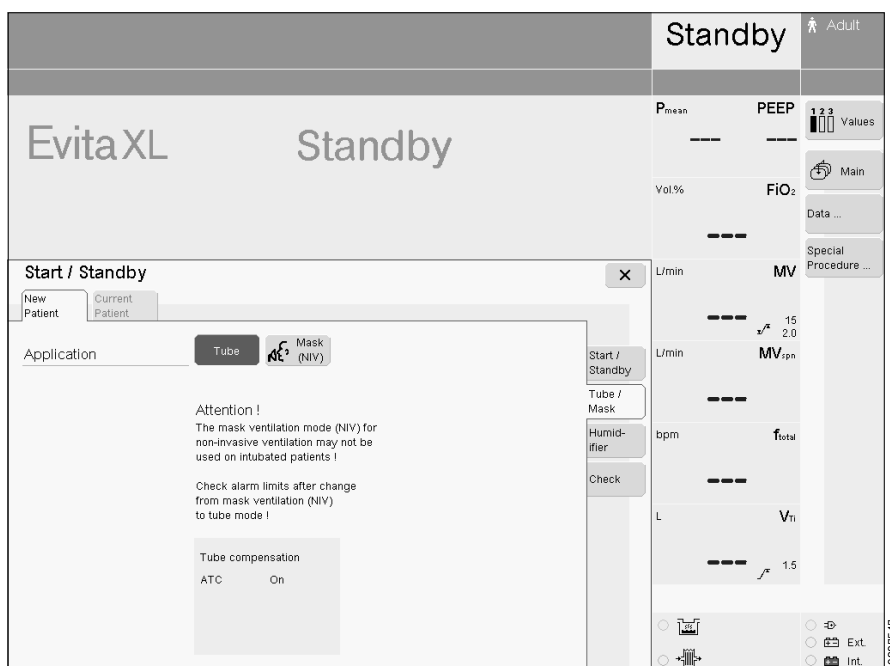
- Perform leak test, see page 50.

Application Mode Selection Tube / Mask (Optional)

In standby mode:

- Touch »Tube/Mask« screen key. The menu for selecting tube or mask is displayed (NIV = non-invasive ventilation).
- Touch the respective screen key; it will turn yellow.
- Press dial knob to confirm, the key turns green. The selected application mode is now active.
 - If  mask (NIV) has been selected:
 -  = Mask Ventilation is displayed.

See page 93 for details on using NIV.



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AC/DC Powered Operation

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AC/DC Powered Operation *

EvitaXL contains a DC power pack with integrated battery to ensure that operation of the ventilator can continue for at least 10 minutes following a power failure (provided that the battery is fully charged).

The ventilator may also be powered from an external battery via this DC power pack.

NOTE: The integrated battery of the DC power pack will only reach its full capacity after a 24 h charge

- Charge internal battery for at least 24 h (see "Charging Batteries" on page 55)

Power Sources Overview

Integrated battery

The power pack must be removed in order to gain access to the two 12 V lead-acid gel batteries integrated in the DC power pack.

The batteries are always supplied together with the DC power pack.

NOTE: The integrated battery is intended exclusively for emergency use and not for normal operation. Therefore, after a switch to the external battery has occurred, immediately reestablish AC line power or DC from the external battery.

External batteries (available option)

Additional rechargeable 12 V or 24 V lead-acid gel type batteries may be connected to EvitaXL via the DC socket. These external batteries are not supplied with the DC power pack.

It is advisable to use 24 V lead-acid gel batteries (or two 12 V lead-acid gel batteries connected in series) with a minimum capacity of 15 Ah. The efficiency of the DC power pack and the associated duty period is significantly higher when using this type of battery than when using 12 V batteries with comparable capacity.

The external battery may also take the form of two 12 V lead-acid gel batteries accommodated in the base of the mobile stand. Refer to "Ordering Information" for details on purchasing these batteries and the required connecting cables.

Commercially available rechargeable lead-acid gel type batteries can also be used. See "Technical Data", page 191, for requirements to be met by the external batteries.

WARNING!

Only use rechargeable batteries !

Explosion hazard!

Single use batteries may explode when being charged with the DC power pack while ventilator is operating on line power.

DC socket

Socket on the back of the DC power pack for connecting an external battery.

This socket is identified as follows:

DC power pack FB: 12 V; 24V DC

WARNING!

Only use rechargeable batteries !

Explosion hazard!

Single use batteries may explode when being charged with the DC power pack while ventilator is operating on line power.

WARNING!

Only external batteries may be connected to the DC socket of the ventilator and only using the connecting cable specified in the Ordering Information.

WARNING!

Do not connect any AC-powered equipment to the external battery connection socket of the ventilator..

AC power

AC line power (= mains power supply) for the ventilator is supplied via the AC power cord.

For voltage ranges /characteristics of AC line power, see "Operating Data" on page 186.

* For an Evita 4 ventilator upgraded with EvitaXL, DC operation is possible even if no DC option was installed previously.

Use of the Power Sources

Operation is possible with either of the following configurations:

- Integrated battery only, with and without AC line power.
- Integrated battery and external battery, with and without AC line power.

EvitaXL draws its electric power from one of the following sources, in the order of priority listed:

1. AC line power
2. External battery
3. Integrated battery

The changeover between these supplies is performed without interrupting operation according to the following rules:

- If sufficient AC power is available, the AC power source is always used.
- If sufficient AC power is not available and a sufficient voltage is present at the DC socket, EvitaXL will be powered by the external battery. No alarm message accompanies this switch to external battery power.
- If sufficient AC power is not available and there is no DC power available at the DC socket (e.g. with a discharged external battery), EvitaXL will be powered by the integrated battery.

In order to make use of as much power as possible, the ventilator switches back from the integrated battery to the external battery if it has recovered. This function is only intended for use in emergencies and may lead to a deep discharge of the battery.

- The operating ventilator must be run on AC power or a fully charged external battery as soon as possible.

NOTE: While running on an external battery, the internal battery is **not recharged**, but rather trickle-charged to prevent further discharge.

Operating times

Operating times for the internal and external batteries depend on the charging condition and type of batteries connected (see "Technical Data", page 191).

Charging Batteries

WARNING!

Leave the ventilator connected to AC power only in well ventilated areas. In sufficient concentrations, the hydrogen generated when charging batteries may otherwise lead to an explosion

When AC supply is connected and the ventilator is switched on, the internal batteries are charged first, followed by the external batteries.

Integrated battery

The integrated battery is only recharged when

- the ventilator is operating on AC power
- and**
- the ventilator is switched on, see "Switching on" on page 63.

For recharging the internal battery, it is sufficient for the ventilator to be operating in Standby mode.

NOTE: Ensure that EvitaXL has been switched on.

Even if AC power is present, the integrated battery will not be charged if EvitaXL is switched off.

The integrated battery is only fully charged after 24 hours.

NOTE: EvitaXL must therefore be switched on and remain connected to AC power in Standby mode for at least 24 hours so that the integrated battery can be charged.

The unit switches over to trickle charge when the end of charge is reached.

External battery

The external battery is only charged when

- the ventilator is being powered by AC power
- and**
- the unit is switched on, see "Switching on" on page 63,
- and**
- the integrated battery has been fully charged.

For recharging the external battery, it is sufficient for the ventilator to be operating in Standby mode.

NOTE: Ensure that EvitaXL has been switched on.

Even if AC power is present, the external battery will not be charged if EvitaXL is switched off.

The voltage of a connected external battery (12 V or 24 V) is detected automatically by the DC power pack.

Charging Times

The charging times specified under "Technical Data" apply when batteries are recharged immediately after a full discharge.

The charging time may be significantly longer if the batteries have discharged several times in succession without being fully recharged on AC power in the meantime.

The batteries must not be degraded in any way.

Charge indication and battery charge

Charging of the integrated and external batteries is interrupted when the charging current drops to a very low value upon reaching the end of charge. The battery is considered to be fully charged and this is indicated by a green battery symbol.

The battery capacity actually available at the end of the charging process depends, among other things, on the condition of the battery and on ambient temperature. The capacity and condition of the battery cannot be determined by the DC power pack.

The green battery symbol indicates that the battery is fully charged. Even though the green symbol lights up, the capacity of old or defective batteries may be so small as to permit operation of EvitaXL for no more than a few minutes.

WARNING!

It is mandatory and responsibility of the user to ensure sufficient battery capacity. See "Battery Maintenance".

Battery Maintenance

To ensure maximum battery life:

- Batteries should always be fully charged and, if possible, never become deep discharged.

If the DC power pack is not used:

- Connect the ventilator to mains power after not more than one month and switch it on for at least two hours in order to recharge the integrated battery.
- Then fully recharge any external batteries which may be connected.

If the battery needs to be left uncharged for more than one month:

- Have the integrated and external batteries electrically disconnected from the ventilator by DraegerService or factory trained and authorized personnel in order to reduce self discharge of the batteries.

Before reconnecting integrated and external batteries, check that their capacity is still adequate. They may have become exhausted or damaged as a result of prolonged storage.

Batteries are wear parts and must be replaced in a manner consistent with their degree of use.

CAUTION !

The capacity of batteries must be checked regularly and the batteries replaced if necessary.

Avoid deep discharges, they lead to premature wear.

CAUTION !

Avoid storing the ventilator for extended periods at temperatures over 50 °C.

The internal battery and O₂ sensors may be damaged, or equipment life may be shortened

Connecting an External Battery (Optional)

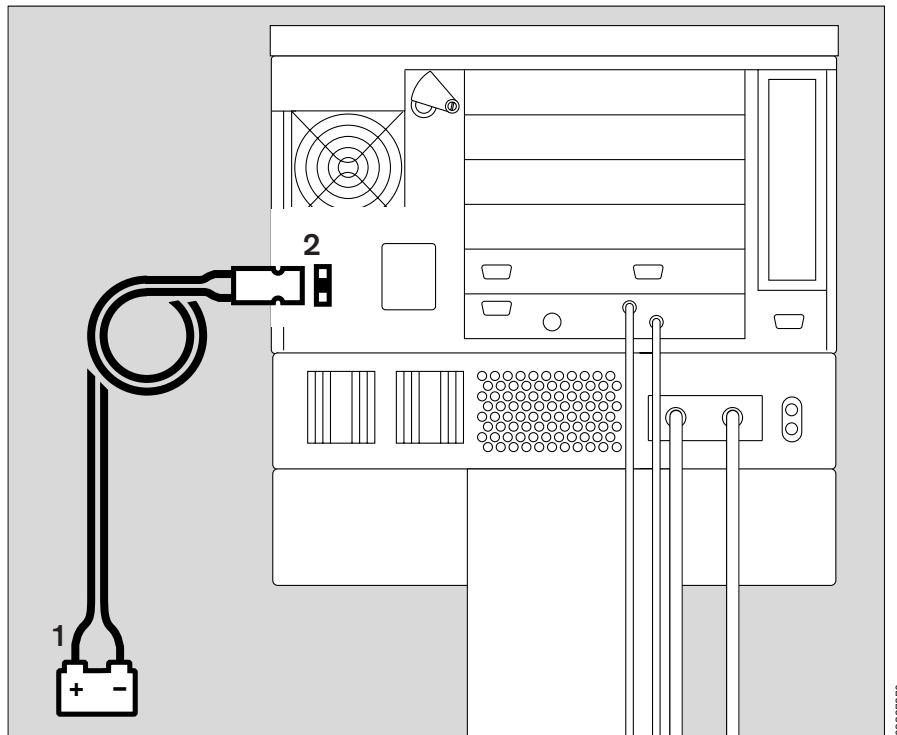
Note the requirements for external batteries, see page 54.

- 1 Connect external battery using the battery cable from battery kit (84 11 822).
- **Ensure that the battery is connected with correct polarity: black to $-$, red to $+$.**
- 2 Plug connector into DC socket on the back of the ventilator.

WARNING!

Do not connect any AC-powered equipment to the external battery connection socket of the ventilator..




The ventilator will automatically detect the voltage of the external battery (12 V or 24 V).



Power source displays

EvitaXL indicates the type of power supplied in the equipment status field at the bottom right of the screen via symbols and colored "LEDs".

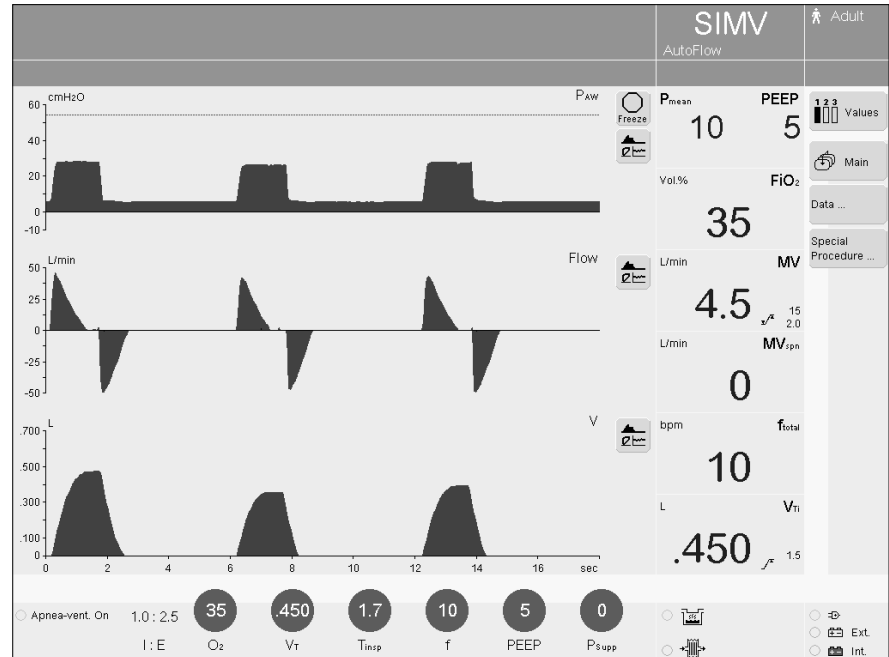
Display (example):

- ☐  : AC line power
- ☐  Ext. : External battery
- ☐  Int. : Integrated battery

A yellow "LED" lights up next to the respective symbol to indicate the source from which the unit is being powered.


Green LEDs next to the battery symbols indicate that the battery/batteries is/are fully charged.

NOTE: Note the important information under "Charge indication and battery charge" on page 56!



Operation with AC Line Power

The ventilator switches to operation with AC power when connected to an AC power source. The integrated battery is recharged during AC power operation. The external battery is recharged once the integrated battery is fully charged.

The LED next to the plug symbol  lights up yellow.

If the mains power supply fails, the ventilator will automatically switches over to the external battery, if available.

If an external battery is not available in the event of a power failure, the ventilator switches over to the integrated battery and continues operation for at least 10 minutes (provided that the integrated battery was fully charged).

- Supply of AC power must be restored without delay.

To ensure that the battery is always fully charged:

- Connect the ventilator to AC line power and switch it on.

WARNING!

Leave the ventilator connected to AC power only in well ventilated areas. In sufficient concentrations, the hydrogen generated when charging batteries may otherwise lead to an explosion

- Leave the ventilator in standby mode or start ventilation.

Operation with Integrated Battery

The ventilator immediately switches over to operation with the integrated battery if the mains power supply fails without an external battery being connected, or in case of a discharged external battery.

NOTE: The integrated battery is merely intended for emergency use and not for normal operation.

The LED next to the symbol for the integrated battery lights up yellow.

The green LED next to the symbol for the integrated battery goes out, as it is no longer fully charged.

The advisory message

Internal battery in operation !

is displayed when the unit switches over to the integrated battery.

The time available for operation with integrated battery depends on its charge. If the battery is fully charged, operation can continue for at least 10 minutes.

A caution message is displayed after 8 minutes of operation:

Internal battery only 2 minutes left !!

- The ventilator must be reconnected to AC power within 2 minutes
or
- It must be connected to a fully charged external battery.

The warning

Internal battery discharged !!!

is displayed after 10 minutes of operation.

- The power supply must be restored immediately, either from an AC source or from a fully charged external battery, otherwise ventilation will be interrupted.

After using power from the integrated battery:

- Recharge integrated and external batteries as soon as possible, see "Charging Batteries" on page 55.

AC/DC Powered Operation

Operation with External Battery (Available Option)

Operation with External Battery (Available Option)

Connect external battery

If the AC power supply fails, EvitaXL immediately switches over to a connected external battery.

The LED next to the symbol for external battery lights up yellow.

The green LED next to the symbol for external battery goes out, as it is no longer fully charged.

NOTE: The changeover to external battery power is performed without any alarm message.

The time available for operation from an external battery depends on the battery charge and the type of battery connected.

If the external battery is exhausted, EvitaXL automatically switches over to the integrated battery and generates an alarm.

NOTE: When AC power is restored, EvitaXL automatically switches back to operation with AC power.

The integrated battery is not recharged while the ventilator is being powered by the external battery.

For this reason:

- Recharge the integrated and external batteries as soon as possible, see "Charging Batteries" on page 55

WARNING!

Do not connect any AC-powered equipment to the external battery connection socket of the ventilator.

Operation

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Operation

Precautions During Operation

WARNING !

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

WARNING !

In case of a fault in any of the built-in monitoring a substitute has to 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.

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 !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. Make adjustments to the FiO₂ according to the blood gas values measured.

WARNING !

Do not block air intake. Ventilator malfunction will result.

WARNING!

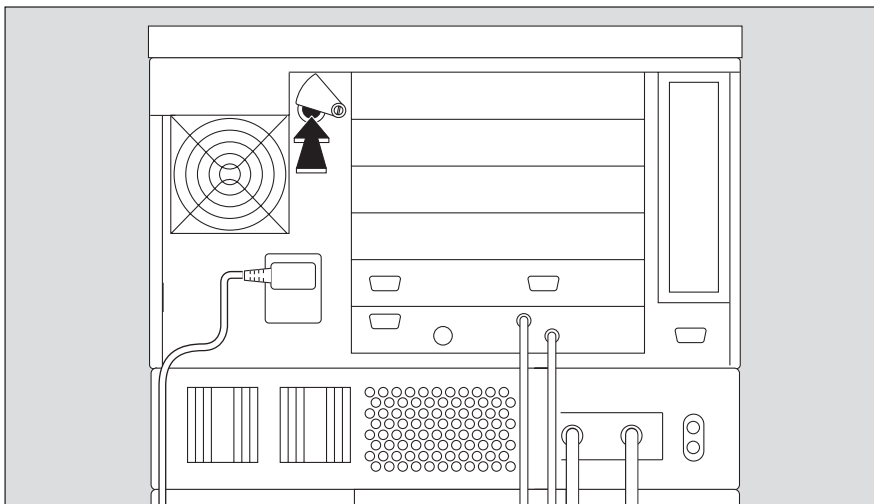
Do not place containers of liquids (such as infusion bottles) on top of or above the EvitaXL ventilator. Liquids getting into the ventilator can cause equipment malfunction with the risk of patient injury.

Perform tests of readiness for operation according to checklist, see page 46.

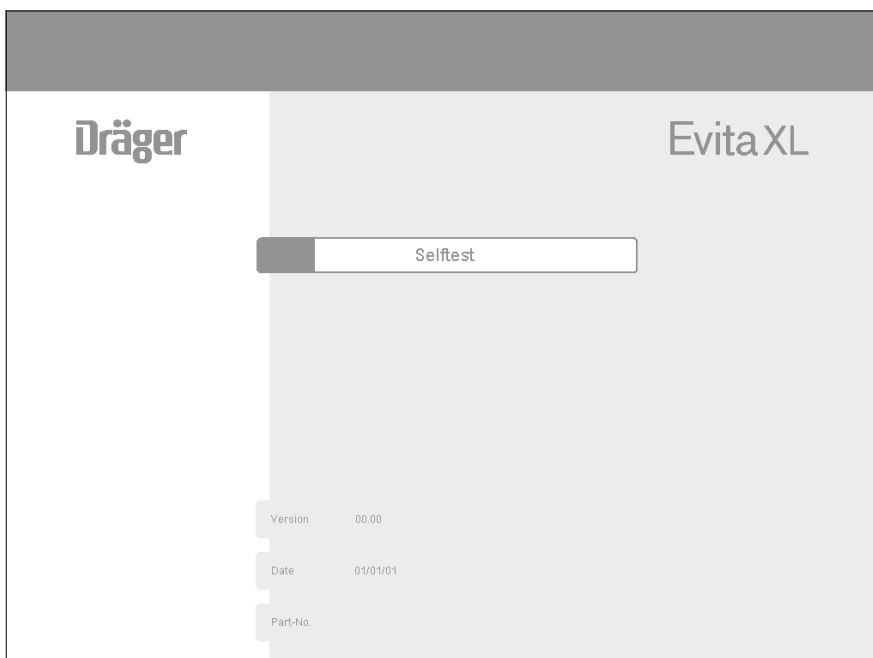
Starting Up

Switching on

- Push power switch button on back panel until it engages = ON.
The protective cover will swivel over the switch button to prevent the ventilator from being inadvertently switched off.



The self-test screen is displayed.
The self-test is performed automatically.
Wait for the test to be completed.
The bargraph indicates the time elapsed for the self-test.



The "Start" screen is then displayed.
(Example: Previous Patient)

Specific patient settings in effect before EvitaXL was switched off, may be restored at this time, including alarm limits, monitoring status, application status, and ventilator status.

To restore previous settings:

- Touch »Previous Patient« screen key, and press dial knob to confirm.



The previous ventilation settings are now in effect again.

EvitaXL key will not display the »Previous Patient« screen key or will not allow to select it following a loss of data or removal of a previously used option, therefore preventing previous settings to be restored in this case. Similarly, EvitaXL prevents restoring previous settings if the ventilator was configured in such a way before switching off that the former patient mode is no longer available.



Setting New Ventilation Parameters

With EvitaXL, the patient mode may be selected in two alternative ways:

- Select » **Adult**« or » **Ped.**«,
- Set an ideal body weight.



Both alternatives can be configured, see "Configuration", page 139.

EvitaXL is configured at the factory for selection of an ideal body weight.

NOTE: The remaining description of the procedure is based on this configuration.



Depending on the required patient mode, touch one of the screen keys:

- either » **Adult**« or » **Ped.**«.
- Touch the screen knob »**Ideal Body Weight**«.
- Turn dial knob to enter the ideal body weight [kg], press dial knob to confirm.

EvitaXL determines the tidal volume V_T and ventilation frequency f on the basis of the ideal body weight and displays these values in the lower part of the menu.

The other ventilation parameters displayed in the lower part of the menu are initial default values.


They are in effect when the ventilator is switched on and when a new ventilation mode is selected (New Patient).



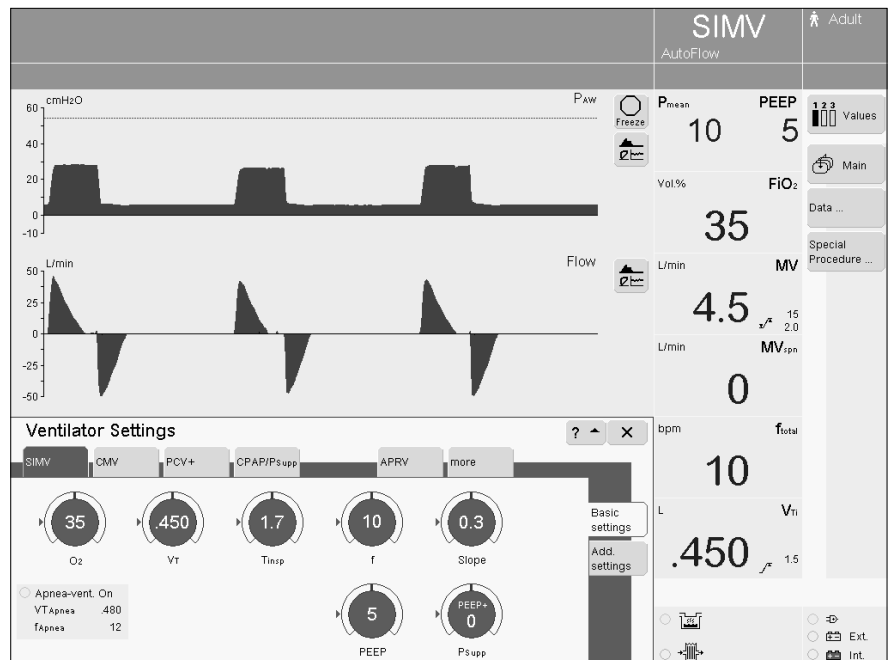
Start ventilation:

- Touch »Start« screen key, press dial knob to confirm. The ventilator starts with these initial values.
- Check settings.

To set ventilation parameters

- Press » Ventilator Settings« key.
- Touch respective ventilation parameters in the »Ventilator Settings« menu, turn dial knob to set, press dial knob to confirm.

Arrows (►) beside the scales on the screen knobs in the »Ventilator Settings« menu indicate initial default values. These start-up values may be configured as required, see "Configuration", page 141.



Setting Ventilation Modes

The following ventilation modes are factory-configured at delivery:

- SIMV
- CMV
- PCV⁺ (BIPAP)
- CPAP-Pressure Support

Other ventilation modes can be selected via the »more« screen key:

- MMV
- PCV⁺ Assist
- APRV

The ventilation modes can also be supplemented, see “Setting Ventilation Mode Extensions” on page 83

CMV

Continuous Mandatory Ventilation

Volume controlled ventilation with fixed, mandatory minute volume MV set with tidal volume VT and ventilator rate (frequency) f.

Set the pattern of ventilation for CMV with the ventilation parameters:

Tidal volume »VT«

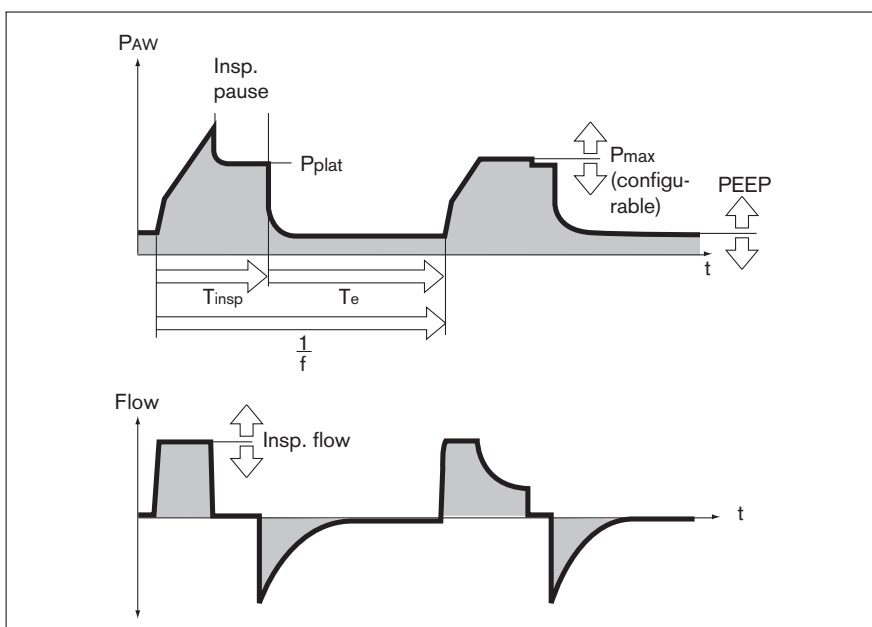
Inspiratory Flow »Flow«

Ventilator rate »f«

Inspiratory time »T_{insp}«

O₂ concentration »O₂«

Positive end-expiratory pressure »PEEP«



Operation

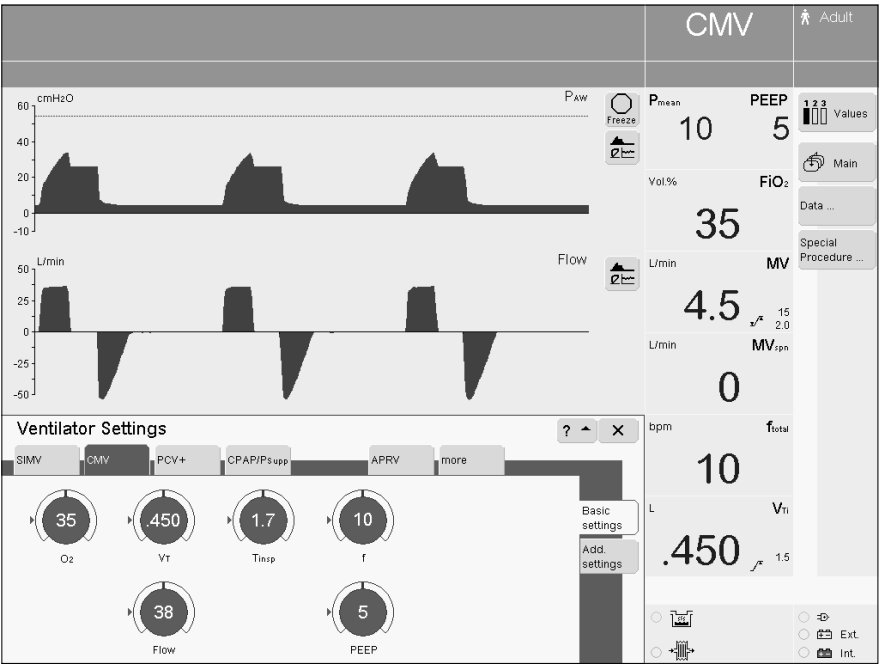
CMV

- To set:
- Touch the respective screen knob.
 - Turn dial knob to adjust setting.
 - Press dial knob to confirm setting.

- To view additional text information on CMV:
- Touch »? ▲« screen key.

- CMV can be supplemented to include the following ventilation mode extensions:
- Flow trigger, page 85.
 - AutoFlow®, page 88.
 - Automatic Tube Compensation (ATC), page 89.
 - Sigh, page 91.
 - Pressure Limited Ventilation (PLV), page 92.
- These supplements may be enabled via »Add. settings«.

NOTE: For setting alarm limits, see page 96.



Operation

SIMV, SIMV/PS

To view additional text information on SIMV, SIMV/PS:

- Touch »? ▲« screen key.

SIMV, SIMV/PS can be supplemented to include the following ventilation mode extensions:

- Flow trigger, page 85.
- Apnea ventilation, page 86.
- AutoFlow[®], page 88.
- Automatic Tube Compensation (ATC), page 89.
- Pressure Limited Ventilation (PLV), page 92.

These functions can be enabled via »**Add. settings**«.

NOTE: For setting alarm limits, see page 96.

MMV, MMV/PS

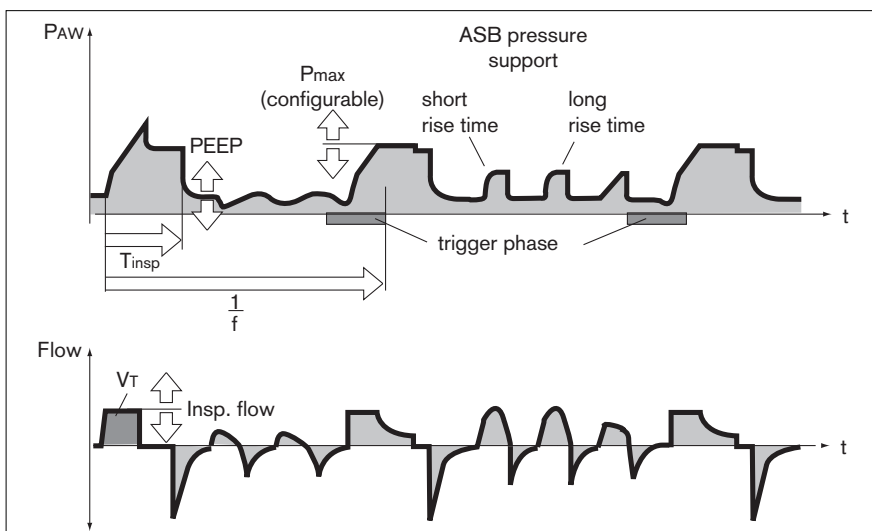
Mandatory Minute Volume Ventilation *

Pressure Support

The overall minute volume is preset to a mandatory level, which can be adjusted via tidal volume V_T and ventilator rate f . The patient can breathe spontaneously, thereby contributing a portion of the overall minute volume.

The difference between the spontaneously breathed minute volume and the set minute volume is provided by mandatory ventilator breaths.

Spontaneous breathing may be assisted by Pressure Support.



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Set the pattern of ventilation for MMV and MMV/PS with the ventilation parameters:

Tidal volume » V_T «

Inspiratory flow »Flow«

Frequency » f «

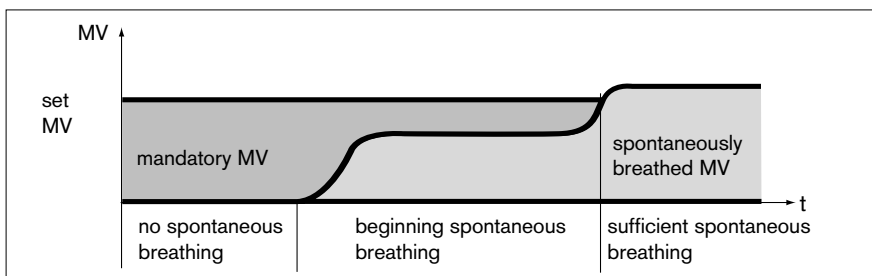
Inspiratory time » T_{insp} «

O₂ concentration »O₂«

Positive end-expiratory pressure »PEEP«

Pressure support »PSupp.«

Pressure rise time »Slope«



01237/547

* Please refer to page 202 for a detailed description of MMV.

Operation

MMV, MMV/PS

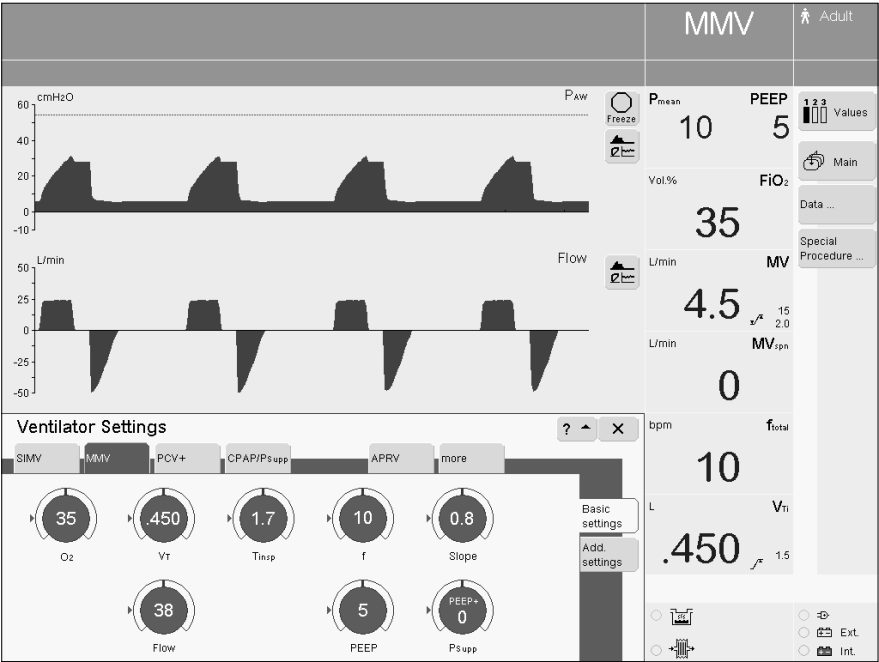
- To set:
- Touch the respective screen knob.
 - Turn dial knob to adjust setting.
 - Press dial knob to confirm setting.

To view additional text information on MMV, MMV/PS:

- Touch »?▲« screen key.

- MMV, MMV/PS can be supplemented to include the following ventilation mode extensions:
- Flow trigger, page 85.
 - AutoFlow[®], page 88.
 - Automatic Tube Compensation (ATC), page 89.
 - Pressure Limited Ventilation(PLV), page 92.
- These functions can be enabled via »Add. settings«.

NOTE: For setting alarm limits, see page 96.



ILV

ILV = Independent Lung Ventilation

Synchronized, independent ventilation of the two lung sides with two Evita ventilators that are connected via analog interface.

The two ventilators are operated in master/slave mode with the master ventilator controlling ventilation.

Preparation for ILV

The following device combinations are possible:

- EvitaXL with EvitaXL
- EvitaXL with Evita 4
- EvitaXL with Evita 2 dura

Requirements for combinations:

- EvitaXL or Evita units must be equipped with the EvitaBus analog interface (available option).
- Interface cable part no. 84 11 794 must be used to connect EvitaXL to another EvitaXL or with an Evita 4 or with an Evita 2 dura.

For all combinations:

EvitaXL with Evita 2 dura

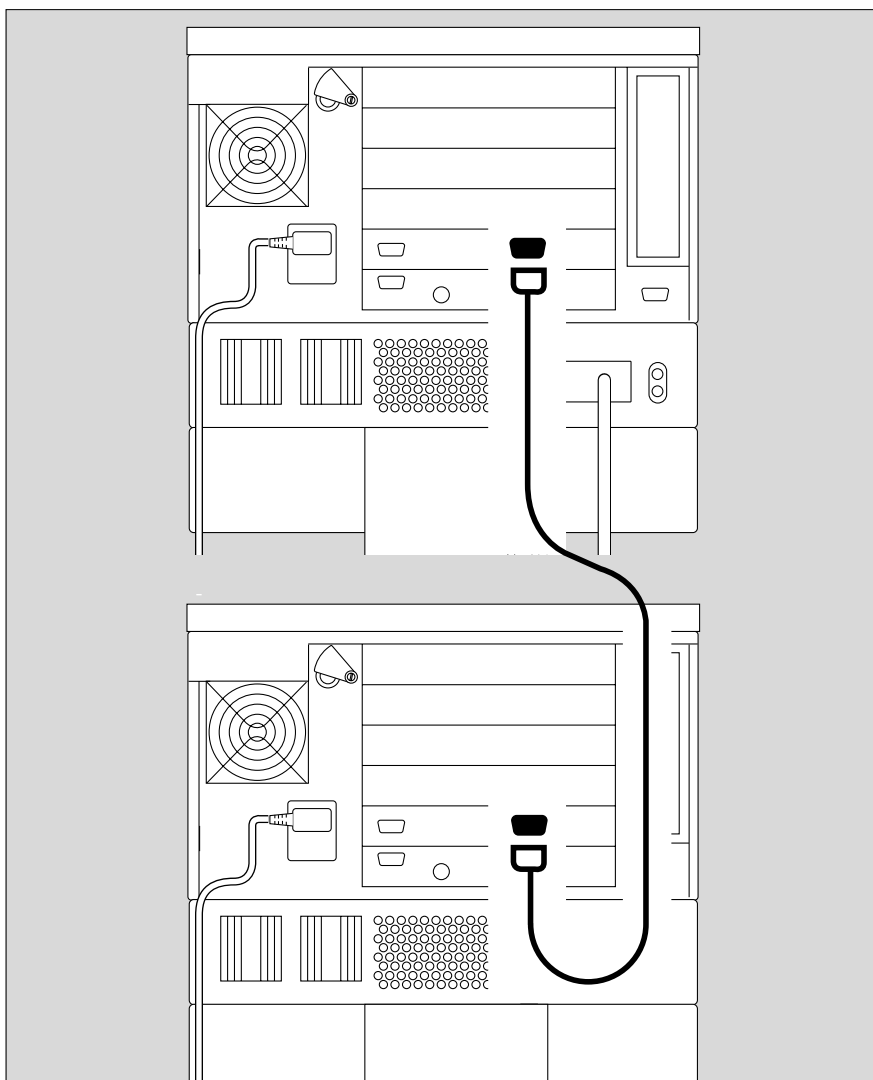
or

EvitaXL with EvitaXL

or

EvitaXL with Evita 4:

- Connect the ILV ports of the two Evita ventilators using interface cable 84 11 794.



Setting the Master and Slave device

To perform independent lung ventilation:

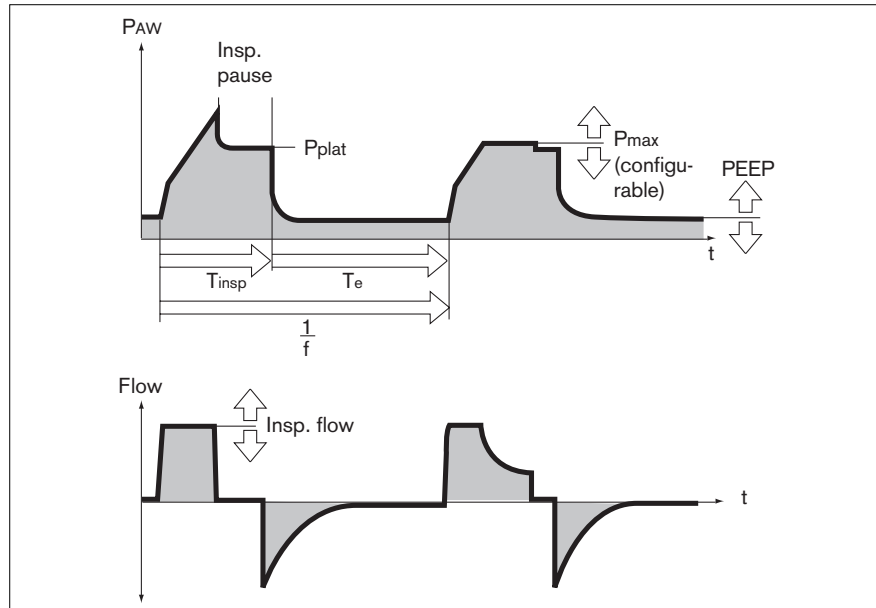
- Set up one device for ILV/Master mode and
- the other device for ILV/Slave mode.
- Set the desired parameters – see page 77.

NOTE: Activate ILV mode only after all parameters for ILV/Master and ILV/Slave ventilators have been adjusted.

Setting ILV/Master

Volume-controlled ventilation with fixed, mandatory minute volume MV, set with tidal volume V_T and ventilator rate f .

For independent lung ventilation of patients with no spontaneous breathing.



Set the ILV ventilation pattern with the parameters:

Tidal volume »**VT**«

Inspiratory flow »**Flow**«

Ventilator rate »**f**«

Inspiratory time »**Tinsp**«

O₂ concentration »**O₂**«

Positive end-expiratory pressure »**PEEP**«

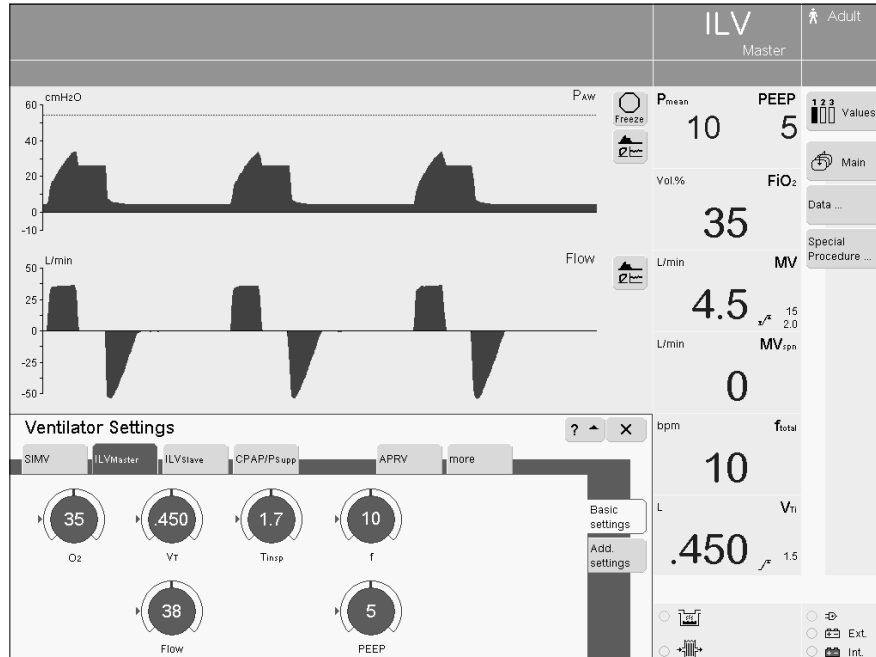
To set:

- Touch the respective screen knob.
- Turn dial knob to adjust setting.
- Press dial knob to confirm setting.

ILV/Master can be supplemented to include the following ventilation mode extensions:

- Flow trigger, page 85.
- Automatic Tube Compensation (ATC), page 89.
- Sigh, page 91.
- Pressure Limited Ventilation (PLV), page 92.

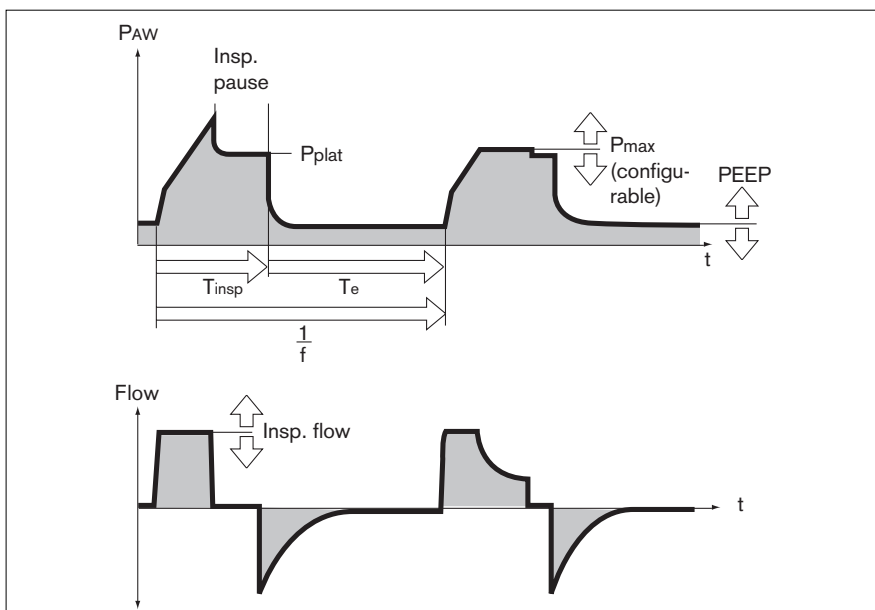
These functions can be enabled via »**Add. settings**«.



Setting ILV/Slave

Volume-controlled ventilation with fixed, mandatory minute volume MV, set with tidal volume V_T and ventilator rate f by the ILV Master device and Slave mode selected.

For independent lung ventilation of patients with no spontaneous breathing.

