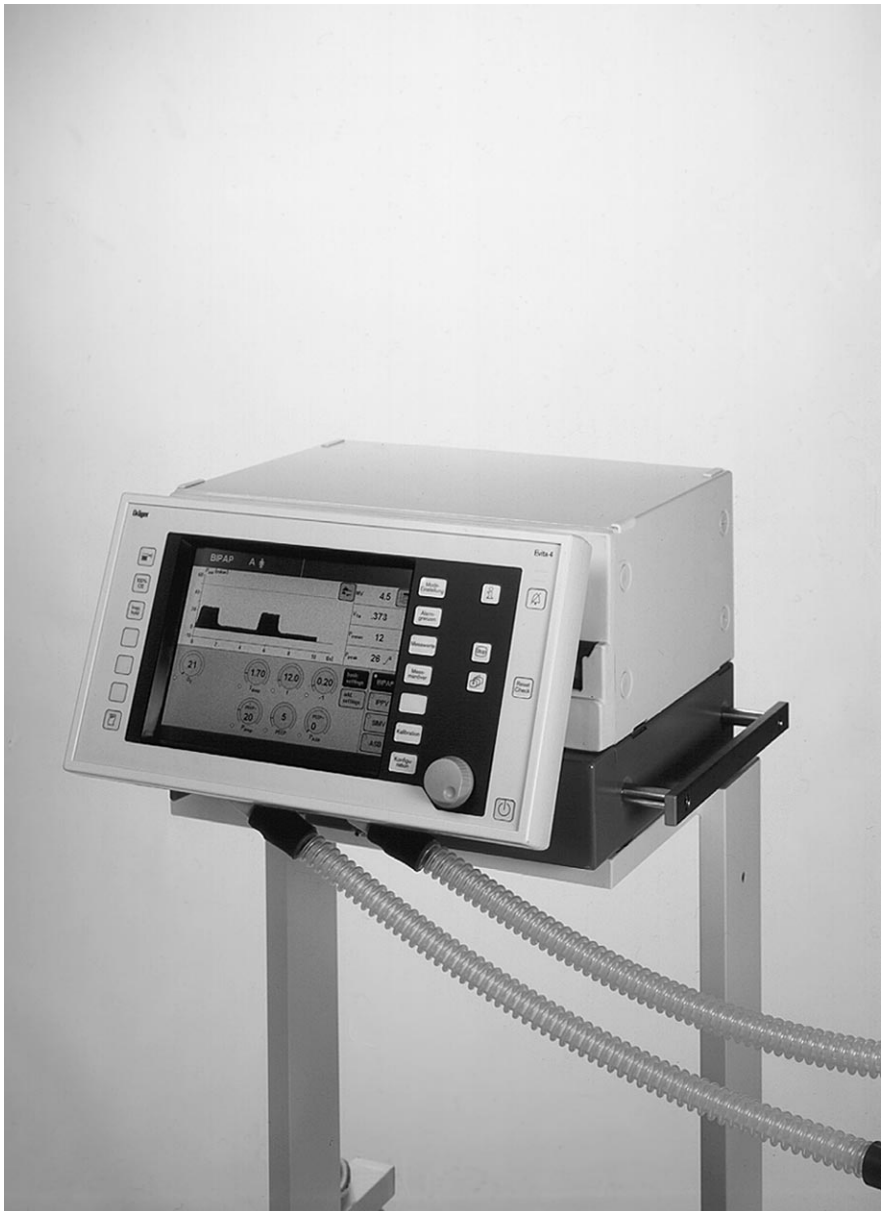
Evita 4

Intensive Care Ventilator

Instructions for Use

Software 3.n



1-178-95

Working with these Instructions for Use

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

Page body...
the Instructions for Use
in combined text/illustrations. The information is expressed in the form of practical actions, giving the user direct hands-on experience in learning how to use the machine.

Left-hand column – the text...
provides explanations and instructs the user 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 the visual reference for the text and make it easier to locate the various parts of the equipment. Elements mentioned in the text are highlighted. Unnecessary details are avoided.
Screen displays prompt the user to proceed and confirm correct actions.

Calibrating the CO_2 sensor

The CO_2 sensor must be calibrated:

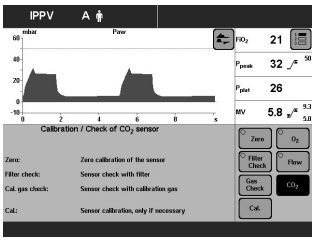
– if the check values are not met on checking calibration with filter or calibration gas.

– as part of the half-yearly inspection of Evita 4.

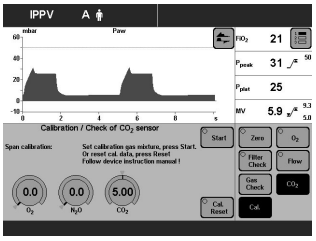
- Switch on Evita 4. Wait about for 3 minutes for the machine to complete its warm-up phase.
- Press the »**Calibration**« key.

Display (example):

- Touch »**CO2**« screen key.



Display (example):



- Carry out CO_2 zero calibration, page 74.

After the CO_2 zero calibration:

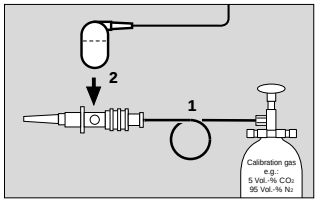
Touch the »**Cal.**« screen key.

- Connect the calibration gas supply. Use the cuvette from the calibration set!

1 Connect the calibration gas cylinder and the cuvette of the calibration set to the hose.

2 Remove the CO_2 sensor from its park bracket and fit it to the cuvette of the calibration set.

- Read the CO_2, O_2 and N_2O concentrations (vol.%) of the calibration gas from the test cylinder.



Contents

For Your Safety and that of Your Patients

Strictly follow the Instructions for Use

Any use of the apparatus requires full understanding and strict observation of these instructions. The apparatus is only to be used for purposes specified here.

Maintenance

The apparatus must be inspected and serviced regularly by trained service personnel at six monthly intervals (and a record kept).
Repair and general overhaul of the apparatus may only be carried out by trained service personnel.
We recommend that a service contract be obtained with DrägerService and that all repairs also be carried out by them. Only authentic Dräger spare parts may be used for maintenance.
Observe chapter "Maintenance Intervals".

Technical safety inspections

The apparatus must be submitted to regular technical safety inspections.

Accessories

Do not use accessory parts other than those in the order list.

Not for use in areas of explosion hazard

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

Safe connection with other electrical equipment

Electrical connections to equipment which is not listed in these Instructions for Use should only be made following consultations with the respective manufacturers or an expert.

Liability for proper function or damage

The liability for the proper function of the apparatus is irrevocably transferred to the owner or operator to the extent that the apparatus is serviced or repaired by personnel not employed or authorized by DrägerService or if the apparatus is used in a manner not conforming to its intended use.

Dräger cannot be held responsible for damage caused by non-compliance with the recommendations given above. The warranty and liability provisions of the terms of sale and delivery of Dräger are likewise not modified by the recommendations given above.

Dräger Medizintechnik GmbH

Intended Medical Application

Contents

Intended Medical Application

Long-term ventilator for intensive care.
For adults, children and neonates.
For premature babies with the "NeoFlow" option.

With the following ventilation modes:

IPPV Intermittent **P**ositive **P**ressure **V**entilation,
controlled and assisted constant-volume ventilation.
With the options:
– CPPV (**C**ontinuous **P**ositive **P**ressure **V**entilation)
– PLV (**P**ressure **L**imited **V**entilation)
– AutoFlow®
for automatic regulation of inspiration flow
– IRV (**I**nversed **R**atio **V**entilation)

SIMV Synchronized **I**ntermittent **M**andatory **V**entilation,
procedure for weaning patients off the ventilator after they have started spontaneous breathing.
With the options:
– PLV (**P**ressure **L**imited **V**entilation)
– AutoFlow®
for automatic regulation of inspiration flow.