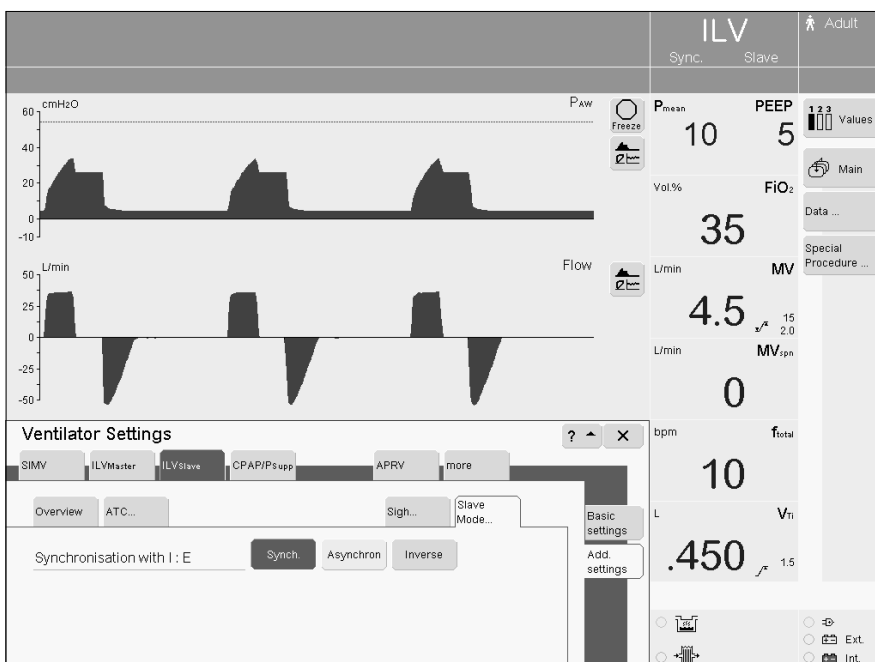


To set Slave mode:

- Touch »Extra settings« screen key.
- Touch »Slave Mode...« screen key.

Select desired slave mode (e.g. »Asynchron«):

- Touch the respective screen key and press dial knob to confirm.



ILV: Master and Slave Synchronization

Master device

I:E ratio

Slave device

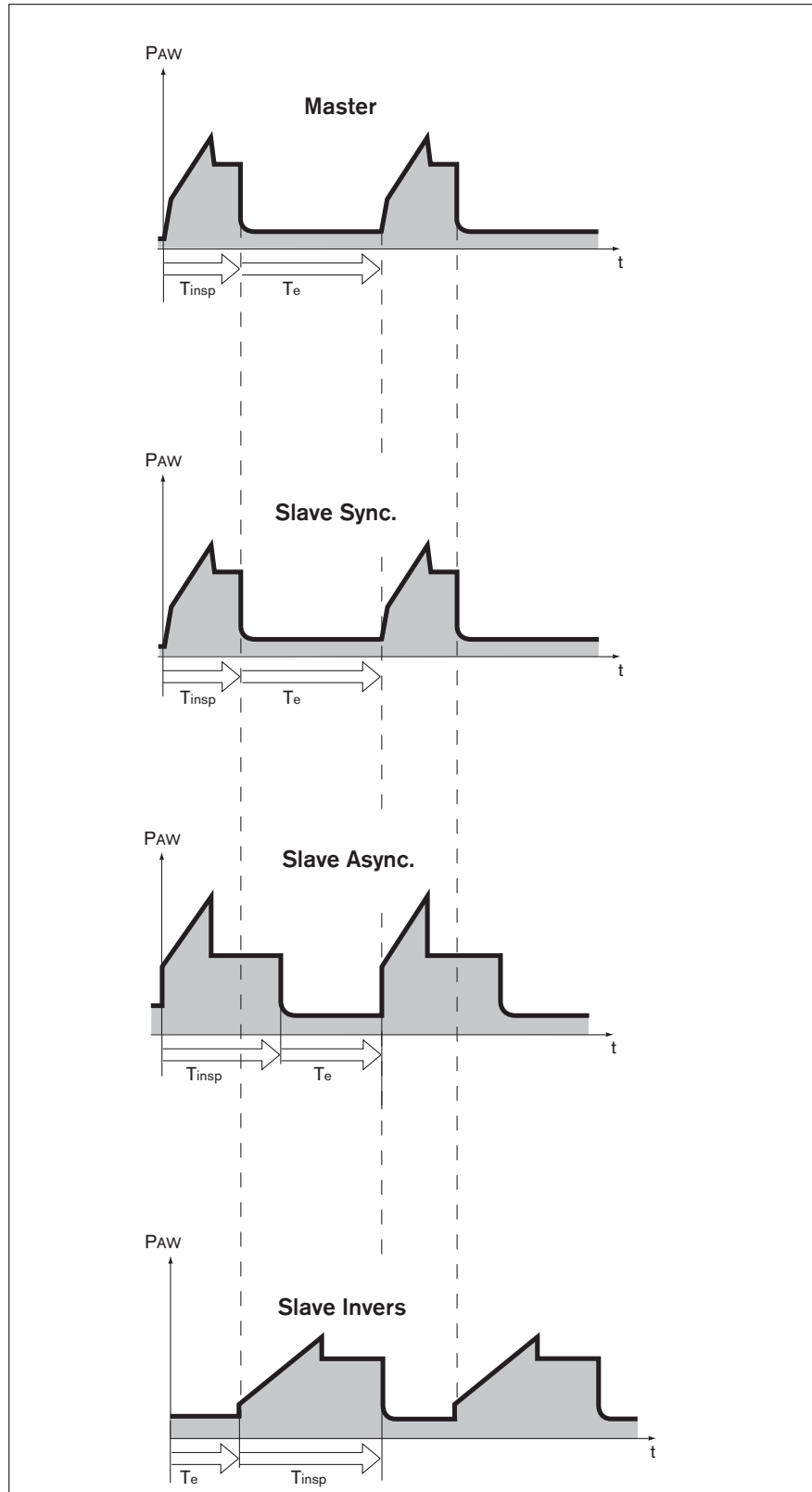
Sync. – The I:E ratio of the slave device is determined by the I:E ratio of the master device. The start of inspiration is synchronised with the inspiration of the master device.

Slave device

Async. – The start of inspiration is synchronised with the inspiration of the master device. The end of inspiration (incl. pause time) is determined by the »T_{insp}« setting. The I:E ratio of the slave device is freely selectable.

Slave device

Inverse – The start of inspiration is synchronised with the start of expiration of the master device and vice versa. The I:E ratio of the slave device is the inverse of the I:E ratio of the master device.



Set the ventilation pattern for ILV/Slave with the following ventilation parameters:

Tidal volume »**V_T**«

Inspiratory flow »**Flow**«

Frequency »**f**«

Inspiratory time »**T_{insp}**«

O₂ concentration »**O₂**«

Positive end-expiratory pressure »**PEEP**«

To set:

- Touch the respective screen knob.
- Turn dial knob to adjust setting.
- Press dial knob to confirm setting.

The »**f**« setting does not go into effect immediately.

Nevertheless, to make sure that the two lung compartments are not ventilated with different ventilator rates in the event of inadvertent separation of the two ventilators:

Set »**f**« on the slave device to the same value as on the master as a safeguard.

In Async. slave mode, the »**T_{insp}**« setting will be immediately in effect. In "Synchronized" and "Inverse" modes, "T_{insp}" becomes only active if the devices are inadvertently separated.

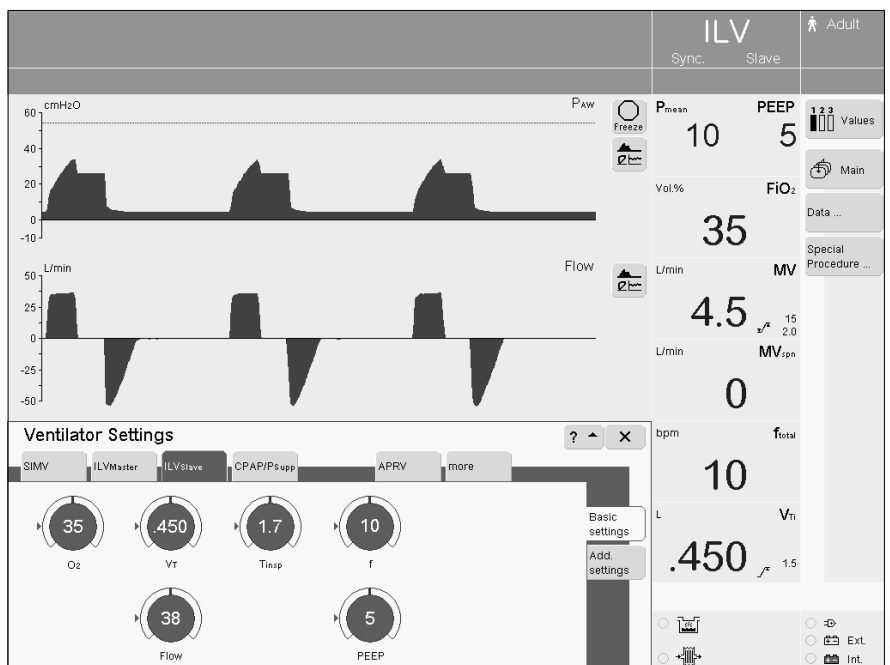
ILV/Slave can be supplemented to include the following ventilation mode extensions:

- Flow trigger, page 85.
- Automatic Tube Compensation (ATC), page 89.
- Sigh, page 91.
- Pressure Limited Ventilation (PLV), page 92.

These functions can be enabled via »**Add. settings**«.

To view additional text information on ILV:

- Touch »?**▲**« screen key.



Operation

PCV+ (BIPAP), PCV+ (BIPAP)/P.Supp.

PCV+ (BIPAP), PCV+ (BIPAP)/P.Supp.

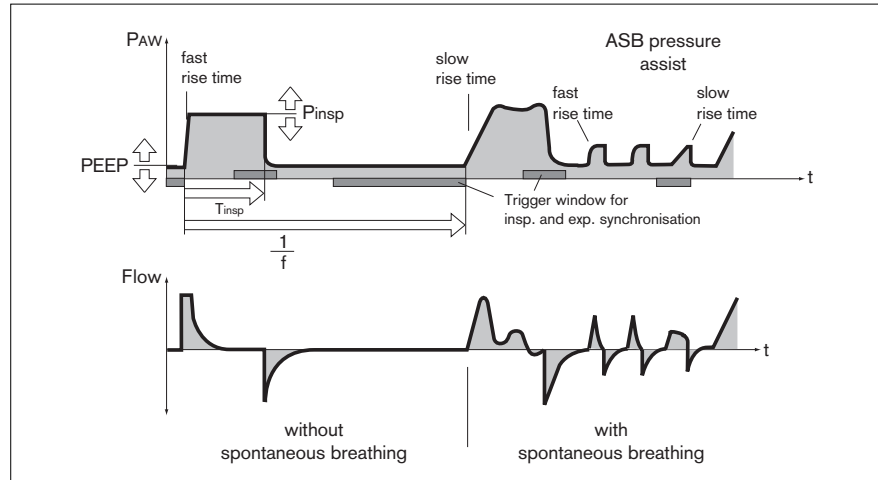
**Pressure Controlled Ventilation Plus,
Pressure Support**

Pressure controlled ventilation combined with free spontaneous breathing at any time during the breathing cycle and adjustable pressure support at CPAP level.

The mandatory portion of the total minute volume MV is set with inspiratory pressure P_{insp} and breath rate f .

In the course of the weaning process, the ventilator rate may be reduced to 0. The ventilator will then automatically switch to CPAP or CPAP/P.Supp. ventilation mode and it will also indicate this new ventilation mode on screen.

NOTE: The »PCV+« screen key and the screen knobs for PCV+ (BIPAP) ventilation parameters will continue to be displayed.



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Set the pattern of ventilation for PCV+ (BIPAP) and PCV+ (BIPAP)/P.Supp. with the ventilation parameters:

Inspiratory pressure » P_{insp} «

Ventilator rate » f «

Time » T_{insp} «

O₂ concentration » O_2 «

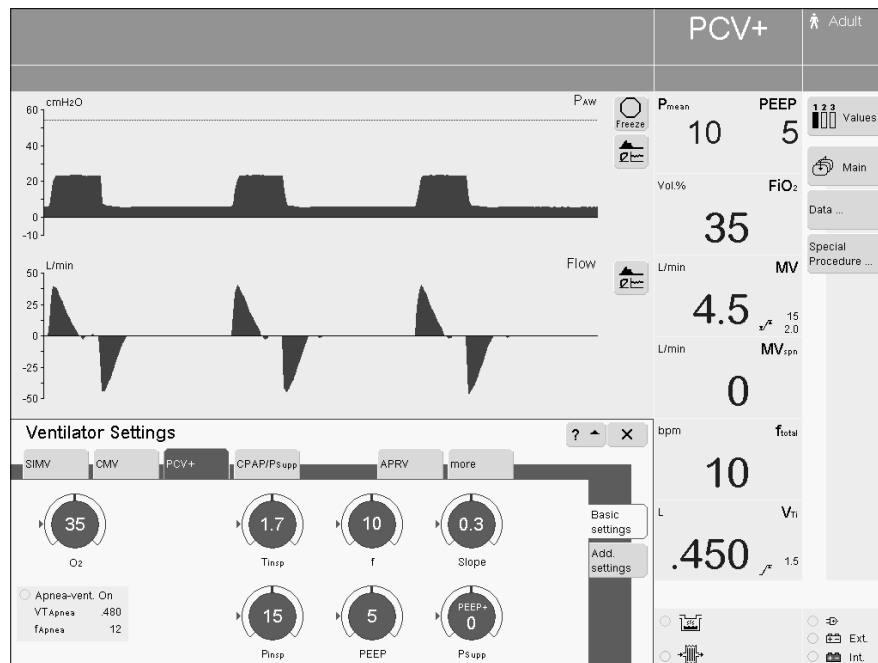
Positive end-expiratory pressure »PEEP«

Pressure support » P_{supp} «

Pressure rise time »Slope«

Inspiratory pressure » P_{insp} « may be reduced to PEEP level. The ventilation pattern then corresponds to CPAP or CPAP/PS.

NOTE: Inspiratory pressure » P_{insp} « is set as an absolute value. Pressure support » P_{supp} « is set as a value above PEEP level.



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To set:

- Touch the respective screen knob.
 - Turn dial knob to adjust setting.
 - Press dial knob to confirm setting.
-

To view additional text information on PCV+ and PCV+/P.Supp.:

- Touch »? ▲« screen key.

PCV+ and PCV+/P.Supp. can be supplemented to include the following ventilation mode extensions:

- Flow trigger, page 85.
- Apnea ventilation, page 86.
- ATC, page 89.

These functions can be enabled via »Add. settings«.

NOTE: For setting alarm limits, see page 96.

PCV+(BIPAP)Assist

Pressure Controlled Ventilation Plus, Assisted*

Pressure-controlled, assisted ventilation
Delivered breaths are equivalent to those of PCV+. The switch from P_{insp} to PEEP pressure is not, however, synchronized with patient expiration. During the entire time of ventilation, the patient may breathe spontaneously at PEEP pressure level.

Each detected spontaneous inspiratory patient effort will trigger a synchronized ventilator breath. The ventilator will deliver an (unsynchronized) breath at the latest after the time defined by »f« has elapsed.

Set ventilation pattern for BIPAP_{Assist} with the following parameters:

Inspiratory pressure »P_{insp}«

Ventilator rate »f«

Inspiratory time »T_{insp}«

O₂ concentration »O₂«

Positive end-expiratory pressure »PEEP«

Pressure rise time »Slope«

Flow trigger »Flow_{trig}«

NOTE: Inspiratory pressure »P_{insp}« is set as an absolute value.

To set:

- Touch the respective screen knob.
- Turn dial knob to adjust setting.
- Press dial knob to confirm setting.

To view additional text information on PCV+Assist:

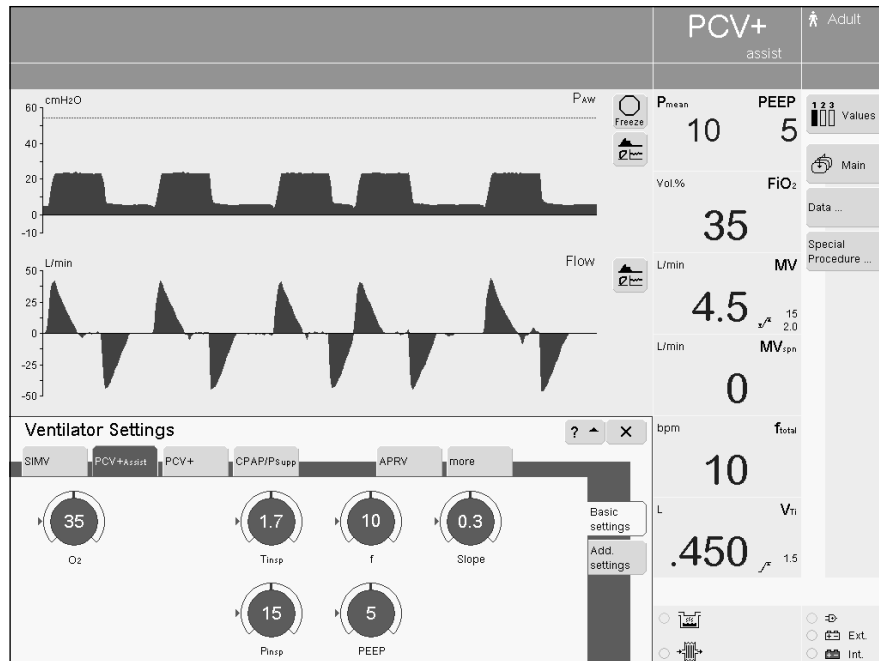
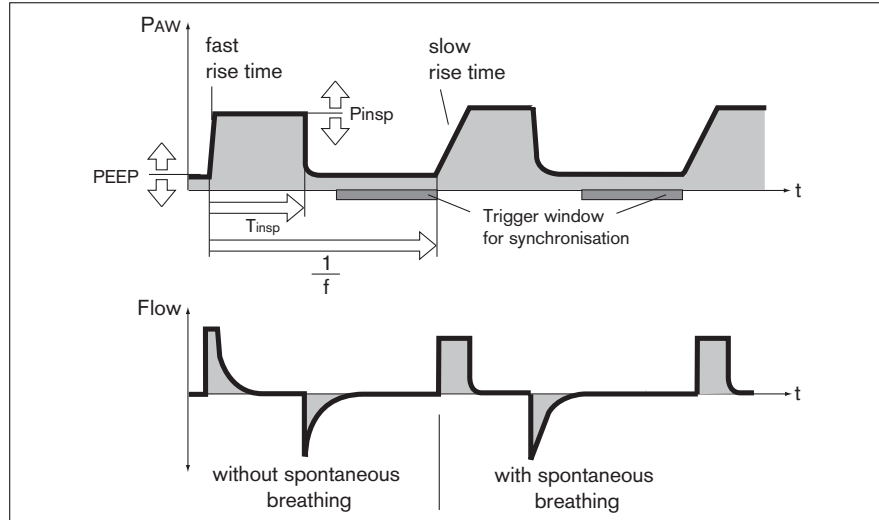
- Touch »? ▲« screen key.

PCV+Assist can be supplemented to include the following ventilation mode extensions:

- Flow trigger, page 85.
- ATC, page 89.

These functions can be enabled via »Add. settings«.

NOTE: For setting alarm limits, see page 96.

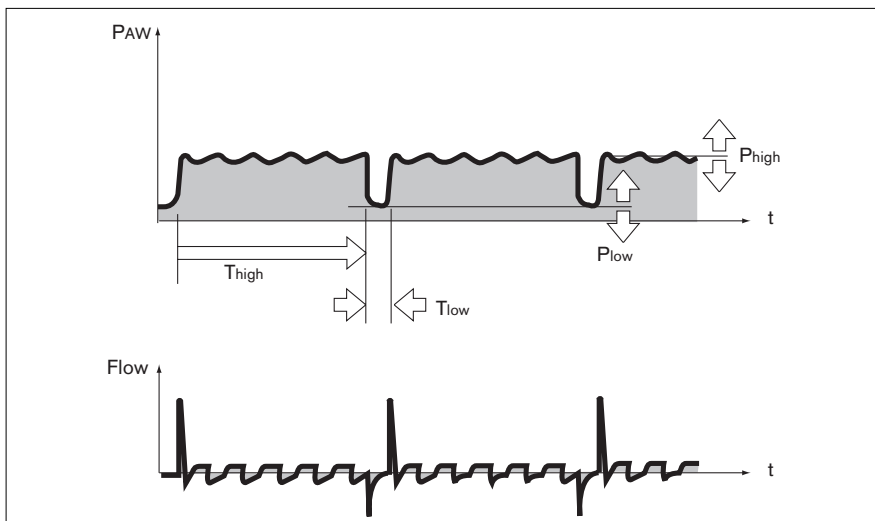


* Please refer to page 203 for a detailed description of PCV+Assist.

APRV

Airway Pressure Release Ventilation*

Free spontaneous breathing at a raised CPAP pressure level together with a short period of low pressure (Release).



Set the pattern of ventilation for APRV with the ventilation parameters:

Inspiratory time »**T_{high}**«

Expiratory time »**T_{low}**«

Inspiratory pressure »**P_{high}**«

Positive end-expiratory pressure »**P_{low}**«

O₂-concentration »**O₂**«

Pressure rise time »**Slope**«

To set:

- Touch the respective screen knob.
- Turn dial knob to adjust setting.
- Press dial knob to confirm setting.

To view additional text information on APRV:

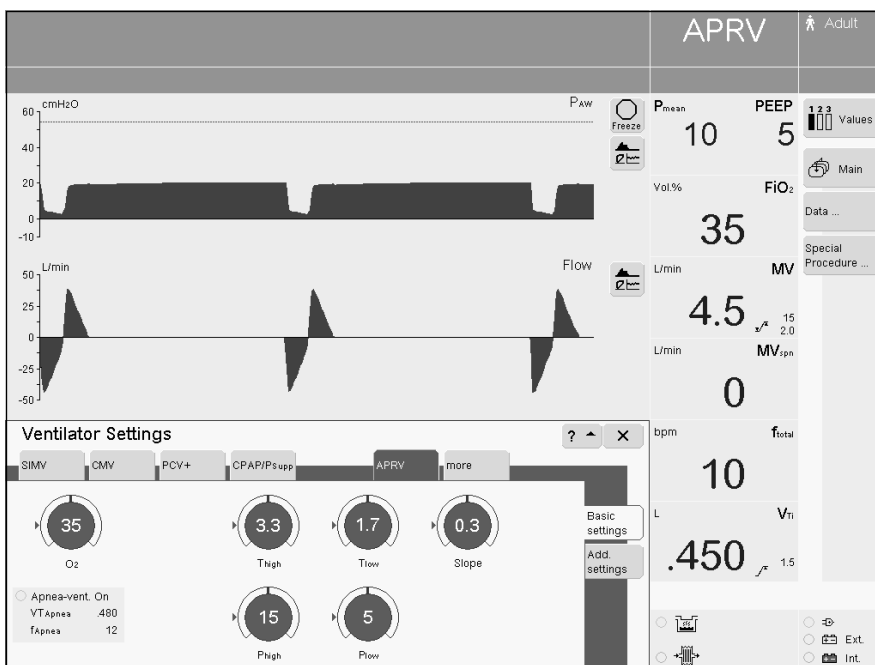
- Touch »?[▲]« screen key.

APRV can be supplemented to include the following ventilation mode extensions:

- Apnea ventilation, page 86.
- ATC, page 89.

These functions can be enabled via »**Add. settings**«.

NOTE: For setting alarm limits, see page 96.

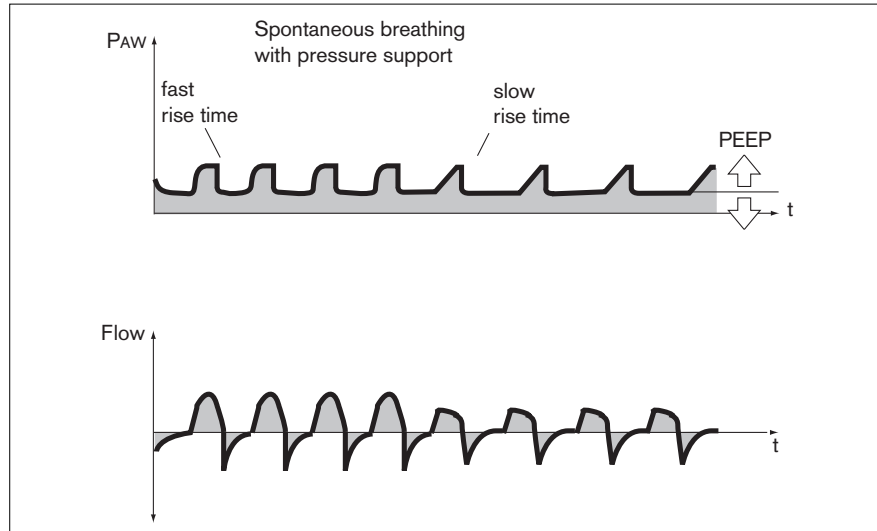


* Please refer to page 205 for a detailed description of APRV.

CPAP, CPAP/P.Supp.

Continuous Positive Airway Pressure Pressure Support*

Spontaneous breathing at a raised pressure level in order to increase the functional residual capacity (FRC). Spontaneous breathing can be augmented with additional pressure by Pressure Support.



Set the pattern of ventilation for CPAP and CPAP/P.Supp. with the following ventilation parameters:

O₂ concentration »O₂«

Positive end-expiratory pressure »PEEP«

Pressure support »P.Supp.«

Pressure rise time »Slope«

To set:

- Touch the respective screen knob.
 - Turn dial knob to adjust setting.
- Press dial knob to confirm setting.

To view additional text information on CPAP, CPAP/P.Supp.:

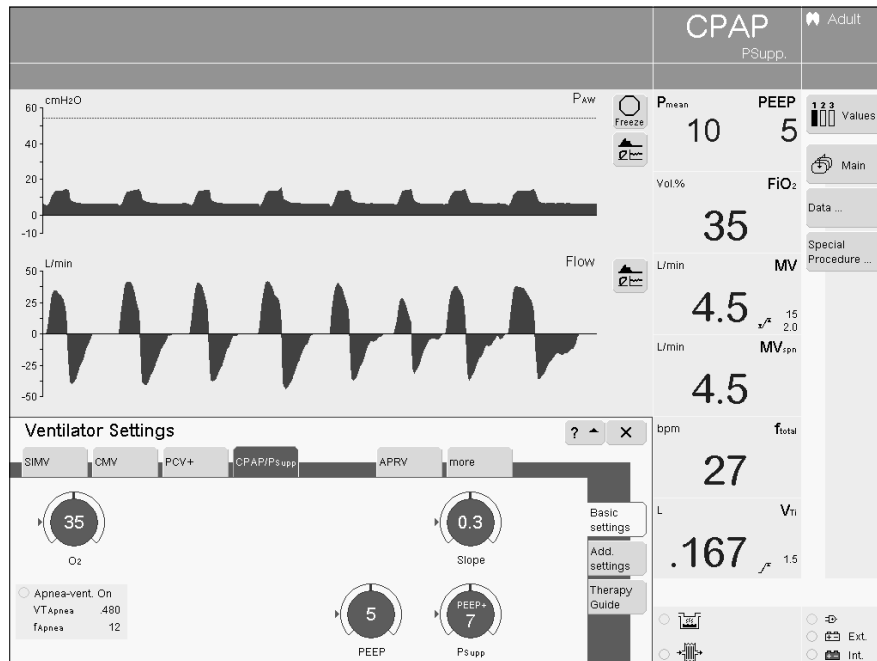
- Touch the screen key »?▲«.

CPAP, CPAP/P.Supp. can be supplemented to include the following ventilation mode extensions:

- Apnea ventilation, page 86.
- ATC, page 89.
- Flow trigger, page 85.

These functions can be enabled via »Add. settings«.

NOTE: For setting alarm limits, see page 96.



* Please refer to page 205 for a detailed description of CPAP/P.Supp.

Setting Ventilation Mode Extensions

The ventilation modes can be combined with the following special functions to optimize ventilation:

- Flow trigger
- Apnea ventilation
- AutoFlow
- ATC
- Sigh
- PLV

Ventilation mode extensions are accessed through the »**Add. Settings**« screen key.

To view additional text information:

- Touch »?▲« screen key .

Ventilation mode	Special functions					
	Flow trigger	Apnea ventilation	AutoFlow	ATC	Sigh	PLV
CMV	X		X	X	X	X
SIMV	X	X	X	X		X
MMV	X		X	X		X
ILV Master	X			X	X	X
ILV Slave				X	X	X
PCV+	X	X		X		
PCV+Assist	X			X		
APRV		X		X		
CPAP/PSupp.	X	X		X		

To review, activate or set:

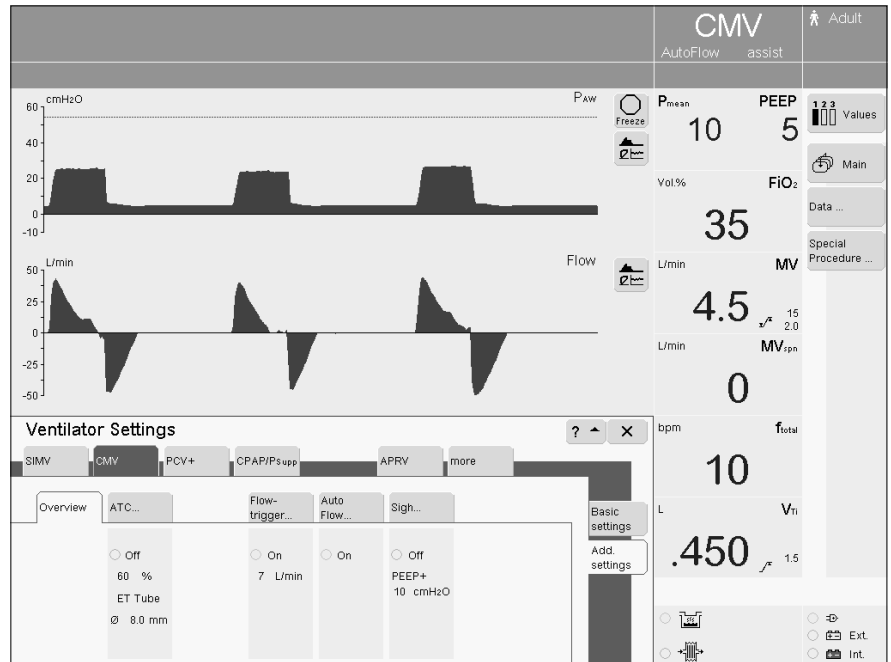
In the menu »Ventilator Settings«

- Touch »Add. settings« screen key.

EvitaXL displays the menu with the overview of supplemental settings available for the preselected or active ventilation mode.

Example:

Additional settings for CMV



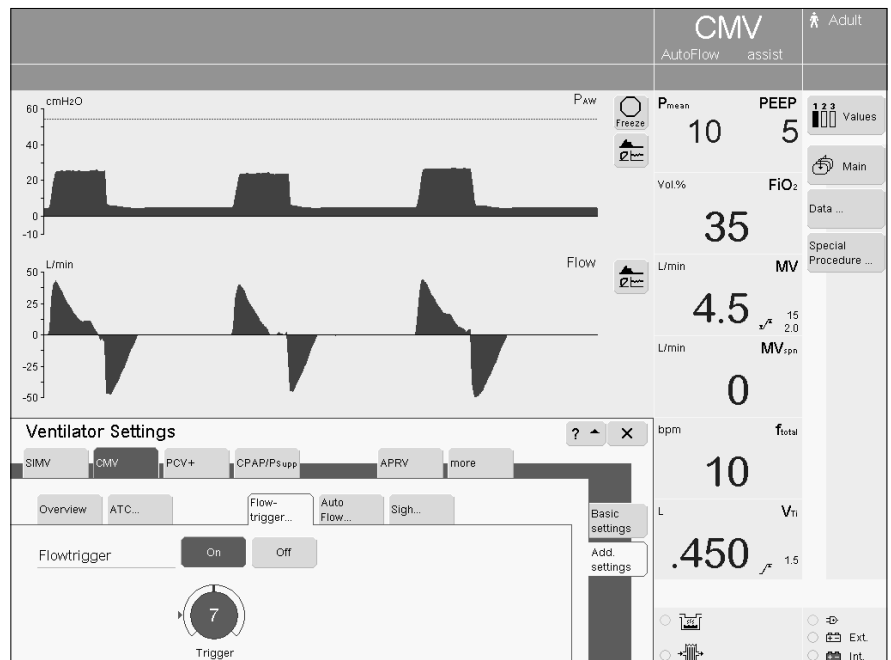
- Touch the respective screen key, e.g. »Flowtrigger...«

EvitaXL displays the menu for setting values and for activation/deactivation.

- Touch screen knob, turn dial knob to set, then press dial knob to confirm.

To activate/deactivate:

- Touch »On« or »Off« screen key respectively, then press dial knob to confirm.



Flow trigger

for synchronization with a patient's spontaneous breathing efforts. When the flow trigger is activated and a trigger level is set, mandatory ventilator breaths are synchronized with the patient's spontaneous breathing efforts. The patient's spontaneous breathing activity is indicated on screen by the brief appearance of a lung symbol instead of the symbol for patient mode.

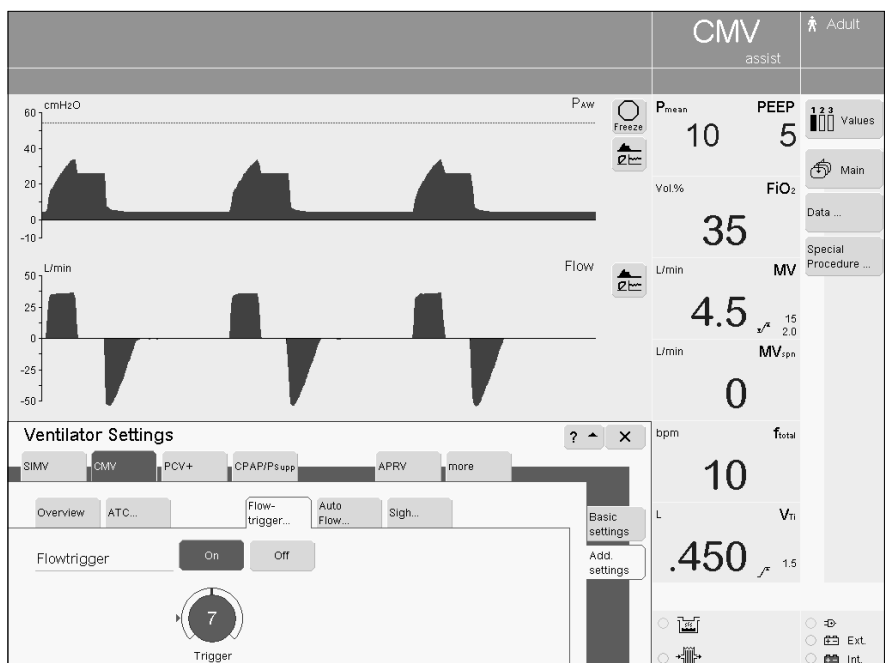
The flow trigger is set with the parameter »Flowtrigger« .

To set

- Touch »Add. settings« screen key in the respective ventilation mode. EvitaXL displays the possible supplemental settings.
- Touch »Flowtrigger...« screen key. EvitaXL displays the menu for setting the flow trigger.
- Touch »Trigger« screen knob. Turn dial knob to set, press dial knob to confirm.

To activate/deactivate the flowtrigger

- Touch »On« or »Off« screen key respectively, then press dial knob to confirm.



NOTE: The flow trigger may only be disabled in the CMV ventilation mode.

Apnea Ventilation

For automatically switching over to volume controlled mandatory ventilation if the patient stops breathing.

Apnea ventilation can be activated in the ventilation modes SIMV, PCV+, CPAP, and APRV.

EvitaXL renders an apnea alarm if either no expiratory flow is measured or insufficient inspiratory gas is delivered during the set apnea delay time $T_{Apnea} \sqrt{x}$ (adjustable, see "Setting Alarm Limits", page 96).

EvitaXL will then start volume controlled ventilation with the set ventilation parameters:

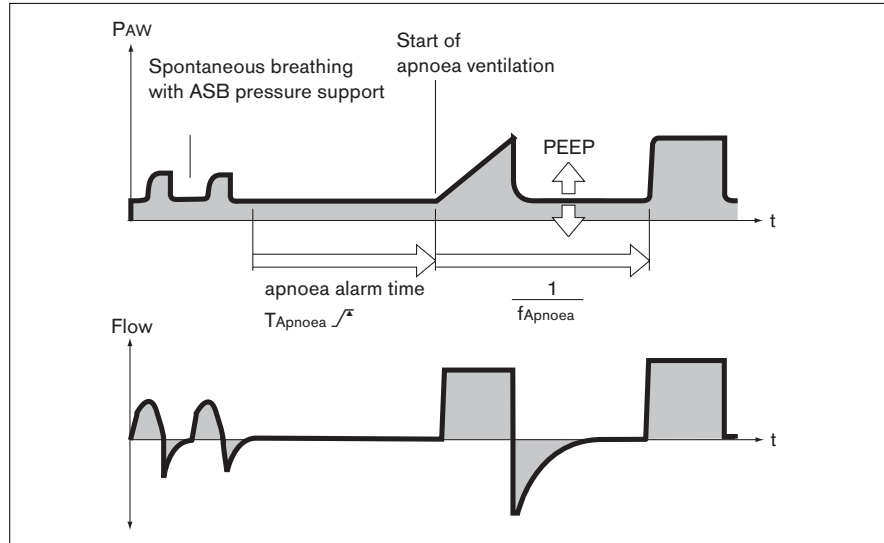
Ventilator rate »f«

Tidal volume »Vt«

The ventilation parameters »O₂« and »PEEP« will correspond to the settings effective at the time. Inspiratory time for apnea ventilation is determined from the set apnea ventilator rate »f« and a fixed I:E ratio of 1:2.

As in SIMV, the patient can breathe spontaneously during apnea ventilation, and mandatory ventilator breaths will be synchronized with the patient's spontaneous breathing.

Apnea ventilator rate remains constant.



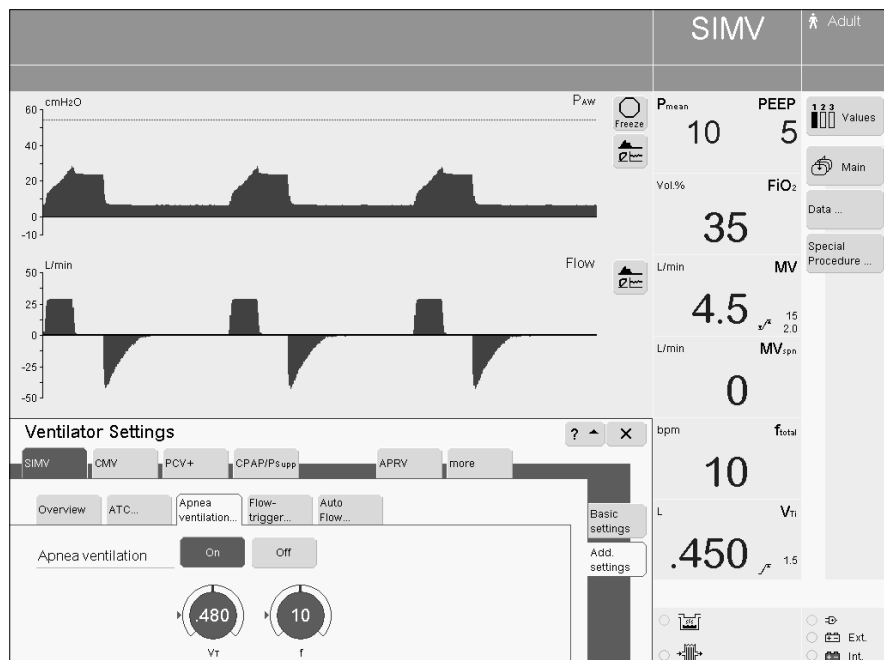
To set:

- Touch »Add. settings« screen key in the respective ventilation mode. EvitaXL displays the possible supplemental settings.
- Touch »Apnea ventilation...« screen key. EvitaXL displays the menu for setting apnea ventilation.
- Touch the screen knobs »Vt« and »f«, Turn dial knob to set, press dial knob to confirm.

To activate/deactivate apnea ventilation:

- Touch »On« or »Off« screen key respectively, then press dial knob to confirm.

EvitaXL displays the status of apnea ventilation on the main screen.



To terminate Apnea Ventilation:

- Press the »**Alarm Reset**« key: the ventilator will resume operating in its previous ventilation mode
or
- select another ventilation mode.

AutoFlow

for automatic control of "Insp. Flow" and "P_{insp}".

AutoFlow is used by the EvitaXL to decelerate and control inspiratory flow by providing a constant pressure throughout the inspiratory phase. The ventilator determines the lowest peak pressure for the selected V_T and the patient compliance, thereby avoiding pressure peaks.

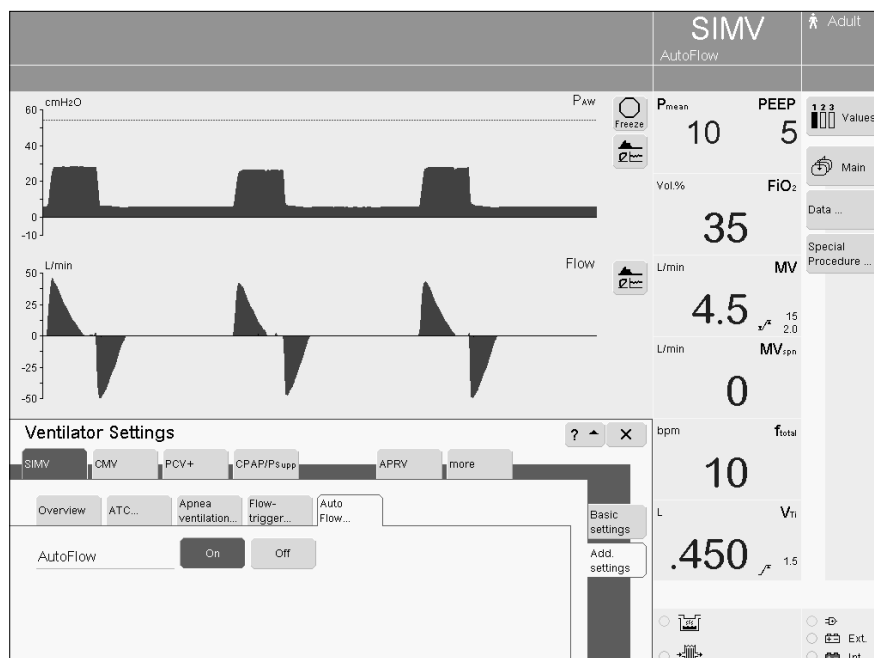
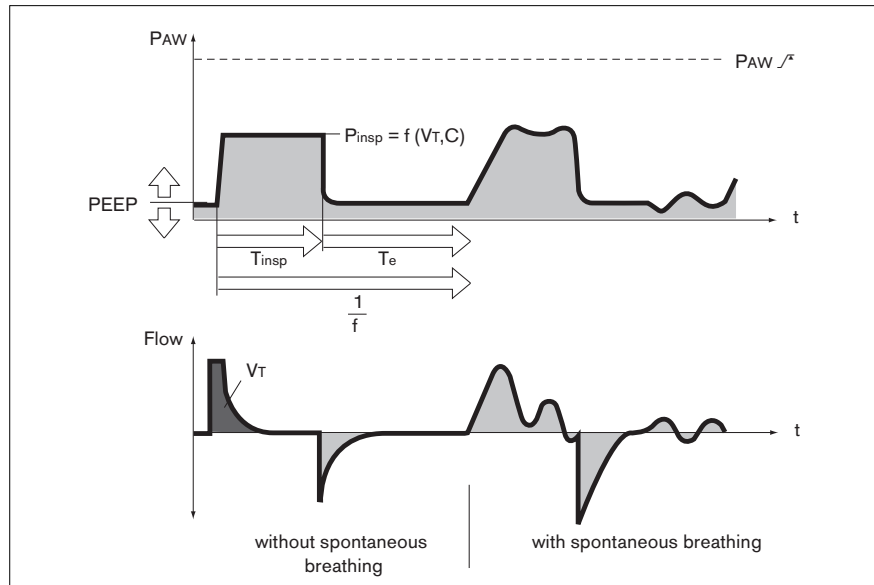
EvitaXL delivers additional inspiratory flow when the patient breathes in – this flow is limited by the set alarm limit V_{Ti}. The patient can also breathe out during the inspiratory plateau phase. Inspiratory pressure is limited by the alarm limit P_{AW}.

WARNING !

Always set the alarm limit »P_{AW} $\sqrt{\text{f}}$ « in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.

WARNING !

When using AutoFlow, always set alarm limits MV $\sqrt{\text{f}}$ and MV $\sqrt{\text{f}}$ in order to avoid excessive or insufficient flow following rapid changes in compliance.



To set:

- Touch »Add. settings« screen key in the respective ventilation mode. EvitaXL displays the possible supplemental settings.
- Touch »AutoFlow...« screen key.

To activate/deactivate AutoFlow:

- Touch »On« or »Off« screen key respectively, then press dial knob to confirm.

EvitaXL displays the status of AutoFlow on the main screen.

ATC

Automatic Tube Compensation *

Automatic compensation of the tube resistance

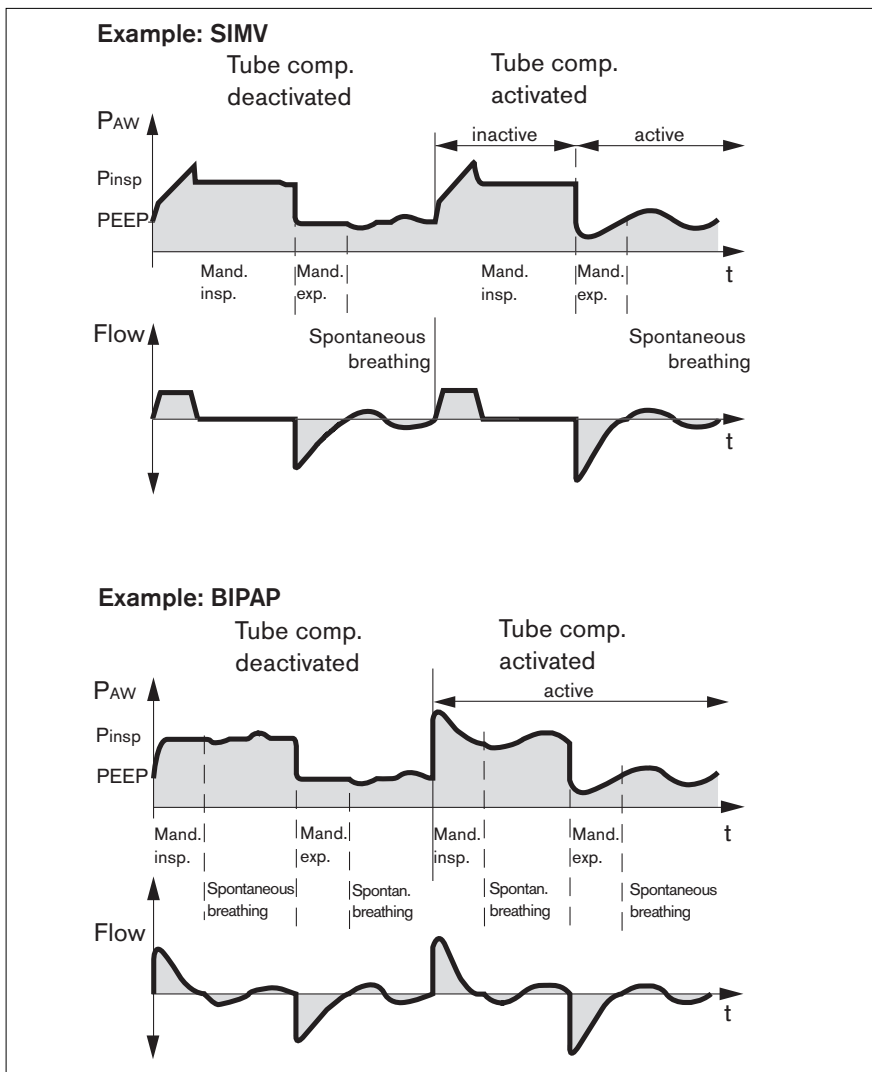
Supplementary function allowing ventilation pressure in the patient circuit to be increased during inspiration and to be decreased during expiration. Airway pressure is adjusted to the tracheal level if 100 % compensation of the tube resistance has been selected.

Automatic tube compensation is active during:

- spontaneous breathing
- pressure supported breathing
- pressure controlled mechanical ventilation
- volume controlled mechanical ventilation with ventilation mode extension "AutoFlow" activated.

Expiratory tube compensation may be independently deactivated.

In volume controlled ventilation modes with constant inspiratory flow (CMV, CMVAssist, SIMV, MMV), automatic tube compensation is only active during expirations following mechanical breaths and phases of spontaneous breathing.



Parameters to be set for ATC:

Tube mode »ET« (endotracheal tube) or »Trach.« (tracheotomy tube)

Inside tube diameter »ID Ø« in mm

Degree of tube compensation

»Comp.« in %

Tube compensation »On«/»Off«

* Please refer to page 209 for a detailed description of ATC.

To set:

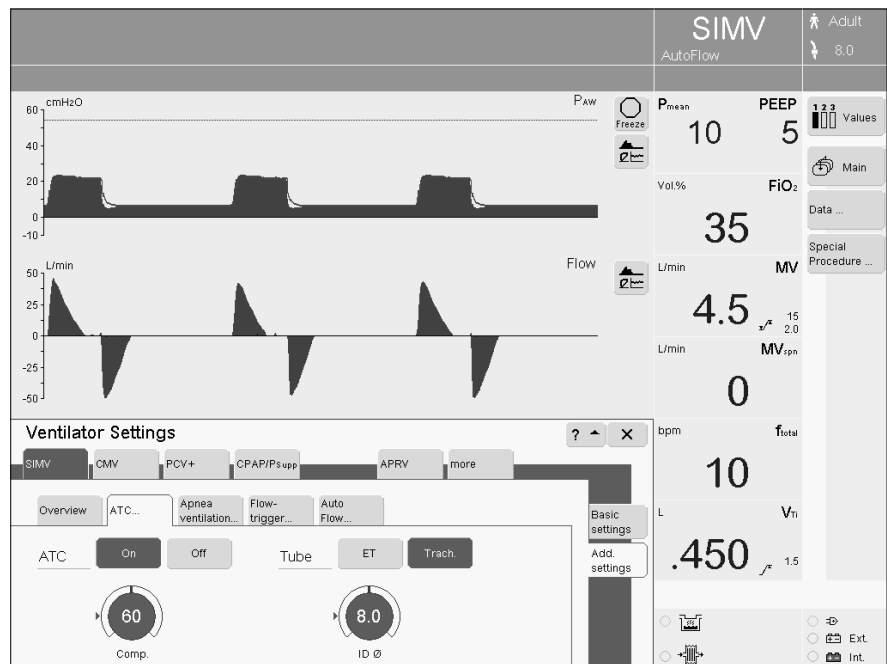
- Touch »Add. settings« screen key in the respective ventilation mode. EvitaXL displays the possible supplemental settings.
- Touch »ATC...« screen key. EvitaXL displays the menu for setting automatic tube compensation.


Select tube type:

- Touch »ET« or »Trach.« screen key, respectively.
- Touch »ID Ø« screen knob, turn dial knob to set value, press dial knob to confirm.
- Touch »Comp« screen knob, turn dial knob to set value, press dial knob to confirm.

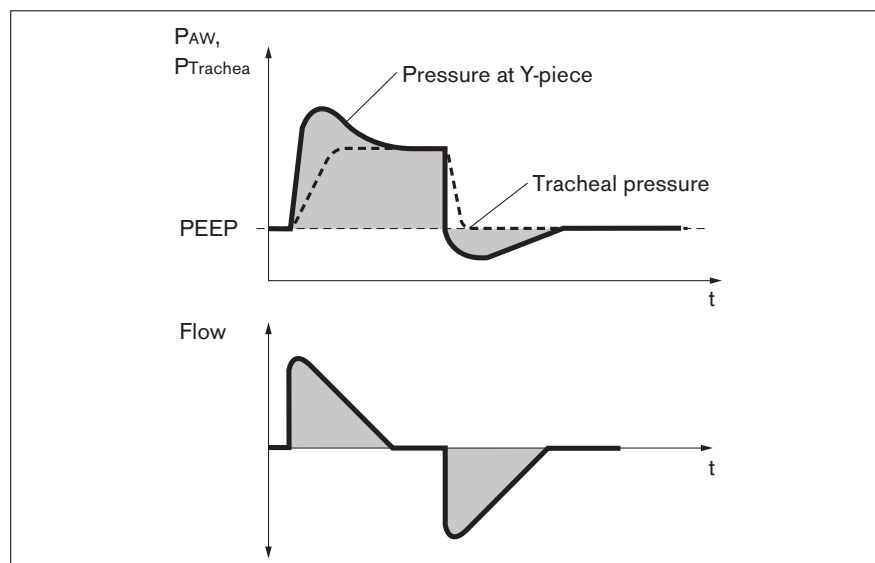
To activate/deactivate ATC:

- Touch »On« or »Off« screen key respectively, then press dial knob to confirm.



EvitaXL indicates activated tube compensation by showing a tube symbol  and the tube diameter in the status line.

When tube compensation is activated, EvitaXL calculates tracheal pressure on the basis of the selected tube (regardless of the degree of compensation selected). This value is then displayed as a green line in the pressure waveform together with the pressure at the Y-piece.

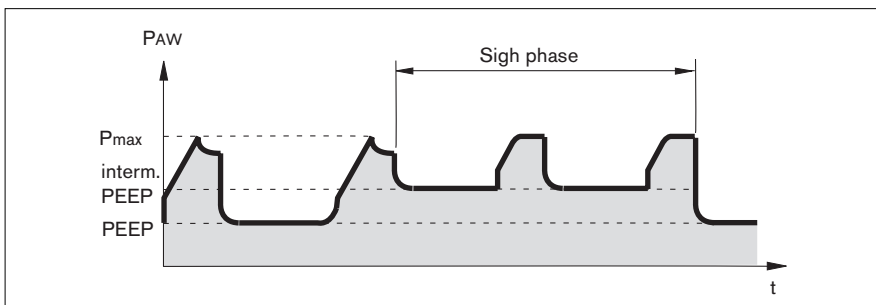


Sigh

Atelectasis can be prevented by activating the Sigh function* and setting sigh breaths in the form of an intermittent PEEP.

When the Sigh function is activated, end-expiratory pressure increases by the set value of intermittent PEEP for two ventilator breaths every 3 minutes.

Sigh is set with the parameter: intermittent PEEP »**int.PEEP**«.

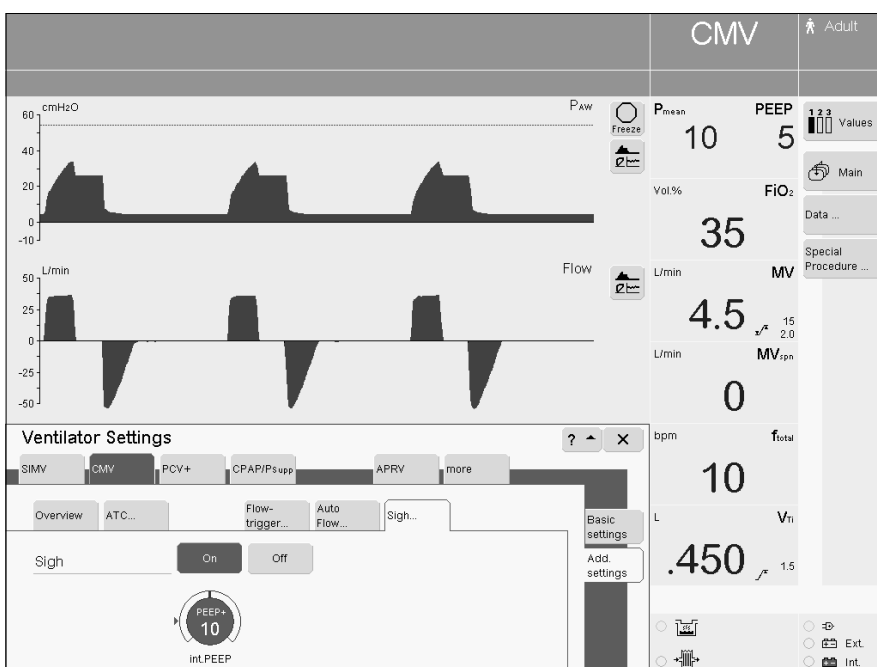


To set:

- Touch »**Add. settings**« screen key in the respective ventilation mode. EvitaXL displays the possible supplemental settings.
- Touch »**Sigh...**« screen key. EvitaXL displays the menu for setting the Sigh function.
- Touch »**int.PEEP**« screen knob, turn dial knob to set value, press dial knob to confirm.

To activate / deactivate the Sigh function:

- Touch »**On**« or »**Off**« screen key respectively, then press dial knob to confirm.



* Please refer to page 200 for a detailed description of the Sigh function.

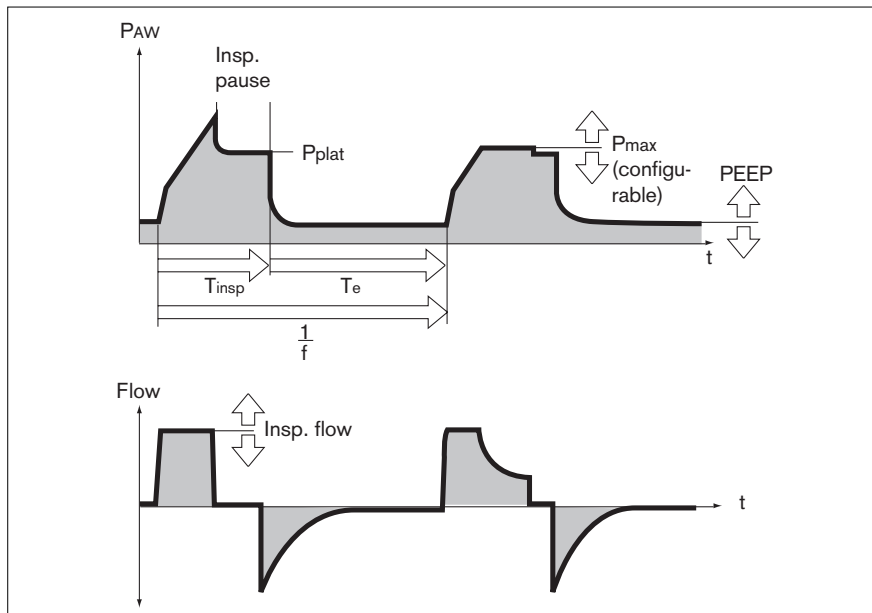
PLV*

Pressure Limited Ventilation

Supplementary function for adjustable limitation of pressure peaks using the P_{\max} pressure limit in ventilation modes CMV, SIMV, MMV and ILV.

Tidal volume remains constant as long as the pressure waveform shows a plateau and the flow waveform shows a brief flow pause between inspiration and expiration.

- Activate/deactivate pressure limitation P_{\max} , see "Setting start-up defaults for O2, I:E, pressure ..." on page 142.



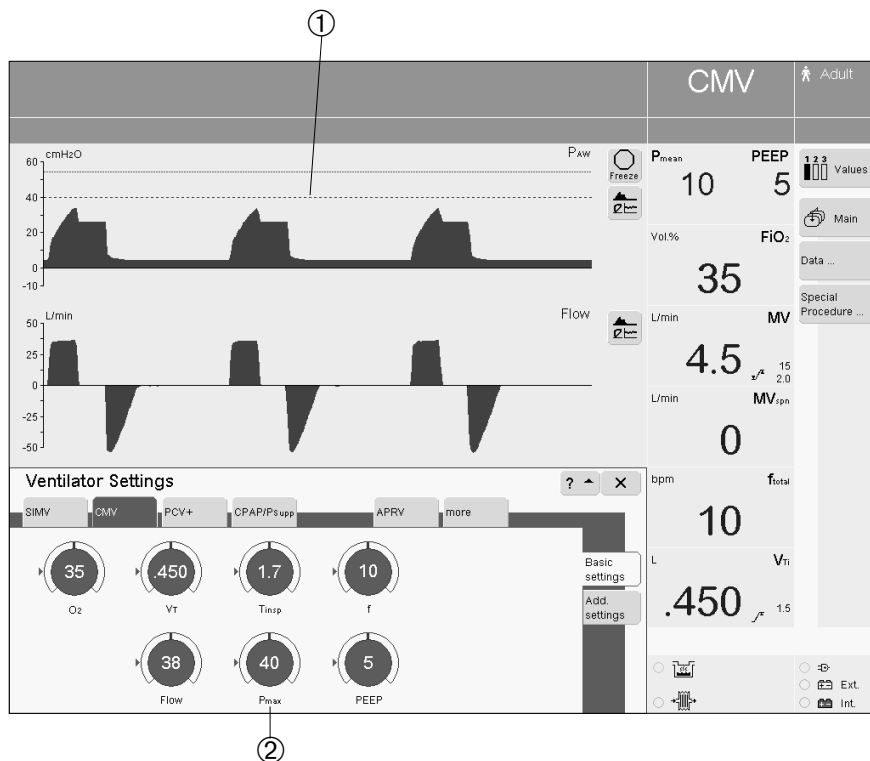
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- 1 When pressure limitation is active, the value for P_{\max} is shown in the real-time waveform of PAW (t) as a blue line.

- 2 The screen knob » P_{\max} « is additionally displayed in the menu »Ventilator Settings«.

Volume monitoring is active. The alarm **Vol. not constant, pressure limited!!** is automatically triggered if the tidal volume V_T can no longer be applied. This visual and audible alarm may be muted with the »Alarm Reset« screen key at the top of the screen until the cause of the alarm is remedied.

Set PLV with » P_{\max} «.



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* Please refer to page 198 for a detailed description of PLV.

NIV Mask Ventilation (Available Option)

Non-Invasive Ventilation

Application mode »Mask« for ventilation with a nasal or facial mask to support non-invasive ventilation of patients with spontaneous breathing.

Choose between mask ventilation and regular ventilation of intubated patients.

WARNING !

Installation of the EvitaXL NIV option should only be performed by DraegerService or factory trained and authorized service personnel.

Using NIV

WARNING !

Precautions when using mask ventilation.

- Never ventilate an intubated patient in »Mask/NIV« mode
- In MASK/NIV« mode, the alarm system is adapted to mask ventilation. Make sure that only patients are ventilated in this mode who can breathe sufficiently on their own, especially when alarms have been manually disabled.
- When masks are used, dead space increases.
- Always follow the mask manufacturer's directions to properly deal with the increased dead space caused by the mask.
- Apnea cannot always be detected reliably. SpO₂ monitoring must be used if available.
- Avoid high airway pressures. Risk of aspiration.
- After changing from »Mask« mode to »Tube« mode, always check and adjust alarm limits and ventilator settings if necessary to ensure that ventilation is monitored comprehensively.

All ventilation modes except »ILV« can be selected in »Mask« mode.

NOTE: Automatic tube compensation (option ATC) activated in »Tube« mode is not in effect in »Mask« mode.

Operation


Using NIV

Selecting »Mask« mode

»Mask« mode can be selected when switching on or during operation.

- Press » **Start/Standby**« key.

In the menu »**Start/Standby**«:

- Touch »**Standby**«, screen key, it will turn yellow.
- Press dial knob to confirm. The key turns green and the ventilator is now in standby mode.
- Touch the screen key »**Tube/Mask**« and
- touch » **Mask (NIV)**«, screen key. The key turns yellow.
- Press dial knob to confirm. The key turns green and the ventilator is now in »**Mask**« mode.



Setting ventilation parameters for NIV

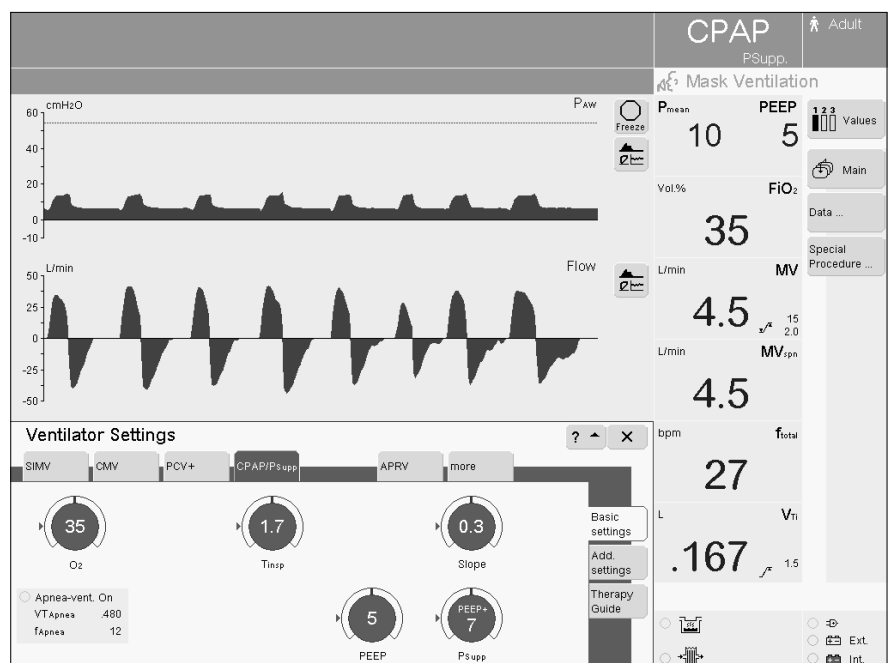
- As described for »**Tube**« mode.

An additional screen knob »**Tinsp**« is displayed for CPAP/PSupp.

EvitaXL limits the maximum duration of a pressure supported breath to 4 seconds in »**Adult**« patient mode and to 1.5 seconds in patient mode »**Ped.**«.

- The maximum duration of a pressure supported ventiator breath can be limited with the »**Tinsp**« screen knob.

»**Tinsp**« also limits the duration of pressure supported breaths in the other ventilation modes which can be combined with Pressure Support.



Monitoring in »Mask« mode**WARNING !**

Only switch off alarms if the safety of the patient will not be compromised by the absence of an alarm.

The operator of the ventilator system must still assume full responsibility for proper ventilation and patient safety in all situations.

The following alarms may be deactivated in order to avoid artifacts:

- **MV** ✓ , lower alarm limit, minute volume
- **V_{Ti}** ✓ , upper alarm limit, inspiratory tidal volume
- **T_{Apnea}** ✓ , upper alarm limit, apnea monitoring
- For activating/deactivating alarms, see "Setting Alarm Limits" on page 96.

An advisory message is constantly displayed in the alarm field if an alarm limit has been deactivated.

EvitaXL automatically selects the configured default alarm limits when changing over to »Tube« application mode.

A time-lag »T_{Disconnect}« between 0 and 60 seconds can be set for the alarm limit PAW ✓ (airway pressure low).

The following alarms are not displayed by EvitaXL in »Mask« mode:

- **PS > 4 s**
- **PS > 1.5 s**
- **PS > T_{insp}**
- **Leakage**

WARNING !

Always check and restore alarm limits and ventilator settings after changing from »Mask« to »Tube« mode in order to ensure comprehensive ventilation monitoring.

Leak compensation in »Mask« mode

Depending on the selected patient mode, EvitaXL compensates for leaks up to the following values in order to detect a patient trigger:

Adult mode: 30 L/min
 Pediatric mode: 15 L/min

EvitaXL compensates for calculated leaks of up to 200 % of the set tidal volume, but not more than max. 2 L (regardless of the patient mode).

Setting Alarm Limits

- Press key » $\sqrt{\text{f}}$ Alarm Limits«.

EvitaXL displays the »Alarm Limits« menu.

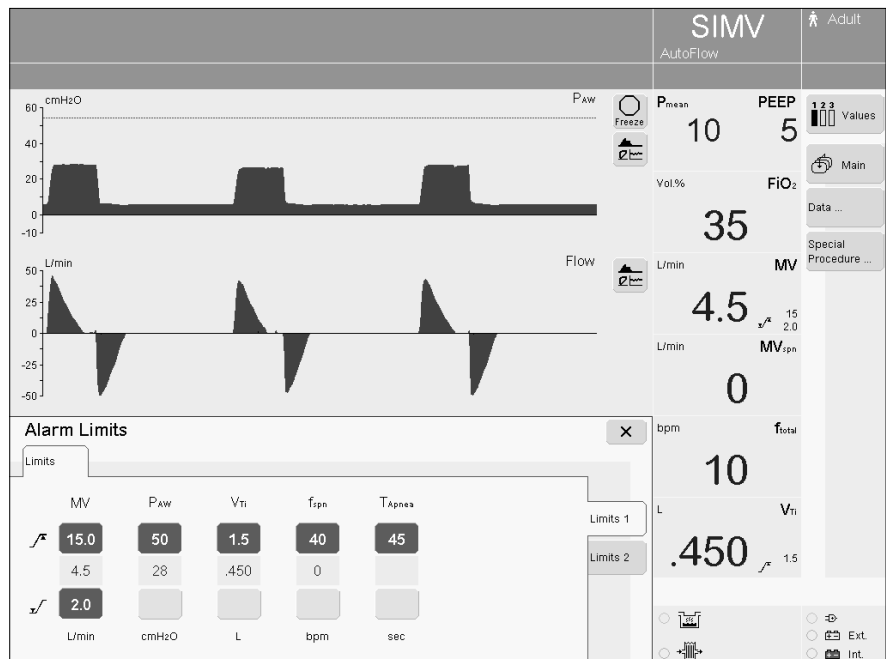
$\sqrt{\text{f}}$ = Upper alarm limit

$\sqrt{\text{f}}$ = Lower alarm limit

The values for the upper and lower alarm limit shown in the screen keys are initial values which are in effect whenever the ventilator is switched on. However, these defaults can also be configured specifically as required by hospital protocol, see "Configuration", page 143. The actual measured value is displayed between the upper and lower alarm limits.

To set:

- Touch the respective screen key, it will turn yellow,
- turn dial knob to set, press dial knob to confirm.

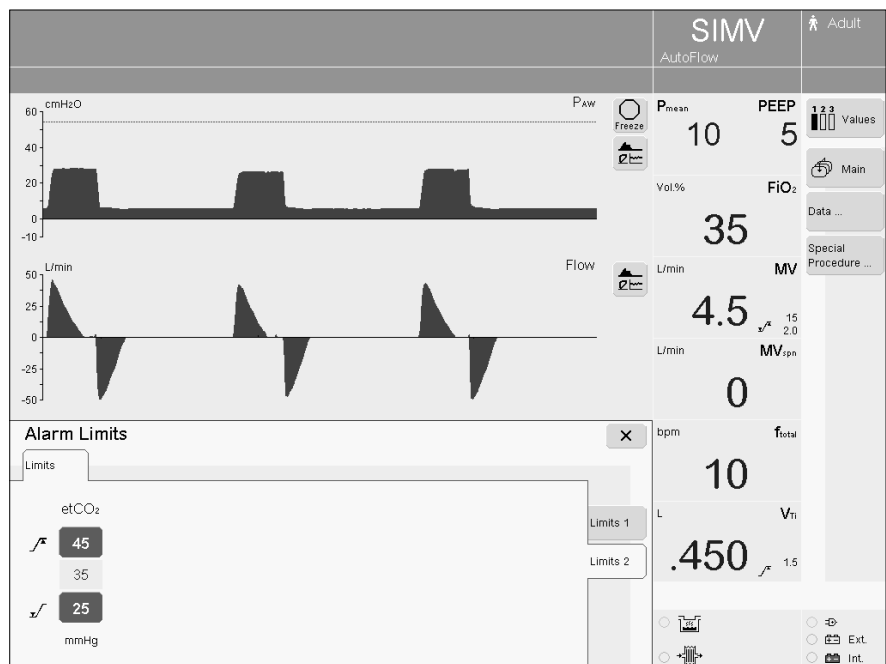


Alarm limits for the optional measured value etCO₂ can be viewed by touching "Limits 2".

- Touch »Limits 2« screen key.

To deactivate (MV $\sqrt{\text{f}}$ for example):

- Reduce »MV $\sqrt{\text{f}}$ « until the following advisory message is displayed: »MV $\sqrt{\text{f}}$ off? Press and turn rotary knob«
- Press dial knob to confirm the advisory message.
- Continue turning dial knob until dashes (--) appear on the display for the alarm limit.
- Press dial knob to confirm.



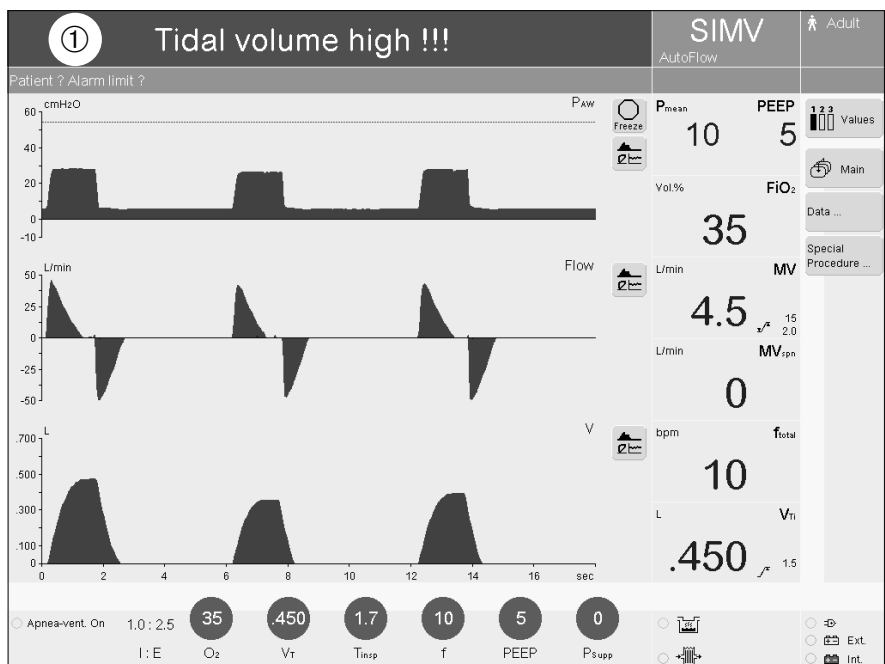
In the Event of an Alarm

- 1 A message corresponding with the alarm event is displayed in the top left-hand line of the screen.

Example:

Tidal volume high !!!

EvitaXL assigns the alarm message its respective priority, accordingly marks the text with exclamation marks and differently colored backgrounds, and generates the corresponding alarm tone sequences.



Warning = top priority message

Warnings are identified by three exclamation marks and appear against a red background.

Example: **Tidal volume high !!!**

EvitaXL generates a 5-tone sequence that is sounded twice and repeated every 7 seconds.

Caution = medium priority message

Cautions are identified by two exclamation marks and appear against a yellow background.

Example:

O2 supply pressure high !!

EvitaXL generates a 3-tone sequence which is repeated every 20 seconds.

Advisory = low priority message

Advisory messages are identified by one exclamation mark and appear against a yellow background.

Example:

Fan malfunction !

EvitaXL generates a 2-tone sequence which is sounded only once.

- Remedy the fault, refer to the troubleshooting list on page 164.

Operation

In the Event of an Alarm

The alarm tone ceases automatically when the fault has been remedied. Cautions and advisory messages disappear automatically.

Warnings (!!!) appear in the color of the status line and must be acknowledged:

- Touch »Alarm Reset« screen key.

The message is deleted from the screen. However, it is saved in the ventilator and can be displayed in the logbook on the "Data" screen via the logbook function, see page 104.




Power failure alarm


If the loudspeaker for generating audible alarms fails due to a fault, a continuous tone will be generated by an auxiliary enunciator. The same continuous tone also draws attention to a power failure (see "Temporary Interruption of Power Supply" on page 44).

Cancel alarm tone

for max. 2 minutes:

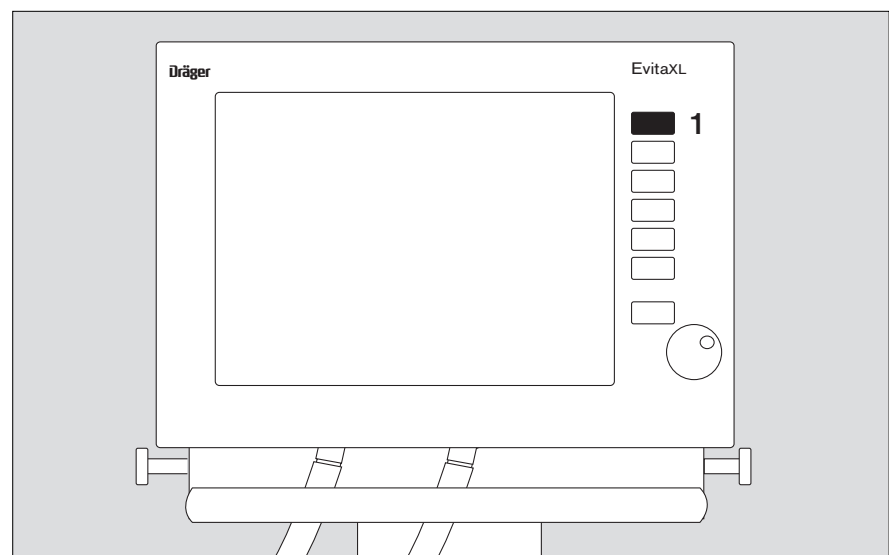
- 1 Press the »« key with the lit yellow indicator LED. The audible alarm will be cancelled for 2 minutes. If the fault that triggered the alarm is still not remedied at that time, the audible alarm starts again.

If you wish to reactivate the audible alarm temporarily:

- 1 Press »« key (with the yellow LED now switched off) again.

Acknowledge:

- Press »Alarm Reset« to acknowledge the alarms that can be suppressed with »Alarm Reset«: please refer to "Troubleshooting" on page 164.




Displaying Graphics

The following real-time waveforms can be displayed:

- PAW (t)
- Flow (t)
- Volume (t)
- etCO₂ (t) (optional)
- or
- a real-time waveform combined with a short trend

- Touch »  **Main**« screen key.

To select a different real-time waveforms:

- Touch the respective screen key »  « and EvitaXL displays the »**Curves**« menu.
- Touch the screen key »**Curve only**«.
- Touch screen key for the desired real-time waveform parameter.
- EvitaXL displays the real-time waveform for this parameter. The menu disappears automatically.
- To freeze real-time waveforms, see "Freeze" on page 100.

To display a real-time waveform in combination with a short trend:

In the menu »**Curves**«

- Touch »**Curve + Shorttrend**« screen key.

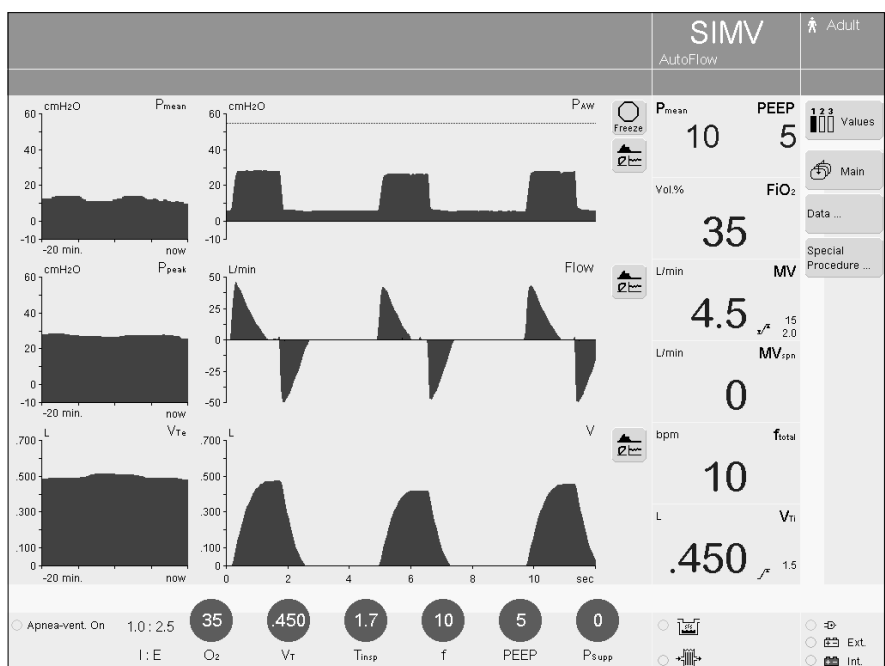
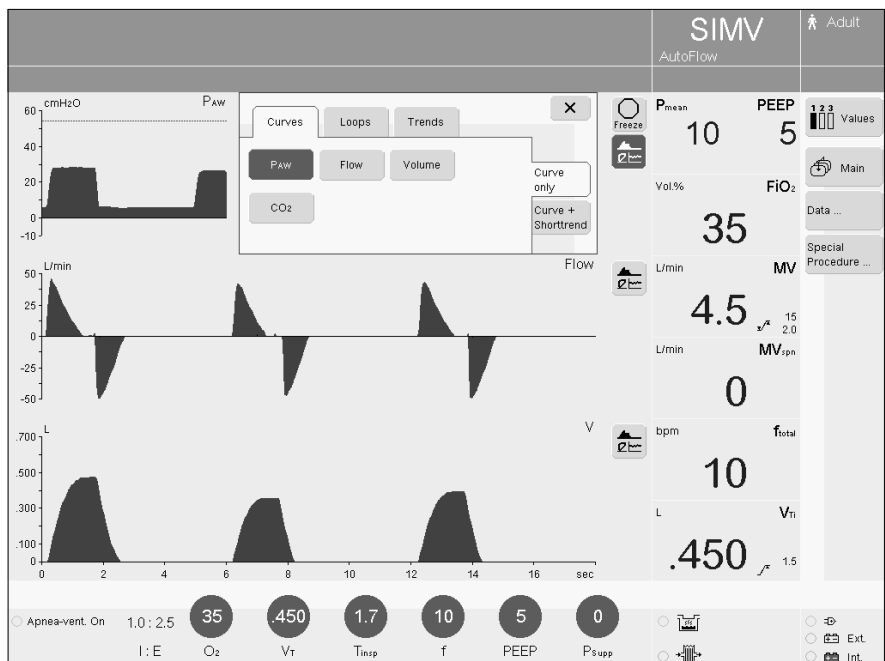
The respective real-time waveform may be combined with the short trend for any parameter to be selected.

The selected real-time curve is displayed in the menu, the screen key of the selected short-trend parameter appears in dark green.

- Touch screen key of the desired parameter to be assigned for the short trend.

EvitaXL displays the associated parameter as a short trend of the last 20 minutes on the left, next to the real-time waveform.

The other two real-time waveforms are also automatically combined with a short trend. If no new parameters have been selected for the short trends, EvitaXL will display the parameters previously selected for the short trend.




Operation

Displaying Graphics

Freeze

To freeze a current real-time waveform or loop.


- Touch » **Freeze**« screen key – it turns dark green with a red symbol. The momentary waveforms and loops are recorded and then stop.

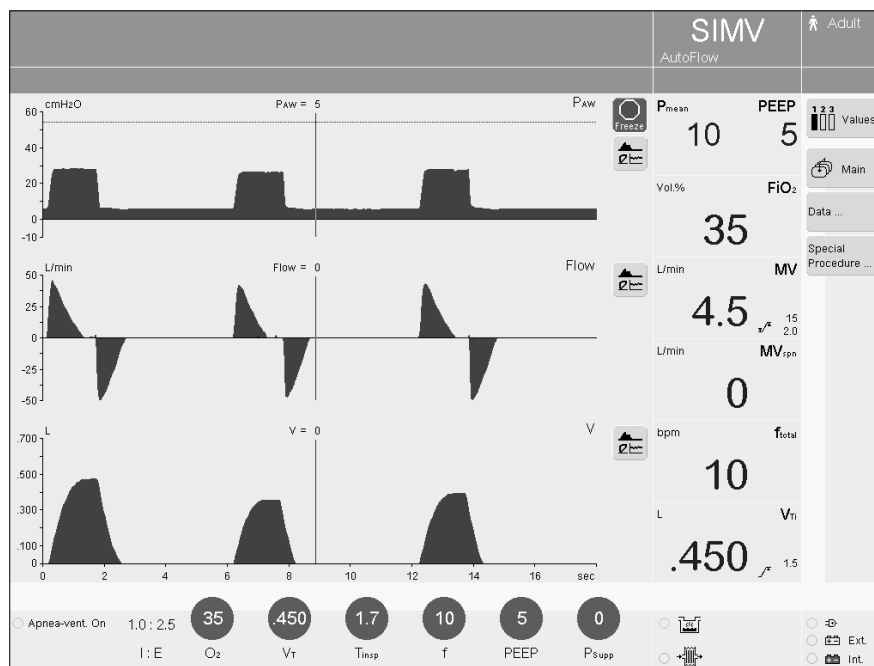
To view a waveform value at a certain point in time or a pair of values in a loop:

- Turn dial knob to position the cross-hair cursor over the required point and the corresponding measured value or pair of values will be displayed above or beside the waveform or loop, respectively.

EvitaXL ends freeze mode automatically three minutes after touching the screen key or three minutes after the dial knob was last turned.



To continue viewing new waveforms/loops:

- Press » **Freeze**« screen key again – the current waveforms or loops are once again recorded.



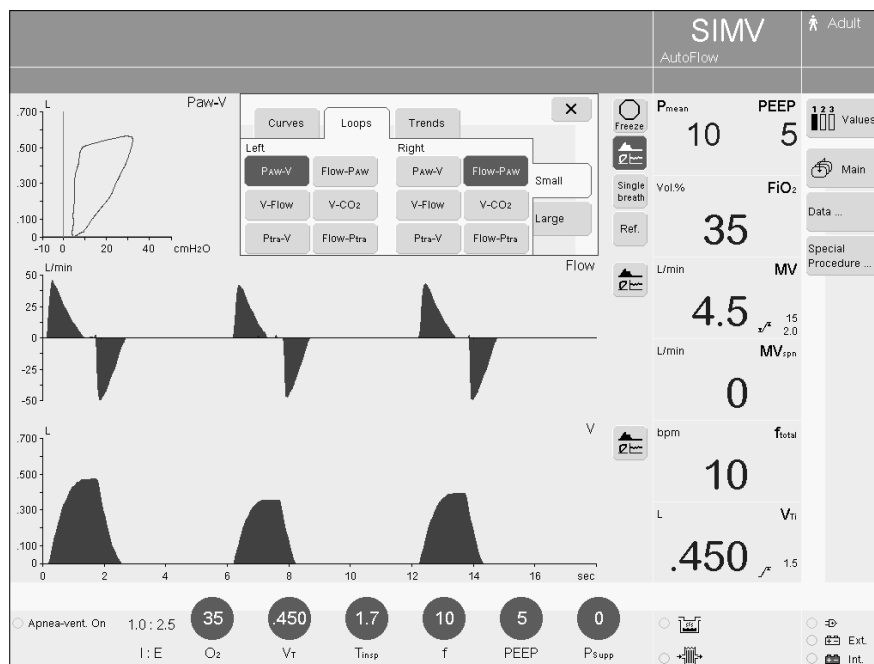
Displaying loops

This mode is used to display two measured values which appear as a loop for each ventilation cycle, such as the PAW-V loop or the Flow-V loop.

- Touch » **Main**« screen key .
- Touch the respective screen key »«.
- Touch »**Loops**« screen key. EvitaXL displays the »**Loops**« menu.

Loops may be displayed in different configurations:

- Two small loops, one on the left, the other one on the right
- or:
- An enlarged loop on the left.



To display small loops:

- Press »**Small**« screen key.

To display a large loop:

- Press »**Large**« screen key.

Select the desired parameter combination:

- Touch screen key for the desired parameter combination.

A list of possible combinations is displayed on the screen.

- Select and confirm parameter combination with the dial knob.

All loops for a breath cycle are recorded by the ventilator. In SIMV mode, this will include, e.g., both the loop for a mandatory ventilator breath as well as the loop for a spontaneous breath, if any.

To display a single loop:

- Touch the screen key »**Single breath**« – EvitaXL will redraw every single loop.

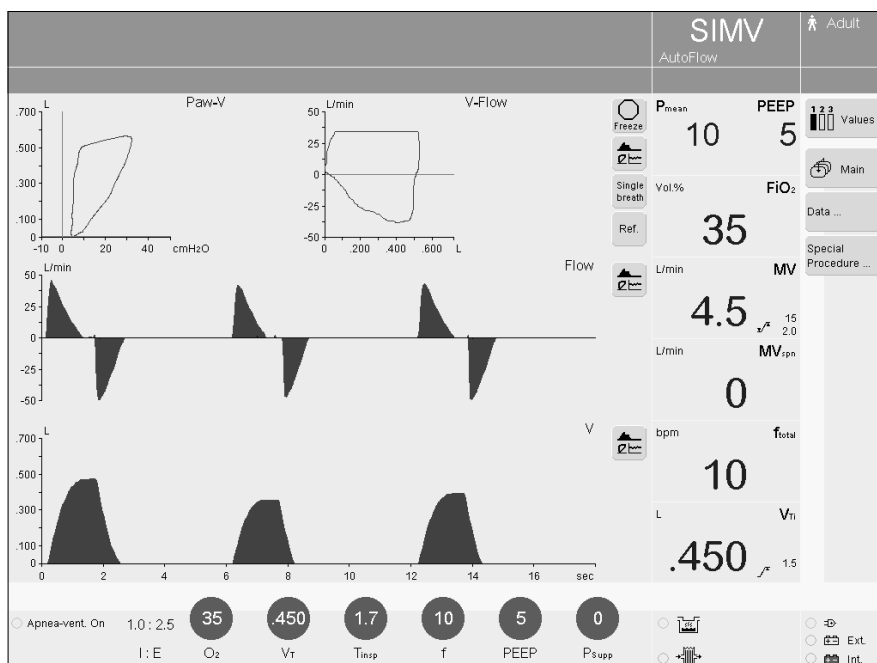
To display a reference loop:

- Touch »**Ref.**« screen key at the desired time to record a reference loop.



The reference loop is drawn in blue and appears continuously in the current loop display. The time at which the reference loop was recorded appears on the left, beside the »**Ref.**« key.

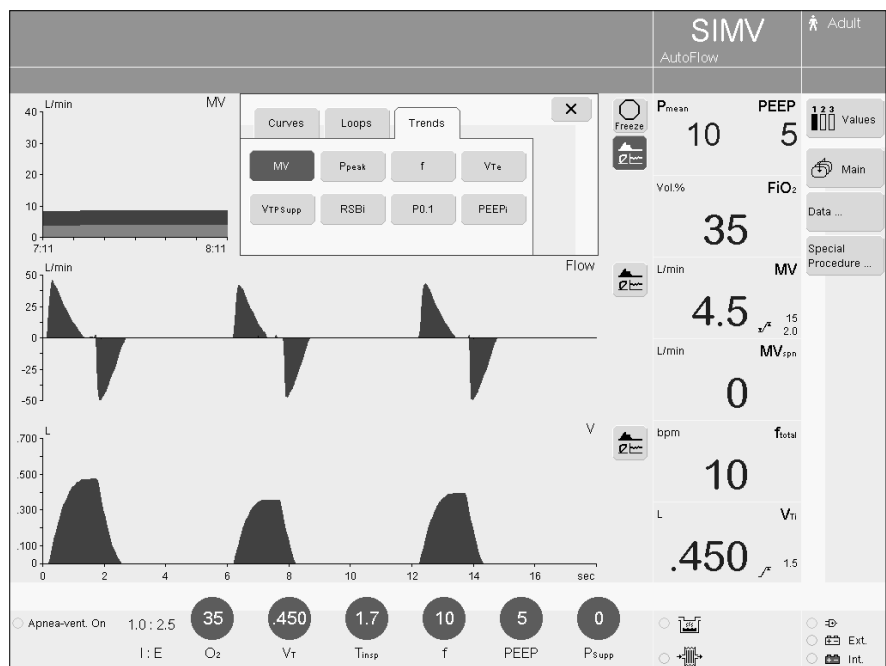
- To freeze loops, see "Freeze", page 100.

The »**Ref.**« screen key is not in effect when the loop has been frozen using »**Freeze**«.



Displaying 1 hr trends


- Touch »  **Main**« screen key.
- Touch the desired »  « screen key.
- Touch »**Trends**« screen key.
EvitaXL now shows a menu for selecting parameters for the display of trends.

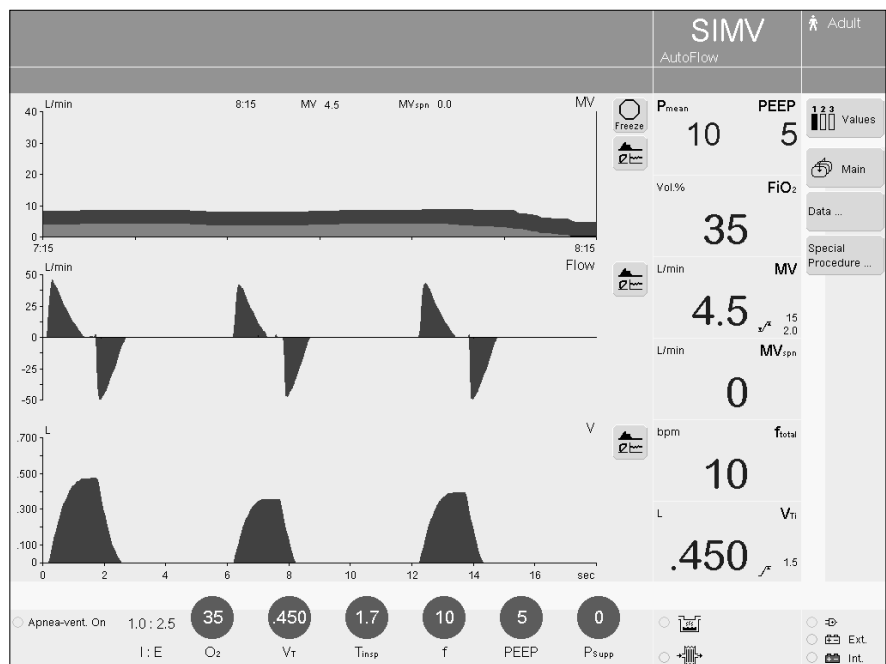


- Touch the desired parameter key.
EvitaXL displays the trend for selected parameters over the last one hour.