MMV Mandatory **M**inute Volume **V**entilation,
spontaneous breathing with automatic adjustment of mandatory ventilation to the patient's minute volume requirement.
With the options:
– PLV (**P**ressure **L**imited **V**entilation)
– AutoFlow®
for automatic regulation of inspiration flow.

SB Spontaneous **B**reathing,
Spontaneous breathing at ambient pressure.

CPAP Continuous **P**ositive **A**irway **P**ressure,
Spontaneous breathing with positive airway pressure.

ASB Assisted **S**pontaneous **B**reathing,
pressure-assisted spontaneous breathing.

BIPAP* Biphasic **P**ositive **A**irway **P**ressure,
Pressure-controlled ventilation combined with free spontaneous breathing during the complete breathing cycle, and adjustable pressure increase to CPAP level.

APRV Airway **P**ressure **R**elease **V**entilation,
Spontaneous breathing on two pressure levels with long time ranges – independently adjustable.

Special modes:

Apnoea Ventilation
For switching over automatically to volume-controlled mandatory ventilation, if breathing stops.
If apnoea occurs, Evita 4 emits an alarm after the preset alarm period (T_{apnoea}) and starts volume-controlled ventilation.

ILV Independent **L**ung **V**entilation,
Separate, differentiated, synchronised ventilation with two Evita units, one for each lung.

Diagnostics:

Intrinsic PEEP-measurement
for determining intrinsic PEEP and measuring trapped volume.

Occlusion pressure measurement
for evaluating breathing drive during spontaneous breathing.

With monitoring for:
airway pressure, Paw
expiratory minute volume, MV
inspiratory O_2 concentration, FiO_2
inspiratory breathing gas temperature, T
expiratory CO_2 concentration, $etCO_2$
inspiratory breathing volume, V_{TI}
apnoea time
tachypnoea monitoring to detect rapid, shallow spontaneous breathing

* Registered trade mark

Automatic gas switch-over.
In the event of a gas failure, the change-over to another gas is automatic.

This equipment must only be used under the supervision of qualified medical staff, so that if any faults or malfunctions occur, help is available immediately.

This equipment must not be used with flammable gases or anaesthetic agents. Danger of fire!

Do not use mobile telephones within 10 metres of ventilators!
Mobile telephones may impair the functioning of electro-medical equipment.

Monitoring Ventilation

Appropriate ventilation monitoring
(recommendations by DGAI)*

The built-in monitoring facilities of the Evita 4 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 O_2 concentration, FiO_2
- inspiratory breathing gas temperature, T
- expiratory CO_2 concentration, $etCO_2$
- inspiratory breathing volume, V_{TI}
- apnoea time
- tachypnoea monitoring

Changes in these parameters may be caused by:

- acute changes in the patient's condition
- incorrect settings and faulty handling
- equipment malfunctions
- failure of power and gas supplies

If a fault occurs in this equipment, separate measuring instruments (such as PM 8030 SD, Oxydig, or AWT 01) should be used.

Back-up ventilation with an independent manual ventilation device

If a fault is detected in the Evita 4, so that its life-support functions are no longer assured, ventilation using an independent ventilation device must be started without delay – if necessary with PEEP and/or increased inspiratory O_2 concentration (e.g. with the Dräger Resutator 2000).

* German Association for Anaesthesia and Intensive Care Medicine

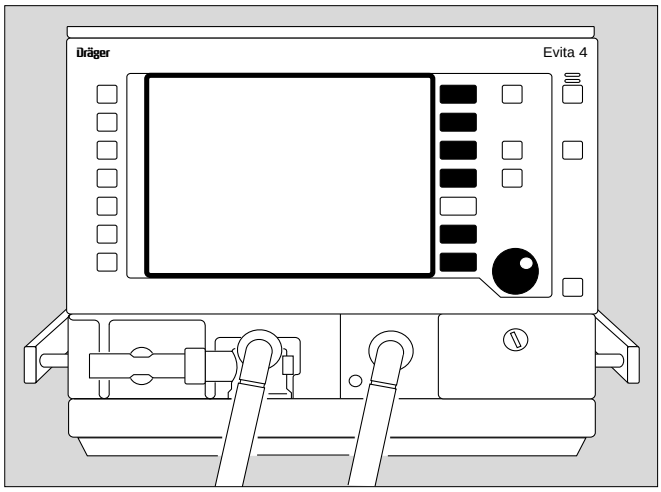
Operating Concept

Contents

Structure of the Control Unit

The main components of the control unit are the screen, a set of **fixed function keys** and the **central rotary dial-knob**.

The function keys are used to call up the **screen pages** appropriate to the application.



In addition to curves, measured values and status displays, the screen contains, in a separate field, touch-sensitive keys and touch-sensitive rotary knobs for parameter setting.

The touch-sensitive **screen keys** and the **screen knobs** are used in a similar way to ordinary keys and knobs:

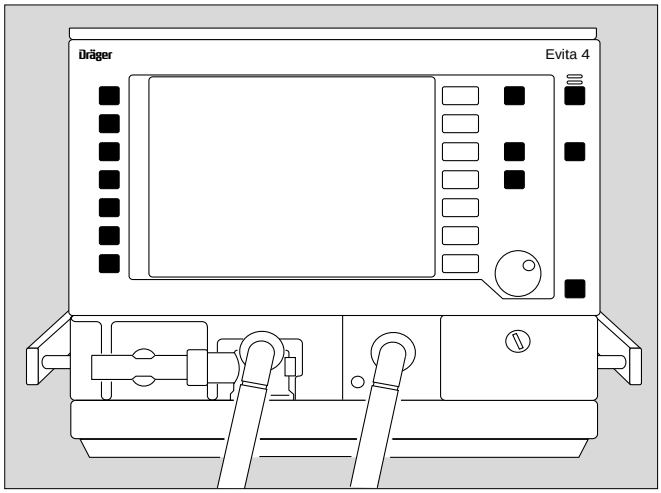
Touching with the fingertip is equivalent to pressing a key or taking hold of a knob.

The display always contains only the screen keys and screen knobs required for function selection and/or adjustment.

Settings and confirmations are made by turning and pressing the central, rotary knob.

The keys for routine functions are placed to the right and left on the outside of the front panel.

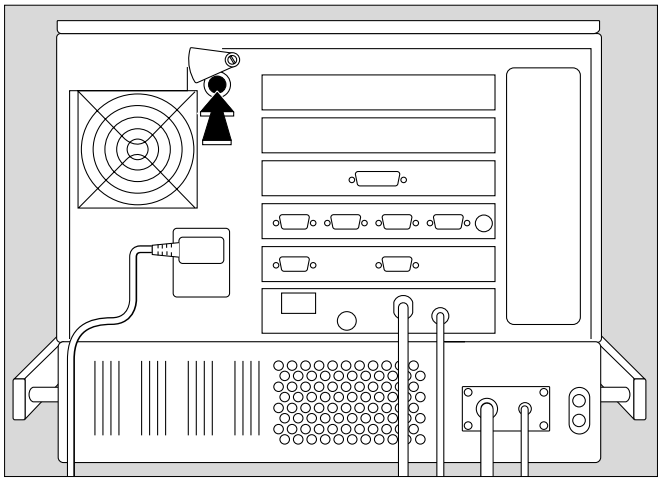
Frequently used function keys are placed on the right, e.g.
the key » « for selecting the standard page
or the »**Alarm Reset**« key for resetting or confirming messages.



Less frequently used function keys are placed on the left-hand side of the front panel,
e.g.
the key » « for switching the medicament nebuliser on/off,
or the »**O2 suction.**« key for bronchial suctioning.

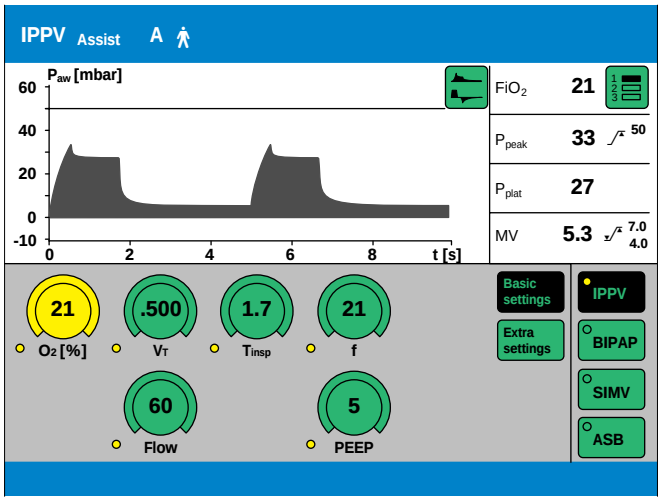
The power switch

for switching the device on/off.
The power switch is located on the back panel and has a pivoting cover to protect against being inadvertently switched off.



On-Screen Controls

The lower half of the screen contains touch-sensitive coloured **screen keys** and **screen knobs**.



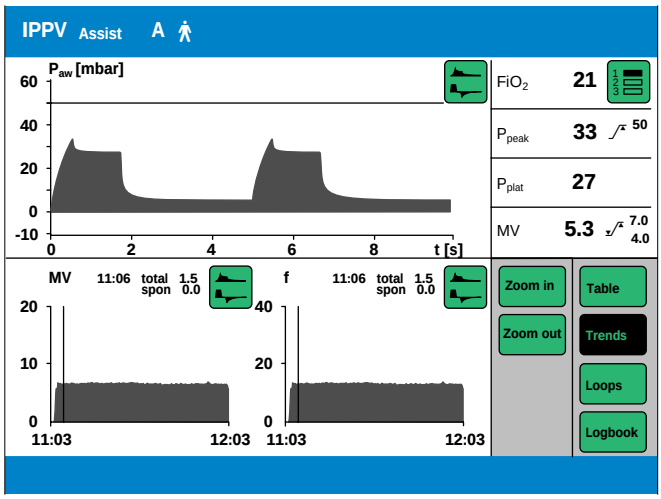
Touching these controls with the fingertip is equivalent to pressing key or taking hold of a knob.

The colour displays the status of the "control" and "LEDs":

green = usable
white = not usable
yellow = adjust/confirm
black = effective function/display

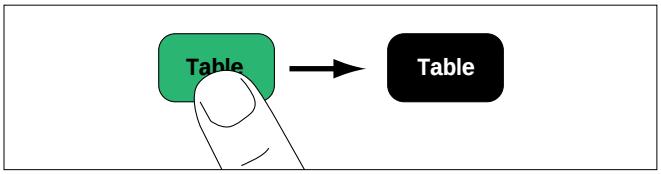
Screen Keys for Selecting Functions without Confirmation

e.g. for paging through the system on-screen
for changing the menu
for switching over displays



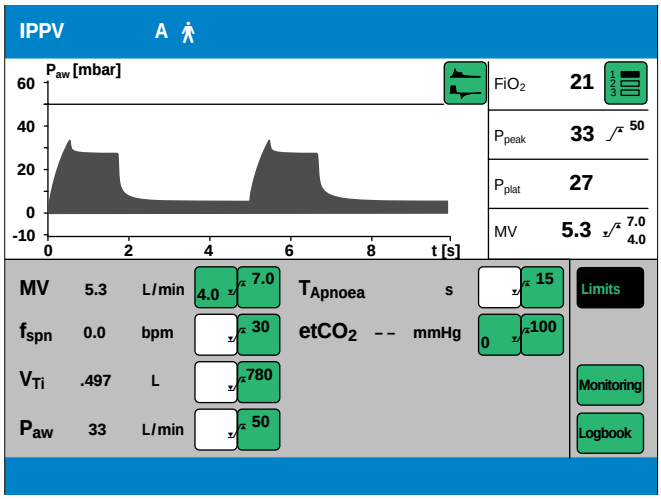
example:

- Press the »**Table**« key = select display.
  The key goes black to show that the function is active.



Screen Keys for Function Selection, Adjustment and Confirmation

Display (example):



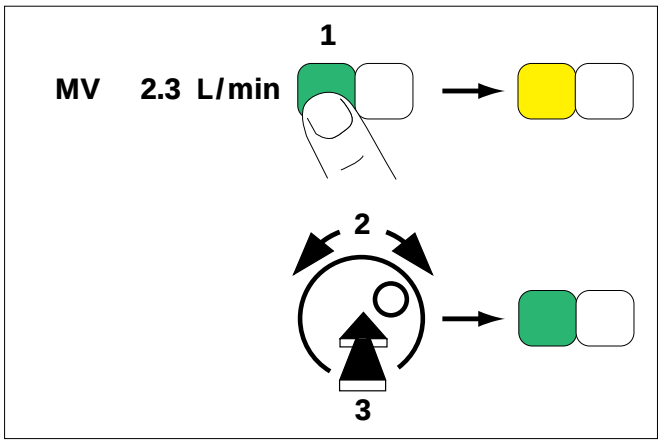
1 Touch the relevant screen key for the alarm limits, e.g.:

MV 2.3 L/min 

The colour changes from green to yellow = setting function is set.

2 Turn the rotary knob = adjust the alarm limit.
The value is displayed in the screen key.

3 Press the rotary knob = the colour changes from yellow to green, and the set alarm limit is confirmed and effective.



To cancel the setting:

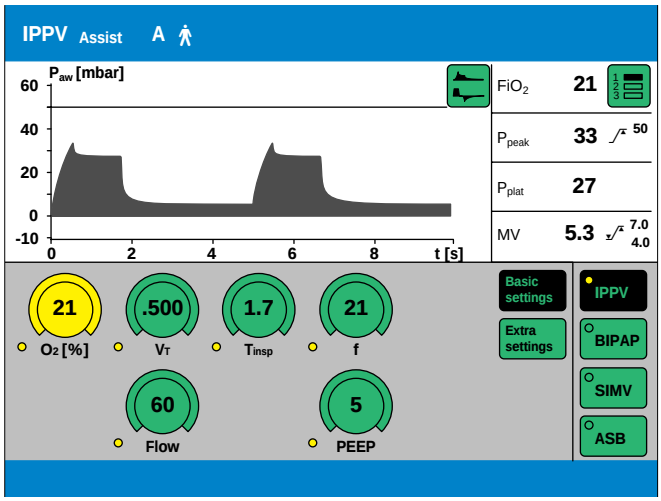
- Touch the screen key again

  or

- touch another screen key.

Screen Knobs for Setting Parameters

Display (example):

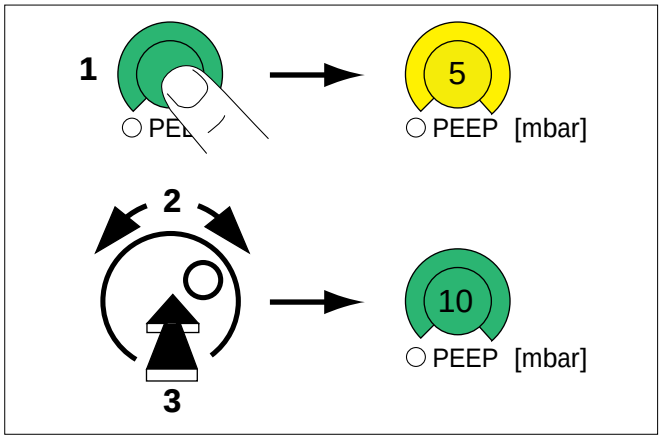


e.g. »**PEEP**« screen knob.