To view a value in the trend at a certain point in time:

- Turn dial knob to position the cross-hair cursor over the desired point.
The value is displayed at the top in the trend display.

NOTE: The cross-hair cursor cannot be moved if the trend has been halted with » **Freeze**«.



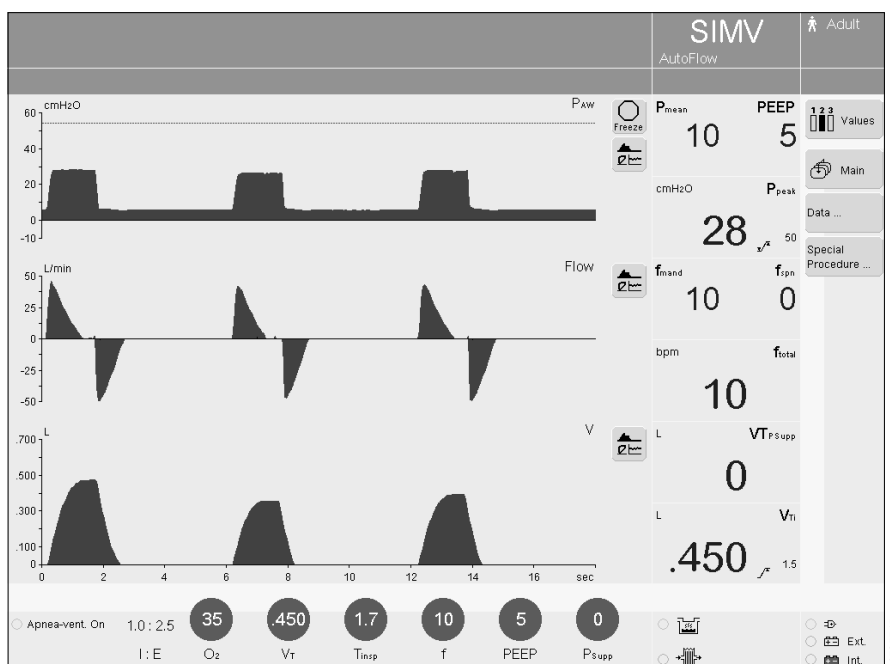
Displaying Measured Values

- Touch »**1 2 3 Values**« screen key, shown on the right of the screen. The bar in the key representing the selection (1, 2, or 3) of main numerical values and active alarm limits turns black.

EvitaXL offers two other selections:

- Touch »**1 2 3 Values**« screen key again. The bar in the key representing the next selection turns black and EvitaXL displays the corresponding values.
- Proceed accordingly to view the third selection.

The three selections are factory configured, however they may also be re-configured as required by hospital protocol, see "Configuration", on page 135



Display all measured values and settings

EvitaXL displays all measured values and settings in two tables for facilitating documentation. Values and settings for listing according to a specific hospital protocol may be compiled in a third table, see "Configuration", on page 135.

- Touch »**Data...**« screen key. EvitaXL displays the »**Data**« menu with its »**Values**« submenu.

The table of hospital-specific values and settings is displayed as the default and the screen key »**Custom. Table**« is white.

To select table 1 or table 2:

- Touch »**Table 1**« or »**Table 2**« screen key, respectively.
- Touch »**x**« screen key to close the table.



Displaying the Logbook

EvitaXL records setting changes, events and alarms and lists them in chronological order with the date and time of occurrence.

Changes are displayed with the former and new settings (example: 5 cmH2O -> 7 cmH2O).

Events include, for instance, use of a nebulizer, flow calibration, etc.

Alarms are recorded in the form displayed by EvitaXL at the time of occurrence. Other alarms, which are triggered with the displayed alarm but are not themselves displayed in the field for alarm messages, are identified by an asterisk (*) preceding their entry in the logbook.

To display the logbook:

- Touch »Data...« screen key, the »Data« menu is displayed.
- Touch »Logbook« screen key, EvitaXL displays the logbook.

When a time is highlighted in the trend display (page 105), the line corresponding to that time is highlighted in yellow in the logbook.

With every recorded change in settings, EvitaXL displays the complete list of new settings for the ventilation mode in effect at the time indicated in the highlighted line.

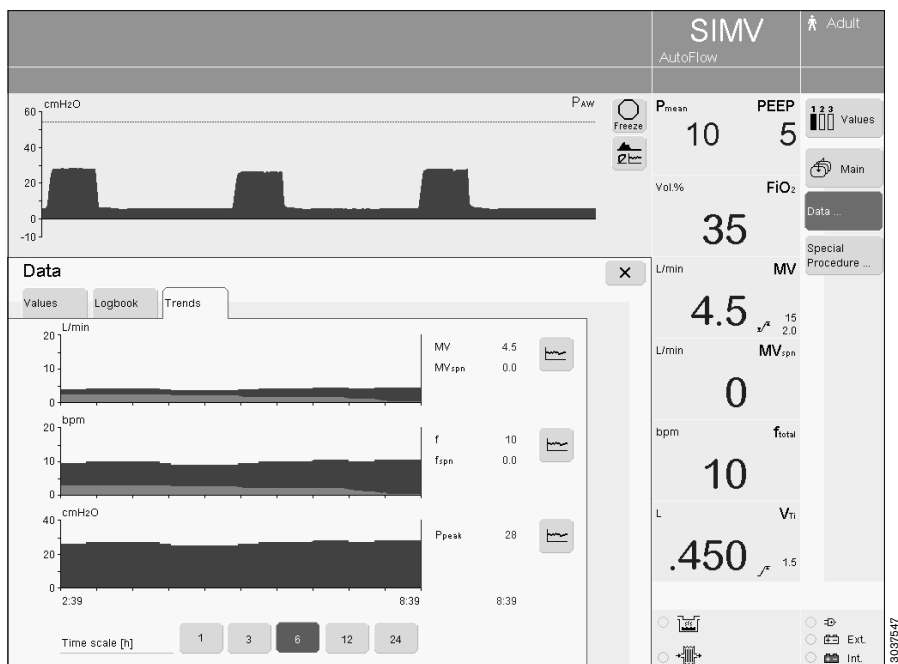
To view all settings for another line entry:

- Turn dial knob to select the desired line.
- Touchy »X« screen key to close the logbook.




Displaying Trends (1-24 hr)

- Touch »Data...« screen key.
- Touch »Trends« screen key.
EvitaXL displays three trends with a common time scale, one below the other.




To select a parameter or parameter combination desired for the trend display:

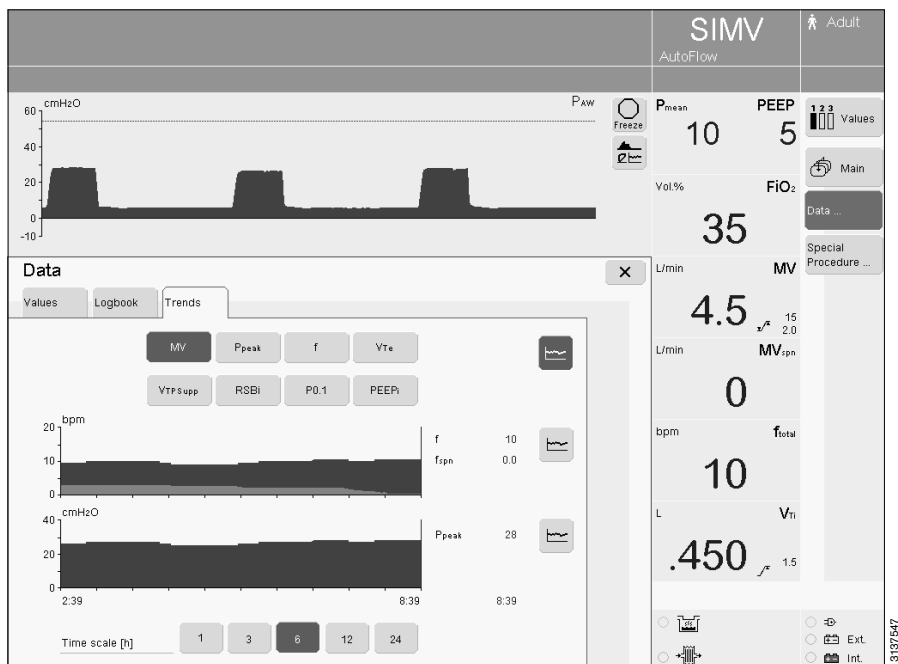
- Touch the respective screen key »«. The menu for trends is displayed.
- Touch the screen key for the desired parameter/parameter combination. Its trend is displayed and the menu disappears.

Select the common time scale in increments, as 1, 3, 6, 12, 24 hr:

- Touch screen key for the desired time scale. The key turns green and the selected time scale is now in effect.

Display a value in the trend for a certain point in time:

- Turn dial knob to position the cross-hair cursor over the desired point in time. The value is displayed on the left, beside the »« screen key.
- Touch »X« screen key to close the trend display.



Special Functions

Nebulizing aerosols

During ventilation in adult mode

Applicable in every ventilation mode. EvitaXL applies pharmaceutical aerosols synchronized with inspiratory flow while maintaining a constant minute ventilation. Depending on the O₂ concentration set, the ventilator supplies the nebulizer with air, oxygen, or a mixture of air and oxygen. Deviations from the set O₂ concentration are thus kept as low as possible.

NOTE: In extreme cases (with a minimum inspiratory flow of 15 L/min), the deviations can be up to ± 4 Vol.%. In order to avoid greater deviations, the nebulizer is switched off at inspiratory flows below 15 L/min.

During ventilation in pediatric mode

Nebulizing of medication aerosols is possible in pressure controlled ventilation modes.

In volume controlled ventilation modes nebulizing is only possible while using the AutoFlow[®] ventilation mode extension.

In contrast to nebulizing in adult patient mode, aerosol is delivered continuously in pediatric mode. Aerosol generated during expiration does not, however, reach the lung.

Depending on the O₂ concentration set, the ventilator supplies the nebulizer with air, oxygen or a mixture of air and oxygen. Deviations from the set O₂ concentration are minimized.

NOTE: It is recommended not to use the nebulizer while ventilating at breath rates below 12 bpm.

For breath rates above 12 bpm, please consult the diagram on page 215 for delivered O₂ concentration.

The maximum deviation from set O₂ concentration is ± 4 Vol.%*.

WARNING !

For breath rates below 12 bpm, deviations from set oxygen concentration may be significantly higher in extreme cases.

These deviations cannot be monitored by the internal O₂ analyzer of the ventilator.

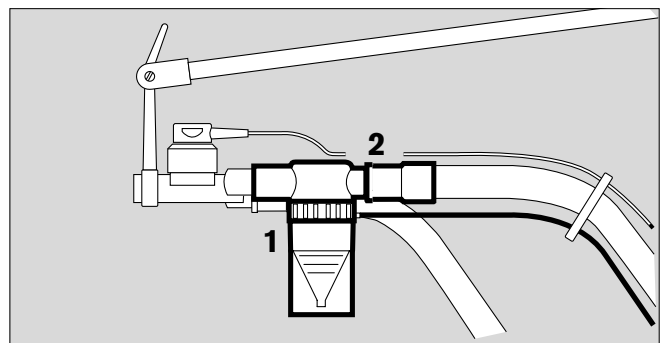
WARNING !

The integrated nebulizer function of EvitaXL is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause considerable deviations in tidal volume and inspiratory O₂ concentration!

- Prepare the nebulizer in accordance with its Instructions for Use.

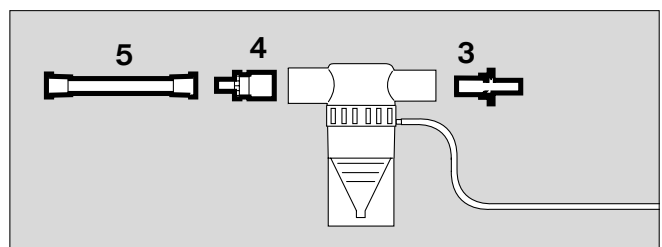
For use when ventilating adults

- 1 Connect nebulizer to the inspiratory side (temperature sensor side) of the Y-piece.
 - 2 Connect inspiratory circuit to nebulizer.
- Place nebulizer in a vertical position.
 - Using clips supplied with patient circuits, route nebulizer hose back to the ventilator along the expiratory circuit.

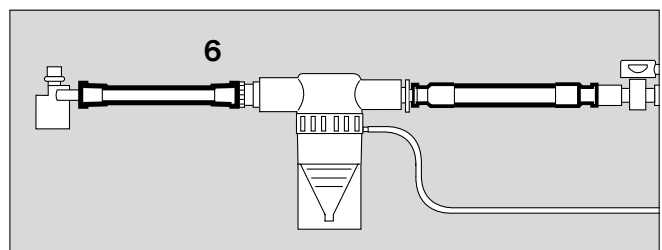


For use during pediatric ventilation

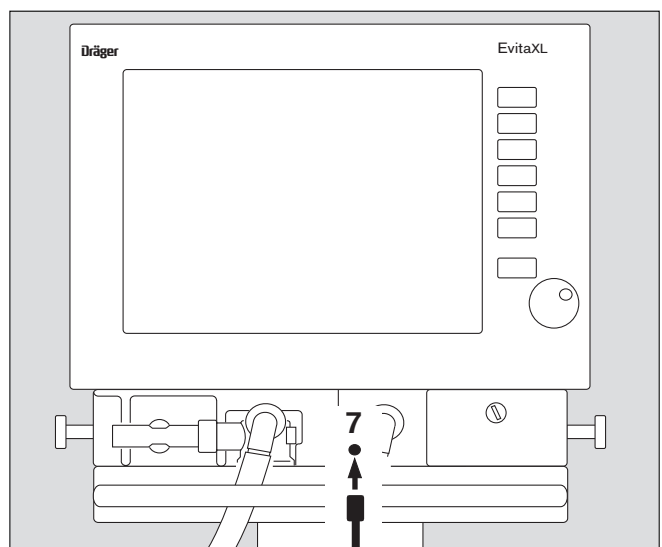
- 3 Insert tapered adapter (ISO Ø15 / Ø11) into nebulizer entry port.
- 4 Insert tapered adapter (ISO Ø22/ Ø11) into nebulizer output port.
- 5 Connect corrugated silicone circuit segment (part no. 84 09 634, 0.13 m) to the nebulizer output port.



- 6 Remove corrugated patient circuit element from the inspiratory port on the Y-piece and connect to the inspiratory port of the nebulizer instead.
- Attach the free end of the corrugated circuit installed to the expiratory port of the nebulizer to the inspiratory port of the Y-piece.



- 7 Connect nebulizer hose onto the nipple in the front of the EvitaXL ventilator unit.
- Fill nebulizer in accordance with its respective Instructions for Use.



WARNING !

Consider effects of aerosols on sensors, filters, and heat and moisture exchangers (HMEs)!

The measuring function of the flow sensor may be impaired.


The flow resistance of filters is liable to increase and may impair ventilation.

Do not put a microbial filter on the nebulizer outlet when in use!

WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!
Risk of increased breathing resistance due to condensation.

To switch nebulizer on:

- Touch »**Special Procedure...**« screen function key.
EvitaXL displays the menu »**Additional Function**«.
- Touch » **Nebulizer**« screen key, the key turns yellow.
- Press dial knob to confirm. The key turns green and the nebulizer is now in operation.
The message **Nebulizer On !** appears on screen.

To switch nebulizer off:

- Touch » **Nebulizer**« screen key.


The ventilator switches the nebulizer off automatically after 30 minutes.
The flow sensor is automatically cleaned and calibrated after nebulizing.

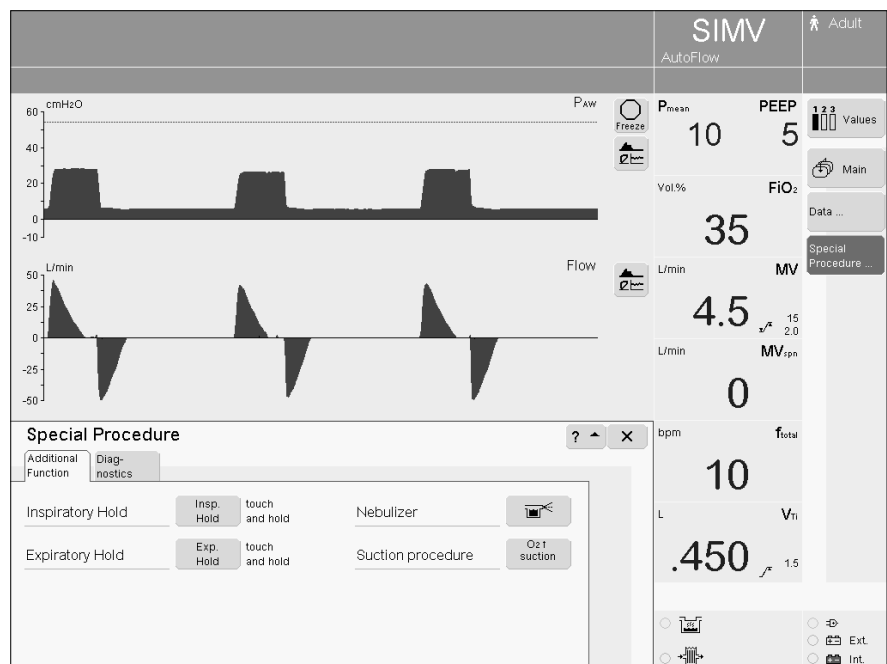
Screen message:

Flow calibration

- Remove any leftover nebulizing solution. Consult nebulizer Instructions for Use.

To view additional text information:

- Touch »?« screen key.



Pre-/post-oxygenation for bronchial suction

To avoid any risk of hypoxia during bronchial suction, EvitaXL offers programmed elevation of oxygen concentrations during the removal of secretions.

After starting the program, EvitaXL ventilates in the set ventilation mode for 180 seconds as pre-oxygenation;

- in adult patient mode with 100 Vol.% O₂,
- in pediatric patient mode with an O₂ concentration that is 25 % higher than the set concentration (e.g. set value 60 Vol.%, delivered 75 Vol.%).

When disconnection for suction occurs, EvitaXL interrupts ventilation. During the time for suction, audible alarms are silenced in order to not disturb the suction routine.

After suction and reconnection, EvitaXL ventilates in the set ventilation mode for 120 seconds as post-oxygenation;

- in adult patient mode with 100 Vol.% O₂,
- in pediatric patient mode with an O₂ concentration that is 25 % higher than the set concentration.

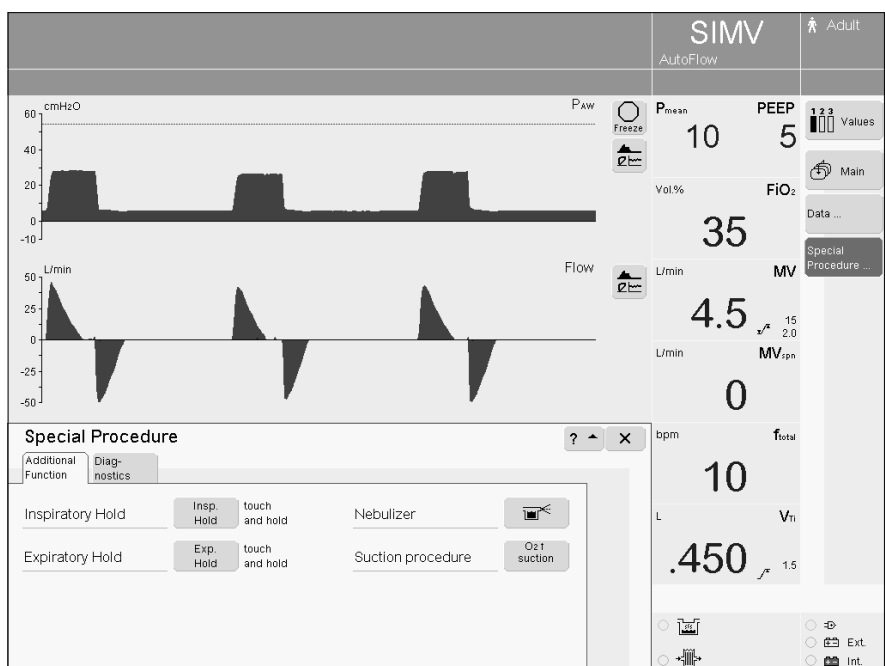
During suction and for 2 minutes afterwards, the lower alarm limit for minute volume is switched off.

Other alarms are switched off during suction and for 15 seconds afterwards.

NOTE: Pre-/post oxygenation is only possible with a functioning flow sensor and while flow monitoring is switched on.

Before suction

- Touch »Special Procedure...« function key.
EvitaXL displays the menu »Additional Function«.
- Touch »O₂ suction« screen key, the key turns yellow.
- Press dial knob to confirm.
The key turns green and the oxygenation program is started.



Operation

Special Functions

EvitaXL ventilates the patient in the set ventilation mode with increased O₂ concentration: 100 % O₂ by volume in adult mode, and 25 % higher O₂ concentration than the set value in pediatric mode.

If PEEP is not set to more than 4 cmH₂O, PEEP will be applied automatically at 4 cmH₂O. This PEEP allows EvitaXL to detect any subsequent disconnection.

All other ventilation parameters remain unaffected.

Display on screen:

O₂ enrichment 180 s

The remaining time is counted down continuously. Pre-oxygenation lasts for a maximum of 180 seconds. During this time, EvitaXL waits for the disconnection associated with suction.

If no disconnection is detected within 180 seconds, the oxygenation program will terminate.

After disconnecting for suction

EvitaXL delivers a very small flow for the duration of suction in order to automatically detect the end of disconnection. The time available for suction is displayed continuously on screen in seconds (example):

Execute suction and reconnect 120 s

If suction is completed and the patient reconnected within the time indicated, EvitaXL will end the disconnection phase.

Automatic canceling of oxygenation program

If there is still no reconnection after 120 seconds, the oxygenation program is interrupted. All alarms are immediately reactivated. EvitaXL continues ventilating in the set ventilation mode.

After reconnection

After reconnection, EvitaXL continues to ventilate in the set ventilation mode, but using 100 Vol.% O₂ for another 120 seconds in adult patient mode, and a 25 % elevated O₂ concentration in pediatric patient mode, as post-oxygenation.

Display on screen:

Final O₂ enrichment 120 s

The remaining time is counted down continuously.

To cancel the oxygenation program:

- Touch »O₂ suction« screen key.

To view additional text information on oxygen enrichment:

- Touch »? ▲« screen key.

To quit the menu:

Touch »x« screen key.

Manual inspiration (Inspiratory hold)

This function may be used in all modes except in CPAP without Pressure Support.

Regardless of the start time, an automatic ventilator breath can be extended for up to 15 seconds.

Or:

Between two automatic ventilator breaths, a ventilator breath may be manually started and held for max. 15 seconds.

The pattern of the manually started ventilator breath corresponds to the ventilation pattern of the currently active automatic ventilation mode.

In CPAP/P.Supp.:

a pressure-assisted ventilator breath (defined by the P_{Supp.} setting) is triggered.

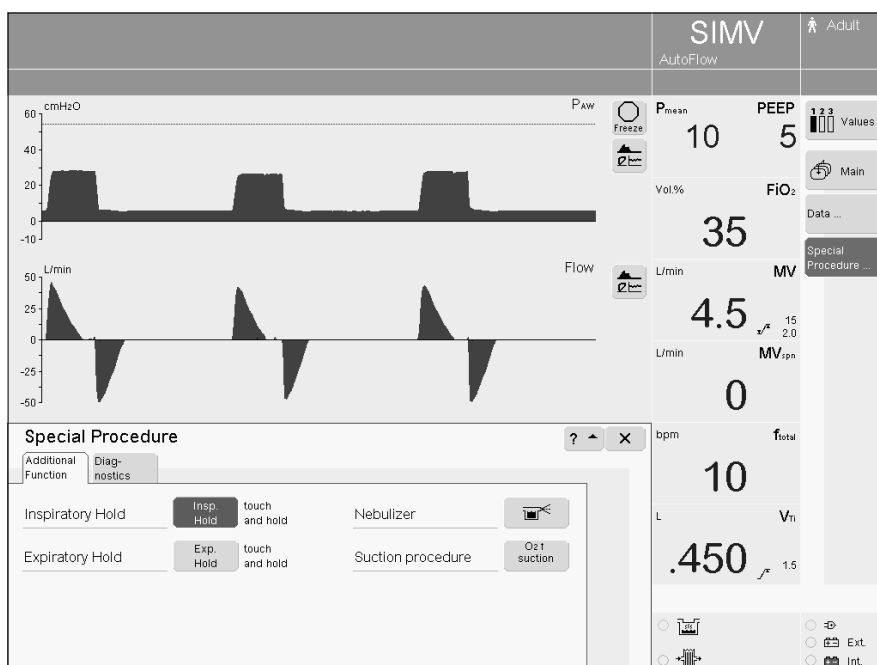
- Touch »**Special Procedure...**« screen function key.
EvitaXL displays the menu »**Additional Function**«.
- Touch and hold the »**Insp. hold**« screen key for the desired duration of inspiratory time. The ventilator will end inspiration after a maximum of 15 seconds.

To view additional text information:

- Touch »?**▲**« screen key.

To quit the menu:

- Touch »**x**« screen key.



Expiratory Hold

This function may be used in all ventilation modes.
Used for determining the measured NIF* value for weaning.

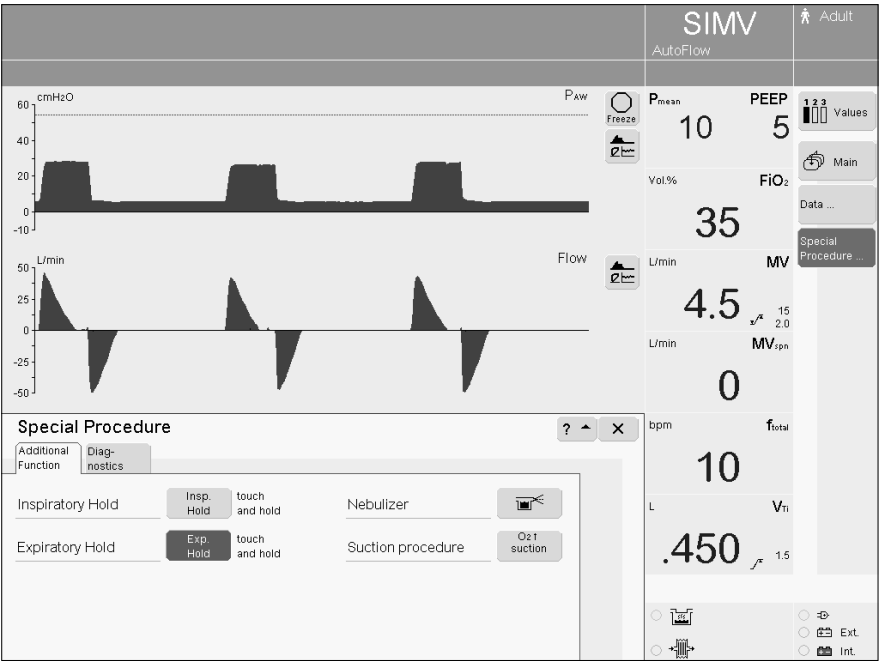
- Touch the function key »Special Procedure...«.
EvitaXL displays the menu »Additional Function«.
- Touch and hold »Exp. hold« screen key for the desired expiratory time.
The ventilator will end expiration after a maximum of 15 seconds.

To view additional text information:

- Touch »?▲« screen key.

To quit the menu:

- Touch »x« screen key.



* For displaying NIF, see page 115.
For a detailed description of NIF,
see page 213.

Diagnostic Functions

Occlusion pressure P 0.1

Occlusion pressure P 0.1 characterizes the negative pressure during a short occlusion (0.1 s) at the start of spontaneous inspiration.

It is a direct measure of a patient's neuromuscular breathing drive.

Patients with healthy lungs and regular breathing generate a pressure drop of -3 to -4 cmH₂O = P 0.1.

Values below -4 cmH₂O represent a high breathing drive, which can only be maintained for a short time.

Values exceeding -6 cmH₂O for a patient with chronic obstructive pulmonary disease indicate impending exhaustion.

This measuring maneuver can be used in all ventilation modes in order to check the breathing drive of a spontaneously breathing patient, or to assess the amount of spontaneous breathing during controlled ventilation.

- Touch »**Special Procedure...**« screen function key.
EvitaXL displays the »**Additional Function**« menu.
- Touch »**Diagnostics**« screen key, the special procedure P 0.1 is displayed automatically.

EvitaXL displays the values for P 0.1 from previous measurements and – in large characters – the value of the last measurement.

- Touch »**Start**«, screen key, the key turns yellow.
- Press dial knob to confirm, the screen key turns green and EvitaXL will start the P 0.1 pressure measuring procedure.

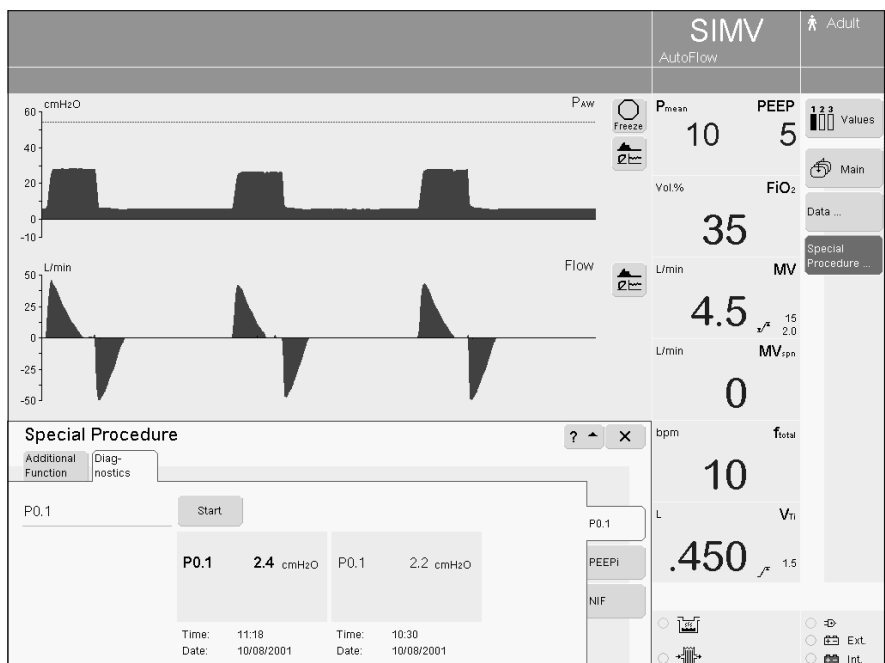
To view additional text information:

- Touch »**? ▲**« screen key

To quit the menu:

- Touch »**x**« screen key.

It is advisable to record the measured P 0.1 value as a trend, so that progress made can be monitored, see "Displaying 1 hr trends" on page 102.



Intrinsic PEEP – PEEP_i

Intrinsic PEEP* is the actual end-expiratory pressure in the lung.

Due to the dynamics of lung mechanics (resistance, compliance, and closing volume) and the set parameters of ventilation, intrinsic PEEP differs from PEEP in the upper airways.

The Intrinsic PEEP measuring maneuver also measures the trapped volume resulting from this difference in PEEP values, i.e. the amount of air trapped in the lungs and therefore not taking part in the process of gas exchange.

This special procedure can be performed in all ventilation modes.

NOTE: Patient activity during this maneuver can distort the values measured.

- Touch »**Special Procedure...**« function key.

EvitaXL displays the »**Additional Function**« menu.

- Touch »**Diagnostics**« screen key.
- Touch »**PEEP_i**« screen key.

EvitaXL displays the last measured value for PEEP_i in larger characters with time / date in the left-hand column.

The value of the previous measurement is shown in the right-hand column.

Along with these measured values, the respective set values of PEEP are displayed.

To start measurement of PEEP_i:

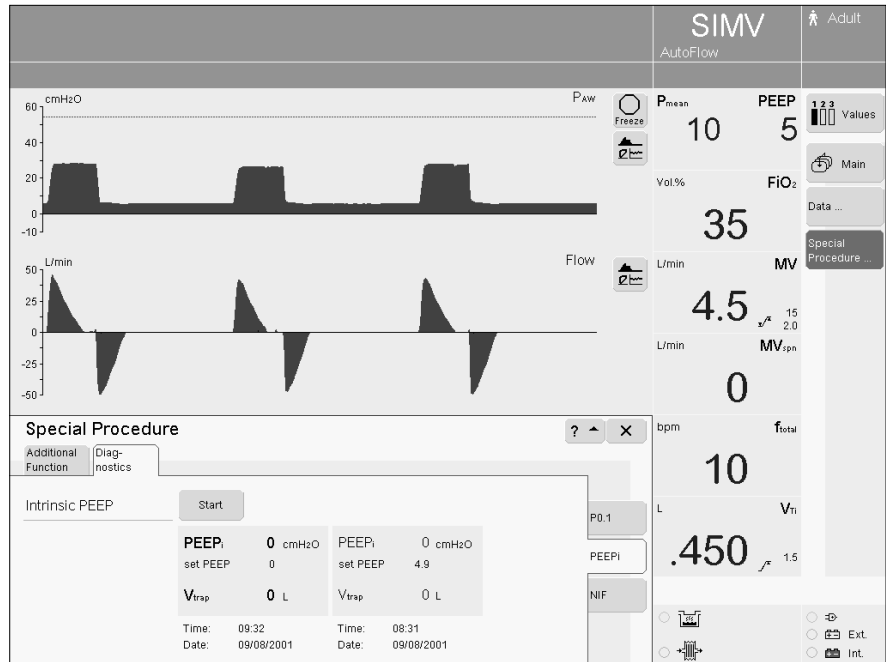
- Touch »**Start**« screen key, the key turns yellow.
- Press dial knob to confirm, the screen key turns green and EvitaXL starts measurement of the value for PEEP_i.

To view additional text information:

- Touch »?**▲**« screen key.

To quit the menu:

- Touch »**x**« screen key.



* Please refer to page 214 for a detailed description of Intrinsic PEEP.

Negative Inspiratory Force NIF

The Negative Inspiratory Force index (NIF)* measures a patient's maximum effort at inhalation after prior exhalation. This value is also known as Maximum Inspiratory Pressure (MIP). The patient circuit is closed during measurement of NIF. As a result of the inhalation effort during a manually extended expiration, the patient generates a negative pressure in relation to current PEEP. The higher this negative pressure, the better the likelihood of weaning a patient successfully. Patients with a NIF exceeding -30 cmH₂O can be weaned successfully with a high probability, while extubation for those with a NIF of only -20 cmH₂O or less will most likely prove unsuccessful. EvitaXL determines value of NIF during a manually extended expiration.

- Touch »**Special Procedure...**« screen function key.
EvitaXL displays the »**Additional Function**« menu.
- Touch »**Diagnostics**« screen key.
- Touch »**NIF**« screen key.

EvitaXL displays the last measured value of NIF in larger characters with time / date in the left-hand column. The value of the previous measurement is shown in the right-hand column.

To measure the NIF value:

- Touch and hold the screen key »**Exp. hold**« for the desired expiratory time. Expiration is terminated by the ventilator after max. 15 seconds.

EvitaXL will end the measuring maneuver automatically after a maximum of 15 seconds.

To view additional text information:

- Touch »?**▲**« screen key.

To quit the menu:

Touch »**X**« screen key.



* References (17), (18), page 221

Sensors

EvitaXL uses the following sensors for measurement and monitoring:

- Flow sensor
- Pressure sensors
- O₂ sensor
- CO₂ sensor (available option)

The last sensor calibration values obtained are saved until the sensors are calibrated again, even if the ventilator was switched off in the meantime.

The pressure sensors for measuring airway pressure are calibrated automatically.

The flow sensor and the O₂ sensor are automatically tested every day.

The flow sensor may be calibrated at any time, even during ventilation.

The O₂ sensor may be calibrated at any time, even during ventilation, and without affecting the applied O₂ concentration.

Calibration of the optional CO₂ sensor may also be checked during ventilation.

Flow sensor calibration

- after replacing the flow sensor.

EvitaXL cleans the flow sensor automatically before it is calibrated.

EvitaXL also automatically cleans and calibrates the flow sensor after use of the nebulizer.

WARNING !

The hot wire in the flow sensors is heated well above its normal operating temperature during the cleaning process. Therefore, avoid flammable gases (e.g. ethanol vapors) after disinfection.

Vent flow sensors after disinfection with ethanol for at least 30 minutes.

- Press »  **Sensor Parameter**« key. The »**Sensor Parameter**« menu is displayed with the »**Flow**« menu. Flow monitoring is now active.

Start calibration:

- Touch »**Start**« screen key. The key turns green and EvitaXL calibrates the flow sensor.

The next inspiratory phase is used for the calibration process. Short inspiratory times are extended to approx. 1 second.

Display on the screen:

Flow calibration

The »**Start**« screen key turns pale green when calibration is complete.



External flow compensation

When a constant external flow of up to 12 L/min is supplied (e.g. when using a nebulizer with external gas supply), EvitaXL is able to take this flow into account and to increase the thresholds for flow sensor monitoring. This helps to avoid "Flow measurement inop." alarms during these applications. The originally measured expiratory volume is maintained: during expiratory flow, EvitaXL will therefore measure a correspondingly higher value for V_Te and MV.

To avoid alarms:

- Adjust upper limit for MV.

Operation

Sensors

For initial calculation of the external flow:

- Start external flow.

In the »Flow« menu:

- Touch »measure« screen key , the key turns green. EvitaXL measures the external flow and displays the value with date and time.

The following message is displayed while measurement is in progress:

Measuring external flow

EvitaXL interrupts calculation of the external flow if it exceeds 12 L/min or if the flow measurement function is faulty.

When the external flow has been calculated successfully, it is taken into account automatically and the screen key »On« appears in green.

If the external flow is no longer applied:

- Touch »Off« screen key, the key turns yellow.
- Press dial knob to confirm, the key turns pale green.

Once EvitaXL has calculated the external flow, it may be taken into account at any time:

- Touch »On« screen key in the »Flow« menu, the key turns yellow.
- Press dial knob to confirm, the key turns green.

If the external flow changes:


- Touch »measure« screen key again and the new external flow is again calculated by EvitaXL.



O₂ sensor calibration

- after replacing the O₂ sensor
(wait 15 minutes for the O₂ sensor to warm up)
- when measured and set values diverge by more than 2 Vol.%.

The O₂ sensor may be calibrated during ventilation.

- Press »  **Sensor Parameter**« key.
- Touch »O₂« screen key.
EvitaXL displays the menu for »O₂«.

Start O₂ calibration:

- Touch »Start« screen key.
The key turns green and EvitaXL now calibrates the O₂ sensor.

Display on screen:

O₂ calibration active

The »Start« screen key turns pale green when calibration is complete.

**CO₂ sensor calibration (optional)**

CO₂ sensors are factory calibrated and may be used without further calibration on any EvitaXL ventilator.

EvitaXL performs a zero calibration as part of the ventilator check procedure.


A full calibration of the CO₂ sensor is only required if the specified test values are not met when checking the calibration with a test filter or with test gas.

The calibration check or calibration may be performed during ventilation.

CO₂ zero calibration

- if the ventilator requests a CO₂ zero calibration with the screen message: **CO₂ zero calibration?**
- if the CO₂ waveform no longer returns to zero during each inspiration,
- before each calibration test, see page 121 or page 122,
- before each CO₂ calibration, page 124.
- Switch EvitaXL on.
Wait about 3 minutes for the complete warm-up of the CO₂ sensor.

After about 3 minutes, measured values will be within their specified range of accuracy.

- Press »  **Sensor Parameter**« key.
- Touch »CO₂« screen key.
EvitaXL displays the menu for »CO₂«.



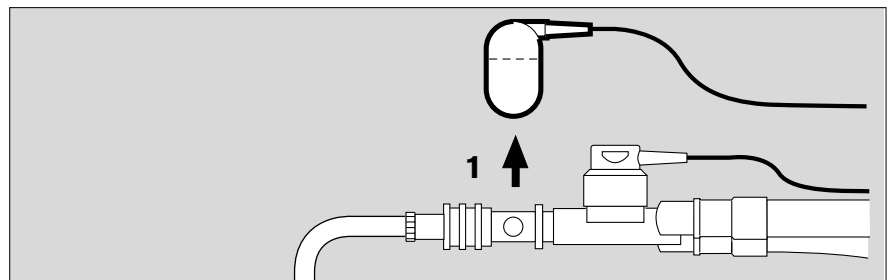
Start zero calibration:

- Touch »**Start**« screen key.
The key turns yellow.
- Press dial knob to confirm.
The key turns green.

Display on the screen:

Park CO₂ sensor

- Press dial knob to confirm.
- 1 Remove CO₂ sensor from the cuvette, and



- 2 place sensor on its park bracket.
- Confirm with dial knob:
EvitaXL now performs the zeroing of the CO₂ sensor.

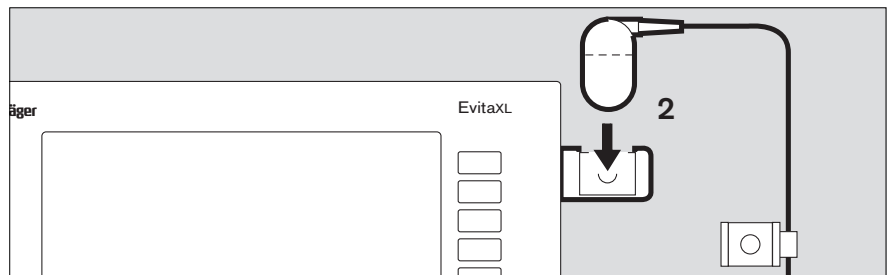
Display:

CO₂ zero calibration

After about 5 seconds, the ventilator confirms with the message:

CO₂ zero ok

- 1 Push sensor back onto the cuvette.



EvitaXL will indicate a failed zero calibration with the following message: **"CO₂ zero?"**.

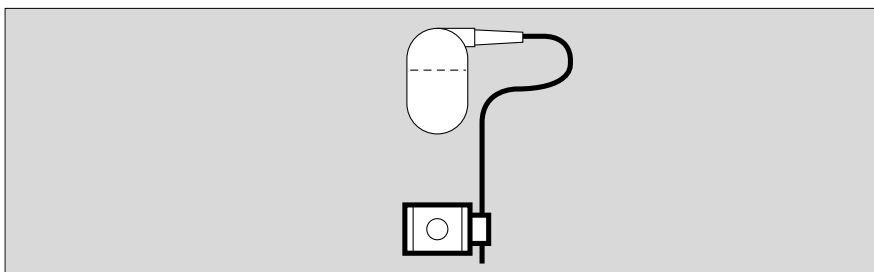
See "Troubleshooting", page 164.

- Repeat CO₂ zero calibration.

Checking CO₂ calibration with test filter

Use test filter provided on the CO₂ sensor cable.

- Switch EvitaXL on and wait for about 3 minutes for the CO₂ sensor to complete its warm-up.

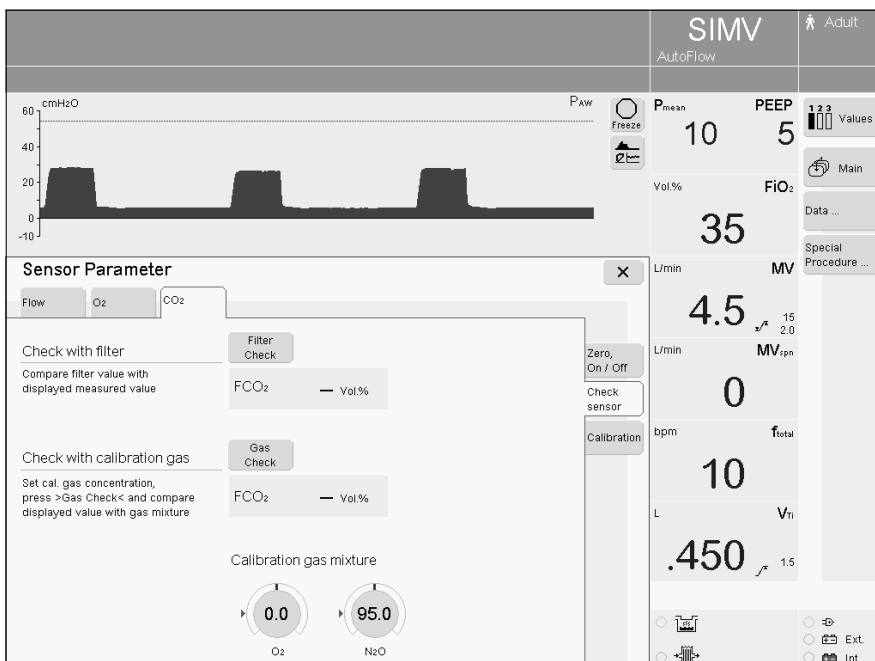


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- First perform CO₂ zero calibration, page 120, then:

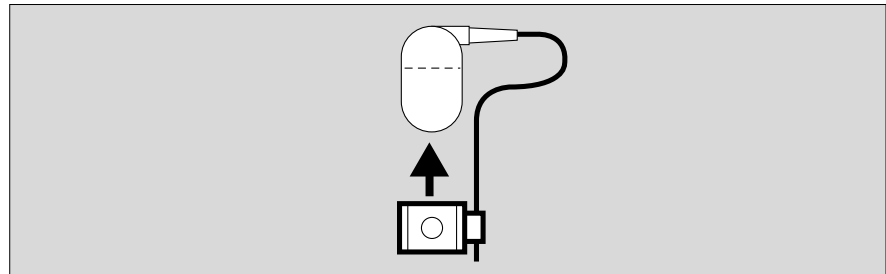
from the »CO₂« menu:

- Touch »Check sensor« screen key.
- Touch »Filter Check« screen key.



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- Place test filter into the CO₂ sensor.



EvitaXL now displays the test value of the CO₂ concentration FCO₂ in the menu.

Example:

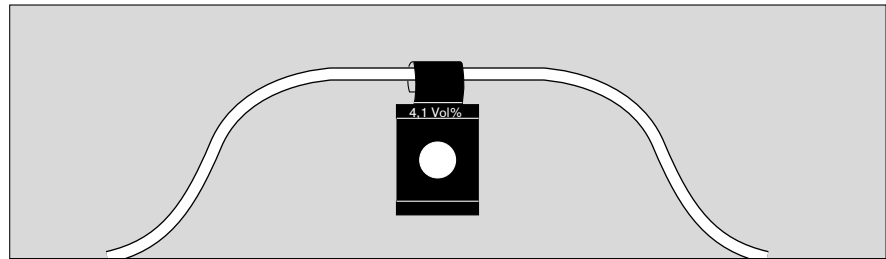
FCO₂ 4.0 Vol. %

This value must agree with the specification on the test filter within $\pm 0,3$ Vol. %.

Example: 4.1 Vol. % on the filter:
permitted value range: 3.8 to 4.4 Vol. %

If the test value is outside the permitted tolerance, the sensor must be checked or calibrated with calibration gas.

- Push CO₂ sensor back onto the cuvette.



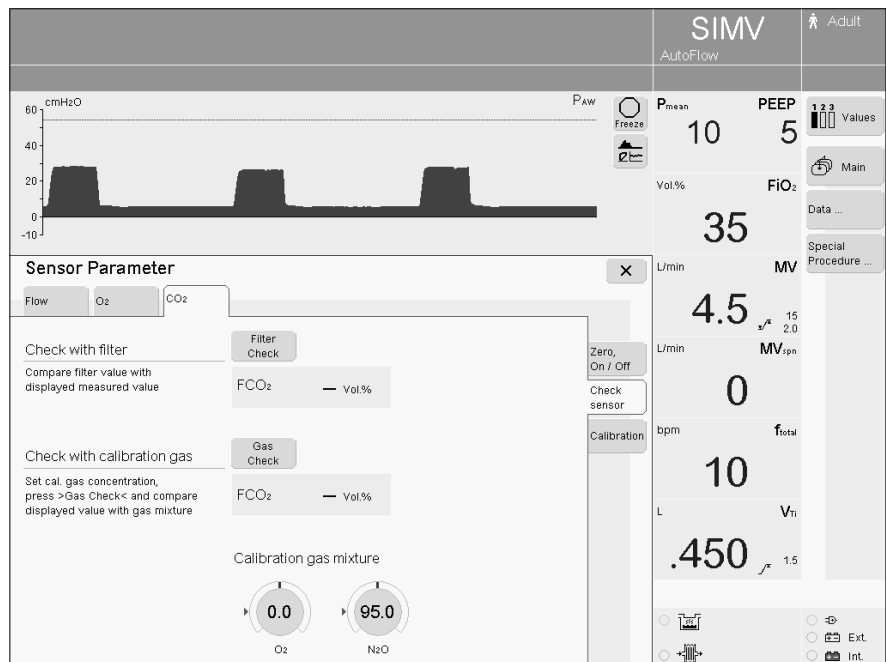
Checking CO₂ calibration with calibration gas

- if the specified calibration value was not met when testing with the test filter
- at least once every six months.
- Switch EvitaXL on and wait for about 3 minutes for the CO₂ sensor to complete its warm-up.

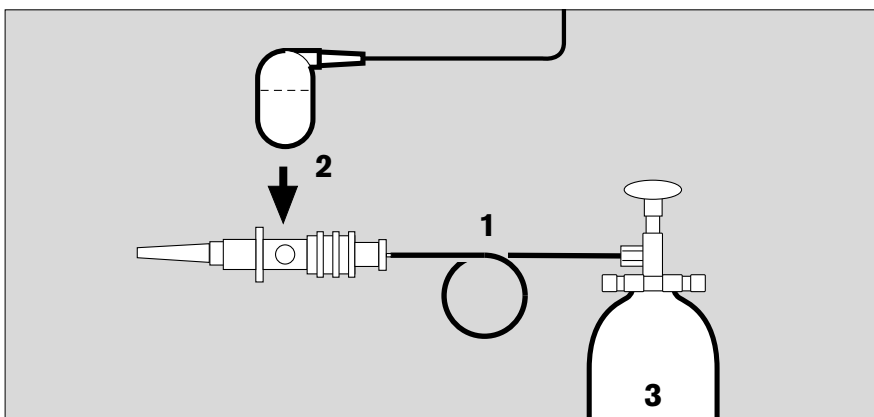
- First perform a CO₂ zero calibration, see page 120, then:

from the »CO₂« menu:

- Touch »Check sensor« screen key.



- Connect calibration gas supply.
Use the cuvette from the calibration set!
- 1 Connect calibration gas cylinder and cuvette of the calibration set to the hose.
 - 2 Remove CO₂ sensor from its park bracket and place onto the cuvette from the calibration set.
 - 3 Read the CO₂, O₂, and N₂O concentrations (Vol.%) of the calibration gas from test cylinder.
Calibration gas e.g.:
5 Vol.% CO₂
95 Vol.% N₂

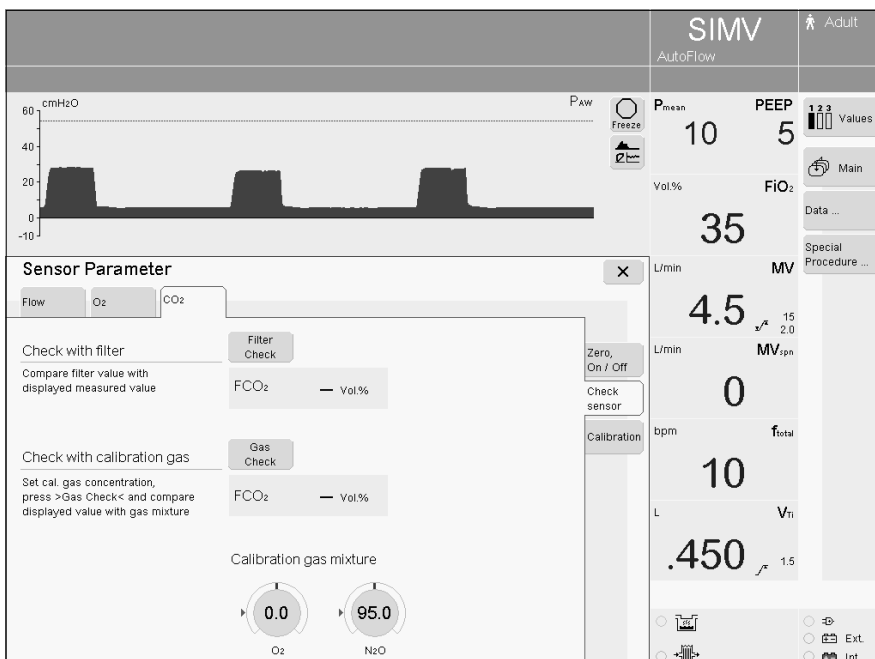


Enter these concentration values with the on-screen parameter setting knobs.

- Touch respective screen knob.
Turn dial knob to enter concentration.
If the calibration gas consists only of CO₂ and N₂, set O₂ and N₂O concentrations to 0.
- Touch »Gas Check« screen key.
EvitaXL displays the CO₂ concentration FCO₂ in the menu.
Example: FCO₂ 5.0 Vol.%

After about 10 seconds, the value of FCO₂ must match the CO₂ content of the calibration gas within ± 0.2 Vol.%.

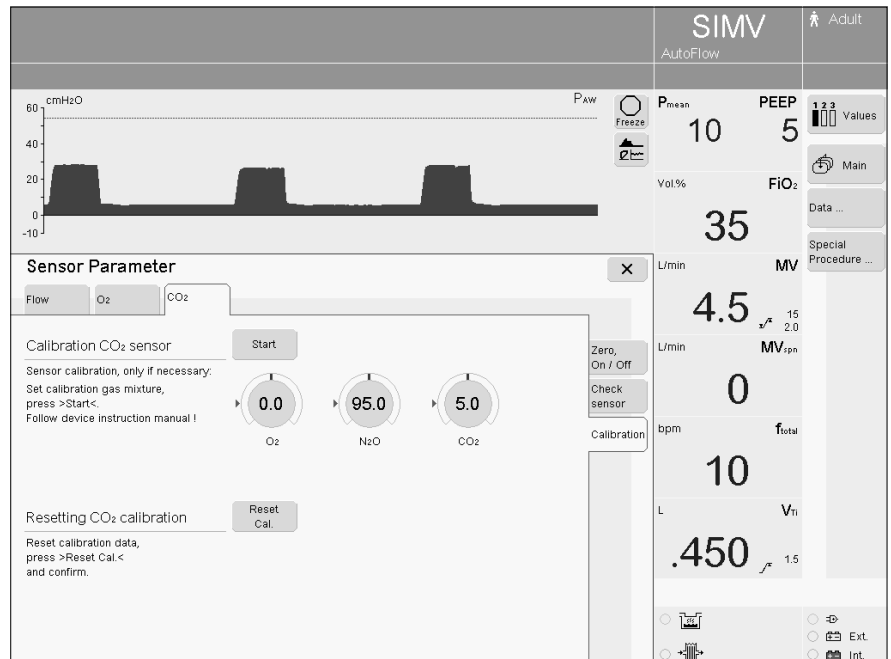
If the calibration value is outside the permitted tolerance, the CO₂ sensor must be recalibrated with calibration gas.



- Push CO₂ sensor back onto the cuvette.

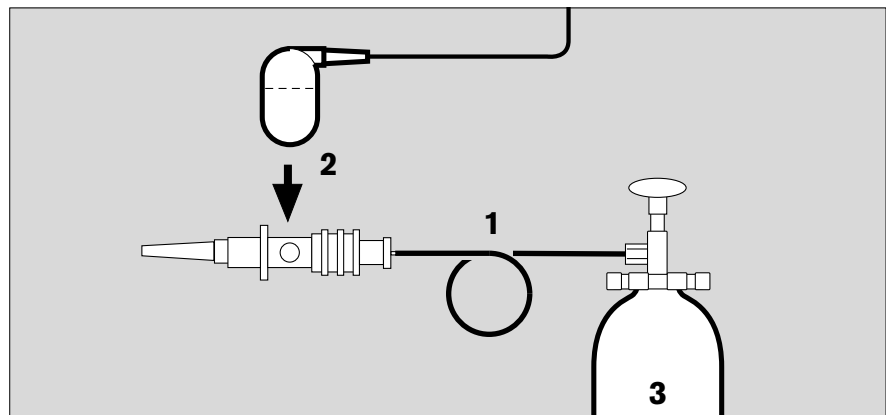
Calibrating the CO₂ sensor

- if specified calibration values are not met upon checking calibration with filter or calibration gas.
- Switch EvitaXL on and wait for about 3 minutes for the CO₂ sensor to complete its warm-up.
- First perform a CO₂ zero calibration, see page 120, then:
from the »CO₂« menu:
- Touch »**Calibration**« screen key. EvitaXL displays the »**Calibration**« menu.



- Connect calibration gas supply.
Use the cuvette from the calibration set!
- 1 Connect calibration gas cylinder and the cuvette of the calibration set to the hose.
- 2 Remove the CO₂ sensor from its park bracket and mount on the cuvette of the calibration set.
- 3 Read CO₂, O₂, and N₂O concentrations (Vol.%) of the calibration gas from the test cylinder. Calibration gas e. g.:
5 Vol.% CO₂
95 Vol.% N₂

Enter these concentration values with the screen knobs.



- Touch the respective screen knob.
- Turn dial knob to enter the concentration.

If the calibration gas consists only of CO₂ and N₂, set the O₂ and N₂O concentrations to 0.

- Touch »Start« screen key.

During calibration, the following message is displayed on screen:
CO₂ calibration. Please wait

EvitaXL performs the calibration and confirms with the message:
CO₂ calibration ok

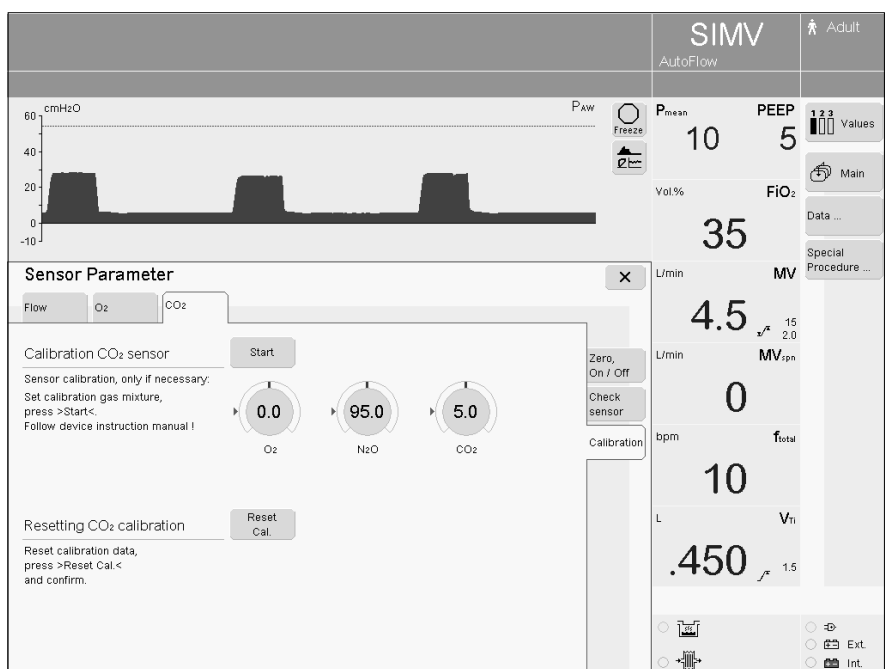
The ventilator indicates a failed calibration with the message:

CO₂ calibration interrupted

or

CO₂ calibration not ok

- Repeat calibration of the CO₂ sensor.



Resetting CO₂ calibration

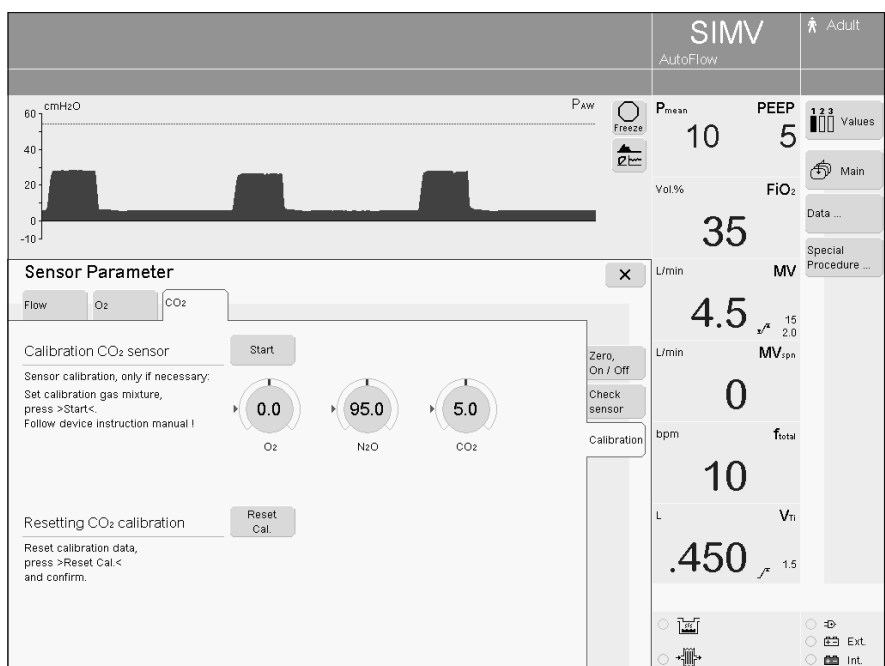
- If calibration with calibration gas was unsuccessful, the factory set calibration value may initially be used.

In the menu »CO₂«:

- Touch the screen key »Calibration«.
- Touch the screen key »Reset Cal.«.

Calibration will be reset after approximately 5 seconds and the factory set calibration value is reactivated.

- **Perform a valid calibration as soon as possible!**




Switching off Monitoring Functions

e.g. if a spent sensor cannot be replaced immediately.

WARNING !

In case of a fault in any of the built-in monitoring a substitute has to 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 when sensors and their respective alarm functions are deactivated.

- Press »  **Sensor Parameter**« key. EvitaXL displays the »Sensor Parameter« menu
- Touch screen key for the sensor to be switched off, e.g. »CO₂«
- Touch »Off« screen key, the key turns yellow.
- Press dial knob to confirm, the key turns green.

The values measured by the respective sensor disappear.

After replacing the sensor:

- Switch monitoring function back on.



Selecting Standby Mode

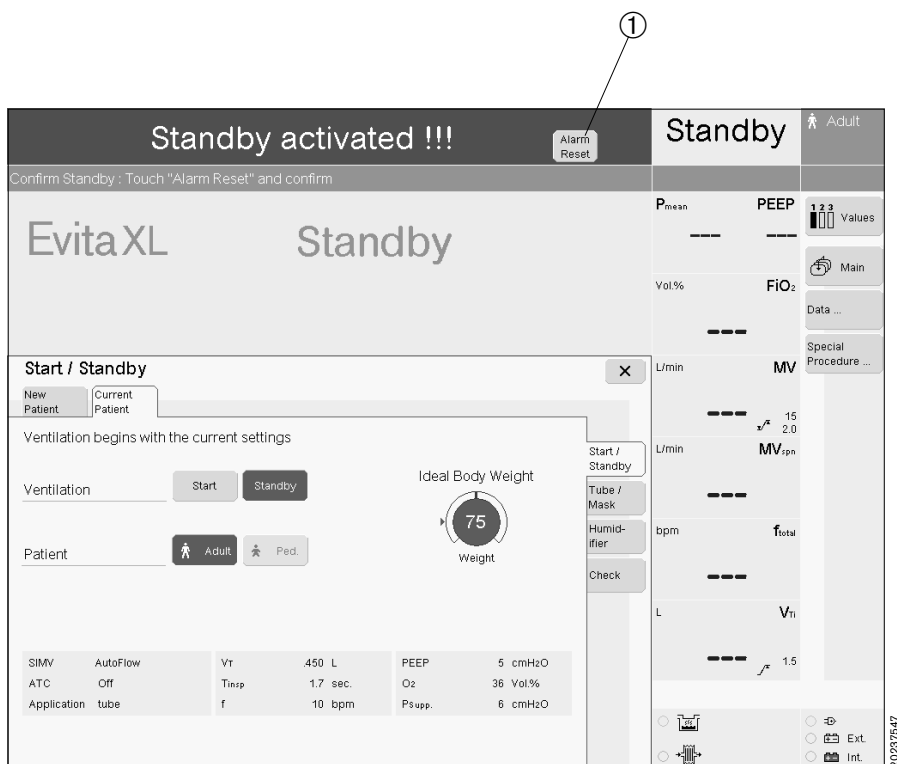
- To perform the ventilator check.
- To keep EvitaXL ready for operation while no patient is connected.
- To change between patient modes..

NOTE: No ventilation takes place in standby mode!

- Press »**Start/Standby**« key. EvitaXL displays the »**Start/Standby**« menu.
- Touch yellow »**Standby**« screen key.
- Press dial knob to confirm, the key turns green.
- 1 Touch »**Alarm Reset**« screen key in the field for alarm messages at the top of the screen.
- Press dial knob to confirm, the key turns green.

The ventilator is now in standby mode.

If the patient mode or ideal body weight is changed in standby mode, EvitaXL will determine new start values for ventilation, see page 65.



Terminating standby mode

- To continue ventilation.
- Touch »**Start**« screen key, the key turns yellow.
- Check settings.
- Press dial knob to confirm. The menu disappears and is replaced by the main screen. EvitaXL starts ventilation.



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Configuration

Specific System Settings	130
Specific Initial Therapy Values	139

Configuration


For setting specific parameters for the system or therapy. These initial (default) values are in effect when the ventilator is switched on.

Specific System Settings

- Press »  **System Setup**« key. EvitaXL displays the »**System Setup**« menu.
The »**System**« menu is displayed automatically with an overview of the parameters which can be set as initial values.

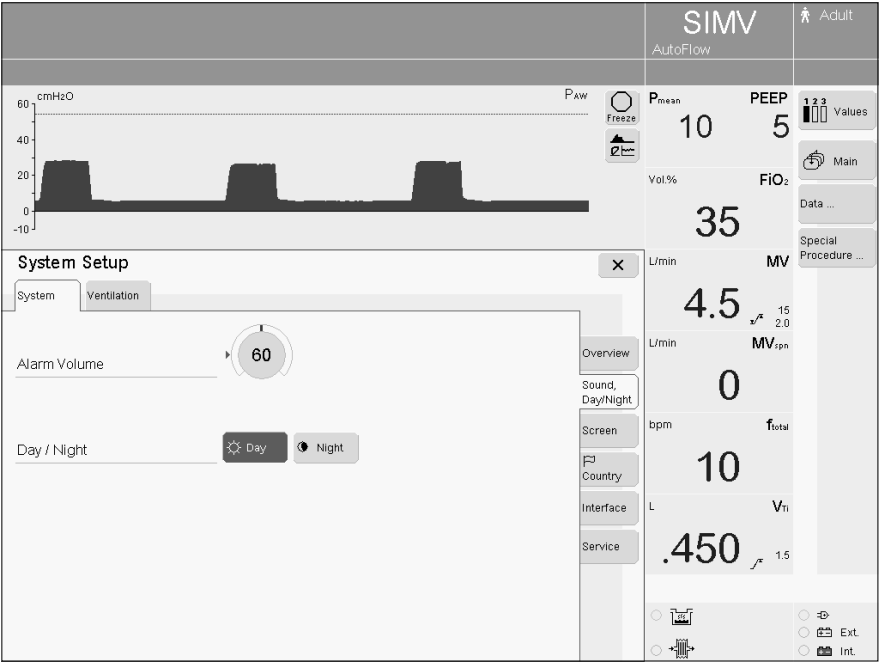


Adjusting volume of the audible alarm


- Press »  **System Setup**« key.
- Touch »**Sound, Day/Night**« screen key. EvitaXL displays the menu for adjusting volume and day/night screen brightness.
- Touch screen key in the line »**Alarm Volume**«.
- Turn dial knob to adjust volume, press dial knob to confirm.

WARNING !

Always adjust audible alarm volume to a level that ensures the operator will be alerted when alarms occur. Failure to identify and correct alarm situations may result in patient injury



Day/night function for screen brightness


- Press »  **System Setup**« key.
- Touch »**Sound, Day/Night**« screen key.

Two options are available: »**Day**« for a strong contrast and bright colors and »**Night**« for reduced screen brightness.

- Touch »**Day**« or »**Night**« screen key, the selected key turns green and the corresponding option is in effect.




Display of waveforms, loops, trends

- Press »  **System Setup**« key.
- Touch »**Screen**« screen key. EvitaXL displays the »**System Setup**« menu.
- Touch »**Graphics...**« screen key. To select graph 1, 2, or 3:
- Touch corresponding key in line »**Graphic 1**«, »**Graphic 2**« or »**Graphic 3**«. The key turns yellow and the selection list is displayed.
- Select and confirm the parameter with the dial knob.



Defining initial measured values




- Press »  **System Setup**« key.
- Touch »**Screen**« screen key.
- Touch »**Values...**« screen key.

EvitaXL displays the menu for compiling the selection of essential measured values (defaults) and their effective alarm limits.

The screen keys are arranged in the same order as the numerical values on the main screen.

Three sets with six values each can be combined.

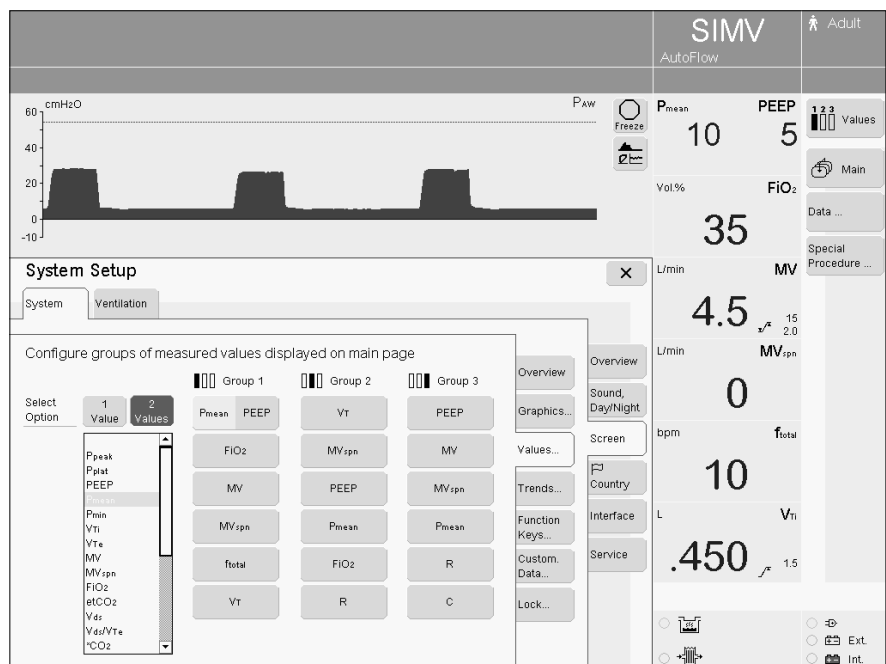
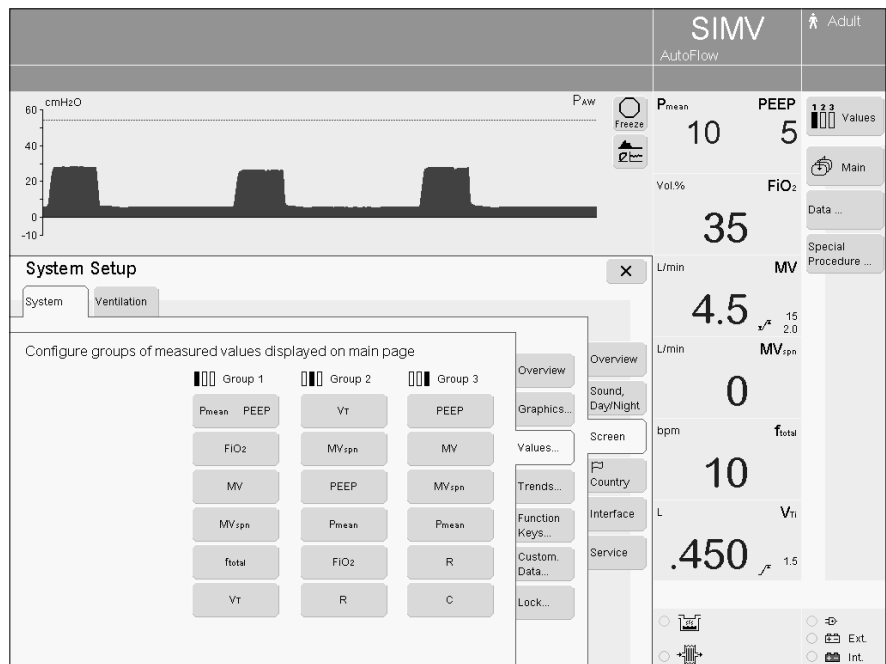
For specifying the parameter selection in the three sets:

- In the respective set ( Group 1,  Group 2 or  Group 3), touch screen key for the line concerned. The key turns yellow.


An additional menu is displayed:

- For choosing between one or two parameters in each line.
- For selecting the parameter.

- Touch »**1 Value**« or »**2 Values**« screen key to select one or two parameters per line.
- Turn dial knob to select parameters from the list, press dial knob to confirm.



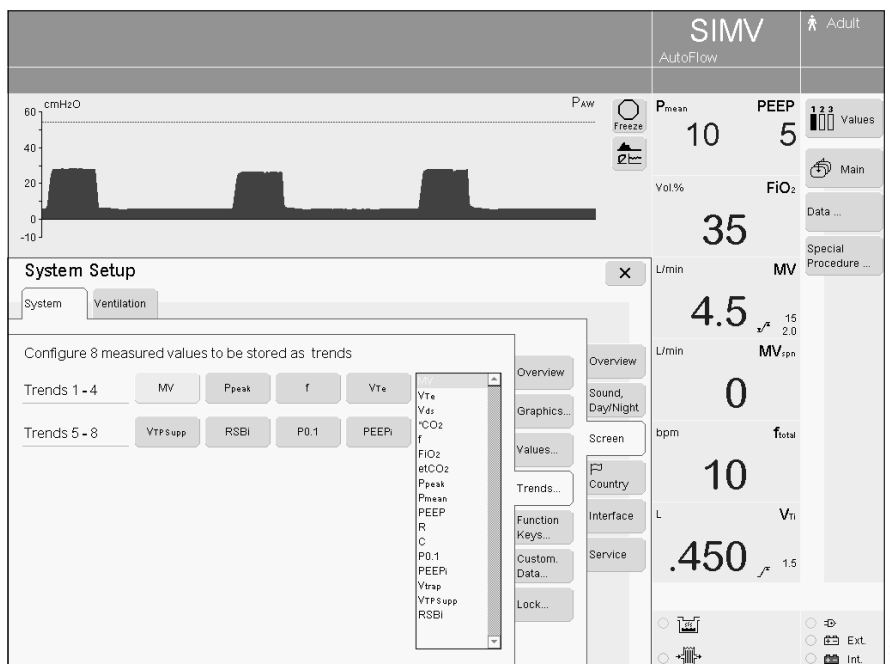
Defining trends to be recorded

- Press »  **System Setup**« key.
- Touch »Screen« screen key.
- Touch »Trends...« screen key.

EvitaXL now displays the menu for selecting measured values for the trend display. Up to eight measured values can be selected, depending on the options available. Only the measured values selected here are saved as a trend.

Touch screen key of the first measured value to be selected. The key turns yellow and the selection list is displayed.

- Select and confirm with the dial knob.




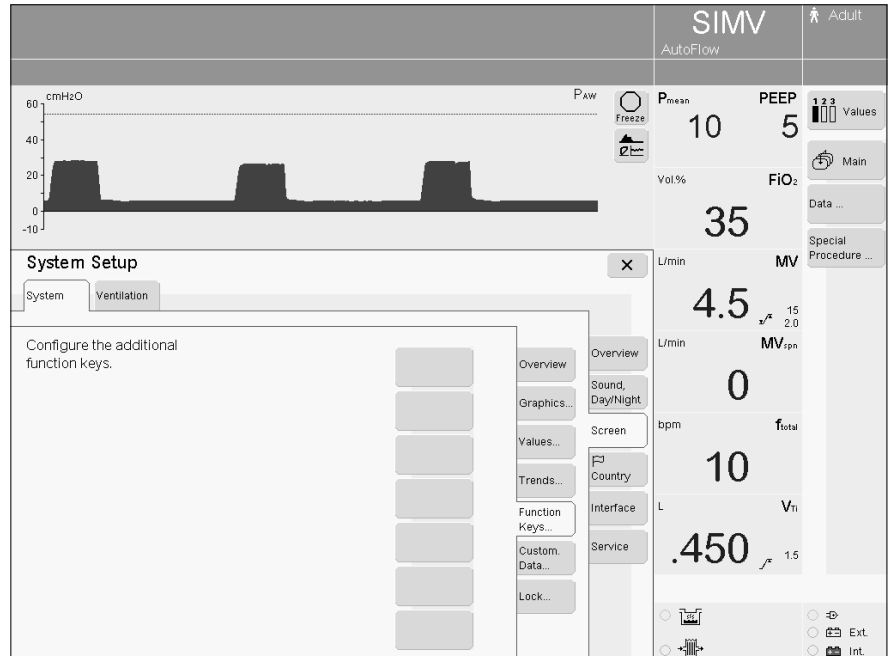
Configuration

Specific System Settings

Defining function keys

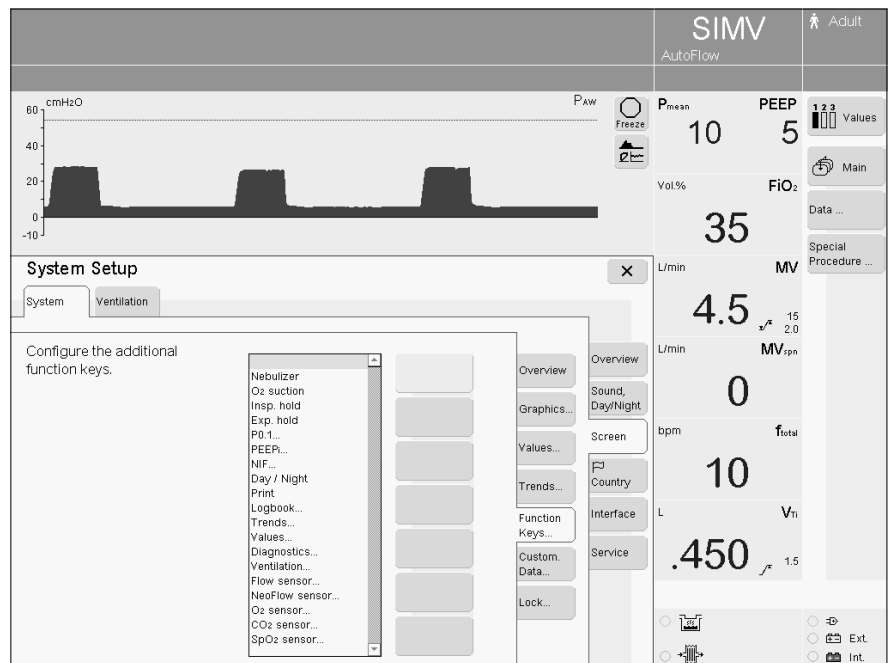
Seven additional on-screen function keys can be defined for accessing a function directly instead of going through a menu.

- Press »  **System Setup**« key.
- Touch »**Screen**« screen key.
- Touch »**Function Keys ...**« screen key.




EvitaXL now displays the menu for defining seven additional function keys.

- Touch the new key to be defined, it turns yellow. A selection list is displayed beside the keys.
- Select and confirm with the dial knob.



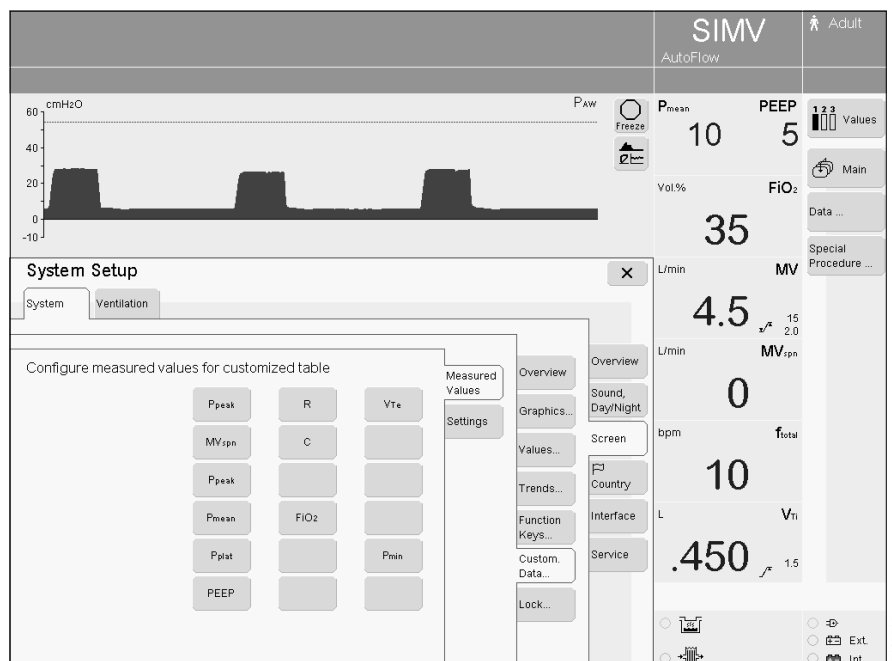
Defining customized tables of values and settings

- Press »  **System Setup**« key.
- Touch »Screen« screen key.
- Touch »Custom. Data ...« screen key.
- Touch »Measured Values« screen key.

EvitaXL first displays the menu for compiling the customized table of measured values.

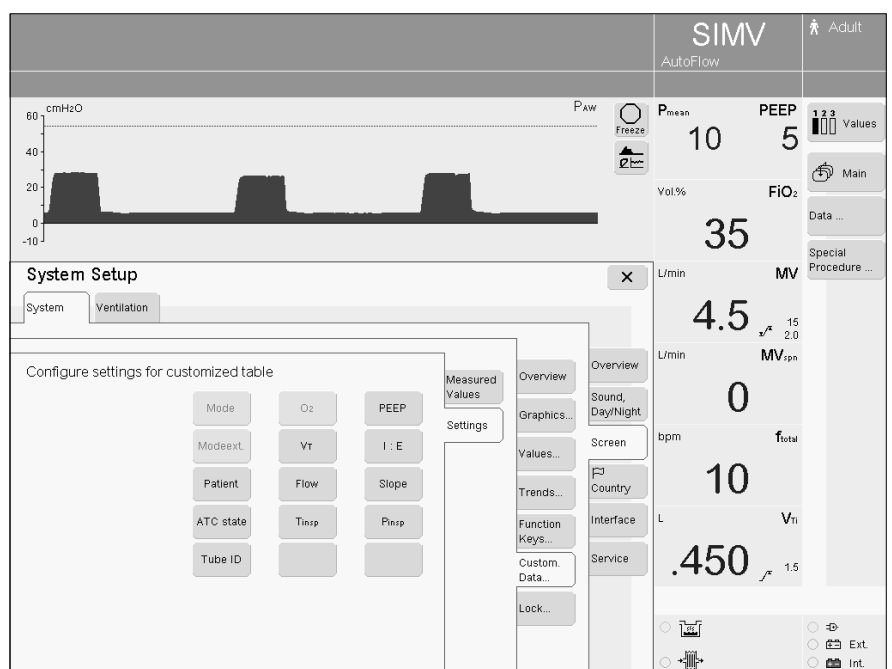
Up to 18 measured values can be compiled. The screen keys reflect the position and order of the measured values in the customized table.

- Touch each successive screen key. It turns yellow and a selection list appears beside the keys.
- Select and confirm with the dial knob.



To configure the settings:

- Touch »Settings« screen key. EvitaXL displays a table with a maximum of 15 settings.
- Configure settings as described above for the measured values.








Configuration

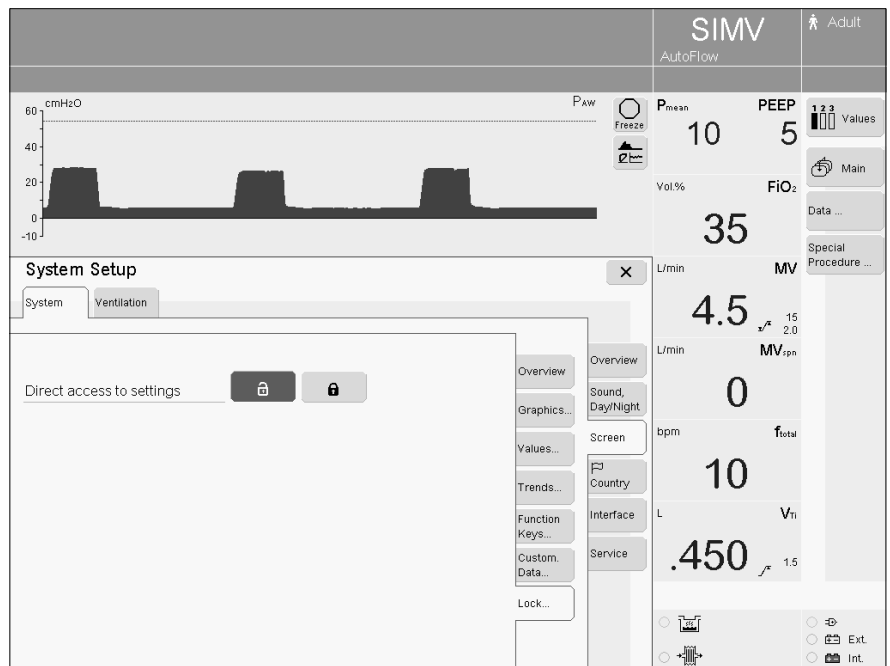
Specific System Settings

Locking direct access to settings

This function is used to prevent parameter settings from being changed directly through the row of screen knobs.

They can still be adjusted using the »  **Ventilator Settings**« key.

- Press »  **System Setup**« key.
- Touch »**Screen**« screen key .
- Touch »**Lock...**« screen key.
- Touch »  « screen key.
The  symbol appears at the bottom of the main screen in the row of screen knobs.
- To deactivate the lock touch »  « screen key.






Selecting the display language

The following languages may be selected:

German	Italian
English	Swedish
US English	Dutch
French	Russian
Spanish	Chinese
Portuguese	

The ventilator is factory configured to the language at the customer site.

To select a different language:

- Press »  **System Setup**« key.
- Touch »  **Country**« the screen key.
- The current language is displayed in the »**Language**« field.
- Touch »  « screen key.
EvitaxL displays a selection list.
- Select and confirm new language with the dial knob.



Selecting units

Specific national units may be selected for the physical parameters pressure and temperature, as well as body height.



- Press »  **System Setup**« key.
- Touch »  **Country**« screen key.

The current units are displayed in the field »Units«.

- Touch screen key of the desired unit.
- Select and confirm new unit with the dial knob.



Setting date and time

- Press »  **System Setup**« key.
- Touch »  **Country**« screen key.

The current date and time are displayed in the fields »Date« and »Time«.


- Touch screen key.
- Set and confirm with the dial knob.



Configuration

Specific System Settings

Configuring the serial interface

- Press »  **System Setup**« key.
 - Touch »Interface« screen key.
- Interface parameters are displayed in the field »COM 1«.
- Touch screen key of the desired interface parameter.
 - Set and confirm with dial knob.




Service

To display the operating status of the internal functional components.

Only available to authorized personnel with the necessary password.

Specific Initial Therapy Values

- Press »  **System Setup**« key.
- Touch »**Ventilation**« screen key.
EvitaXL displays the »**System Setup**« menu with an overview of those therapy parameters that can be set as initial (default) values.



Setting the patient range

From the menu »**System Setup**«, submenu »**Ventilation**«.

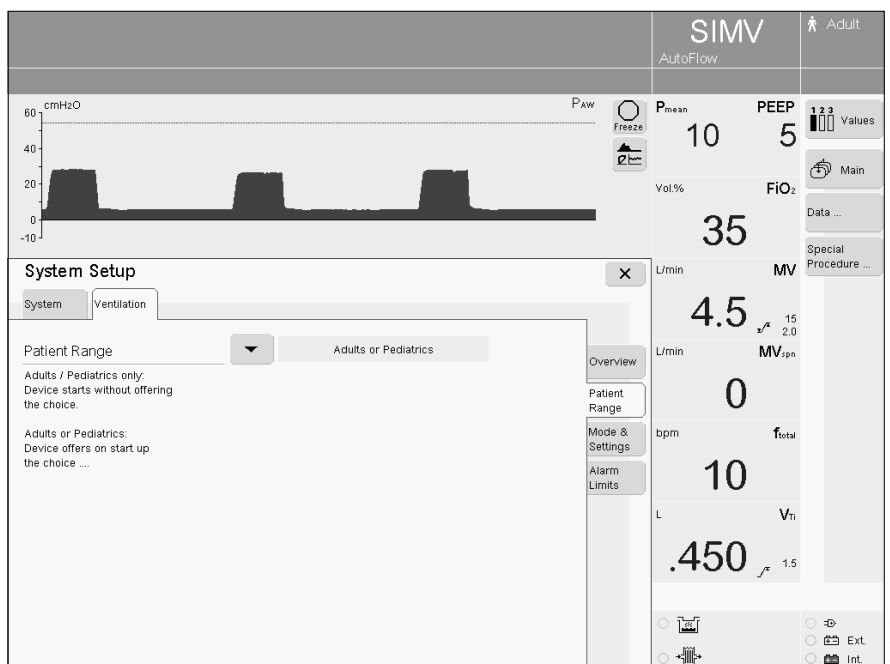
- Touch »**Patient Range**« screen key and enter access code 3032.
- The numbers must be touched in the correct order.

EvitaXL displays the menu for setting the patient mode to be in effect when the ventilator is switched on.


EvitaXL displays the last patient mode set.

"Adults or Pediatrics" is used here as default.

- Touch »▼« screen key and a selection list is displayed.
- Select and confirm the default patient mode with the dial knob.



Selecting a start-up default for the ventilation mode

- Press »  **System Setup**« key.
- Touch »**Ventilation**« screen key.
- Touch »**Mode & Settings**« screen key and enter access code 3032.
EvitaXL first displays an overview of all configurable parameters.
- Touch »**Modes...**« screen key.

Four ventilation modes are displayed in the line »**Modes**«.

The screen key on the left marked "Startup" shows the mode in effect upon start of the ventilator and is followed by three keys for other ventilation modes.


To select the initial ventilation mode:

- Touch »**Startup**« screen key.
EvitaXL displays a list of possible ventilation modes.
 - Select and confirm with the dial knob.
- Other ventilation modes can be defined for the remaining three screen keys in the same way.



Setting start-up defaults for VT and f...

These are set in accordance with the

- patient mode (adult or pediatric) and
- patient weight.
- Press »  **System Setup**« key.
- Touch »**Ventilation**« screen key.
- Touch »**Mode & Settings**« screen key and enter access code 3032.
- Touch screen key »**VT, f...**«.

VT, f as a function of patient weight:

- Touch »**By Weight**« screen key.

EvitaXL displays the default values for VT and f for different weights.

In the line »**Start-up by weight**«:

- Touch »**On**« screen key and confirm with the dial knob.

Set values:

- Touch corresponding screen keys for VT and f.
- Adjust and confirm with the dial knob.



VT, f as a function of the patient mode:

- Touch »**By Patient**« screen key.

EvitaXL displays default values for VT and f applicable to adults and children.

In the line »**Start-up by patient**«:

- Touch »**On**« screen key and confirm with the dial knob.


Set values:

- Touch the respective screen keys for VT and f.
- Adjust and confirm with the dial knob.

To restore the manufacturer's default settings:

- Touch »**Dräger Default**« screen key.
- Press dial knob to confirm.

Setting start-up defaults for O₂, I:E, pressure ...

- Press »  **System Setup**« key.
- Touch »**Ventilation**« screen key.
- Touch »**Mode & Settings**« screen key and enter access code 3032.
- Touch »**O₂, I:E, pressure...**« screen key.

EvitaXL displays the default values used for pressure, O₂ and I:E.

In the respective lines:

- Touch the corresponding screen key.
- Adjust and confirm with the dial knob.

In addition to the ventilation parameters VT and f, EvitaXL also displays a table with the parameters inspiratory time T_i derived from the ratio of inspiratory to expiratory time I:E, and Flow.

To restore the manufacturer's default settings:


- Touch »**Dräger Default**« screen key.
- Press dial knob to confirm.