1 Touch the »**PEEP**« screen knob:
It changes colour from green to yellow = setting function selected.

2 Turn rotary knob = Adjust setting. The value is displayed in the knob.

3 Press rotary knob = Confirm. The knob changes colour from yellow to green, and the setting is validated and takes effect.



While pressure values, such as Pmax, are being set, they are displayed in the Paw (t) curve as a dashed black line.

To cancel the setting:

- Press the screen knob again

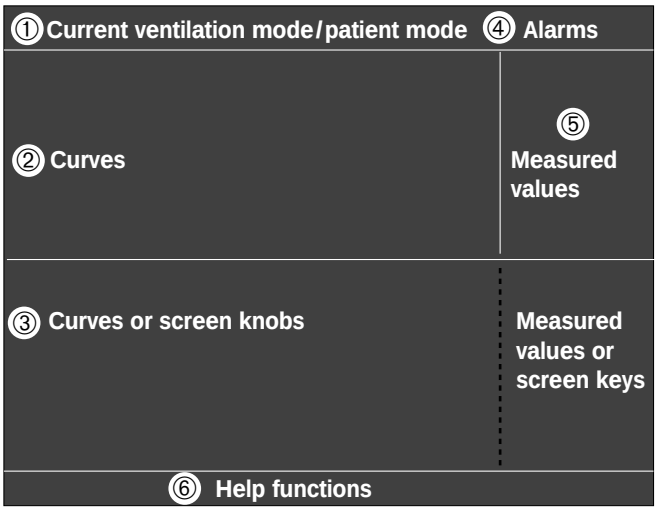
  or

- press another screen knob.

Screen Pages

All the screen pages have the same structure, i.e. their contents are always arranged in the same positions on the screen:

Messages indicating ventilation modes and alarms, displays of measured values and curves, and help functions, always appear in the same position on the screen:



① The active ventilation mode/patient mode is displayed on the left-hand side of the top line. The ventilation mode is indicated by its abbreviation, e.g. BIPAP.

The patient mode is indicated by a symbol:
A for adults
P for paediatric

In the case of spontaneous breathing activity by the patient, a lung symbol is briefly displayed as indicator.

② **Curves** are displayed in the upper left-hand quarter of the screen.

③ The lower half of the screen shows curves and measured values or **screen keys** and **screen knobs** – depending which screen page is selected.

④ **Alarms** are displayed on the right of the top line.

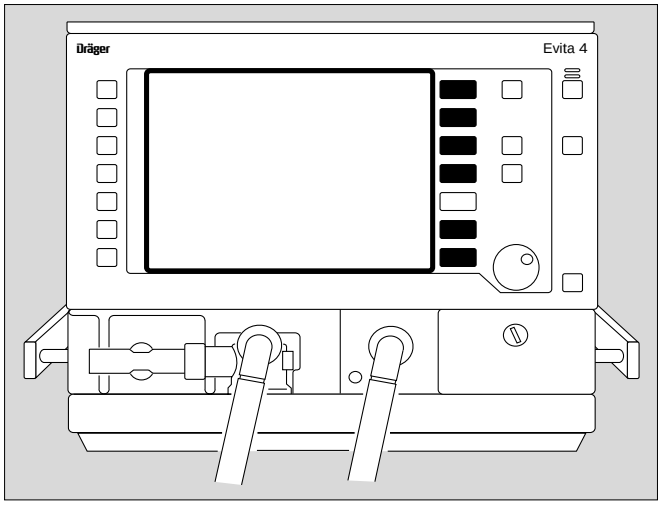
⑤ **Measured values** are displayed in the upper right-hand quarter of the screen.

⑥ **Help functions** appear in the bottom line of the screen. On the right, Evita 4 provides setting instructions. On the left, Evita 4 provides information on the current status – this information can be accessed by pressing key » i «

The solid function keys to the right of the screen are used to select the screen pages for the following specific application situations:

– **Settings**
– **Alarm limits**
– **Measured values**
– **Special measurement procedures**

– **Calibration**
– **Configuration**

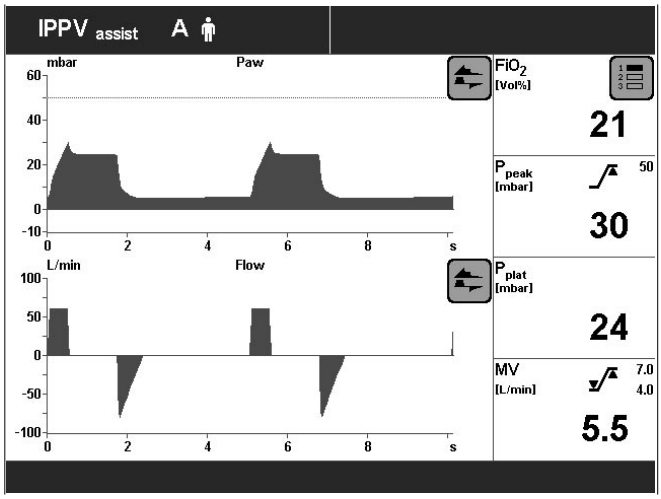


Screen page

For displaying the ventilation status

- Press » « key.

Display (example):



The standard page shows the ventilation situation at a glance – reduced to the most important measurement parameters and curves.

Four measured values are shown on the right, and two curves on the left.

Other measured values and curves can be selected in the standard page and all subsequent screen pages.

To select other measured value combinations:

- Touch screen key » « repeatedly.

To select other curves:

- Touch key » «, and touch the screen key corresponding to the desired curve.

»Settings« screen

For displaying the setting parameters.

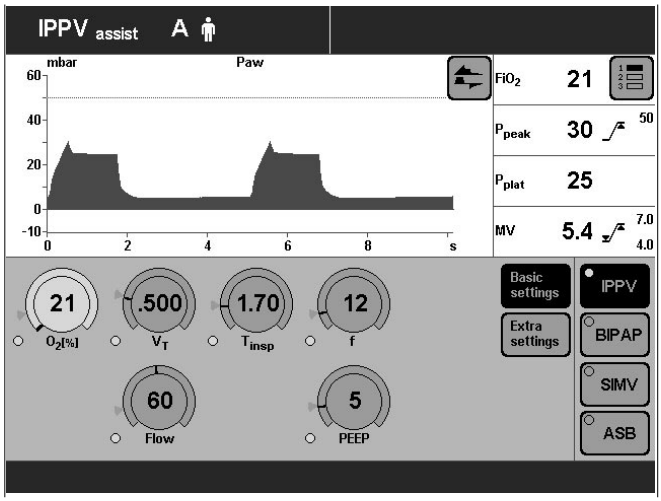
The bottom right-hand side of the screen contains the screen keys for selecting the ventilation modes.

The screen key displayed in black (IPPV in the example) represents the currently activated ventilation mode.

The bottom left-hand side of the screen contains the on-screen rotary control knobs.

The values of the setting parameters are displayed in the screen knobs relevant to the ventilation mode.

The user-definable start-up settings are marked by an arrow (▶) on the scales of the screen knobs. See "Configuration" on page 90 onwards.

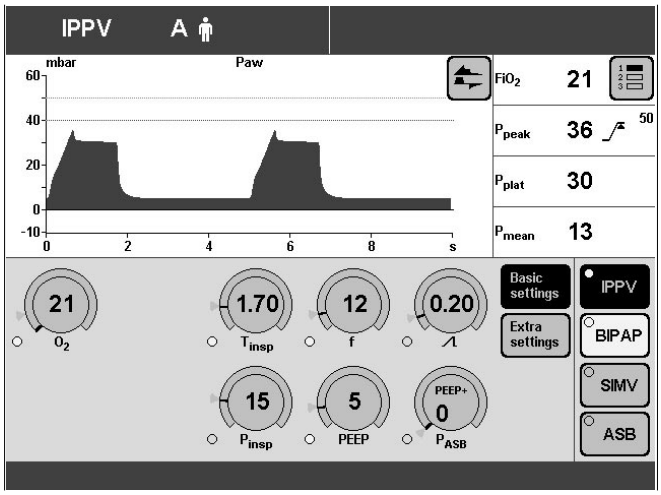


Changing the settings of an active ventilation mode

- Touch the appropriate screen knob, which will change colour from green to yellow = setting function enabled.
- Turn the rotary knob on the control unit = adjustment of the value of setting in the screen knob.
- Press the rotary knob: the screen knob changes colour from green to yellow = the setting is confirmed (validated) and active.

Selecting another ventilation mode and setting its parameters

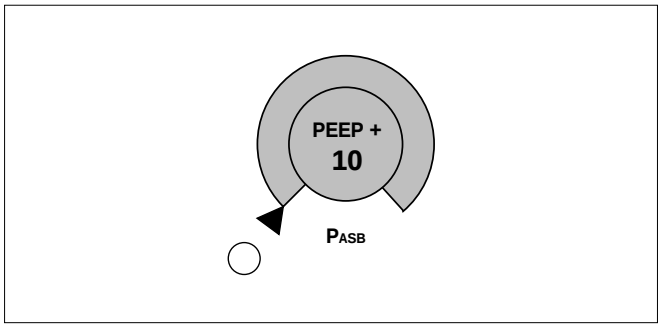
- Touch the appropriate screen key, e.g. »**BIPAP**«. The key changes colour from green to yellow, and the parameter setting page for BIPAP is displayed.



To set the parameters for BIPAP:

- Touch the screen knob, which changes colour from green to yellow = adjustment function selected.
- Turn rotary knob = adjust value displayed in screen knob.
- Press rotary knob: the screen knob changes colour from yellow to green = setting validated and effective.

If the indicator "LED" next to a screen knob is illuminated white, the knob setting will only be effective after the new ventilation mode has been switched on (example: »**PASB**« knob).



If the indicator "LED" is illuminated yellow, the relevant knob setting is already active in the existing ventilation mode (example: »**O2**« knob).

The start-up values effective on switching on the ventilator are marked on the relevant knob-scale with an arrow (▶).
Example: PASB = 0 mbar

- Press the rotary knob: the screen key changes colour from yellow to black = the ventilation mode is active.

For detailed instructions on setting the ventilation modes, please refer to page 42.

Cancel selection/setting

- Press the screen key or screen knob again.

or

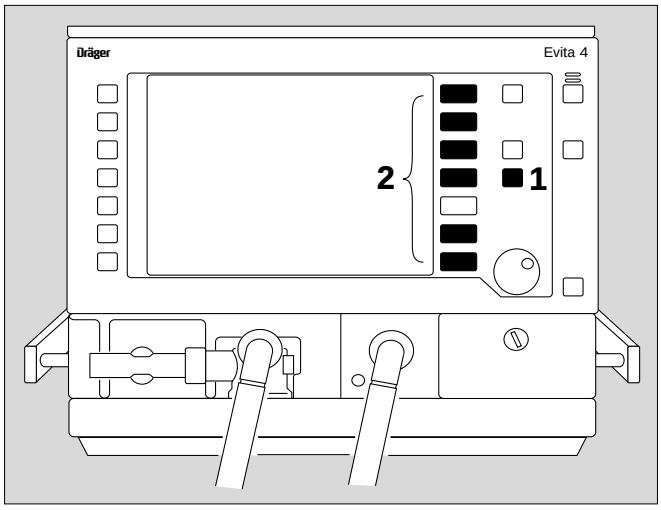
- Press another screen key or another screen knob.

To quit a screen page:

1 Press » « key = return to standard page

or

2 press any of the function keys next to the screen on the right.



»Alarm limits« Screen Page

This page is used for:

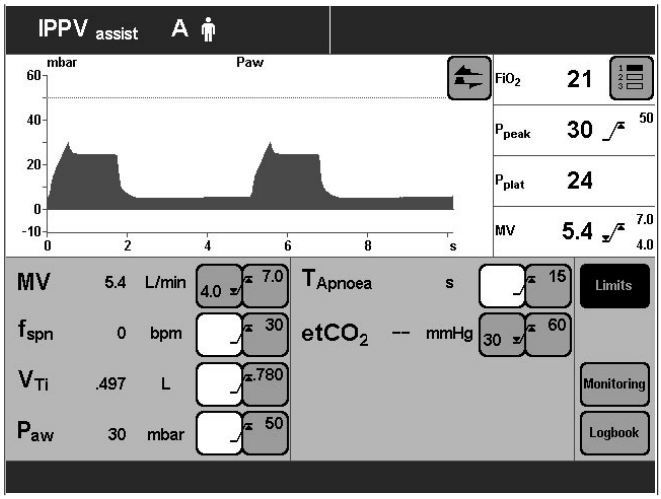
Displaying the measured values and the corresponding alarm limits.

Setting the alarm limits.

Setting the monitoring function.

Displaying the logbook.

The alarm limits are grouped together in a field and combined with a curve and four measured values.



Limits, monitoring and logbook are selected by the screen keys on the right of the screen.
The currently activated screen key is highlighted in black.

Displaying/Setting Alarm Limits

- Touch the »**Limits**« screen key. The screen key will change to black.
  The monitored measured values will be displayed, together with their alarm limits:

Example:

MV 6.8 mbar 

Left-hand screen key = lower alarm limit.
Right hand screen key = upper alarm limit.

Set the alarm limit:

- Touch the relevant screen key.
  The key changes colour to yellow = adjustable.
- Turn the rotary knob = adjust value displayed in the key
- Press the dial-knob. The screen key changes colour to green = setting confirmed.
  The alarm limit is now effective.

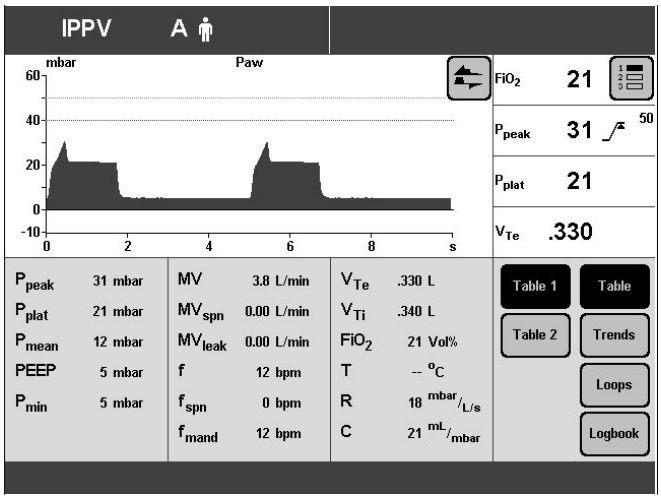
For detailed operating instructions, please refer to page 63.

»Measured values« Screen Page

This page is used to display:
– the measured values in table format
– the trend curve
– loops
– logbook.

Tables, trend, loop and logbook are selected by the right-hand block of screen keys.

Example table of measured values »**Table 1**«

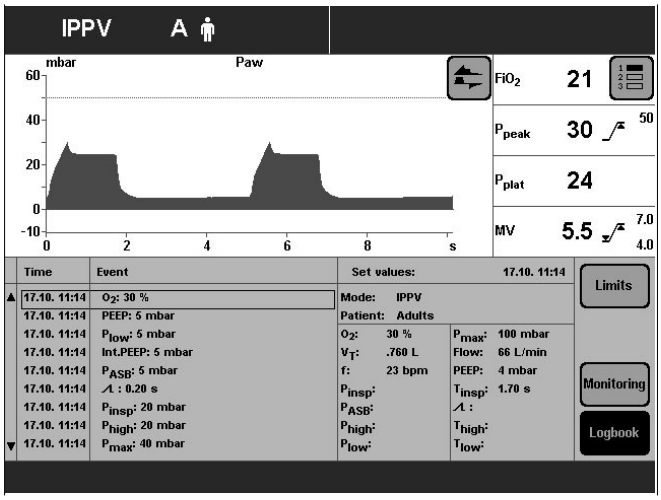


For detailed operating instructions, please refer to page 66.