Setting start-up defaults for special functions


To define the following start-up settings:

- AutoFlow on/off
- Apnea ventilation on/off
- Leakage compensation on/off
- Tube compensation on/off
- Tube compensation parameters

- Press »  **System Setup**« key.
- Touch »**Ventilation**« screen key.
- Touch »**Mode & Settings**« screen key and enter access code 3032.
- Touch »**Add. settings ...**« screen key.
- Touch the respective screen key to activate or deactivate a corresponding special function.
- Press dial knob to confirm.
- Touch the respective screen key to set parameters for automatic tube compensation.
- Adjust and confirm with the dial knob.



Setting start-up defaults for alarm limits

- Press »  **System Setup**« key.
- Touch »Ventilation« screen key.
- Touch »Alarm Limits« screen key and enter access code 3032.

The current start-up alarm limits are displayed.

↗ = upper alarm limit

↘ = lower alarm limit

- Touch the respective screen key.
- Set and confirm with the dial knob.



Parameter	Adjustment range	Factory default start-up value (Draeger default)	Customized start-up value
↗ MV	0.5 to 41 L/min	$(VT \cdot f) + 50 \%$
↘ MV	0.1 to 40 L/min	$(VT \cdot f) - 20 \%$
↗ PAW	10 to 100 cmH2O	50 cmH2O
↗ VTi	0.03 to 4 L	$VTi + 100 \%$
↗ fspn	5 to 120 bpm	50 bpm
↗ TApnea	5 to 60 seconds	15 seconds
↗ etCO ₂ (optional)	0 to 100 mmHg (0.1 to 15 kPa)	60 mmHg (9 kPa)
↘ etCO ₂ (optional)	0 to 99 mmHg (0 to 14.9 kPa)	30 mmHg (4.5 kPa)

Values set may be entered in the column "Customized start-up value".

To restore factory default settings:

- Touch »**Dräger Default**« screen key.
- Press dial knob to confirm.

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Care

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Disinfecting / Cleaning / Sterilizing	
Schedule for the EvitaXL Intensive Care Ventilator	153
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Care

- Clean and prepare the ventilator after each patient.

WARNING !

To avoid risks to hospital staff and patients, disinfect and clean ventilator after use.

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

- Always observe accepted hospital hygiene protocols regarding the frequency of patient circuit and expiratory valve changes.

Recommendation:

- Change patient circuit system and expiratory valve as needed. Keep replacement systems ready.

WARNING !

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

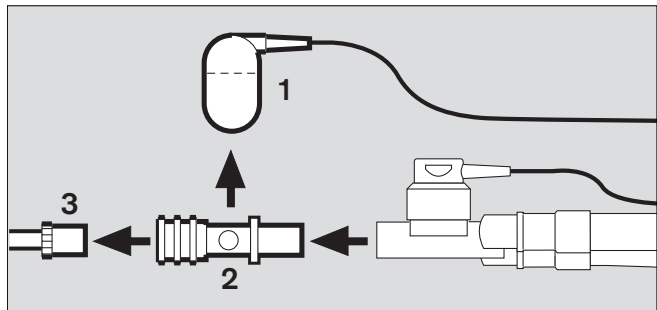
Dismantling Components

- Switch off both ventilator and humidifier, and remove their power plugs from wall outlets.
- Drain water traps and patient circuit.
- Empty water container of the humidifier.

CO₂ sensor (available option)

- 1 Remove CO₂ sensor from its cuvette. Unplug sensor in the back of the EvitaXL ventilator.
 - 2 Remove CO₂ sensor cuvette from Y-piece.
 - 3 Remove ET-tube connector from cuvette.
- Wipe-disinfect CO₂ sensor, see page 151.

Condition the cuvette in an automatic parts cleaning and disinfection machine, see page 151.

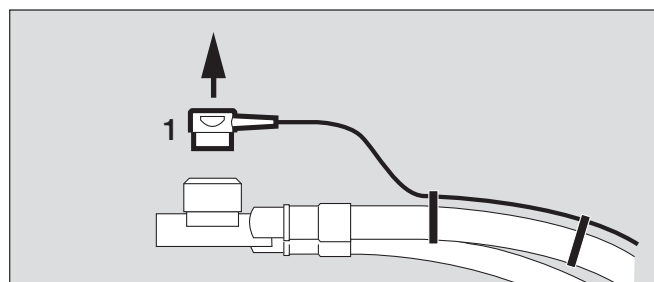


Temperature sensor

- 1 Remove temperature sensor from Y-piece – or from its receptacle on the reusable pediatric circuit. Do not pull on cable.
- Unplug sensor probe in the rear of the EvitaXL ventilator.
 - Wipe-disinfect temperature sensor, see page 151.

CAUTION !

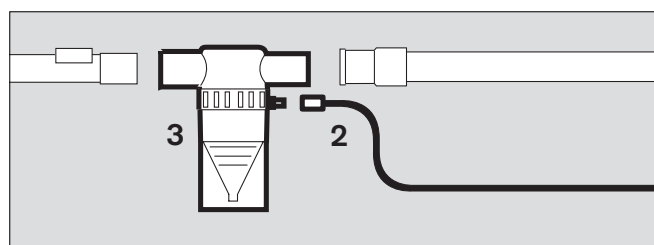
The temperature sensor is not designed for disinfection in an automatic parts washer or for bath disinfection.

**SpO2 sensor (optional)**

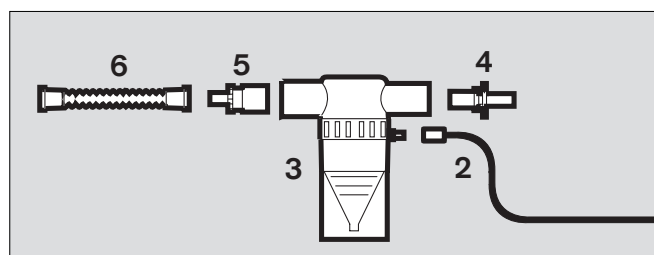
- Unplug connector from the back of the unit.
- Wipe-disinfect the SpO2 sensor, see page 151.

Nebulizer (option)

- 2 Remove nebulizer hose from the nebulizer and from the nebulizer port on the ventilator.
- 3 Detach nebulizer from the patient circuit (adult patient circuit), or



- 3 Remove nebulizer from the infant patient circuit.
 - 4 Pull catheter connector (tapered ISO connector $\varnothing 15/ \varnothing 11$) from the nebulizer input.
 - 5 Pull adapter (tapered ISO connector $\varnothing 22/ \varnothing 11$) from the nebulizer output.
 - 6 Pull corrugated patient circuit segment from the connector.
- Dismantle and process nebulizer in accordance with its accompanying Instructions for Use.
 - The individual parts of the nebulizer and the adapter parts may be processed in an automatic parts washer and disinfection machine, see page 152.

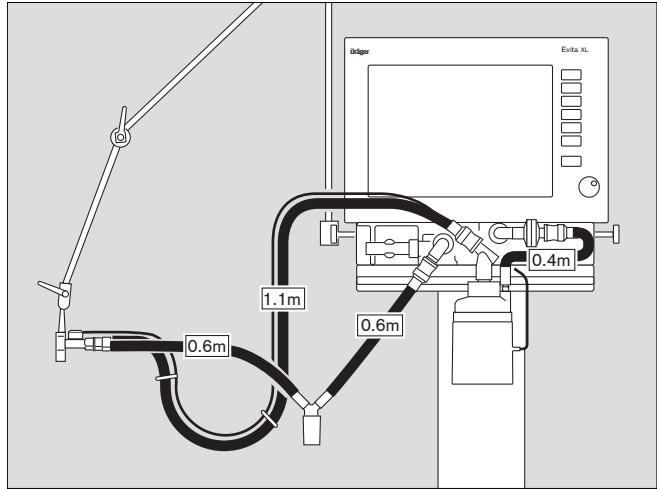


Patient circuit

- Remove patient circuit from adapters and ventilator ports.

For a Draeger reusable patient circuit:

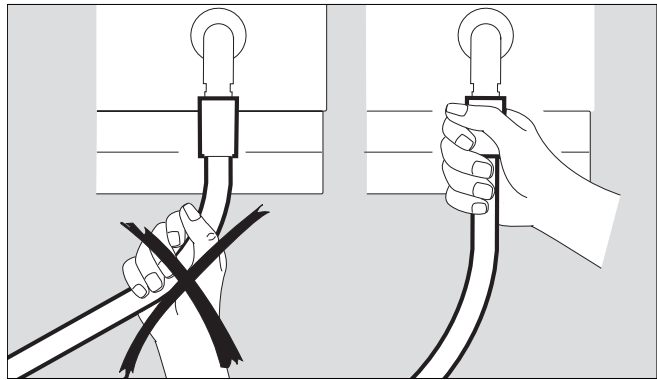
- Remove water traps from patient circuit.
Remove collecting jars from water traps and the expiratory valve.
- Prepare patient circuit, water traps, and associated collecting jars, as well as the the patient wye, for processing in an automatic parts washer and disinfection machine, see page 151.



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CAUTION !

When removing a reusable patient circuit, always grasp hoses by their sleeve, never by the hose itself, to avoid possibly tearing the hose at the sleeve or ripping it out of the sleeve.



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Flow sensor

- Tilt the control panel upwards, pressing the segments on the right and left down and at the same time tilting the control unit into the required position.
- 1 Push flow sensor as far as possible to the left and
 - 2 remove it.

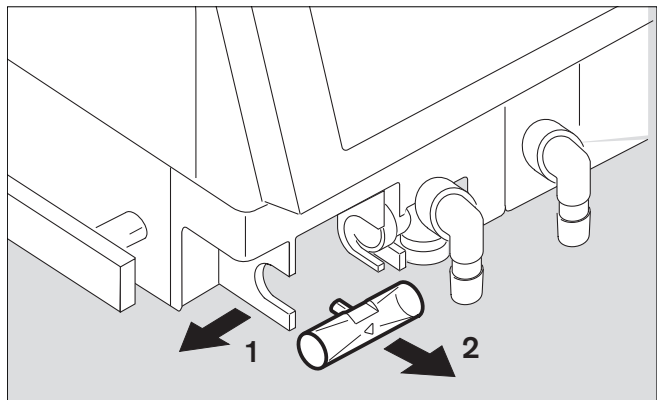
CAUTION !

Flow sensor is not compatible with parts washer equipment and may not be autoclaved or steam-sterilized. It is not temperature stable and would be destroyed.

- Disinfect the flow sensor in 70 % ethanol solution for approximately 1 hour.

WARNING !

Vent flow sensor after disinfection with ethanol for at least 30 minutes or rinse with sterile water. Otherwise, residual ethanol vapors might ignite and destroy the sensor during calibration.

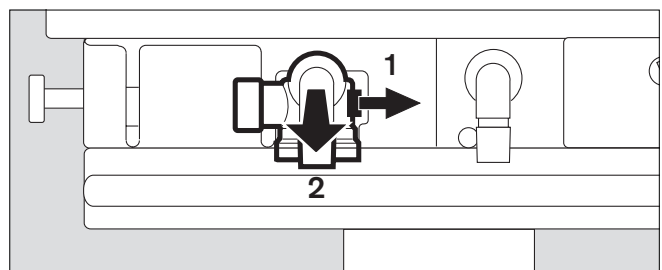


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NOTE: The flow sensor may be reused as long as automatic calibration is possible.

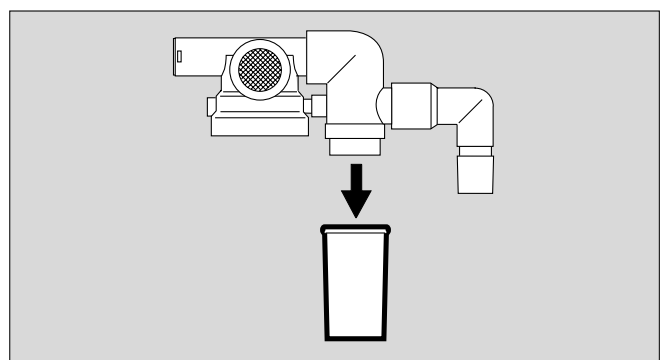
Expiratory valve

- 1 Push catch to the right, while
- 2 pulling out the expiratory valve at the same time.



If the expiration valve is equipped with an optional water trap:

- Pull off the collecting jar.



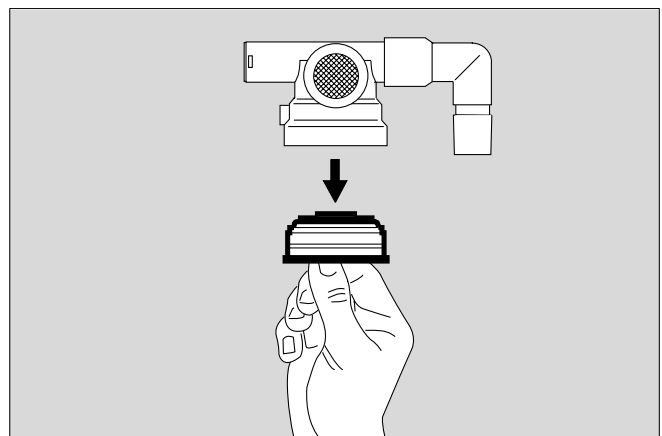
The expiratory valve is only dismantled if severely soiled:

- Unscrew cover lid by hand and remove together with the diaphragm.

CAUTION !

Do not disassemble expiratory valve beyond removing diaphragm!

- Prepare expiratory valve for disinfection and cleaning in an automatic parts washer and disinfection machine, and
- prepare for autoclaving.
- Always place an opened expiratory valve into a disinfection or autoclave tray so it will not be damaged by other parts.

**Breathing gas humidifier**

- Disassemble according to its respective Operating Instructions and prepare for disinfection/sterilization.

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., alkylamines, phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized.

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. If in doubt, ask the supplier/manufacturer of the disinfectant/cleaning agent.

WARNING !

Sterilization of parts in ethylene oxide (EtO) may lead to a patient health risk:

Patients may become exposed to EtO that may have diffused into components.

WARNING !

To avoid any risk of infection for hospital staff or other patients, clean and disinfect ventilator after use.

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

CAUTION !

The surface of the EvitaXL screen is made of Plexiglas[®] (polyacrylate).

Exposure to alcohol or agents containing alcohol will likely cause fissure cracks.

Ventilator without circuits, gas supply hoses, or temperature sensor

- Wipe disinfect with a disinfectant based on the suggested active ingredients. Make sure to comply with manufacturer's instructions.

Temperature sensor, SpO2 sensor (optional)

- Wipe disinfect

CO2 sensor and test filter (optional)

- Wipe off any soiling with cotton swabs, in particular on the windows of the CO2 sensor.
- Wipe-disinfect, e.g. with 70 % ethanol.

CO2 cuvette (optional)

- Wipe off any soiling with disposable tissue and cotton swabs, particularly the inside and outside of the cuvette windows.
- Disinfect in a moisture saturated environment at 93 °C (200 °F) for 10 minutes using a cleaning and disinfecting machine. **Use detergent only.**

Or:

- IBath disinfect using a disinfectant based on the suggested active substances, e.g. Cidex, Johnson & Johnson

Or:

- Autoclave at 134 °C (273 °F).

Components of reusable patient circuit and expiratory valve (or, in the event of severe soiling, its disassembled components)

- Disinfect in a moisture saturated environment at 93 °C (200 °F) for 10 minutes using a cleaning and disinfecting machine. **Use detergent only.**

If a cleaning and disinfection machine is not available:

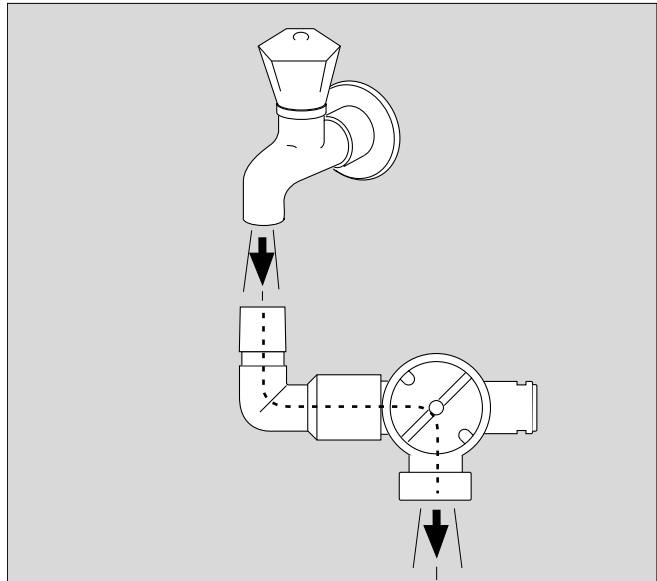
- Bath-disinfect components using a disinfectant based on the suggested active substances.
- Then rinse with clean water, preferably from a soft water supply.
- Shake water out thoroughly, and leave the products to dry.

Expiration valve and its individual parts after disinfection

- Rinse thoroughly with clear water, preferably from a soft water supply. Shake water out thoroughly.
- After rinsing thoroughly, dry expiratory valve.
- After disinfecting with moist heat, we recommend that the expiratory valve or its disassembled components be autoclaved at 134 °C (273 °F) to remove any remaining liquid.

CAUTION !

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



Ventilation hoses, water traps and associated water jars, Y-piece, temperature sensor

- These parts may be autoclaved at 134 °C (273 °F).

Nebulizer

- Process in accordance with its accompanying instructions for use.

Bacteria filter

- Must be processed in accordance with its accompanying Instructions for Use.

Breathing gas humidifier

- Must be processed in accordance with its separate Instructions for Use.

Disinfecting / Cleaning / Sterilizing Schedule for the EvitaXL Intensive Care Ventilator

Applicable for use with non-infectious patients.

If the ventilator was used with infectious patients, all parts that conduct breathing gas must be additionally sterilized after disinfecting and cleaning.

The breathing gas conducting parts listed here can be steam-sterilized at 134 °C (273 °F). See "Sterilizing" column.

This table is intended as a guideline only.

Always follow accepted hospital procedures and protocols for cleaning and disinfecting

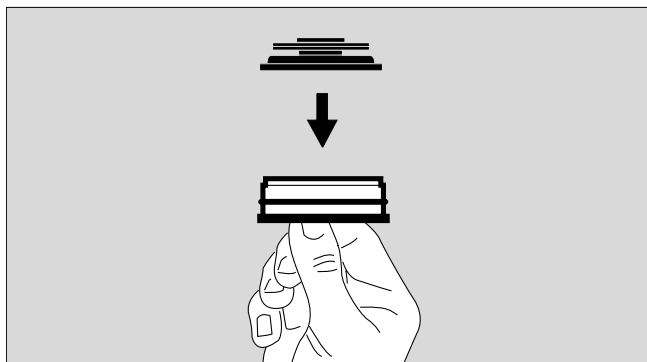
Part	How often	How			
		Disinfecting and cleaning			Sterilizing
		Autoclaving at 93 °C, 10 minutes	Wiping ¹	Bath immersion	Steam 134 °C, 10 minutes
EvitaXL ventilator	after each patient	no	outside	no	no
Mobile stand, circuit support arm, gas supply hoses	after each patient	no	outside	no	no
Patient circuit, patient wye, water traps, and collecting jars	after each patient/ weekly	yes	no	possible	yes
Expiratory valve	after each patient/ weekly ²	yes	no	possible	yes
Flow sensor	after each patient/ weekly	no ³	outside	possible ²	no
Temperature sensor	after each patient/ weekly	no	yes	no	yes
CO ₂ sensor (optional)	daily	no	yes ⁴	no	no
Cuvette of the CO ₂ sensor (optional)	daily	yes	no	yes	yes
Test filter for CO ₂ sensor (optional)	daily	no	yes ⁴	no	no
SpO ₂ sensor (optional)	after each patient/ weekly	no	yes	no	no
Breathing gas humidifier	after each patient/ weekly	In accordance with separate Instructions for Use			
Medicament nebuliser (optional)	after each patient/ weekly	In accordance with separate Instructions for Use			
Bacterial filter		In accordance with separate Instructions for Use			

1. with an approved wipe disinfectant based on the recommended active ingredients, see page 150
2. Nebulization may lead to formation of more extensive deposits requiring more frequent replacement.
3. Special treatment, bath disinfect in 70% ethanol, see page 148
4. Wipe-disinfect, e.g. with 70 % ethanol, see page 146.

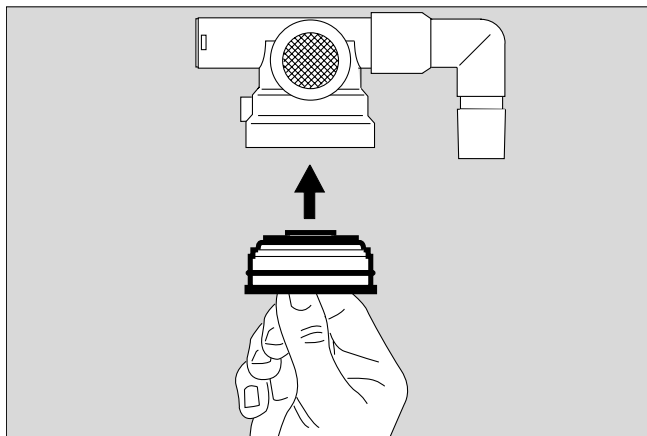
Re-assembly

Assembling the expiratory valve

- The parts must be entirely dry to prevent malfunctioning.
- Hold cover lid by its flange and place diaphragm on the collar of the lid. Be careful to fit the diaphragm properly.

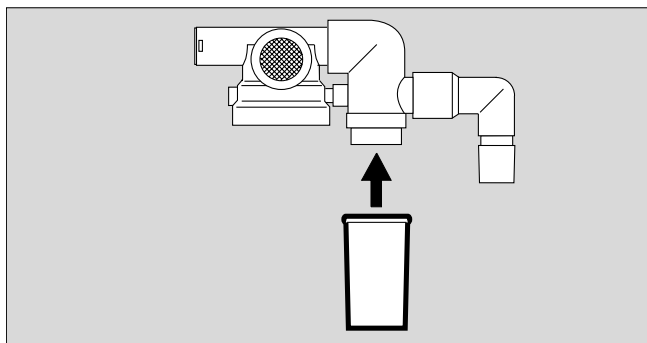


- Insert lid with diaphragm on top into the housing from below and screw in tightly.



If the expiratory valve has an optional water trap:

- Install collecting jar.



Aerosol nebulizer

- Assemble in accordance with its separate Instructions for Use, see page 107.

Breathing gas humidifier

- Assemble in accordance with its separate Instructions for Use. For installation, see page 40 and page 43.

Before Reusing on a Patient

- Assemble ventilator as described under "Preparation" on page 35.
- Perform checks of readiness for operation, see page 46.

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Maintenance

Maintenance Intervals	159
User Replaceable Parts	160
Correct Disposal of Batteries and O ₂ Sensors	161
Correct Disposal of the Ventilator	161

Maintenance

CAUTION !

Maintenance

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

For repairs we recommend that you contact DraegerService.

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 !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly.

We recommend that you contact DraegerService for maintenance service for the EvitaXL Ventilator.

WARNING !

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

Draeger cannot warrant or endorse the safe performance of third party replacement parts for use with the EvitaXL ventilator.

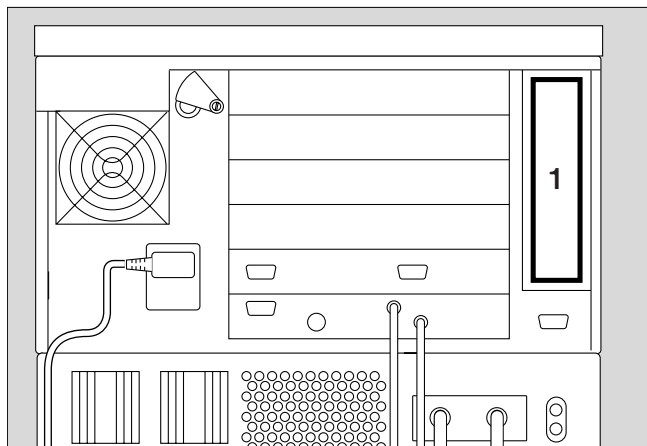
Maintenance Intervals

O2 sensors	<p>Replace when the following message is displayed: O2 measurement inop !!! or when calibration is no longer possible. For disposal of spent sensor capsules, see page 161.</p>
Air-intake filter,	<p>Clean or replace after 4 weeks, see page 160, Disposal with normal domestic waste.</p>
Cooling-air filter	<p>Replace every year, see page 160. Disposal with normal domestic waste.</p>
Filters in the compressed gas inlets	<p>Replace every 2 years.</p>
Battery of the DC integrated power pack	<p>Service every 6 months in conjunction with the semi-annual preventive maintenance inspection. Replacement every two years at the latest, to be performed by DraegerService or factory trained and authorized technical service personnel. Check battery capacity every six months Replace battery if necessary. Lead-acid gel batteries should be disposed of as special waste, see page 161.</p>
External battery (optional)	<p>Service every 6 months in conjunction with the semi-annual preventive maintenance inspection. Check battery capacity every six months Replace battery if necessary.</p>
Clock module	<p>To be replaced every 6 years by DraegerService or factory trained and authorized technical service personnel.</p>
Pressure reducer	<p>Complete overhaul every 6 years by DraegerService.</p>
Equipment inspection and service	<p>Every 6 months to be performed by DraegerService or factory trained and authorized technical service personnel.</p>

User Replaceable Parts

Replacing the cooling air filter

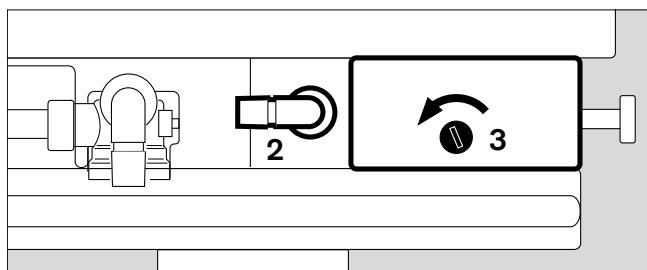
- Clean or replace after 4 weeks.
Replace after 1 year at the latest.
- 1 Remove cooling-air filter from its frame in the back of the ventilator.
- Replace or clean in warm water with detergent added; dry well.
- Insert cooling-air filter into its frame, taking care not to crease it.
- Dispose of used cooling-air filter with domestic waste.



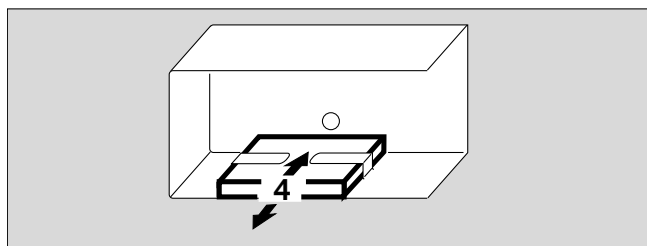
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Removing and reinserting the ambient air intake filter

- Clean or replace after 4 weeks.
Replace after 1 year at the latest.
- 2 If necessary, swivel port to the left.
- 3 Loosen screw with a coin and remove protective cover.
- 4 Remove ambient-air intake filter from the protective cover.
- Slide the cleaned or new ambient air filter under the tabs.
- Replace protective cover, and tighten screw with a coin.
- Dispose of used ambient-air filter with domestic waste.



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Correct 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.

For installation of a new O2-sensor capsule, see "Installing an O2 sensor capsule" on page 36.

Correct Disposal of the Ventilator

- at the end of its useful life.
- Contact a licensed waste disposal company for appropriate disposal of EvitaXL.
Follow all local, state, and federal regulations with respect to environmental protection when disposing of the ventilator.

NOTE: Because the battery installed in EvitaXL is considered hazardous waste, the internal DC battery must be removed by DraegerService or factory trained and authorized technical service personnel before the ventilator may be disposed of.

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Troubleshooting

Troubleshooting	164
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Troubleshooting

Alarm messages in the alarm display field are displayed in hierarchical order.
For example, if two faults are detected simultaneously, the more urgent of the two is displayed.

The priority level of the alarm messages (see page 97 for definitions) is identified by exclamation marks:

- Warning = !!! Message with top priority
- Caution = !! Message with medium priority
- Advisory = ! Message with low priority

In the table below, messages are listed in alphabetical order.
This table is intended to help identifying possible causes of an alarm and to assist with prompt corrective action. The various causes and remedies should be worked through in the order listed until the problem has been resolved.

Message		Cause	Remedy
Air supply down	!!!	Air supply pressure too low.	Make sure pressure is greater than 3 bar (43.5 psi).
Air supply down	!	Air supply pressure too low. Air supply pressure not required when FiO ₂ = 100 Vol.%.	Make sure pressure is greater than 3 bar (43.5 psi).
Air supply pressure high	!!	Air supply pressure too high.	Ensure pressure is below 6 bar (87 psi).
Air supply pressure high	!	Air supply pressure too high. Air supply is not needed for FiO ₂ = 100 Vol.%.	Ensure pressure is below 6 bar (87 psi).
Airway obstructed?	!!!	The ventilator applies only a very small volume with each mechanical breath, e.g. because the tube is blocked.	Check patient condition. Check tube.
		Patient "fights" against the mechanical breaths in pressure-controlled ventilation, with the result that set inspiratory pressure is reached with only a very small volume applied.	Check patient condition, Check ventilator settings.
		Neonatal flow sensor not installed in the breathing system.	Check patient condition. Check ventilator settings.
Airway pressure high	!!!	The upper alarm limit for airway pressure has been exceeded. The patient is "fighting" the ventilator, cough.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary.
		Kinked patient circuit	Check patient circuit and tube.

Message		Cause	Remedy
Airway pressure low	!!!	Leaking cuff.	Inflate cuff and perform leak test.
		Leak or disconnection.	Check patient circuit for tight connections. Check that the expiratory valve is properly engaged.
Ambient pressure sensor ?	!!	Ambient pressure sensor faulty.	Ventilator functions are not affected. However, the ventilator must not be used in aircraft or helicopters. Call DraegerService.
Apnea	!!!	Patient's spontaneous breathing has stopped.	Apply controlled ventilation.
		Stenosis	Check patient condition. Check tube.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor. Replace if necessary.
Apnea alarm off Only in »Mask/NIV« application mode	!	Apnea monitoring has been switched off in application mode NIV.	Set upper alarm limit for apnea monitoring to the desired value again.
Apnea ventilation	!!	Due to detected apnea, the ventilator has automatically switched to mandatory ventilation.	Check ventilation mode selected. Return to the original ventilation mode with »Alarm Reset«. Check patient condition. Check tube.
Breathing cycle not detected	!!!	The ventilator is not delivering any gas.	Set P _{max} higher than PEEP setting. Extend alarm time T _{Apnea} \sqrt{x} or increase CMV ventilator rate.
		Device faulty.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.
Check frequency ILV Slave Message on slave device during ILV	!	The breathing rate of the master and slave devices differ by more than 12 %.	Adjust the rate of the slave ventilator to that of the master.
Check settings	!!	Power interruption while setting a ventilation pattern or alarm limits.	Check ventilator pattern and alarm limits. Confirm message with »Alarm Reset« key.
Clean CO₂ cuvette	!!!	Window of cuvette for CO ₂ measurement is dirty.	Use clean cuvette.
		Sensor window for CO ₂ measurement is dirty.	Clean CO ₂ sensor.

Message		Cause	Remedy
CO2 measurement inop	!!!	CO2 sensor faulty.	Replace faulty CO2 sensor.
		CO2 measurement incorrect.	Ventilator functions are not affected. Ensure adequate external monitoring without delay. Deactivate integrated CO2 monitoring. Call DraegerService.
CO2 monitoring off	!	CO2 monitoring is switched off.	Switch CO2 monitoring on again (see page 126), or ensure adequate external monitoring without delay.
CO2 sensor?	!!!	CO2 sensor was disconnected during operation.	Reinsert connector.
		CO2 sensor for CO2 measurement not properly positioned on cuvette.	Place CO2 sensor on cuvette.
		CO2 sensor for CO2 measurement faulty.	Replace faulty CO2 sensor.
CO2 zero ?	!!!	Zero point for CO2 measurement is outside the permissible range.	Perform zero calibration, page 120.
		Zero calibration for CO2 measurement was unsuccessful.	Perform CO2 zero calibration correctly, page 120.
Device failure	!!!	Device faulty.	Ventilation may be continued if the message disappears when the »Alarm Reset« , key is pressed. If it does not: disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O2 concentration as necessary. Call DraegerService.
etCO2 high	!!!	CO2 measurement above upper alarm limit for end-expiratory CO2 concentration.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary.
etCO2 low	!!!	CO2 measurement below lower alarm limit for end-expiratory CO2 concentration.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary..
Execute device check	!	Device check not performed.	Perform device check, page 46. Confirm message with »Alarm Reset« key.
Exp. hold interrupted	!	The »Exp. hold« key has been pressed for more than 15 seconds.	Release »Exp. hold« key.
Exp. valve inop.	!!!	Expiratory valve not properly connected to socket.	Push expiratory valve firmly into socket until it clicks into place.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 116, replace if necessary.
		Expiratory valve faulty.	Replace expiratory valve.

Message		Cause	Remedy
Ext. battery polarity reversed	!	External battery has been connected with wrong polarity while using DC.	Connect external battery correctly page 57.
Ext. battery - Voltage high	!	External battery has been connected with excessively high voltage while using DC.	Connect a 12 V or 24 V battery.
External Flow	!	EvitaXL takes into consideration the externally supplied flow when monitoring correct operation of the flow measurement.	Deactivate calculation of the external flow, (see page 117).
Fan failure ?	!!!	Temperature in ventilator is too high. Fan failure.	Check fan function, clean or replace cooling air filter. Check ambient temperature. Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.
Fan malfunction	!	Temperature in ventilator too high.	Check fan function, clean or replace cooling air filter. Check ambient temperature. Ventilation may be continued. Call DraegerService.
FiO ₂ high	!!!	O ₂ sensor not calibrated.	Calibrate O ₂ sensor, page 119.
		Faulty O ₂ blender.	Ventilator functions are not affected. Ventilation may be continued. Use external O ₂ monitoring and deactivate the integrated O ₂ monitoring. Call DraegerService.
FiO ₂ low	!!!	O ₂ sensor not calibrated.	Calibrate O ₂ sensor, page 119.
		Faulty O ₂ blender.	Ventilator functions are not affected. Ventilation may be continued. Use external O ₂ monitoring and deactivate the integrated O ₂ monitoring. Call DraegerService.
Flow measurement inop.	!!!	Water in flow sensor.	Dry flow sensor.
		Flow sensor faulty.	Calibrate flow sensor (see page 116), replace if necessary.
		Flow measurement faulty.	Ventilator functions are not affected. Ventilation may be continued. Use external flow monitoring and deactivate the integrated flow monitoring. Call DraegerService.
Flow monitoring off	!	Flow monitoring is switched off.	Switch flow monitoring on again, as described on page 126, or immediately ensure adequate external monitoring.

Message		Cause	Remedy
Flow sensor?	!!!	Flow sensor not fully inserted into the rubber lip of the expiratory valve.	Insert flow sensor correctly.
Hard key failed	!!	Dial knob can no longer be pressed.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.
Hard key xx failed	!!	Key xx (e.g. »100 % O ₂ «) can no longer be pressed.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.
High frequency	!!!	Patient is breathing at a high spontaneous rate.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
ILV Sync. inop. Message on both ventiators during ILV	!!!	Frequency on master ventilator less than 4 breaths per minute.	Set a higher breath rate.
		Fault in communication between the ventilators.	Ventilator functions are not affected, but there is no communication between the two units. Replace ventilator to continue use of ILV. Call DraegerService.
Insp. hold interrupted	!	The »Insp. hold« key was held down longer than 15 seconds.	Release »Insp. hold« key.
Internal battery discharged	!!!	The ventilator is being powered by its integrated DC battery due to the absence of AC line power or an external battery. The time for operation with power from the integrated battery has expired.	Connect ventilator immediately to AC line power or to a fully charged external battery.
Internal battery in operation	!	The ventilator is being powered by its integrated DC battery due to the absence of AC line power or an external battery. The maximum time for operation with power from the integrated battery is 10 minutes.	Connect ventilator to AC line power or to a fully charged external battery within 10 minutes.
Internal battery only 2 minutes left	!!	The ventilator is being powered by its integrated DC battery due to the absence of AC line power or an external battery. The remaining time for operation with power from the integrated battery is 2 minutes.	Connect ventilator to AC line power or to a fully charged external battery within 2 minutes.

Message		Cause	Remedy
Key overused	!!	Dial knob pressed too often within a short space of time.	Acknowledge message with »Alarm Reset« key. If the message reoccurs frequently: disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.
Key overused ?	!!	Due to very frequent key use, the screen contents of the display are repeatedly redrawn.	Confirm message with key »Alarm Reset«.
		Brief communication failure between the display processor and main processor.	Confirm message with key »Alarm Reset«. Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.
Key xx overused ?	!!	Key has been pressed several times in a short period (e.g. »100 % O ₂ «).	Confirm message with key »Alarm Reset«. Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration if necessary. Call DraegerService.
Leakage Not displayed in application mode »Mask/NIV«	!	Measured leakage minute volume MV _{leak} is 20 % higher than the minute volume measured on the expiratory side.	Check that patient circuit connections are leakproof. Check that the tube is correctly fitted.
Loss of data	!!!	Lithium battery discharged.	The ventilator functions are not affected. Ventilation may be continued. Check settings. Call DraegerService.
MEDIBUS COM. inop.	!	The MEDIBUS cable has been unplugged during operation while using EvitaLink.	Re-insert connector and secure it against disconnection with the two screws.
		MEDIBUS cable faulty.	Use a new MEDIBUS cable.
		Interface faulty.	Ventilation may be continued. Call DraegerService.
Mixer inop.	!!!	Faulty O ₂ blender. FiO ₂ can deviate considerably.	Disconnect patient from the ventilator immediately and continue ventilation with another independent ventilator without delay. Use PEEP and/or elevated O ₂ concentration as necessary. Call DraegerService.

Message		Cause	Remedy
Multi functional board inop.	!!	The multifunction board for operating the nurse call is faulty.	Acknowledge message with the »Alarm Reset« key. The ventilator functions are not affected. However, correct operation of the nurse call cannot be guaranteed; disconnect nurse call. Call DraegerService.
Multi functional board inop.	!	The multifunction board for operating the nurse call is faulty.	Acknowledge message with the »Alarm Reset« key. The ventilator functions are not affected. However, correct operation of the nurse call cannot be guaranteed; disconnect nurse call. Call DraegerService.
MV high	!!!	The minute volume has exceeded the upper alarm limit.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, (see page 116), replace if necessary.
		Water in flow sensor.	Drain water trap in patient circuit. Dry flow sensor.
		Ventilator malfunction.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration if necessary. Call DrägerService.
MV low	!!!	The minute volume has fallen below the lower alarm limit.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary.
		Stenosis.	Check patient condition. Check tube.
		Leak in patient circuit.	Establish leakproof patient circuit.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor (see page 116), replace if necessary.
		Ventilator malfunction.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration if necessary. Call DraegerService.
MV low alarm off Only in application mode »Mask/NIV«	!	Monitoring of the lower alarm limit for the minute volume has been deactivated in NIV application mode.	Set alarm limit MV $\sqrt{\quad}$ to the required value again.

Message		Cause	Remedy
Nebulization interrupted	!!	Only in pediatric mode. Nebulizing is only possible in pressure-controlled ventilation or with AutoFlow.	Change patient mode. Restart nebulizer. Acknowledge alarm with »Alarm Reset«.
		Only in pediatric mode, only for ventilation with AutoFlow. Flow sensor not ready for measurement.	Switch flow monitoring on or calibrate flow sensor (see page 116), or replace flow sensor, or change mode. Restart nebulizer. Acknowledge alarm with »Alarm Reset«.
Nebulizer on	!	The nebulizer is switched on, (see page 106).	Switch off nebulizer off, if necessary, (see page 106).
O2 measurement inop.	!!!	O2 sensor provides invalid measured values.	Calibrate O2 sensor (see page 119), replace if necessary.
		O2 measurement malfunction.	Ventilation may be continued: use external O2 monitoring and deactivate integrated O2 monitoring. Call DraegerService.
O2 monitoring off	!	O2 monitoring switched off.	Switch O2 monitoring on again (see page 126), or immediately ensure an adequate alternative monitor function.
O2 supply down	!!!	O2 supply pressure too low.	Make sure pressure is greater than 3 bar (43.5 psi).
O2 supply down	!	O2 supply pressure too low. O2 supply pressure is not required when FiO2 = 21 Vol.%.	Make sure pressure is greater than 3 bar (43.5 psi).
O2 supply pressure high	!!	O2 supply pressure too high.	Ensure pressure is below 6 bar (87 psi).
O2 supply pressure high	!	O2 supply pressure too high. O2 supply pressure is not required when FiO2 = 21 Vol.%.	Ensure pressure is below 6 bar (87 psi).
PEEP high	!!!	Expiratory system obstructed.	Check patient circuit and expiratory valve.
		Expiratory resistance is increasing.	Check bacteria filter. Replace if necessary.
		Ventilator faulty.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O2 concentration as necessary. Call DraegerService.
PEEP valve inop.	!!!	Internal PEEP valve faulty.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O2 concentration as necessary. Call DraegerService.
Pressure limited	!	P _{max} pressure limit is active.	Check patient condition. Check ventilation pattern. Correct setting if necessary.

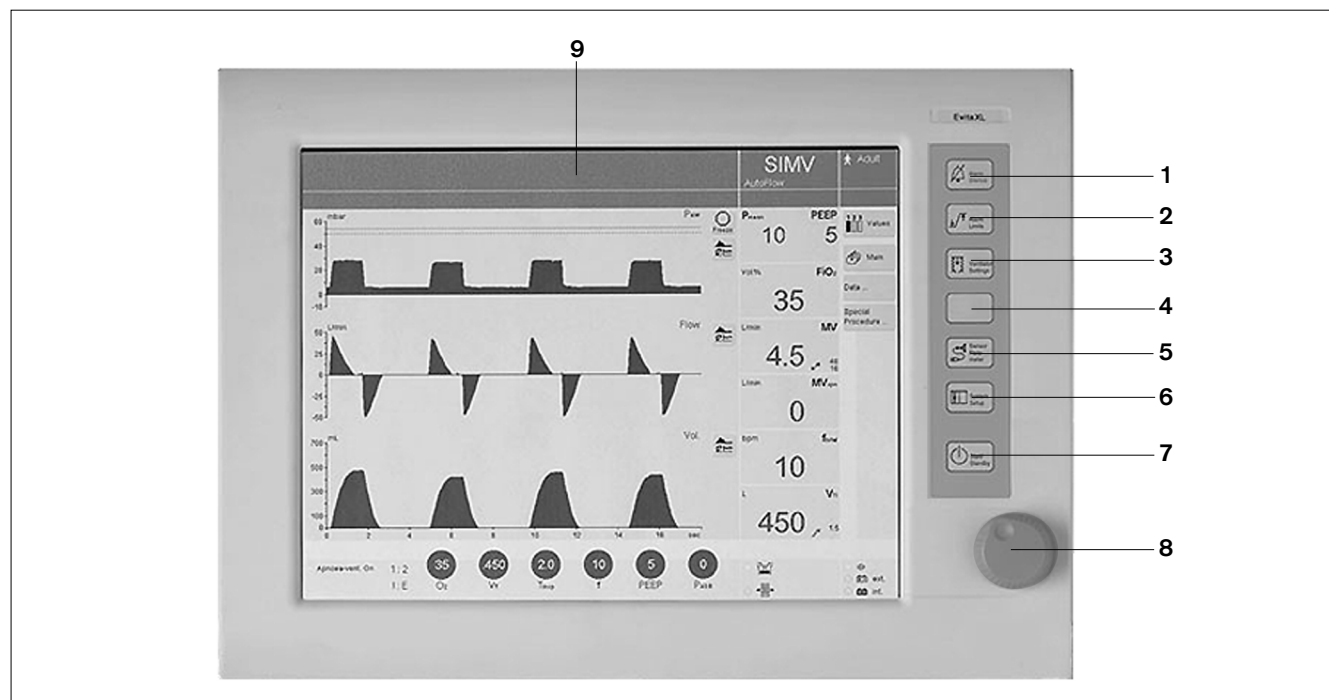
Message		Cause	Remedy
Pressure measurement inop. !!!		Fluid in expiratory valve.	Replace expiratory valve (see page 149), then clean and dry.
		Pressure measurement malfunction.	Disconnect patient from the ventilator and continue ventilation immediately with another independent ventilator. Use PEEP and/or elevated O ₂ concentration if necessary. Call DraegerService.
P_{supp.} > 4 s Not displayed in application mode »Mask/NIV«	!!!	Only appears in adult patient mode. The pressure support cycle has been switched off 3 times due to time limitation.	Check patient circuit for leaks.
P_{supp.} > 1,5 s	!	Only appears in pediatric mode. The pressure support cycle has been switched off 3 times due to time limitation.	Check patient circuit for leaks.
Standby activated	!!!	EvitaXL has been switched to standby.	Confirm standby with »Alarm Reset« key.
Temperature high	!!!	Breathing gas temperature higher than 40 °C.	Switch humidifier off.
Temperature meas. inop.	!!!	Temperature sensor faulty.	Install new temperature sensor, page 41.
Temperatur sensor ?	!!!	Temperature sensor probe has been disconnected during operation.	Reconnect probe.
		Sensor cable broken.	Install new temperature sensor.
Tidal volume high	!!!	The upper alarm limit of the applied inspiratory tidal volume VT has been exceeded during three consecutive ventilator breaths.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary.
		Leak or disconnection.	Check that patient circuit and connections are leakproof.
Tidal volume high	!	The inspiratory tidal volume VT has exceeded the upper alarm limit.	Check patient condition. Check ventilation pattern. Correct alarm limit if necessary.
		Leak or disconnection.	Check that patient circuit and connections are leakproof.
Volume not constant, Pressure limited	!!	Due to pressure limit or time limit, the set tidal volume VT has not been applied.	Prolong inspiratory time »T _{insp} «. Increase inspiratory flow »Flow«. Increase pressure limit »P _{max} «. Press »Alarm Reset« key to suppress the visual and audible alarm until the cause of the alarm is remedied.
VT high alarm off Only in application mode »Mask/NIV« (optional)	!	The upper alarm limit for the inspiratory tidal volume VT _i \sqrt{f} has been deactivated in application mode NIV.	Set alarm limit for VT _i \sqrt{f} to the desired value again.