Display Logbook

- Touch the »**Logbook**« screen key.
- Turn the dial-knob = select alarm events.

For detailed operating instructions, please refer to page 68.



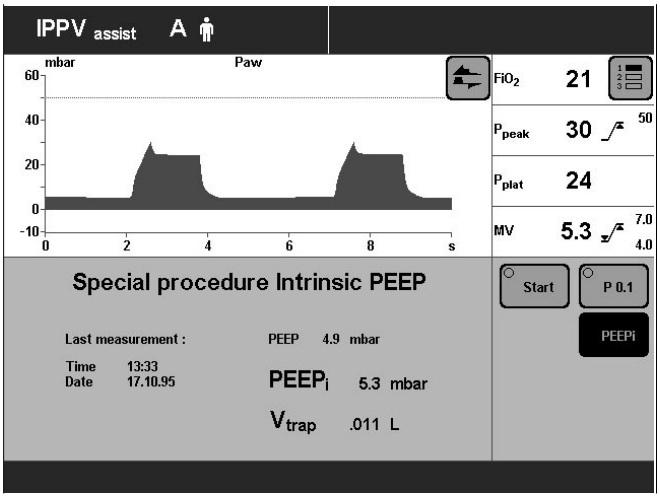
»Special Procedures« Screen Page

This page is used to display and perform the following special measuring procedures:

– Intrinsic PEEP
and
– Occlusion pressure P 0.1

The desired special procedure is selected by the appropriate screen key on the right. The result of the last special procedure is displayed.

Example: Intrinsic PEEP:



To start the special procedure:

- Touch the »**Start**« screen key.

For detailed operating instructions, please refer to page 77 and 78.

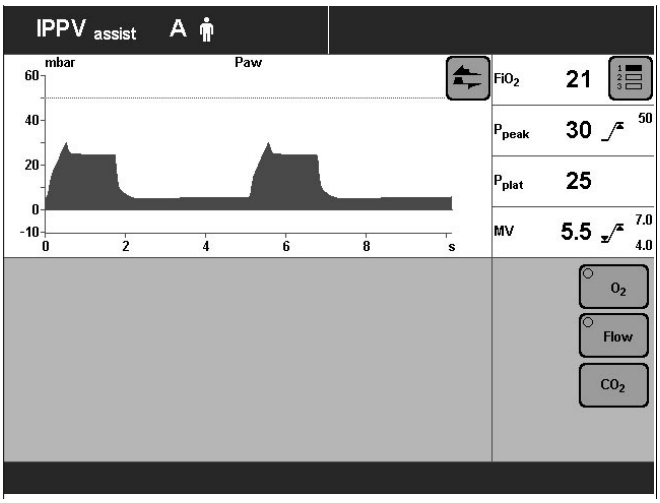
»Calibration« Screen Page

This page is used for calibrating
– the O_2 sensor
– the Flow sensor
– the CO_2 sensor

- Select the desired sensor with the »**O_2**«, »**Flow**« or »**CO_2**« screen keys.
  Calibration starts as soon as the relevant key is pressed.

Evita 4 provides the necessary calibration instructions in the Help Function line at the bottom of the screen.

For detailed operating instructions, please refer to page 81.



»Configuration« Screen Page

For selecting/adjusting the following functions:

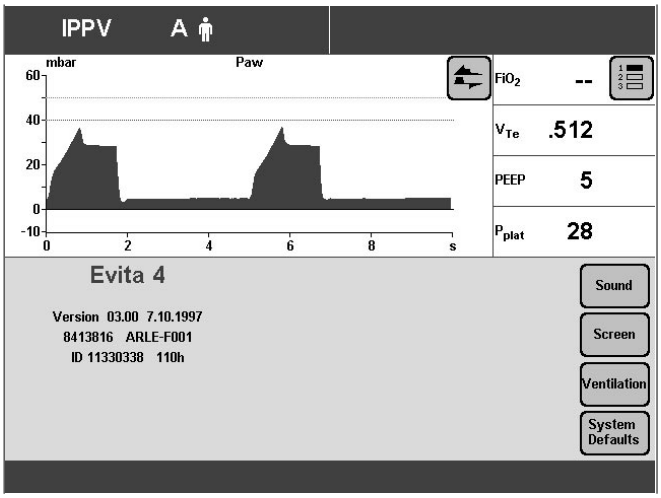
Sound
Setting the volume of the alarm tone.

Screen
Selecting the displayed measured values.
Selecting the displayed curves.
Selecting the displayed trends.

Ventilation
Selecting ventilation modes.
Selecting the patient mode.
Selecting the initial setting.

System Defaults
Setting the external interface.
Setting the time and date.
Selecting the language and measurement units.
Selecting service diagnosis.

For detailed operating instructions, see page 90.

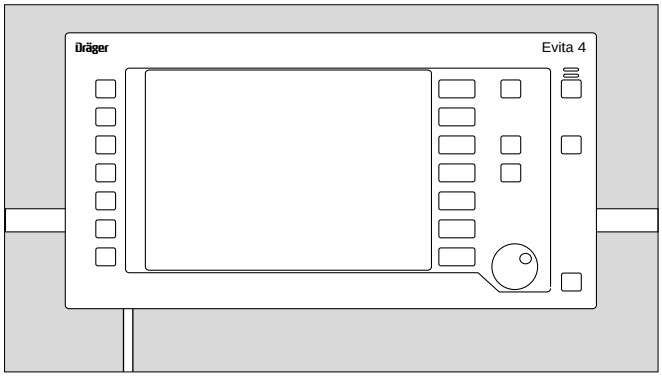


Control Unit Location

To adapt to the situation of the ventilation location, the control unit can be placed

either directly on the device
or
separately, on a wall rail.

For detailed instructions on placing, see page 40.

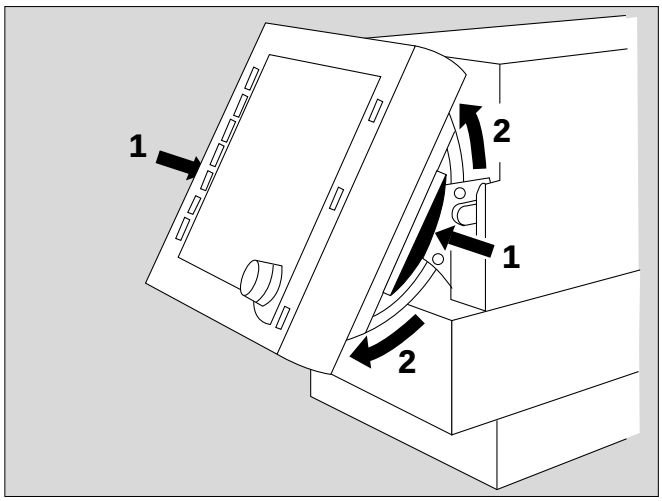


Ergonomic Positioning

To ensure best viewing, free of reflections.

1 Hold down the blue segments on the right and left and

2 at the same time, tilt the control unit to the desired position.



Preparation

Contents

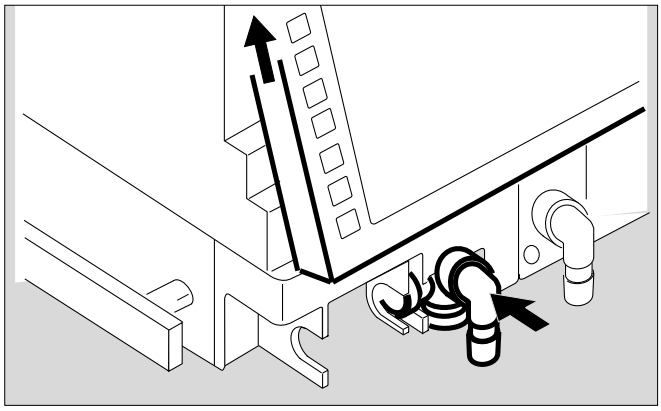
The following instructions include:

– Equipment assembly.
– Electrical and gas connections.
– Setting the language for the display texts.
– Automatic device check with sensor calibration.

Attaching components

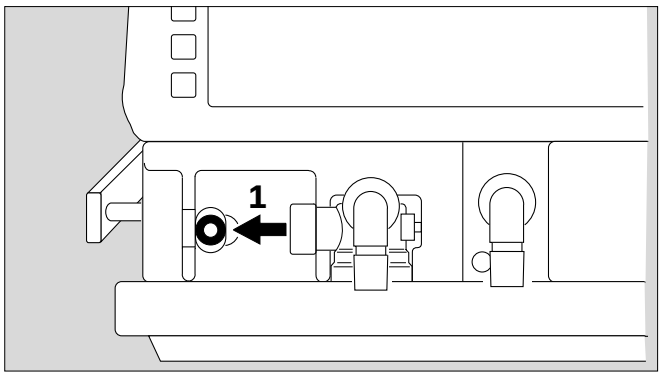
Fitting the expiration valve

- Always use a sterilised expiration valve.
- Tilt the control unit upwards.
- Push the expiration valve as far as it will go into the mounting. Check that it is properly engaged by gently pulling the port.



Fitting the flow sensor

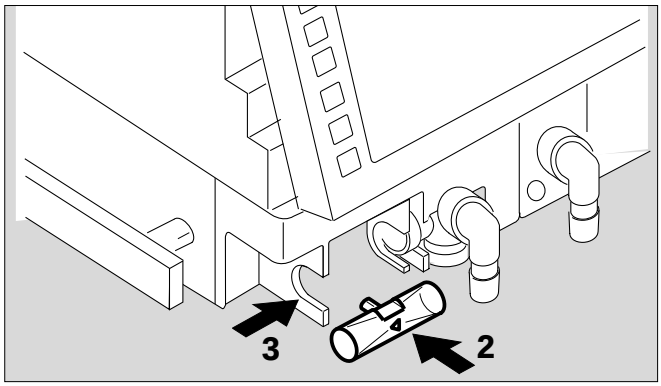
1 Push socket to left as far as it will go.



2 Fit flow sensor – with the probe facing towards the ventilator – into the mounting and push it into the socket as far as it will go.

Then:

3 Push flow sensor to the right as far as it will go into the rubber lip of the expiration valve.



Fitting O_2 sensor capsule

– when using the system for the first time

– when the display reads:
O_2 measurement inop

– when calibration can no longer be performed.

● Tilt control unit upwards.

1 Turn port downwards or to the left.

2 Use coin to loosen screw, and remove protective cover.

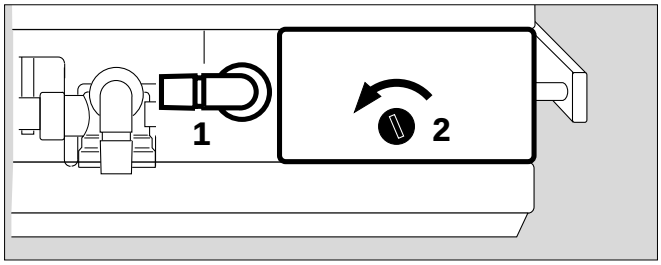
3 Loosen the two knurled screws and open the sensor housing.

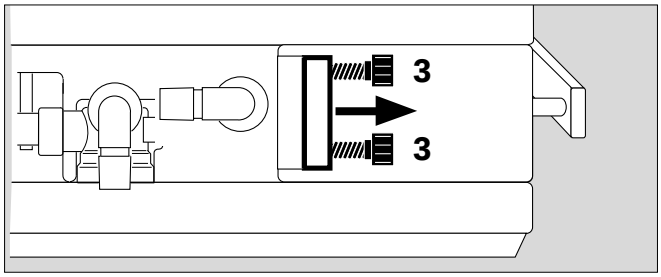
4 Insert new sensor capsule.
The sensor end with the circular tracks on the contacts goes into the housing.

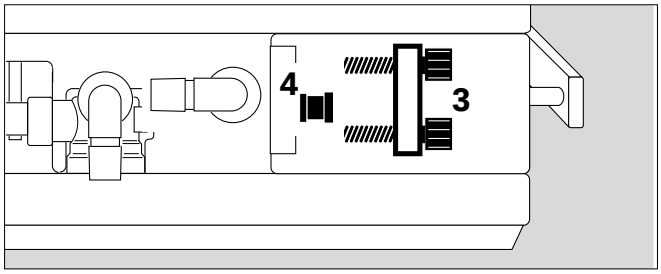
● Close the sensor housing securely with the two knurled screws.

● Screw protective cover back in place.

● Dispose of the used sensor, please refer to page 125.







Note on the Use of Heat and Moisture Exchangers

The use of a heat and moisture exchanger in the patient connection can increase breathing resistance considerably.
An increase in breathing resistance will lead to greater effort in spontaneous breathing and greater trigger effort during assisted ventilation. Under unfavourable conditions, an increase in breathing resistance can lead to an inadvertent PEEP.
This breathing resistance in the patient hose system cannot be monitored by the ventilator.

● Therefore you should regularly check the condition of the patient and the ventilator's measured values for volume and resistance.

● Follow the Instructions for Use of the heat and moisture exchanger!

● Do not use the heat and moisture exchanger at the same time as a medicament nebuliser or humidifier!

Ventilation Adults and Children

From 100 mL tidal volume V_T upwards

Patient mode: »Adults«

Do not use a heat and moisture exchanger at the same time as a humidifier!
Risk of increased breathing resistance due to condensation.

Connecting Aquapor humidifier

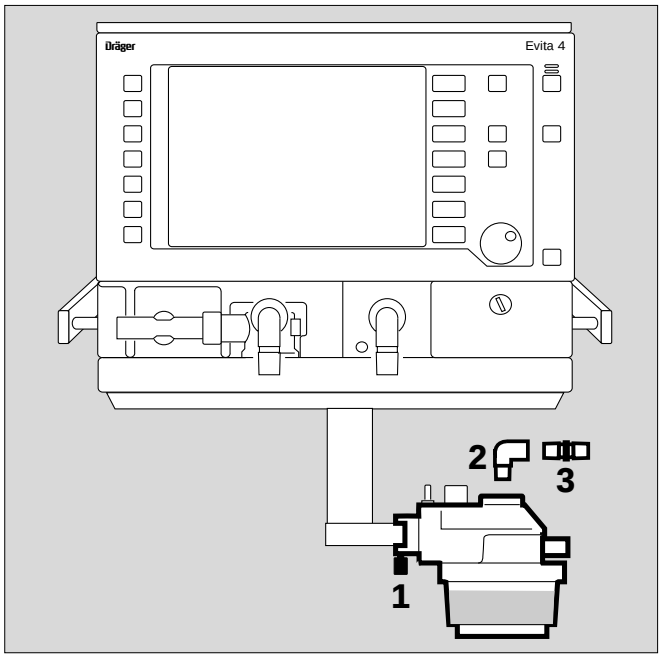
Prepare Aquapor following the relevant Instructions for Use.

1 Hang Aquapor from rail by bracket and tighten screws.

2 Insert elbow connector into Aquapor.

3 Insert the double connector into the elbow connector.

- Fill Aquapor bowl to the upper mark with distilled water.



Connecting ventilation hoses

Do not use antistatic or conductive hoses*.