What's What

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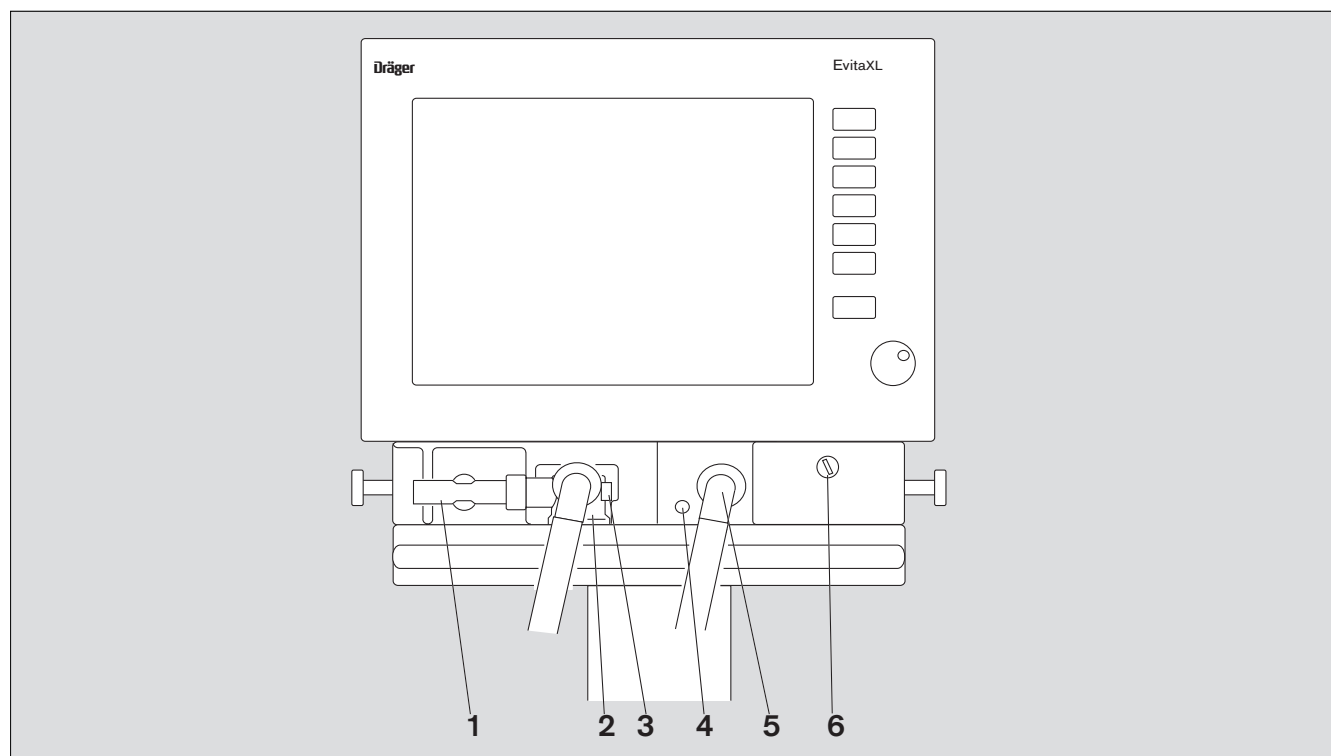
What's What

Control Panel



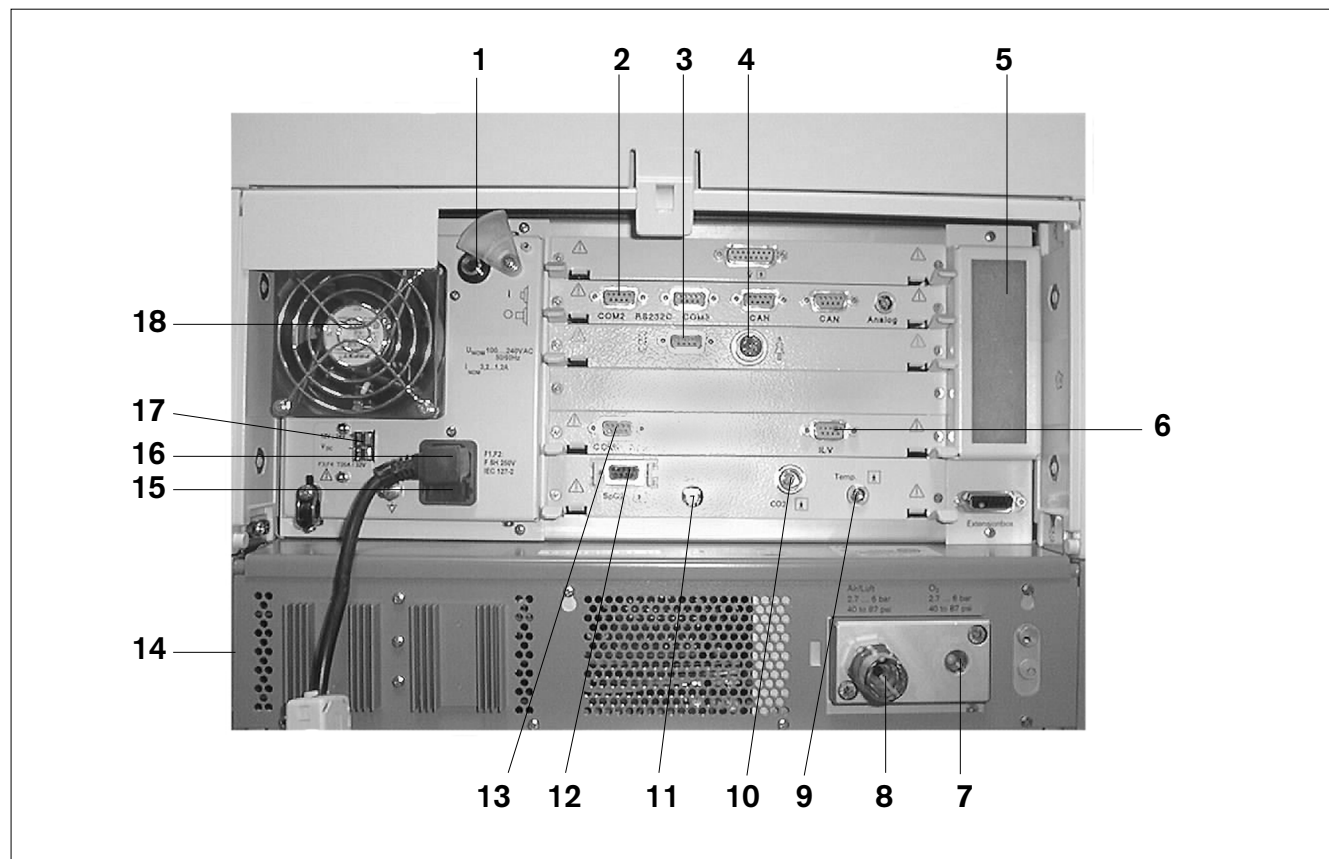
- 1 » **Alarm Silence**« key for silencing audible alarms for 2 minutes
- 2 » **Alarm Limits**« key for setting alarm limits
- 3 » **Ventilator Settings**« for setting ventilation modes and parameters
- 4 Unassigned key for future functions
- 5 » **Sensor Parameter**« key for calibrating sensors and for activating/deactivating monitoring
- 6 » **System Setup**« for configuring ventilator functions
- 7 » **Start/Standby**« for switching between operation and standby mode
- 8 Central rotary dial knob for selecting and confirming settings
- 9 Touch-sensitive screen for displaying application-specific screen views.






Front Connections



- 1 Flow sensor
- 2 Expiratory valve with expiratory connector port
- 3 Latch for expiratory valve
- 4 Nebulizer connection
- 5 Inspiratory connector port
- 6 Locking screw for protective cover
(behind it: O₂ sensor and ambient-air intake filter)

Back Panel



- | | |
|--|---|
| 1 Power switch with protective flap | 11 »Sync.« socket for C-Lock-ECG synchronization for optional SpO2 measurement (optional) |
| 2 »COM2«, »COM3« sockets for RS 232, two CAN interfaces and analog interface (optional) | 12 »SpO2«  socket for functional SpO2 measurement (available option) |
| 3 Connection »  « for Remote Pad (available option) | 13 »COM1 RS232C« socket for RS 232 interface, e.g. for printer |
| 4 Connection »  « for nurse call (available option) | 14 Rating plate (not visible) on the left-hand side panel |
| 5 Cooling-air filter | 15 AC fuses |
| 6 »ILV« socket for the connecting cable for independent lung ventilation with two Evita ventilators | 16 Connector for power cord |
| 7 Connection for oxygen | 17 DC socket |
| 8 Connection for medical air | 18 Fan |
| 9 »Temp«  socket for temperature sensor | |
| 10 »CO2«  socket for CO2 sensor (optional) | |

021237376

Labels

Main WARNING/CAUTION 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
DraegerService 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 (USA) LAW RESTRICTS THIS DEVICE TO
SALE BY OR ON THE ORDER OF A PHYSICIAN

Air intake CAUTION label

CAUTION !

DO NOT BLOCK
AIR INTAKE



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Technical Data

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Technical Data

Environmental Conditions

In operation

Temperature	10 to 40 °C
Atmospheric pressure	700 to 1060 hPa
Rel. humidity	5 to 90 %

In storage

Temperature	–20 to 60 °C (–4 to 140 °F)
Atmospheric pressure	500 to 1060 hPa
Rel. humidity	5 to 95 %

Settings

Ventilation frequency f	0 to 100 bpm
Inspiration time T _{insp}	0.1 to 10 s
Tidal volume V _T	
Pediatric range	0.02 to 0.3 L, BTPS*
Accuracy	greater of ±10 % of set value, or ±10 mL
Adult range	0.1 to 2.0 L, BTPS*
Accuracy	greater of ±10 % of set value, or ±25 mL
Inspiratory Flow	
Pediatric range	6 to 30 L/min
Adult range	6 to 120 L/min
Inspiratory pressure P _{insp}	0 to 80 cmH ₂ O
Inspiratory pressure limit P _{max}	0 to 100 cmH ₂ O
O ₂ concentration	21 to 100 Vol. %
Accuracy	greater of ±5 % of set value, or ±2 Vol. %
Positive end-expiratory pressure PEEP or intermittent PEEP	0 to 35 cmH ₂ O
Trigger sensitivity	0.3 to 15 L/min
Pressure assist Pressure Support	0 to 80 cmH ₂ O
Rise time for pressure assist	0 to 2 s
Independent lung ventilation ILV	
Master	with trigger/without trigger
Slave	synchr./asynchr./inverse I : E

* BTPS
Body Temperature, Pressure, Saturated.
Measured values relating to the conditions of the patient lung:
body temperature 37 °C, water vapor-saturated gas, ambient pressure.

ATC Automatic Tube Compensation

Adult mode

Inside tube diameter (ID Ø)	
Range	5 to 12 mm
Resolution	0.5 mm
Degree of compensation (Comp.)	
Range	0 to 100 %
Resolution	1 %

Pediatric mode

Inside tube diameter (ID Ø)	
Range	2.5 to 8 mm
Resolution	0.5 mm
Degree of compensation (Comp.)	
Range	0 to 100 %
Resolution	1 %

Performance Data

Control principle	time-cycled, volume-constant, pressure-controlled
Intermittent PEEP frequency	2 cycles every 3 minutes
Nebulizing of pharmaceutical aerosols	for 30 minutes
Bronchial suction	
Disconnection detection	automatic
Reconnection detection	automatic
Pre-oxygenation	max. 3 minutes
Active suction phase	max. 2 minutes
Post-oxygenation	2 minutes
Valve response time T _{0...90}	≤5 ms
Supply system for spontaneous breathing and pressure support	adaptive CPAP system with high initial flow
Max. flow rate	2 L/s in 8 ms
Max. inspiratory flow	180 L/min
Equipment compliance (with Fisher & Paykel MR 730 humidifier and reusable silicone adult patient circuit)	≤2 mL/cmH ₂ O
Insp. Resistance	≤2.3 cmH ₂ O/L/s
Exp. Resistance	≤3.8 cmH ₂ O/L/s
Dead Space Volume incl. CO ₂ -cuvette	≤16 mL

Technical Data

Performance Data

Equipment compliance (with Fisher & Paykel MR 730 humidifier and reusable silicone pediatric patient circuit)	≤1 mL/cmH2O
Insp. Resistance	≤4.1 cmH2O/L/s
Exp. Resistance	≤4.1 cmH2O/L/s
Dead Space Volume incl. CO2-cuvette	≤6 mL
Additional functions	
Inspiratory relief valve	opens if medical air supply fails (pressure <1.2 bar, 17.4 psi), enables spontaneous breathing with filtered ambient air.
Safety valve	opens the breathing system at 100 cmH2O.

Display of Measured Values

Airway pressure measurement

Max. airway pressure	Ppeak
Plateau pressure	Pplat
Pos. end-exp. pressure	PEEP
Mean airway pressure	Pmean
Min. airway pressure	Pmin
Range	0 to 99 cmH2O
Resolution	1 cmH2O
Accuracy	±2 cmH2O

O2 measurement in main flow (inspiratory side)

Inspiratory O2 concentration FiO2	
Range	15 to 100 Vol.%
Resolution	1 Vol.%
Accuracy	±3 Vol.%

Flow Measurement

Minute Volume MV

Spontaneously breathed minute volume MVspon	
Range	0 to 99 L/min, BTPS*
Resolution	0.1 L/min, or, for values less than 1 L/min: 0.01 L/min
Accuracy	±8 % of measured value
T10...90	approx. 35 s

* BTPS
Body Temperature, Pressure, Saturated.
Measured values based on the conditions of the patient lung:
body temperature 37 °C, steam-saturated gas, ambient pressure.

Tidal volume V_{Te}

Spontaneously breathed tidal volume $V_{T\text{spont}}$

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Tidal volume $V_{TP.\text{Supp.}}$

Inspiratory tidal volume during a pressure support breath

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Frequency Measurement

Breathing frequency f_{tot}

Spontaneous breathing frequency f_{spont}

Range	0 to 150 bpm
Resolution	1 bpm
Accuracy	±1 bpm
T _{10...90}	approx. 35 s

Breathing gas temperature measurement

Range	18 to 51 °C
Resolution	1 °C
Accuracy	±1 °C

CO₂ measurement in main flow (optional)

End-expiratory CO₂ concentration $etCO_2$

Range	0 to 100 mmHg or 0 to 13.3 Vol.% or 0 to 13.3 kPa
Resolution	1 mmHg or 0.1 Vol.% or 0.1 kPa
Accuracy	±2 mmHg ±5 % of measured value
T _{10...90}	≤25 ms
Warm-up time	max. 3 minutes

Technical Data

Performance Data

CO₂ production $\dot{V}CO_2$

Range	0 to 999 mL/min, STPD*
Resolution	1 mL/min
Accuracy	±9 % of measured value
T ₁₀ ...90	12 minutes

Serial dead space V_{ds}

Range	0 to 999 mL, BTPS
Resolution	0.1 mL
Accuracy	greater of ±10 % of measured value or ±10 mL

Dead space ventilation V_{ds}/V_T

Range	0 to 99 %
Resolution	1 %
Accuracy	±10 % of measured value

Computed value displays:

Compliance C

Range	0.7 to 200 mL/cmH ₂ O
Resolution	
Range 0.7 to 99.9 mL/cmH ₂ O	0.1 mL/cmH ₂ O
Range 100 to 200 mL/cmH ₂ O	1 mL/cmH ₂ O
Accuracy	±20 % of measured value*

Resistance R

Range	3 to 200 cmH ₂ O/L/s
Resolution	
Range 3 to 99.9 mL/cmH ₂ O	0.1 cmH ₂ O/L/s
Range 100 to 200 mL/cmH ₂ O	1 cmH ₂ O/L/s
Accuracy	±20 % of measured value**

Leakage minute volume MV_{leak}

Range	0 to 99 L/min, BTPS
Resolution	0.1 L/min or for values less than 0.1 L/min: 0.01 L/min
Accuracy	±18 % of measured value
T ₁₀ ...90	approx. 35 s

Rapid Shallow Breathing RSB

Range	0 to 9999 1/(min x L)
Resolution	1/(min x L)
Accuracy	see measurement of V _T and f

* C-values may be considerably biased as spontaneous breathing increases; compliance with the measuring accuracy therefore cannot be guaranteed for spontaneous breathing.

** R-values may be considerably biased as spontaneous breathing increases; compliance with the measuring accuracy therefore cannot be guaranteed for spontaneous breathing.

Negative Inspiratory Force NIF

Range	–45 to 0 cmH ₂ O
Resolution	1 cmH ₂ O
Accuracy	±2 cmH ₂ O

Waveform displays:

Airway pressure PAW (t)	–10 to 100 cmH ₂ O
Flow (t)	–150 to 180 L/min
Volume V (t)	0 to 2000 mL
Exp. CO ₂ concentration FCO ₂	0 to 100 mmHg or 0 to 13 kPa or 0 to 13 Vol.%

Monitoring

Expiratory minute volume MV

Upper alarm limit alarm	if MV exceeds the upper alarm limit.
Setting range	41 to 0.1 L/min, in 0.1 L/min increments
Lower alarm limit alarm	if MV falls below the lower alarm limit.
Setting range	0.01 to 40 L/min, in 0.1 L/min increments

Airway pressure PAW

Upper alarm limit alarm	if the "PAW high" value is exceeded.
Setting range	10 to 100 cmH ₂ O
Lower alarm limit alarm	if the value "PEEP +5 cmH ₂ O" (linked to set value of PEEP) is not exceeded for at least 96 ms in 2 successive ventilator breaths.

Insp. O₂ concentration FiO₂

Upper alarm limit alarm	if FiO ₂ exceeds the upper alarm limit for at least 20 seconds.
Lower alarm limit alarm	if FiO ₂ falls below the lower alarm limit for at least 20 seconds.
Range	both alarm limits are automatically linked to the set value: for settings below 60 Vol.:. threshold ±4 Vol.%. 60 Vol.% and above: ±6 Vol.%

End-expiratory CO₂-concentration etCO₂ (optional)

Upper alarm limit alarm	if the upper alarm limit has been exceeded
Setting range	0 to 100 mmHg or 0 to 15 kPa
Lower alarm limit alarm	if the lower alarm limit fell below
Setting range	0 to 99 mmHg or 0 to 14 kPa

Technical Data

Operating Data

Functional oxygen saturation SpO₂ (optional)

Upper alarm limit alarm	if the upper alarm limit has been exceeded
Setting range	51 to 100 %
Lower alarm limit alarm	if the lower alarm limit has been undershot
Setting range	50 to 99 %

Pulse (optional)

Alarm at upper limit	if value has exceeded the upper alarm limit
Setting range	21 to 250 bpm
Alarm at lower limit	if value has fallen below lower alarm limit
Setting range	20 to 249 bpm

Inspiratory breathing gas temperature

Alarm at upper alarm limit	if temperature reaches 40 °C (EvitaXL may also be used without temperature sensor if the sensor is not connected on switching on)
----------------------------	--

WARNING! We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Tachypnea monitoring

Alarm	during spontaneous breathing, when the spontaneous breath rate has been exceeded.
Setting range	5 to 120 bpm

Volume monitoring



Lower alarm limit alarm	if the set tidal volume VT could not be applied (alarm limit linked to set value of VT).
Upper alarm limit alarm	if the applied tidal volume exceeds the alarm threshold, inspiration is interrupted and the expiratory valve is opened.
Setting range	21 to 4000 mL

Apnea alarm delay time

Alarm	if no breathing activity is detected
Setting range	5 to 60 s, adjustable in 1 second steps.

Operating Data

AC power connection	100 V – 10 % to 240 V +10 % 50/60 Hz
Current	
at 230 V	max. 1.3 A
at 100 V	max. 3.2 A
Power consumption	typically approx. 125 W

Ventilator fuses	
Range 100 V to 240 V	F 5 H 250 V IEC 127-2 (2x)
Protection class	
Ventilator	Class I
CO ₂ sensor (sensor connected)	Type BF 
Temperature sensor (sensor connected)	Type BF 
Gas supply	
O ₂ gauge pressure	43.5 psi (3 bar) – 10 % to 80 psi (5.5 bar) + 10 % at 60 L/min (peak flow 200 L/min)
O ₂ connection thread	DISS, male (oxygen)
Air gauge pressure	43.5 psi (3 bar) – 10 % to 80 psi (5.5 bar) + 10 % at 60 L/min (peak flow 200 L/min)
Air connection thread	DISS, male (air)
Dew point	5 °C below ambient temperature
Oil concentration	<0.1 mg/m ³
Particle size	Dust-free air (filtered with filter size <1µm)
Gas consumption of control system	Medical air or O ₂ approx. 3.6 L/min
Output for pneumatic medicament nebuliser	Medical air or O ₂ max. 2 bar, max. 10 L/min
Automatic gas switch-over	if one gas fails (inlet pressure < 22 psi), the device switches to the other gas.
Sound pressure level (for free-field measurement over a reflecting surface)	max. 47 dB (A)
Dimensions (W x H x D)	
Basic ventilator unit	530 x 315 x 450 mm (20.9" x 12.4" x 17.7")
Ventilator with mobile cart	580 x 1360 x 660 mm (22.8" x 53.5" x 26.0")
Weight	
Basic ventilator unit	approx. 29 kg (64 lbs) (incl. shelf)
Electromagnetic compatibility (EMC) (conforming to European Directive 89/336/EEC)	Tested in accordance with EN 60601-1-2
Classification as per EC Directive 93/42/EEC Addendum IX	II b
UMDNS code	17-429
Universal Medical Device Nomenclature System – Nomenclature for medical products	

* STPD
Standard Temperature, Pressure, Dry.
Measured values based on standardized physical conditions: 0 °C, 1013 hPa, dry gas

Technical Data

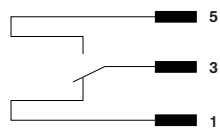
Materials Used

Materials Used

Part	Appearance	Material
Reusable patient circuit	milky, transparent	silicone rubber
Water traps	yellow, transparent	polysulphone
Y-piece	yellow, transparent	polysulphone
Connector for temperature measurement	milky, transparent	silicone rubber
Expiratory valve		
Housing, closure	white	polyamide
Diaphragm	whitish and grey	silicone rubber and aluminum
CO2 cuvette	yellow, transparent	polysulphone with glass windows
Temperature sensor/cable	milky/green or blue	silicone rubber
CO2 sensor/cable	grey/grey	polyurethane

Nurse Call (Available Option)

- Pin assignment
- 6-pin round DIN socket
- Floating DC contact
- Input voltage max. 40 V =
- Input current max. 500 mA
- Switching capacity max. 15 W



Ventilator Outputs

Digital outputs

COM 1

plus

COM2 and COM3 (optional)

can be configured for:

LUST protocol

Baud rate: 1200, 2400, 4800, 9600, 19200 Baud

Data bits: 7

Parity: even

Stop bits: 1

MEDIBUS protocol

Baud rate: 1200, 2400, 4800, 9600, 19200 Baud

Data bits: 8

Parity: even, odd, no

Stop bits: 1 or 2

(19200 baud are required for transmitting high-speed data, e.g. for displaying flow waveforms)

Printer protocol HP Deskjet series 500

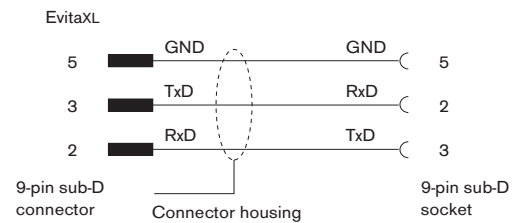
Baud rate: 1200, 2400, 9600, 19200 Baud

Data bits: 8

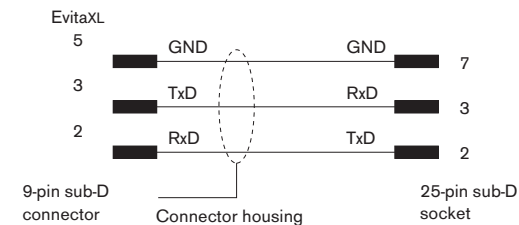
Parity: no

Stop bits: 1

Pin assignment of the MEDIBUS cable



Pin assignment of the printer cable



Cable length

Up to 15 m

Load impedance

3000 to 7000 ohm

Signal level

(for load impedance from 3000 to 7000 ohm)

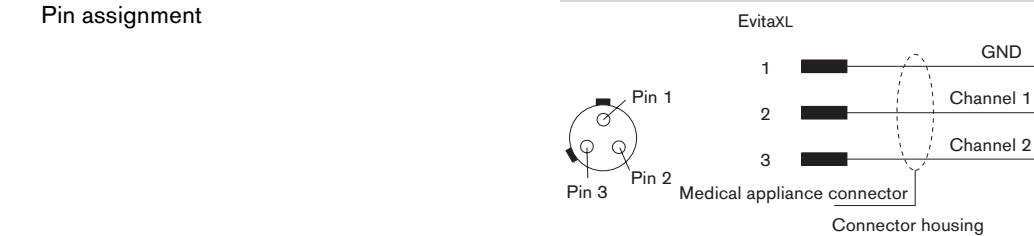
Low

High

between 3 and 15 V

between -3 and -15 V

Electrical isolation	Serial port COM1, as well as COM2 and COM3 (optional) are electrically isolated from the ventilator electronics. The test voltage for electrical isolation is 1500 V. CAUTION: Ports COM2 and COM3 are not electrically isolated from one another.
Digital output for independent lung ventilation (ILV)	
Analog interface	
Voltage level	0 to 4.095 V
Impedance of analog channels	Output impedance is 200 Ω . The input impedance of connected equipment should be not less than 1 M Ω otherwise the output signal will become distorted.
Accuracy	0 V : 0 V to 0.005 V 4.095 V : 4.075 V to 4.115 V
Electrical isolation	The socket is electrically isolated from the ventilator electronics. The test voltage for electrical isolation equals 1500 V. CAUTION: Ports COM2 and COM3 are not electrically isolated from one another.



DC Power Pack (DC-DC Converter)

Electrical ratings for the DC (input) socket

DC input voltage	10 to 30 V DC
Input current	
12 V battery	Typically 13 A, max. 30 A
24 V battery	Typically 6 A, max. 15 A

Power characteristics

Time bridged following an AC power failure
(with fully operational batteries*)

— Fully charged integrated battery	Typically 14 minutes; at least 10 minutes
— Two fully charged external 12 V lead-acid gel-type batteries (order no.18 43 303) with a capacity of 17 Ah each	Typically 2 hours

External batteries**

Type	Lead-acid gel-type batteries, sealed, maintenance-free
Minimum capacity	
12 V battery	30 Ah (take note of the charging current requirements)
24 V battery	15 Ah (take note of the charging current requirements)
Max. charging current through the DC power pack (the battery used must be rated for at least this charging current)	
12 V battery	Approx. 5.5 A
24 V battery	Approx. 3 A
Charging time*** (for 18 43 303), two batteries connected in series	
24 V lead-acid gel-type battery	Typically 8 to 10 hours

Integrated batteries

Type	Lead-gel batteries, sealed, maintenance-free
Charging time***	Typically 1.5 to 2.5 hours

Protection class I

* see "Charge indication and battery charge" on page 56

** see "AC/DC Powered Operation" on page 54

*** see "Charging Times" on page 56

Data Protocols

LUST protocol

LUST:

List-controlled universal interface driver program compatible with the RS 232 interface in Evita ventilators from software version 7.n upwards.

The LUST protocol consists of 4 different transmission telegrams:

- Identification telegram
- Status telegram
- Data telegram
- Alarm telegram

The first three telegrams are only sent in response to a request from the external unit. The alarm telegram is sent automatically when an alarm occurs or disappears.

Telegram control

The following ASCII* control characters are used to request the individual telegrams:

"ACK" Request for an identification telegram.

"NAK" Request for a status telegram.

"ENQ" Request for a data telegram.

Output of all telegrams can be controlled via certain control characters:

"DC1" (x-on) Enables telegram output.

"DC3" (x-off) Halts output at any time.

Following an enable ("DC1"), the interrupted telegram is resent without being adjusted to the actual status.

Requesting a telegram overrides the effect of "DC3"; the telegram interrupted by "DC1" is lost and the requested telegram is sent.

Output of an alarm telegram can also be controlled:

"DC2" Enables output of the alarm telegrams.

"DC4" Halts the output of alarm telegrams.

Ongoing transmissions are not interrupted by "DC4". This is only possible with "DC3" (x-off).

A telegram request ("ACK", "ENQ" or "NAK") does not act to re-enable the output of alarm telegrams.

Following a "DC2", the last event is transmitted by the alarms in each case. If no alarm events have occurred, an alarm telegram with all active alarms is requested with each "DC2".

Unknown control characters are ignored.

* See page 222 for a list of special ASCII characters used.

Identification telegram

The identification telegram contains the device designation and a list of all measured values sent in the data telegram.

It has the following structure:

Telegram header

"STX" Start character
050 Identification number
0 Channel number

Telegram body

The body of the telegram first contains the device name:

"ESC EvitaXL"

This is then followed by any number of blocks, each separated by "ESC". Each block contains all the data pertaining to a measured value, each separated by "RS".

Each block has the following structure:

"ESC" (signal No.) "RS" (signal name, long form)

"RS" (signal name, short form) "RS" (unit)

"RS" (minimum) "RS" (maximum)

The following table lists the complete identification telegram:

Signal No.	Signal name, long form	Short form	Unit	Minimum value	Maximum value
00	Time	t	h:min	.0.00	23.59
01	Exp. tidal volume	VT _e	L	0.000	2.000
02	Breathing Frequency	f	1/min	..0	240
03	Minute Volume	MV	L/min	.0.00	99.99
04	Peak-pressure	Peak	mbar	..0	120
05	Plateau-pressure	Plat	mbar	.0	99
06	PEEP-pressure	PEEP	mbar	.0	99
07	Minimum-pressure	P _{min}	mbar	-20	99
08	Mean-pressure	Mean	mbar	.0	99
09	Insp. O ₂ -concentration	FiO ₂	%	15	99
10	Compliance	C	mL/mbar	..0.0	255
11	Resistance	R	mbar/(L/s)	..0.0	200
12	Spont. minute volume	MV _s	L/min	.0.00	99.99
13	Spont. frequency	f s	1/min	..0	240
14	Airway Temperature	Temp	deg C	18	45
15	Intrinsic PEEP	P _{intr}	L/min	.0.0	99.99
16	Trapped Volume	V _{trap}	mL	...0	9999
17	Occlusion Pressure	P ₀₁	mbar	.0.0	99.9
18	End tidal CO ₂ in mmHg	CO ₂ E1	mmHg	.0	99
19	End tidal CO ₂ in kPa	CO ₂ E2	kPa	.0.0	99.9
20	End tidal CO ₂ in %	CO ₂ E3	%	.0.0	99.9
21	CO ₂ Production	CO ₂ P	mL/min	..0	999
22	Dead Space	V _{ds}	mL	..0	999
23	Rel. Dead Space	V _{ds}		..0	999
24	SpO ₂	SpO ₂	%	..0	100
25	Puls	Puls	bpm	..0	999
26	Tidalvolume ASB	VT ASB	mL	...0	9999
27	Negative Inspiratory Force	NIF	mbar	-45	.0
28	Rapid Shallow Breathing	RSB	1/L*min	...0	9999

Leading zeroes (identified by "0.0" or "..0" in the table) are replaced by one or two blanks.

End of telegram

"EOT"

Status telegram

The status telegram contains all settings, alarm limits, ventilation modes, and status messages.

It has the following structure:

Telegram header

"SOH" Start character
050 Identification number
0 Channel number

Telegram body

The body of the telegram contains any number of status messages, each separated by "GS". Each status message consists of a number and a name.

"GS" (number of the status message) (message text)

Data, such as settings and alarm limits, are enclosed between "FS" in the status message.

All status messages are listed in the following tables.

Settings

00	date : "FS"dd"FS"."FS"mm"FS"."FS"yy"FS"
01	O2 setting = "FS"nnn"FS" %
02	Max. inspiratory flow = "FS"nnn"FS" L/min
03	Insp. tidal volume = "FS"n,nnn"FS" L
06	I : E = "FS"nn,n"FS" : "FS"1,0"FS"
06	I : E = "FS"1,0"FS" : "FS"nn,n"FS"
07	Max. breathing pressure = "FS"nnn"FS" mbar
08	Breath rate (frequency) = "FS"nnn,n"FS" 1/min
09	PEEP = "FS"nn"FS" mbar
10	Psupp. (ASB) = "FS"nn"FS" mbar
11	Interm. PEEP = "FS"nn"FS" mbar
12	APRV P-low = "FS"nn"FS" mbar
13	APRV P-high = "FS"nn"FS" mbar
14	APRV T-low = "FS"nn,n"FS" s
15	APRV T-high = "FS"nn,n"FS" s
16	Apnea Time = "FS"nn"FS" s
17	Tachypnea warning = "FS"nnn"FS" bpm
18	Flow Trigger = "FS"nn,n"FS" L/min
19	Pressure increase rate = "FS"n,nn"FS" s
28	Pinsp = "FS"nnn"FS" mbar
84	Ti = "FS"nn,nn"FS" s

Alarm limits

20	MV low limit = "FS"nn,nn"FS" L/min
21	MV high limit = "FS"nn,nn"FS" L/min
25	CO2 upper limit = "FS"nnn"FS"mmHg
25	CO2 upper limit = "FS"nn.n"FS" %
25	CO2 upper limit = "FS"nn.n"FS"kPa
26	CO2 lower limit = "FS"nnn"FS"mmHg
26	CO2 lower limit = "FS"nn.n"FS" %
26	CO2 lower limit = "FS"nn.n"FS"kPa
27	PAWLimit = "FS"nnn"FS" mbar
29	Insp. tidal volume high limit = "FS"n,nnn"FS" L
71	Tdisconnect = "FS"nn"FS" s
80	Pulse high limit = "FS"nnn"FS" bpm
81	Pulse low limit = "FS"nnn"FS" bpm
82	O2 saturation high limit = "FS"nnn"FS" %
83	O2 saturation low limit = "FS"nnn"FS" %

Ventilation modes

30	Mode IPPV
31	Mode IPPV/ASSIST
34	Mode SIMV
35	Mode SIMV/ASB
38	Mode CPAP
39	Mode CPAP/ASB
40	Mode MMV
41	Mode MMV/ASB
42	Mode APRV
43	Mode SYNCHRON MASTER
44	Mode SYNCHRON SLAVE
45	Mode Apnea ventilation
48	Mode BIPAP
49	Mode BIPAP/ASB
60	Mode SIMV/AutoFlow
61	Mode SIMV/ASB/AutoFlow
62	Mode IPPV/AutoFlow
63	Mode IPPV/ASSIST/AutoFlow
64	Mode MMV/AutoFlow
65	Mode MMV/ASB/AutoFlow
66	Mode ASYNCHRON MASTER
67	Mode CPAP/PPS
68	Mode BIPAP/ASSIST
69	IV – Invasive ventilation
70	NIV – Non-invasive ventilation

Status messages

24	Flow monitoring on
24	Flow monitoring off
50	Audio alarm inactive on
50	Audio alarm inactive off
51	Nebulizer on
51	Nebulizer off
53	O2 calibration on
53	O2 calibration off
54	O2 monitoring on
54	O2 monitoring off
55	Suction on
55	Suction off
56	Flow calibration on
56	Flow calibration off
57	CO2 calibration on
57	CO2 calibration off
58	CO2 monitoring on
58	CO2 monitoring off
85	SpO2 monitoring on
85	SpO2 monitoring off
97	Neonatal
98	Adult
99	Pediatric

End of telegram

"EOT"

Data telegram

The actual measured values defined by the identification telegram are transmitted in the data telegram. Invalid measured values contain dashes instead of numerical values. In addition, the data telegram also contains all the messages in the status telegram which have changed since the last status or data telegram.

The telegram has the following structure:

Telegram header

"SOH" Start character
 050 Identification number
 0 Channel number

Telegram body

The body of the telegram contains all the measured values defined in the identification telegram and any number of status messages. The number of digits for the measured values is defined in the identification telegram and does not exceed five. Commas are also transmitted, leading zeroes are replaced by blanks.

"ESC" (signal number) (measured value)
 "GS" (number of the status message) (message text)
 "GS" (number of the status message) (message text)

Alarm telegram

Alarm telegrams cannot be requested. They are transmitted automatically as soon as the alarm status changes. Automatic transmission of alarms can, however, be activated and deactivated, see telegram control on Seite 192.

The individual messages are sent

- when an alarm occurs,
- when the alarm status is cancelled.

The alarm telegram has the following structure:

Telegram header

"BEL" Start character
 050 Identification number
 0 Channel number

Telegram body

"ESC" (alarm/warning/advisory) (status)
 (alarm number) (alarm text)

The meaning of the individual fields is as follows:

01	Device failure
02	Air supply down
03	O2 supply down
04	pressure meas. inop
05	O2 measurement inop
06	flow measurement inop
07	mixer inop
08	exp. valve inop
09	fan 1 defect
10	Temperature meas. inop
12	Temperature high
13	flow sensor ?
14	PEEP high

15	CO2 measurement inop
16	CO2 sensor ?
17	clean CO2 cuvette
18	CO2 zero ?
22	apnea
23	FiO2 high
24	FiO2 low
25	MV low
26	MV high
27	airway pressure low
28	airway pressure high
29	fail to cycle
30	high frequency
32	volume not constant
33	ASB > 4 s
34	etCO2 high
35	etCO2 low
36	air supply pressure high
37	air supply high
38	apnea ventilation
39	Insp. hold interrupted
40	loss of data
41	Flow monitoring off
42	Monitoring FiO2 off
43	Monitoring CO2 off
44	Monitoring SpO2 off
45	O2 supply high
46	fan 2 defect
47	malfunction fan 2
48	malfunction fan 1
49	SpO2 low
50	SpO2 high
51	pulse low
52	pulse high
53	no pulse
54	SpO2 sensor ?
55	SpO2 meas. inop
57	battery not loaded
58	battery only for 2 min.
59	int. battery activated
60	ext. battery wrong
61	PEEP valve inop
62	neo. flow meas. inop
63	standby activated
64	nebuliser on
65	Tidalvolume high
67	check evita
68	frequency ILV Slave ?
69	pressure limited

70	ILV sync. inop
71	MEDIBUS inop
73	ASB > 1.5 s
74	Leakage
75	neo.flow monitoring off
76	neo.flowsensor unsuitable
77	nebuliser off
78	PPS-insp.> 1.5 s
79	PPS-insp.> 4 s
80	ASB > T _{insp}
81	backup ventilation
82	Exsp. hold interrupted
83	neo. flow?
84	apnea alarm off
85	MV low alarm off
86	VT high alarm off
87	Evita Remote error
88	Tube obstructed
89	Ext. Flow compensated
90	Error multi functional board
91	Ambient pressure sensor?

End of telegram

"EOT"

Theory of Operation

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Theory of Operation

Ventilation Modes

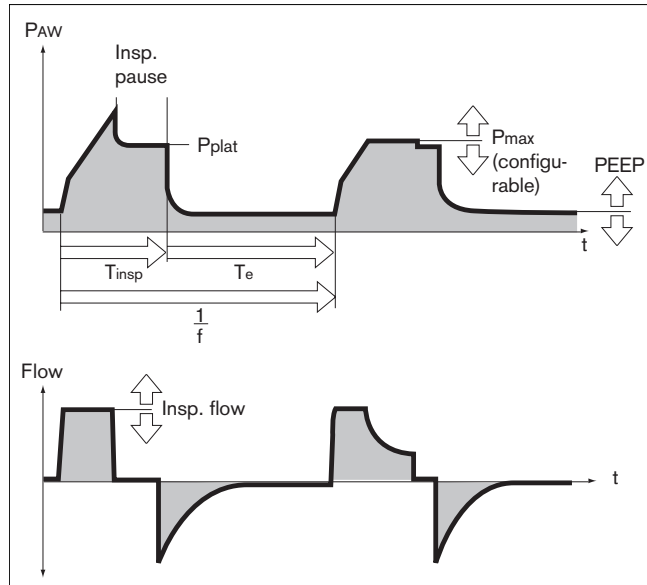
Volume-Controlled Ventilation With PLV and AutoFlow®

AutoFlow is a new supplemental function that controls inspiratory flow during mandatory ventilator breaths in the volume controlled ventilation modes CMV, SIMV and MMV. In order to better explain the improvement achieved by this function, the conventional modes are explained first:

Classic volume constant mandatory ventilator breath

In mandatory ventilator breaths without AutoFlow, the »Insp.Flow« parameter restricts inspiratory flow. If the inspiratory flow is so high that the set tidal volume V_T is reached before inspiratory time T_{insp} has fully elapsed, the inspiratory valve closes, and the breathing gas supply stops. The expiratory valve remains closed until the end of the inspiratory time T_{insp} . This phase, the inspiratory pause, can be identified in the $P_{\text{AW}}(t)$ waveform as the plateau P_{plat} . This type of mandatory ventilator breath, which for technical reasons is found in the same form in almost all intensive care ventilators, has two serious drawbacks:

- If the lungs are extremely non-homogeneous, the pressure peaks can lead to the overdistension of specific lung areas, and
- the limited inspiratory flow as well as the fact that inspiratory and expiratory valve are closed during the inspiratory pause, may cause the patient to "fight" the ventilator, unless the pattern of ventilation is regularly adapted to the needs of the spontaneously breathing patient.



Manual pressure limiting with P_{max}

EvitaXL can prevent pressure peaks, while maintaining the set tidal volume V_T , by means of the pressure limit P_{max} . The tidal volume V_T remains constant as long as a pressure plateau P_{plat} is still detectable and the flow waveform shows a brief period of zero flow between inspiration and expiration.

EvitaXL performs this function by reducing »Insp. Flow« upon reaching the set P_{max} . If the tidal volume V_T can no longer be applied with the selected pressure P_{max} due to reduced compliance, a "Volume not constant" alarm is automatically generated.

AutoFlow®

The AutoFlow function can be activated in the »Add. settings« menu. AutoFlow takes over the task of setting both »Insp. Flow« and »P_{max}«; the screen knobs for these parameters are no longer displayed.

With AutoFlow, inspiratory flow is automatically adjusted to changes in lung conditions (C, R) and to the spontaneous breathing demands of the patient.

WARNING !

When using AutoFlow, always set the alarm limit »PAW \nearrow « in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.

The maximum delivered peak airway pressure is limited to 5 cmH₂O below the »PAW \nearrow « alarm limit.

Typically, the selected inspiratory time T_{insp} is much longer than the lung filling time. The inspiration pressure P_{insp} corresponds to the minimum value calculated from the tidal volume V_T and compliance C of the lung.

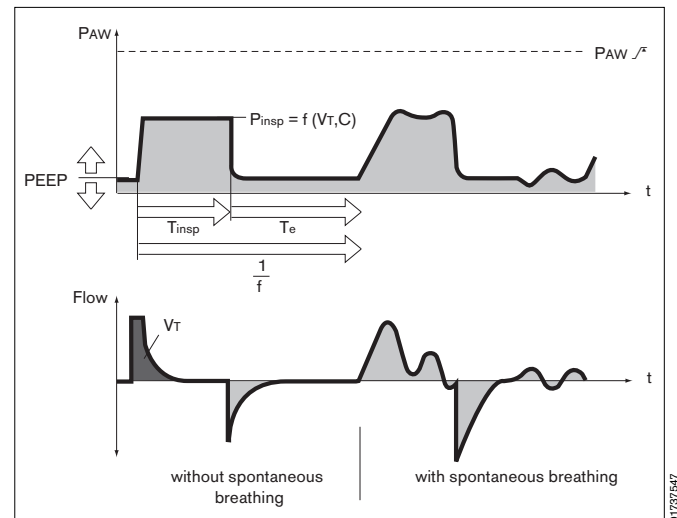
The inspiratory flow is automatically controlled so that there is no pressure peak caused by the resistances of the tube and the airways. The plateau pressure P_{plat} varies with changes in compliance C , as is normal in all volume-controlled ventilator breaths. With AutoFlow, these fluctuations occur in increments with a maximum of 3 cmH₂O between ventilator breaths.

If tidal volume V_T is reached (inspiratory flow = 0) before inspiratory time T_{insp} has fully elapsed, the control system for the inspiratory and expiratory valves ensures that the patient can breathe in and out during the remaining inspiratory time, even during the constant pressure plateau P_{plat} .

If the patient breathes in or out during mandatory inspiration, the plateau pressure P_{plat} is not changed for the duration of this ventilator breath: only inspiratory and expiratory flow are adapted to the patient's demand. The applied tidal volume V_T may differ from the set tidal volume V_T in individual ventilator breaths, but as an average over time a constant tidal volume V_T is supplied.

Overshoot in tidal volume V_T can be limited by the alarm limit » $V_{Ti} \nearrow$ «. If the set alarm limit is exceeded once, EvitaXL generates an advisory (!) message; if the alarm limit is exceeded three times, EvitaXL generates a warning (!!!).

Tidal volume is actively limited to the value of the alarm limit » $V_{Ti} \nearrow$ « by switching to PEEP level (expiration) when necessary.

**WARNING !**

When using AutoFlow, always set alarm limits $MV \searrow$ and $MV \nearrow$ in order to avoid excessive or insufficient flow following rapid changes in compliance.

An inspiratory time T_{insp} set to a value shorter than the time required to fill the lungs can be recognized in the flow waveform: the flow at the end of inspiration has not fallen to zero. In this situation, it must be decided whether the current patient condition permits extending inspiratory time in order to reduce peak pressure even further.

This effect can also develop in the course of ventilation, e.g. due to a buildup of secretions. In this situation, pressure is limited by the alarm limit »PAW \nearrow «. The pressure rise is held to 5 cmH₂O below the alarm limit »PAW \nearrow «. The "Volume not constant" alarm will only become active when the set tidal volume V_T is no longer fully applied.

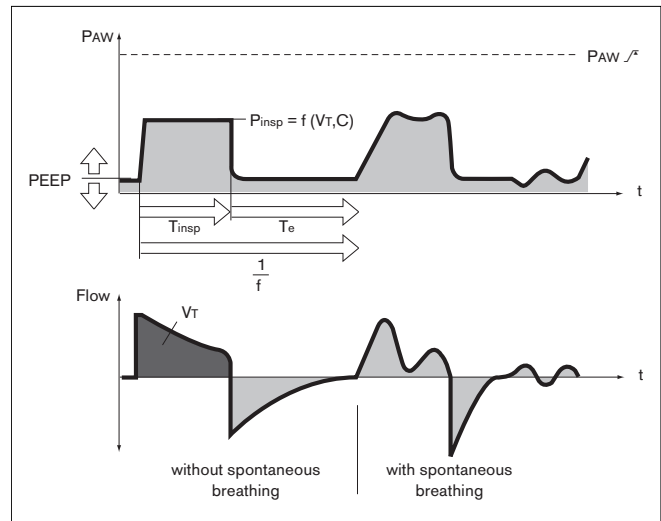
The start of a mandatory inspiration can be synchronized with a patient's own efforts using the adjustable flow trigger. Only while in CMV mode can the flow trigger be completely switched off (CMV Assist \rightarrow CMV).

The steepness of the pressure rise from PEEP level to the inspiratory level can be even more closely adapted to the needs of the patient by adjusting pressure rise time »Slope«.

Start-up procedure with AutoFlow

When AutoFlow is switched on, EvitaXL applies a volume controlled ventilator breath with minimum inspiratory flow and subsequent inspiratory pause.

The plateau pressure P_{plat} calculated for this ventilator breath serves as the startup value for inspiratory pressure under AutoFlow.



Sigh

"Sigh" operates in the form of an intermittent PEEP in CMV, CMV Assist and ILV.

The purpose of expiratory sigh during ventilation is to open collapsed areas of the lung, or to keep open "slow" areas of the lung.

Since atelectatic alveoli have a longer time constant – also caused by obstructed bronchioli – increased airway pressure maintained over a longer period is required to open them.

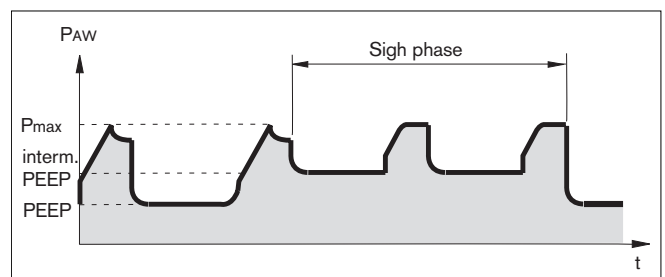
Commonly, a sigh breath is achieved by simply increasing the pressure level of a ventilator breath; however, due to the short time available, the filling of the »slow« alveoli is only marginally improved.

In the EvitaXL, the sigh operates during expiration with an intermittent PEEP for 2 breaths every 3 minutes.

Mean airway pressure is higher, and a longer filling time can be expected.

In order to avoid lung overinflation, pressure peaks during the sigh phase can be limited using pressure limit P_{max} without impairing the sigh function.

During the sigh phase, the "Volume not constant" alarm is disabled.



SIMV

Synchronized Intermittent Mandatory Ventilation

Combination of ventilator breaths and spontaneous breathing. SIMV enables the patient to breathe spontaneously during predefined, regular ventilation pause intervals, while mandatory mechanical breaths provide a minimum ventilation during the remaining cycle time.

Minimum ventilation is controlled by setting two parameters: tidal volume (V_T) and ventilator rate (f). It is then the result of the product of $V_T \times f$.

The ventilation pattern results from the set values of V_T , Insp. Flow, breath rate f and inspiratory time T_{Insp} .

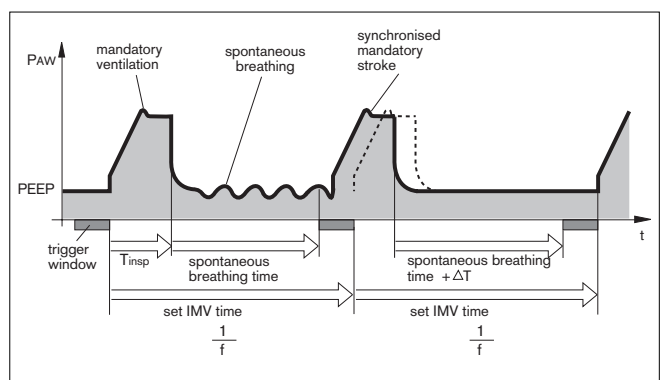
The flow trigger of the ventilator ensures that a ventilator breath is triggered in synchrony with a patient's spontaneous inspiratory effort within a "trigger window". This prevents mandatory ventilator breaths from being applied during spontaneous expiration.

The duration of the trigger window is 5 seconds in adult patient mode and 1.5 seconds in pediatric mode, respectively. If the expiratory time is less than 5 seconds (or 1.5 seconds in pediatric mode), the trigger window covers the entire expiratory time.

Synchronization of mandatory ventilator breaths by itself effectively reduces SIMV time, which would result in an undesirable increase in the effective IMV rate. EvitaXL therefore extends the subsequent time allowed for spontaneous breathing by the lost time difference ΔT – thus preventing an increase in the SIMV rate. The mandatory breathing rate f , together with tidal volume V_T responsible for minimum ventilation, is kept constant.

If the patient has inspired a significant volume at the beginning of the trigger window, the ventilator reduces its subsequent mandatory breath by shortening the time for the inspiratory flow phase and overall inspiratory time. Tidal volume V_T remains constant, and overinflation of the lungs is avoided.

During the spontaneous breathing phases, the patient can be assisted with pressure using Pressure Support. As part of progressive weaning, the breath rate f is further reduced on the ventilator, thus extending the periods of spontaneous breathing until the required minute volume is eventually supplied entirely by spontaneous breathing.



MMV

Mandatory Minute Ventilation

In contrast to SIMV, the MMV ventilation mode provides mandatory breathing only if spontaneous breathing is not yet sufficient and has fallen below a preselected minimum minute ventilation.

This minimum ventilation is controlled by the two set values of tidal volume V_T and ventilator rate f as a result of the product $V_T \times f$.

Unlike SIMV, mandatory breaths are not applied regularly, but only during periods of insufficient ventilation.

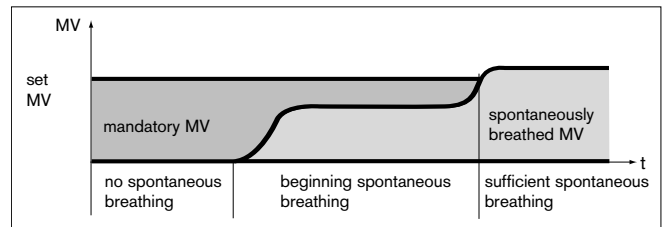
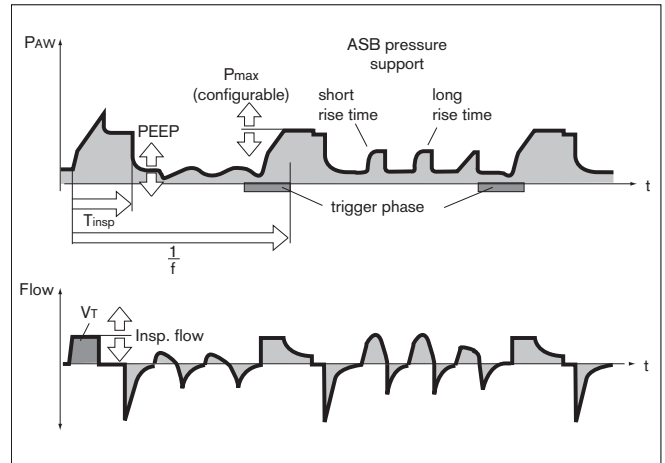
The frequency of mandatory breaths is determined by the level of spontaneous breathing: if spontaneous breathing is sufficient, mandatory breaths are not used at all.

If spontaneous breathing is not sufficient, intermittent mandatory breaths of the set tidal volume V_T are applied.

With no spontaneous breathing at all, the mandatory breaths are applied at the set rate f .

EvitaXL continuously balances the difference between spontaneous breathing and the set minimum ventilation.

As soon as the balance becomes negative due to insufficient spontaneous breathing, EvitaXL applies a mandatory ventilator breath at the set tidal volume V_T , so that the balance is again positive.



Experience shows, patients breathe very irregularly. Phases of shallow breathing alternate with phases of tachypnea and large respiratory effort. In order to allow for these individual fluctuations, the balancing process also takes into account the extent to which the set minimum ventilation has been exceeded.

Within a maximum of 7.5 seconds after an apnea, EvitaXL progressively reduces this value to zero.

In this way, the response time of EvitaXL is automatically adapted to the preceding cycles of spontaneous breathing before activating mandatory ventilation:

If this spontaneous breathing was close to the minimum ventilation, the machine responds rapidly within the cycle time ($1/f$). However, if the patient's spontaneous breathing was much higher than the set minimum ventilation, EvitaXL will tolerate a longer breathing pause. In extreme cases of sudden apnea after a phase of deep breathing, the response time will be 7.5 seconds plus the trigger time, with a minimum of 1 IMV cycle time.

Response times longer than 15 seconds may only occur if the minimum ventilation with a low IMV frequency f is set to correspondingly low values.

In this case, EvitaXL will trigger an apnea alarm that will disappear again after the start of mandatory ventilator breaths. If IMV-time was set to a value longer than the alarm limit T_{Apnea} / f , and if there is no spontaneous breathing between mandatory ventilator breaths, the apnea alarm would be triggered regularly.

Example: $f = 3/\text{min} = \text{MV time} = 20 \text{ seconds}$

$T_{\text{Apnea}} / f = 15 \text{ seconds}$

This system is designed to prevent mandatory ventilation being prematurely triggered in the event of irregular spontaneous breathing, while providing an alarm in the case of extended low ventilation levels.

PCV+ (BIPAP)

Pressure Controlled Ventilation Plus)

The PCV+ (BIPAP) ventilation mode is a pressure/time-cycled ventilation mode in which the patient can always breathe spontaneously. PCV+ is therefore often described as a time-cycled alternation between two CPAP levels.*

The time-cycled change of pressure provides controlled ventilation, which is a form of pressure controlled ventilation PCV. However, the continuously available opportunity of spontaneous breathing allows the transition from controlled breathing to independent spontaneous breathing to take place smoothly during weaning, without requiring any change in the mode of ventilation. Both the change from expiratory to inspiratory pressure level, as well as the change from inspiratory to expiratory pressure level are patient synchronized for easy adaptation to a patient's spontaneous breathing pattern.

The rate of the pressure level changes is kept constant, even though synchronization occurs via a trigger time window with a fixed time constant.

The duration of the "trigger window" is 5 seconds in adult patient mode and 1.5 seconds in pediatric mode, respectively. If the expiratory time is less than 5 seconds (or 1.5 seconds in pediatric mode), the trigger window covers the entire expiratory time. At the P_{insp} pressure level, the "trigger window" is $1/4 \times T_{\text{insp}}$ seconds long.

Recent clinical research** has shown this smooth adaptation to the patient's spontaneous breathing to require less sedation, allowing the patient to return to spontaneous breathing more rapidly.

* References (3), (4), (7), (11), (12), page 221

** Reference (8), page 221

As in all pressure controlled ventilation modes, the patient is not locked into a fixed tidal volume (V_T). The tidal volume basically results from the pressure difference between settings for PEEP and P_{insp} .

Changes in lung compliance and airways, as well as the patient's active breathing against the ventilator, can lead to changes in tidal volume. This is a desired effect in this ventilation mode.

Knowing that tidal volume, and therefore minute volume, are not constant, the alarm limits for minute volume must be carefully adjusted.

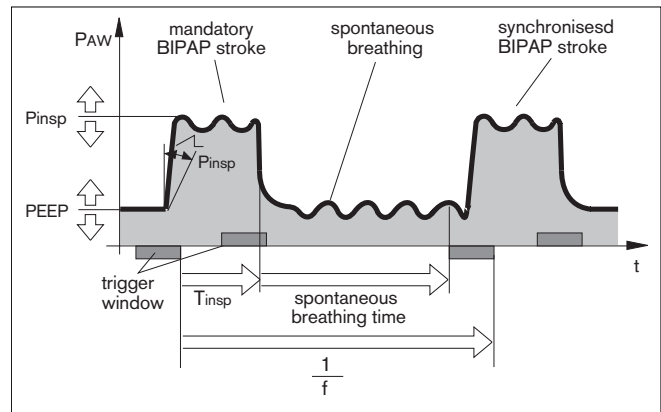
The display of measured expiratory tidal volume V_{Te} must be used to set the required difference between the two pressure levels. Any increase in the pressure differential will cause an increased PCV+ ventilator breath.

As with CMV, the time pattern is set using the basic setting parameters of ventilator rate f and inspiratory time T_{insp} . EvitaXL calculates the resulting inspiratory and expiratory times and displays them in the lower graphics screen field below the waveform display. The lower pressure level is set with the PEEP parameter, while the upper level is set with P_{insp} .

When switching modes from SIMV to PCV+, only the P_{insp} setting needs to be changed - while maintaining the previous timing pattern.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the rise time setting »Slope«. The effective time for the increase in pressure cannot become greater than the set inspiratory time T_{insp} .

This precaution ensures that the upper pressure level P_{insp} is reached reliably during inspiration. During weaning, the transition from controlled ventilation to fully spontaneous breathing is achieved by gradually reducing inspiratory pressure P_{insp} and/or rate f .



PCV+Assist (BIPAP_{Assist})

Pressure Controlled Ventilation Plus, Assisted

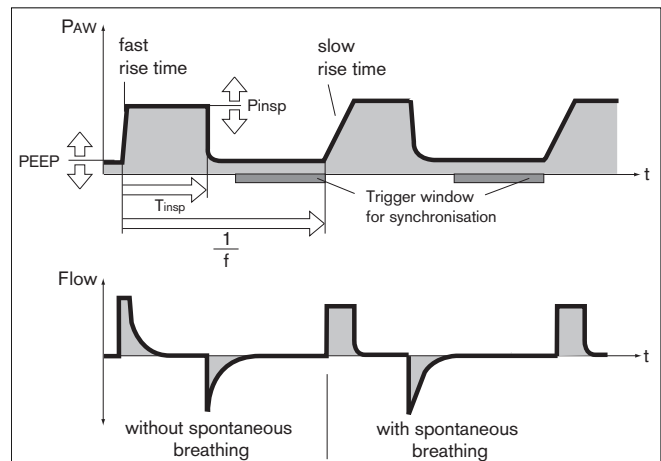
Pressure-controlled, assisted ventilation

Used for all patients, from those unable to breathe spontaneously to those breathing spontaneously before being weaned off the ventilator.

Inspiratory ventilator cycles are equivalent to those of PCV+, however, the switch from P_{insp} to PEEP is not synchronized with patient expiration. The duration of P_{insp} is rather determined by T_{insp} . Spontaneous breathing is possible at any time during ventilation.

Each recognized inspiratory effort by the patient will trigger a synchronized inspiratory cycle.

The ventilator will start a non-synchronized inspiratory cycle at the latest after the inspiratory time fixed by »f« and » T_{insp} « has elapsed.



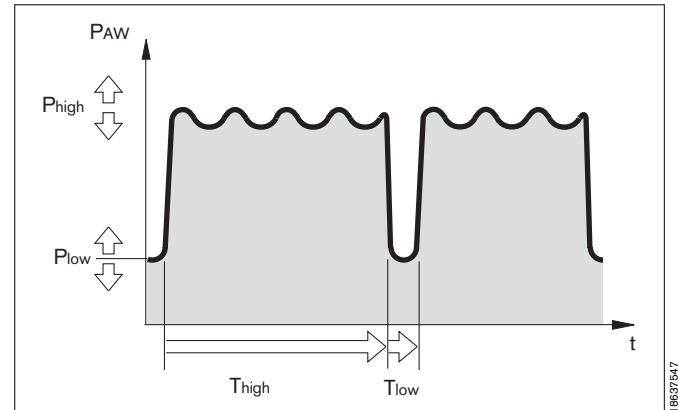
APRV

Airway Pressure Release Ventilation

Spontaneous breathing under continuous positive airway pressure with brief pressure release. This ventilation mode is suitable for patients with a poor gas exchange. The patient breathes spontaneously at a high pressure level P_{high} for an adjustable length of time T_{high} . For very short expiratory times T_{low} , EvitaXL switches to a low pressure level P_{low} . The normal lung areas are emptied, but the "slow" lung areas only change volume to a lesser extent.*

In this way, the ventilation/perfusion ratio can be improved for patients with a poor gas exchange.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the rise time setting »Slope«. The effective time for the increase in pressure cannot become greater than the set time T_{high} .



Pressure Support

Pressure support for insufficient spontaneous breathing.

The ventilator function for assisting insufficient spontaneous breathing is similar to that of an anesthetist manually assisting and monitoring a patient's spontaneous breathing by feeling the breathing bag.

The ventilator takes over part of inspiration, with the patient maintaining control of spontaneous breathing.

The CPAP system supplies the spontaneously breathing patient with breathing gas even during weak inspiratory efforts.

Pressure support is started:

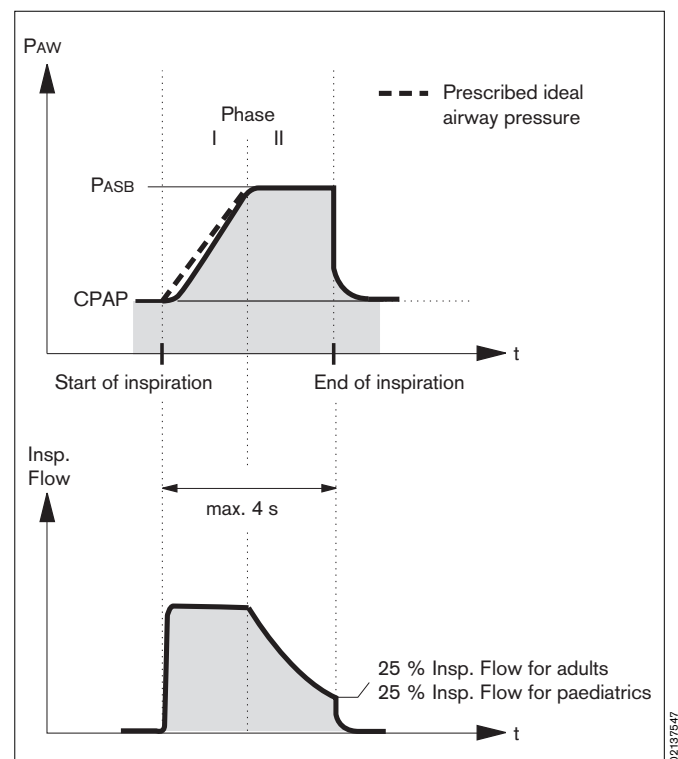
- when the spontaneous inspiration flow reaches the set value of the flow trigger, or, at the latest
- when the spontaneously inspired volume exceeds 25 mL (12 mL in pediatric mode).

The ventilator then produces an increase in pressure up to the preselected support pressure $P_{\text{supp.}}$, which is adjustable to the breathing requirements of a patient.

The pressure rise time is adjustable from 64 milliseconds to 2 seconds.

With a rapid rise in pressure, EvitaXL supports the patient's insufficient spontaneous breathing with a high peak flow.

With a slow rise in pressure, EvitaXL begins gently with a regular inspiratory flow. The patient has to contribute more to the breathing effort, and breathing muscles are trained.



* References (6), (7), (8), (9), page 221

With the patient adjusted pressure rise, activity defines the required inspiration flow, which can rise to 2 L/s in just 8 ms..

Pressure support is terminated:

- when inspiratory flow returns to zero during phase I,
i.e. when the patient exhales or fights the ventilator,
or
- when inspiratory flow in phase II falls below a certain ratio
of the maximum value previously supplied when compared
to the peak inspiratory flow supplied:
for adult ventilation: 25 % of inspiratory flow
for pediatric ventilation: 25 % of inspiratory flow,
or
- at the latest after 4 seconds (1.5 seconds during pediatric
ventilation) if the two other criteria have not triggered
termination of the breath.

If this 4-second criterium is activated three times in
succession, EvitaXL will generate an alarm and will alert to
the possibility of a leak in the patient circuit.

Measurements

Flow measurement

Independent of whether ventilation is pressure or volume controlled, positive pressures are generated both in the patient circuit as well as in the patient's lung. The volume delivered by the ventilator is distributed to both the patient lung and the circuit used between patient and ventilator. The distribution occurs according to the ratio of lung compliance versus patient circuit compliance.

Resulting expiratory deviations for the measured value of flow and the calculated values of minute ventilation and tidal volume are minimal when ventilating adults. This is due to the relatively large lung compliance compared to the compliance of the patient circuit.

Since only the volume actually entering and leaving the lungs is relevant for the efficiency of ventilation, and since larger deviations would be possible during pediatric ventilation, EvitaXL always compensates for the influence of patient circuit compliance.

Compensating for the effect of patient circuit compliance

During the ventilator check before the start of ventilation, EvitaXL determines the compliance of the patient circuit. It then compensates the effect of this compliance on flow and volume measurement during ventilation.

Dependent on airway pressure, EvitaXL increases ventilatory volume in the same amount that will be remaining in the ventilation circuit.

Besides the influence of patient circuit compliance flow/volume measurement is affected by the physical parameters such as temperature and humidity as well as by leaks in the circuit system. EvitaXL takes these effects into account and corrects set and measured values accordingly.

Recalculating for standardized gas conditions

The volume of a gas depends on the gas conditions, temperature, pressure, and humidity. For the purposes of lung physiology, reference is made to the conditions inside the lung for values of minute ventilation and tidal volume: 37 °C body temperature, pressure inside the lung, 100 % relative humidity.

Measured values for flow and volume under these conditions are characterized as BTPS*. Medical gases from cylinders or from a central supply, on the other hand, are dry (approximately 0 % relative humidity) and are delivered from the ventilator at 20 °C. Flow and volume measurements under these conditions are characterized as NTPD**. The difference between values measured as NTPD or BTPS is typically around 12 %.

* BTPS = Body Temperature, Pressure, Saturated.

** NTPD = Normal Temperature, Pressure, Dry.

Example: 500 mL tidal volume NTPD become 564 mL BTPS when warmed to 37 °C and humidified to 100 % relative humidity. EvitaXL controls tidal volume in such a way that the set value of tidal volume is applied under BTPS conditions in the lung..

Automatic leakage compensation

EvitaXL determines the difference between the delivered flow on the inspiratory side and the flow measured on the expiratory side. This difference provides a measure of the amount of leakage and is displayed by EvitaXL as the leakage minute volume MV_{leak} .

During volume controlled ventilation, EvitaXL can compensate for this leakage.

Example:

Tidal volume setting $V_T = 500$ mL, 10 % tube leak.

Leakage compensation Off

EvitaXL delivers 500 mL. This is displayed as the inspiratory tidal volume V_{Ti} . 50 mL escape as leakage during inspiration, 450 mL reach the lung. 450 mL are also expired, of which 45 mL again escape as leakage. A tidal volume of 405 mL is measured on the expiration side and indicated as V_{Te} .

As a result, an inspiratory minute volume of 5.0 L/min will be delivered at a breath rate of 10 bpm and an expiratory minute volume of 4.05 L/min will be measured. The lung is ventilated with an MV of 4.5 L/min.

Without leakage compensation, the set V_T directly determines the volume delivered by EvitaXL.

Leakage compensation On

With automatic leakage compensation, EvitaXL will deliver 550 mL on the basis of the measured leakage minute volume, instead of the 500 mL set. 500 mL enter the lung and the displayed inspiratory tidal volume V_T is 500 mL.

The volume of 450 mL measured on the expiratory side is displayed without compensation, even when leakage compensation is activated. The minute volume measured on the expiratory side is 4.5 L/min and is also displayed uncompensated.

Otherwise, leak compensation might obscure a low minute volume alarm. EvitaXL is intended to generate an alarm in any case of low minute ventilation.

With leakage compensation, the set V_T directly determines the volume to be delivered to the patient.

This example has, however, been simplified:

In fact, the calculated leakage correction takes into account the pressures in the patient circuit. A higher percentage volume is lost on the inspiratory side than on the expiratory side because the pressure during inspiration is higher. The displayed leakage minute volume MV_{leak} is based on the mean pressure P_{mean} .

Leakage minute volume MV_{leak} also takes into account inspiratory leaks. The sum of minute volume MV plus leakage minute volume MV_{leak} therefore will exceed the minute volume actually delivered to the patient during inspiration.

Unlimited volume compensation is inappropriate.

EvitaXL compensates for losses of up to 100 % of the set tidal volume V_T .

Due to technical tolerances, a small leakage minute volume may be displayed even for a tight patient circuit.

Leakage compensation in application mode »Mask« (NIV)

Depending on the set patient mode, EvitaXL compensates leakages up to the following values in order to detect a patient trigger:

Adult mode: 30 L/min

Pediatric mode: 15 L/min

EvitaXL compensates calculated leaks of up to 200 % of the set tidal volume, but not more than 2 L maximum (regardless of patient mode).

Tube compensation ATC

The special function »Tube compensation« regulates airway pressure at the tracheal level. This function calculates and displays tracheal pressure on the basis of a mathematical tube model, the set tube type and the inside diameter of the tube.

The selected tube type and the inside diameter of the tube must correspond with the real tube for correct calculation of tracheal pressure. EvitaXL calculates tracheal pressure on the basis of a square function of tube resistance and patient flow:

$$P_{Trachea} = PAW - K_{Tube} \times Flow^2$$

$P_{Trachea}$: Pressure in the trachea

PAW : Pressure at the Y-piece of the hose system

K_{Tube} : Tube coefficient (see table)

Flow: Patient flow
(inspiration: flow >0; expiration: flow <0)

When automatic tube compensation is active, EvitaXL controls ventilation pressure during spontaneous breathing and during pressure-controlled mechanical breathing cycles in such a way that the breathing effort required by the resistance of the tube is compensated in accordance with the selected degree of compensation.

Compensation may be independently deactivated for the expiratory breathing cycle.

Depending on the direction of the patient flow, the airway pressure is increased during inspiration or decreased during expiration. Airway pressure can be increased to not more than 5 cmH₂O below the set upper alarm limit PAW $\sqrt{\text{ }}$ and be reduced to not less than 0 cmH₂O.

The maximum airway pressure is limited to

PAW $\sqrt{\text{ }}$ – 5 cmH₂O.

The advisory message **Pressure limited !** is displayed.

Pressure support is calculated on the basis of a square function of tube resistance and patient flow:

$$\Delta\text{PAW} = \text{Comp.} \cdot K_{\text{Tube}} \cdot \text{Flow}^2$$

ΔPAW : Pressure support on the tube

Comp.: Degree of compensation 0 to 100 %

K_{Tube} : Tube coefficient (see table)

Flow: Patient flow

The tube coefficient K_{Tube} is largely determined on the basis of the results obtained by Gutmann, Wolf et al., see literature reference (19) on page 221.

The tube coefficient K_{Tube} for the full-length tube is always taken as the basis. The effect of reduced length is negligible.

Tube type	Inside tube diameter (mm)	Tube coefficient K_{Tube} (cmH ₂ O/L ² /s ²)
Endotracheal tube	2.50.....	480.00
	3.00.....	250.00
	3.50.....	140.00
	4.00.....	80.00
	4.50.....	50.00
	5.00.....	34.40
	5.50.....	23.70
	6.00.....	17.21
	6.50.....	13.05
	7.00.....	10.56
	7.50.....	8.41
	8.00.....	6.57
	8.50.....	5.17
	9.00.....	4.29
	9.50.....	3.80
	10.00.....	3.50
	10.50.....	3.00
	11.00.....	2.50
	11.50.....	2.00
	12.00.....	1.50

Tube type	Inside tube diameter (mm)	Tube coefficient K_{Tube} (cmH ₂ O/L ² /s ²)
Tracheotomy tube	2.50.....	480.00
	3.00.....	250.00
	3.50.....	140.00
	4.00.....	80.00
	4.50.....	50.00
	5.00.....	30.96
	5.50.....	15.40
	6.00.....	10.00
	6.50.....	7.90
	7.00.....	6.38
	7.50.....	5.20
	8.00.....	4.50
	8.50.....	3.70
	9.00.....	2.95
	9.50.....	2.65
	10.00.....	2.50
	10.50.....	2.05
	11.00.....	1.65
	11.50.....	1.35
	12.00.....	1.10

Weaning Parameters

P 0.1, RSB, NIF:

A physician judging the ability of a patient to be weaned off the ventilator will consider a number of criteria. Besides diagnostic and laboratory results, ventilatory parameters may be used for estimating the likelihood of successful weaning.

EvitaXL calculates the following weaning indicators:

- Occlusion pressure P 0.1
- Rapid Shallow Breathing (RSB) index
- Negative Inspiratory Force (NIF)

Occlusion pressure P 0.1

Respiratory drive can be measured at the start of inspiration by measuring the mouth pressure during a short term occlusion: within the first 100 ms, the pressure is not influenced by physiological reactions that would try to compensate for the occlusion (e.g. reflexive interruption of breathing or increased respiratory drive). In principle, this pressure is also independent of the muscle strength of the diaphragm. Therefore, the negative mouth pressure P 0.1 after 0.1 seconds is a direct measure of neuromuscular breathing drive*.

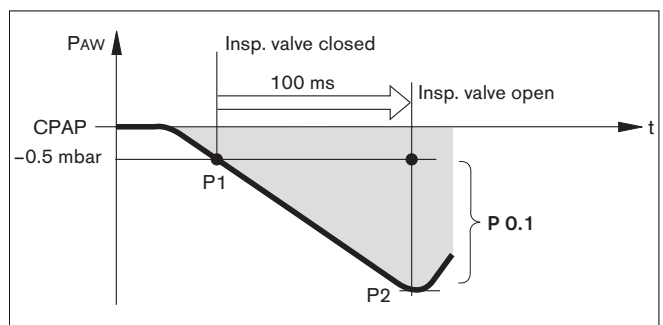
For patients with healthy lungs and regular breathing, P 0.1 will be about -3 to -4 cmH₂O. A high P 0.1 signifies a high breathing drive, which can only be maintained for a limited period of time. P 0.1 values beyond -6 cmH₂O, e.g. for a COPD** patient, indicate impending exhaustion (RMF – respiratory muscle fatigue).

When weaning COPD patients off the ventilator, measurement of P 0.1 can define the weaning point.

To measure P 0.1, EvitaXL keeps the inspiratory valve closed after one expiration and measures the airway pressure produced by the patient's inspiratory effort during 100 ms (P1).

The 100 ms time interval starts when a negative pressure of -0.5 cmH₂O is measured as a result of the inspiratory effort. A second pressure value (P2) is activated after 100 ms. Simultaneously, the inspiratory valve is opened so that the patient can breathe again normally.

The occlusion pressure P 0.1 is the difference between the pressure values P2 – P1.



* References (10), (15), page 221

** COPD = Chronic Obstructive Pulmonary Disease

Rapid Shallow Breathing (RSB) Index

The Rapid Shallow Breathing index (RSB) is the quotient of spontaneous breathing frequency (spontaneously breathed breaths per minute) and tidal volume:

$$\text{RSB [1/(min x L)]} = \frac{\text{fspont [1/min]}}{\text{VT [L]}}$$

The lower the RSB index for a patient with spontaneous breathing, the more probably he or she can be weaned successfully. The significance of the RSB index is due to the fact that patients who can be weaned successfully tend to have a lower spontaneous breathing frequency and a higher tidal volume than those who are not yet ready to be weaned.

In their 1991 study* Yang and Tobin showed that the RSB index is an effective instrument for predicting the success of an attempt to wean the patient. Patients with an RSB index <100 1/(min x L) were weaned with a probability of 80 %, while 95 % of those with an RSB index >100 1/(min x L) were not yet ready to be weaned. EvitaXL indicates the RSB index in CPAP and in Pressure Support modes.

Negative Inspiratory Force NIF

The Negative Inspiratory Force Index (NIF)** measures a patient's maximum inhalation effort after exhaling. The patient system is closed during measurement of NIF. This value is also known as the Maximum Inspiratory Pressure (MIP). As a result of the inhalation effort during manually extended expiration, the patient generates a negative pressure in relation to PEEP. The probability that the patient can be weaned successfully increases with the magnitude of this negative pressure. Patients reaching a NIF < -30 cmH₂O can in all probability be weaned successfully, while those with a NIF of less than -20 cmH₂O will most likely prove unsuccessful. EvitaXL determines the value of NIF during manually extended expiration. The patient system closes following an expiration by the patient while the »Exp. hold« key is held down and EvitaXL measures the maximum inhalation effort made by the patient. The NIF is measured as a pressure relative to PEEP. The measuring procedure is ended when the »Exp. hold« key is released or after a maximum of 15 seconds. The last measured NIF value and the time of measurement are shown on screen in Table 2 of measured values.

* Reference (16), page 221

** References (17), (18), page 221

Intrinsic PEEP

Intrinsic PEEP is measured in two phases: EvitaXL keeps the inspiratory and expiratory valves closed during measuring interval 1, so that it is impossible for gas to flow into the patient circuit or to escape from it. During this closed phase, pressure is equalized between the lungs and the circuit system. EvitaXL measures the pressure over time.

Measuring phase 1 is terminated:

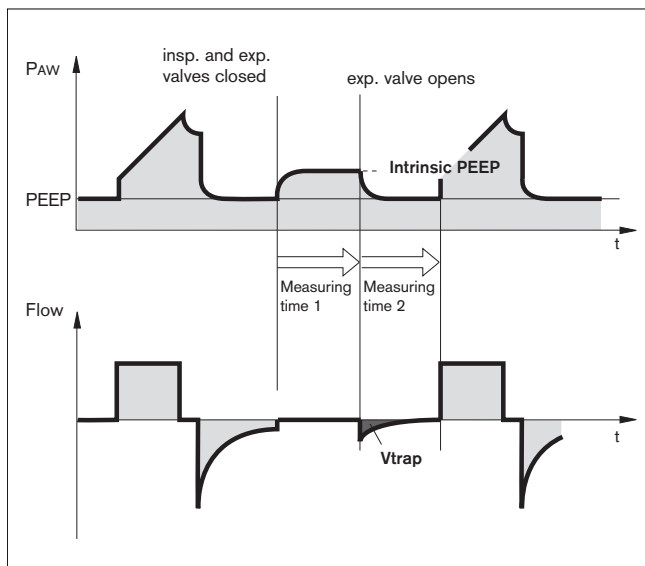
- when no pressure changes are detected any longer
 - at the earliest after 0.5 seconds,
- at the latest after 3 seconds in adult mode and 1.5 seconds in pediatric mode, respectively.

The start value corresponds to PEEP, and the value at the end of the closed phase is the intrinsic PEEP.

At the end of measuring interval 1, EvitaXL opens the expiratory valve and measures expiratory flow generated by intrinsic PEEP during a defined measuring interval 2. During this period, lung pressure is allowed to decrease to PEEP level.

Measuring interval 2 is terminated

- when the expiratory flow has returned to 0, but after 0.5 seconds at the earliest.
- at the latest after 7 seconds in adult mode or after 3.5 seconds in pediatric mode, respectively.



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The integrated flow corresponds to the air volume trapped in the lungs V_{trap} by Intrinsic PEEP.

Measuring times of the measuring phase 1 for Intrinsic PEEP:

For adult ventilation max. 3 seconds

For pediatric ventilation max. 1.5 seconds

Measuring times of the measuring phase 2 for V_{trap} :

For adult ventilation max. 7 seconds

For pediatric ventilation max. 3.5 seconds

Insp. O₂ Concentration When Nebulizing Pharmaceutical Aerosols

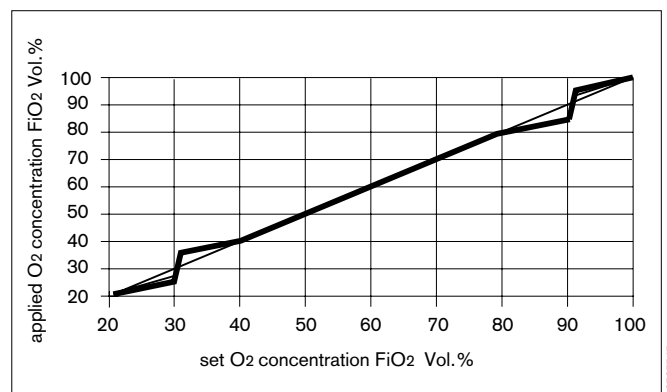
The integrated nebulizer function of EvitaXL is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white body core). Other nebulizers may cause considerable deviations in tidal volume and inspiratory O₂ concentration!

To minimize the deviation from the set O₂ concentration, EvitaXL uses blended gas to drive the nebulizer.

In adult patient mode this blended gas is produced by switching between the supply gases (medical grade air and oxygen) in synchrony with inspiration. In pediatric patient mode, the nebulizer is driven continuously with air and oxygen alternating.

The driver gas of the nebulizer therefore roughly corresponds to the set FiO₂.

The graph shows the possible deviations of the applied O₂ concentration as a function of the set FiO₂ with a minimal inspiratory flow (15 L/min) in adult ventilation or at ventilation frequencies above 12 bpm during pediatric ventilation.



Abbreviations

Abreviation	Definition
Alarm Info	Display additional alarms
APRV	Airway Pressure Release Ventilation Spontaneous breathing at continuous positive airway pressure with short-term pressure release
ASB	Assisted Spontaneous Breathing Pressure supported spontaneous breathing
ATC	Automatic Tube Compensation
AutoFlow	Special function for automatic regulation of the inspiratory flow
BIPAP (PCV+)	Biphasic Positive Airway Pressure Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
BIPAP _{Assist} (PCV+ _{Assist})	Biphasic Positive Airway Pressure Assisted Ventilation mode for assisted ventilation with continuous positive airway pressure with two different pressure levels
body Wt	Body weight [kg]
bpm	breath per minute
BTPS	Body Temperatur, Pressure. Saturated Measured values based on the condition of the patient's lungs, with body temperature 37 °C, water vapor-saturated gas, atmospheric pressure
C	Compliance
CAN	Controller Area Network
CMV	Continuous Mandatory Ventilation Mandatory ventilation with positive pressure breaths
CMV _{Assist}	Trigger assisted Continuous Mandatory Ventilation
CPAP	Continuous Positive Airway Pressure Breathing with continuous positive pressure in the airways
CPAP-P _{supp}	Pressure-supported breathing with continuous positive airway pressure
CPPV	Continuous Positive Pressure Ventilation Controlled ventilation with continuous positive airway pressure
EMC	Electromagnetic compatibility
etCO ₂	End-expiratory CO ₂ concentration
FeCO ₂	Expiratory CO ₂ concentration
f	breath rate (frequency) in bpm

Abbreviation	Definition
fApnea	Breath rate setting for apnea ventilation
FiO ₂	Inspiratory O ₂ concentration
fmand	Mandatory mechanical portion of overall breath rate
fspn	Spontaneous breathing portion of overall breath rate
Fail to cycle	Breathing cycle failure. Ventilator detects no inspiration
FiO ₂	Inspiratory O ₂ concentration
Flow	Set value of the maximum inspiratory flow
Flowtrig	Set value of the flow trigger threshold
IBW	Ideal body weight
ID Ø	Internal tube diameter (set value)
ILV	Independent Lung Ventilation Ventilation with 2 ventilators, 1 for each lung
int.PEEP	Intermittent positive end-expiratory pressure = exp. sigh
IPPV	Intermittent Positive Pressure Ventilation
IPPV _{Assist}	Trigger assisted Intermittent Positive Pressure Ventilation
IRV	Inversed Ratio Ventilation Ventilation with inversed ratio of inspiration/expiration
ISO 5369	International standard for mechanical ventilators – "Lung Ventilation"
I : E	Ratio of Inspiration to Expiration
K _{Tube}	Tube coefficient
Comp.	Degree of tube compensation (set value)
LUST	List-controlled universal interface driver program
MEDIBUS	Draeger communication protocol for medical devices
MMV	Mandatory Minute Volume Ventilation
MV	Minute Volume
MV _{leak}	Leakage minute volume
MV _{spn}	Spontaneously breathed minute volume
NeoFlow	Option for neonatal ventilation
NIF	Negative Inspiratory Force Maximum inhalation effort
NIV	Non-invasive ventilation
NTC	Negative temperature coefficient


































Theory of Operation

Abbreviations

Abreviation	Definition
O ₂	Set value for inspiratory oxygen concentration [Vol.%]
P 0.1	100 ms occlusion pressure
PAW	Airway pressure
PCV+ (BIPAP)	Pressure Controlled Ventilation plus Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
PCV+Assist (BIPAPAssist)	Pressure Controlled Ventilation plus Assisted Ventilation mode for assisted ventilation with continuous positive airway pressure with two different pressure levels
PEEP	Positive End-Expiratory Pressure
PEEP _i	Intrinsic Positive End-Expiratory Pressure
P _{high}	Set value of the upper pressure level APRV
P _{insp}	Set value of the upper pressure level in PCV+
P _{low}	Set value of the lower pressure level in PCV+
P _{max}	Set value for pressure limited ventilation
P _{mean}	Mean airway pressure
Pleth	Plethysmogram
PLV	Pressure Limited Ventilation
P _{peak}	Peak pressure
P _{Plat}	End-inspiratory airway pressure
PS	Pressure Support
P _{Supp.}	Set value of Pressure Support
O ₂ ↑ suction	Oxygenation program active
QRS	Intraventricular excitation propagation in the ECG
R	Resistance
Reset Alarm	Acknowledge (reset) an alarm message
RSB	Rapid Shallow Breathing Quotient of spontaneous breathing rate and tidal volume
SB	Spontaneous Breathing Spontaneous breathing at ambient pressure
SIMV	Synchronized Intermittent Mandatory Ventilation
Slope	Pressure rise time for Pressure Support
SpO ₂	Functional oxygen saturation
T	Inspiratory breathing gas temperature
T _{Apnea}	Apnea alarm delay time
T _e	Expiration time

Abbreviation	Definition
TGI	Tracheal Gas Insufflation
T _{high}	Time for the upper pressure level in APRV
T _{insp}	Set value of the inspiratory time
T _{low}	Time for the lower pressure level in APRV
UMDNS	Universal Medical Device Nomenclature System
	Universal Medical Device Nomenclature
$\dot{V}CO_2$	CO ₂ production [L/min]
V _{ds}	Serial dead space
V _T	Setting for tidal volume
V _{TApnea}	Setting for tidal volume of apnea ventilation
V _{TPsupp.}	Inspiratory breathing volume during an pressure support breath
V _{Te}	Expiratory tidal volume
V _{Ti}	Inspiratory tidal volume
V _{trap}	Volume trapped in the lung by intrinsic PEEP, and exhaled during subsequent expiration.

Symbols

Symbols	Explanation
 Alarm Silence	Suppress audible alarm for 2 minutes
 Alarm Limits	Set alarm limits
 Ventilator Settings	Settings for ventilation
 Sensor Parameter	Sensor calibration
 System Setup	Configuration
 Start/Standby	Standby/ventilation
 Main screen	Back to main screen
 Select different sets of measured values	
 Freeze	Freeze
 Display alarm limit in trend	
 Nebul.	Nebulizer active
 Real-time waveforms, loops, and trends	
 Breathing gas humidifier	
 HME heat and moisture exchanger	
 AC power	
 ext.	External battery
 int.	Internal battery
 Lower alarm limit	
 Upper alarm limit	
 Install flow sensor	
 Slope	Pressure rise time for Pressure Support
 Direct access to settings unlocked/locked	
 Adult	Adult mode
 Ped.	Pediatric mode
 Neo.	Neonatal mode
 ? ▲	Supplementary information
 x	Quit menu
 Refer to Operating Instructions!	
 Protection class type B	
 Protection class type BF	
 Spontaneous breathing activity by the patient	
 Nurse call	
 Tube compensation activated	

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Special ASCII Characters Used

Characters	Explanation	Hexadecimal code	Control characters
NUL	Null	00	^@
SOH	Start of Heading	01	^A
STX	Start of Text	02	^B
ETX	End of Text	03	^C
EOT	End of Transmission	04	^D
ENQ	Inquiry	05	^E
ACK	Acknowledge	06	^F
BEL	Bell	07	^G
BS	Backspace	08	^H
HT	Horizontal Tabulation	09	^I
LF	Line Feed	0A	^J
VT	Vertical Tabulation	0B	^K
FF	Form Feed	0C	^L
CR	Carriage Return	0D	^M
SO	Shift Out	0E	^N
SI	Shift In	0F	^O
DLE	Data Link Espace	10	^P
DC1	Device Control 1	11	^Q
DC2	Device Control 2	12	^R
DC3	Device Control 3	13	^S
DC4	Device Control 4	14	^T
NAK	Negative Acknowledge	15	^U
SYN	Synchronous Idle	16	^V
ETB	End of Transmission Block	17	^W
CAN	Cancel	18	^X
EM	End of Medium	19	^Y
SUB	Substitute	1A	^Z
ESC	Escape	1B	^[
FS	File Separator	1C	^\
GS	Group Separator	1D	^]
RS	Record Separator	1E	^^
US	Unit Separator	1F	^_
SP	Space	20	
DEL	Delete	7F	

Ordering Information

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Ordering Information

Name/Description	Order No.
Basic ventilator	
EvitaXL	84 14 999
Upgrade kit EvitaXL (requires Evita 4)	84 14 879
Options	
Communications kit	84 11 735
SpO ₂ measurement kit	84 13 035
NeoFlow	84 13 563
Breathing Support Package	84 13 562
Mask ventilation (NIV)	84 14 474
Nurse call kit	84 14 476
Connector for connecting the nurse call	18 46 248
CapnoPlus etCO ₂ measurement kit	84 13 780
DC power pack	84 13 034
DC connecting cable	84 13 135
Accessories required for operation	
Hinged circuit support arm	84 09 609
or	
Quick-stop support arm 2	2M 85 706
High pressure O ₂ hose with filter 3 m (10 ft) DISS	45 00 807
High pressure Air hose with filter 3 m (10 ft) DISS	45 00 808
Air supply filter and water trap, straight	D 700133
O ₂ supply filter and water trap, straight	D 700131
"EvitaMobil" trolley (high) with column extension, 50 mm	84 14 455
Cabinet 8H, (14.2") high (4 drawers)	M 31 796
Cabinet 4H (2 drawers)	M 31 795
"EvitaMobil" cylinder holder set	84 11 970
alternatively, (for installation in mobile cart):	
Air compressor	84 13 890

Name/Description	Order No.
Humidifier accessories	
Mounting brackets (for Fisher Paykel MR 370)	84 11 074
Temperature sensor	84 05 371
For CO₂ measurement (optional)	
Test filter	68 70 281
Calibration kit	84 12 710
Test gas cylinder 5 Vol.% CO ₂ , 95 Vol.% N ₂	86 50 435
CO ₂ main flow sensor	68 70 300
Holder for parking CO ₂ sensor	84 12 840
Special accessories	
Instrument tray	84 12 723
Wall bracket, module 2000 Type 13 (alternative to mobile cart)	84 08 613
Pneumatic pharmaceutical nebulizer	84 12 935
Adult size test lung	84 03 201
MEDIBUS cable	83 06 488
Printer cable	83 06 489
ILV cable	84 11 794
Battery cable set	84 11 822
external lead-acid gel type battery 12 V / 17Ah (2 required)	18 43 303
Exchange parts for disinfection	
Expiratory valve (patient block)	84 10 580
Water trap for expiratory valve	84 13 125
For ventilating adults:	
Patient circuit, adult (for use with Fisher & Paykel humidifier)	84 06 550
Cuvette, adult	68 70 279
Cuvette, pediatric	68 70 281
Replacement parts	
O ₂ sensor capsule	68 50 645
Flow sensor (set of 5)	84 03 735

Name/Description	Order No.
Set of ambient air filters/cooling air filters (set of 10)	84 11 724
Lithium battery for data protection	18 35 343
For hinged arm:	
Holder	84 09 746
Hose clamp	84 09 841

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