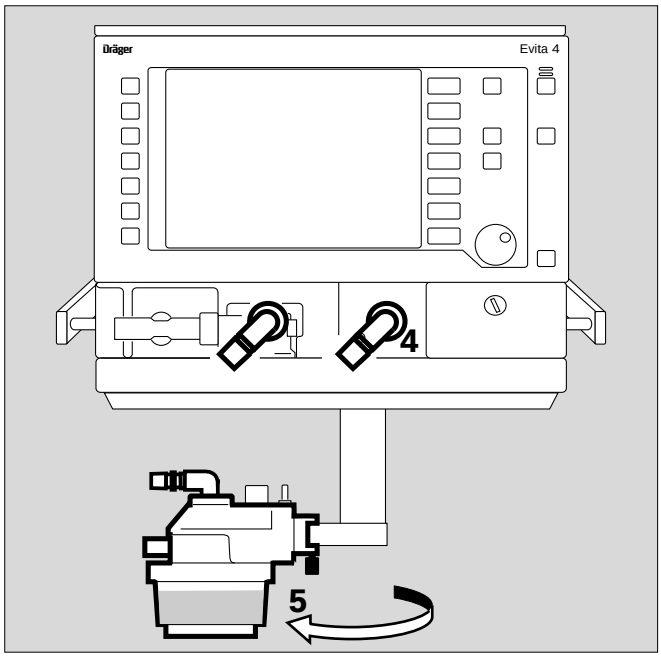
Depending on the desired position of the ventilator in relation to the bed, the hinged arm can be fitted to either side of the machine.

Attachment on **left-hand** side:

4 Turn both ports to the left.

5 Turn Aquapor to the left.

The following description applies when the ventilation hoses have been attached on the **left-hand** side.



* DIN VDE 0750 Part 215:
The use of anti-static or electrically conductive material in the breathing system of the lung ventilator is not considered conducive to greater safety. On the contrary, the use of these materials increases the danger of electric shock to the patient and of fire due to the presence of oxygen.

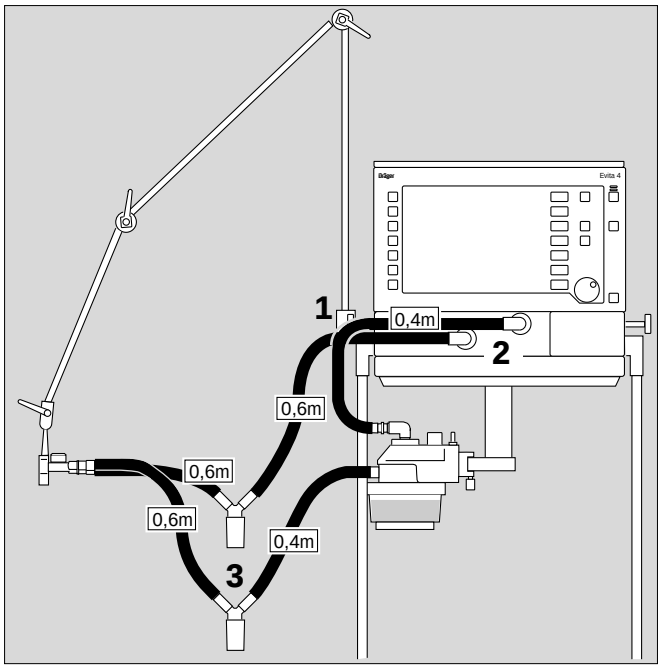
1 Hang the hinged arm from the rail on the left-hand side and tighten screws.

- Connect ventilation hoses, and note length of hose (metres).

2 Turn ports in direction of hoses.

3 Install water traps in vertical position.

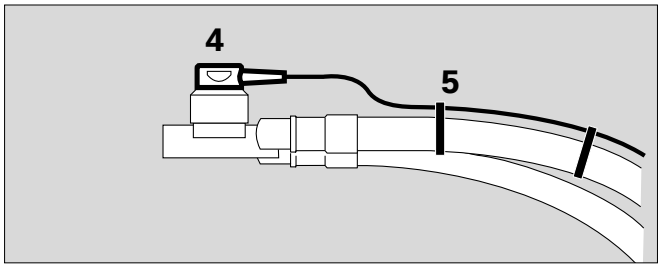
- Connect the Y-piece, with the rubber sleeve of the Y-piece on the inspiratory side.



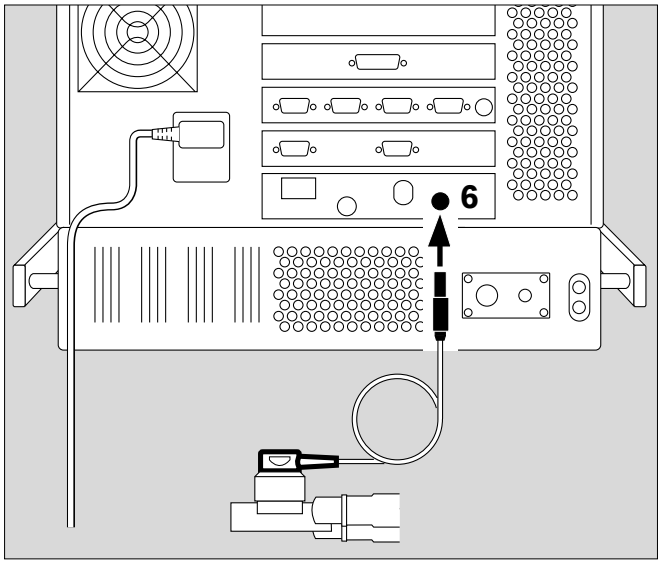
Fitting temperature sensor

4 Push sensor as far as it will go into the rubber sleeve on the inspiratory side of the Y-piece. Align the Y-piece so that the sensor is at the top.

5 Attach the sensor cable with hose clips.



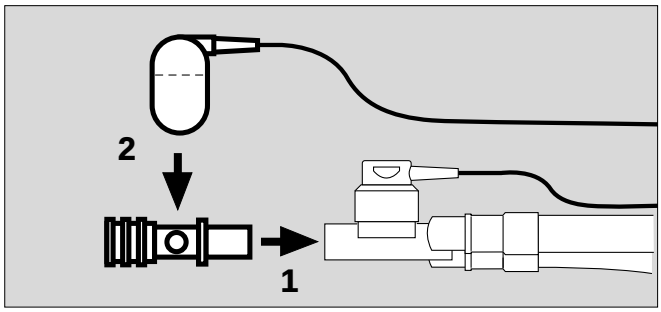
6 Insert the probe of the temperature sensor into the socket at the rear of the unit.



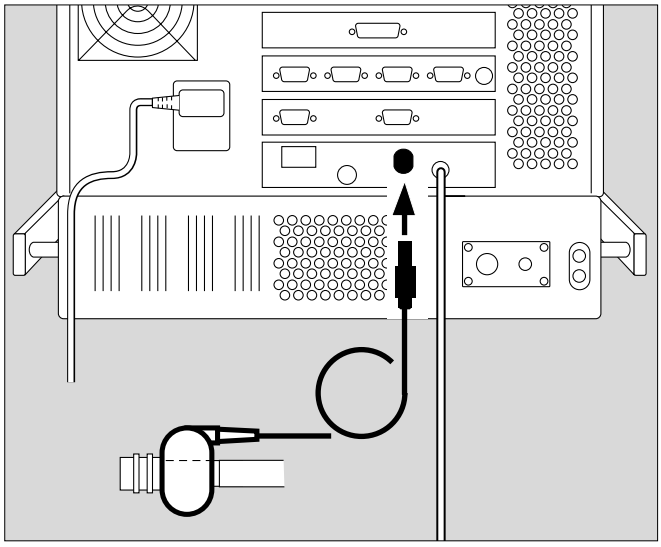
Fitting CO_2 cuvette and CO_2 sensor

1 Fit the cuvette to the patient connection of the Y-piece, with the cuvette windows facing the side.

2 Push the CO_2 sensor on to the cuvette, with the cable trailing towards the unit.



- Insert the probe of the CO_2 sensor in the CO_2 socket on the rear panel of the Evita 4.

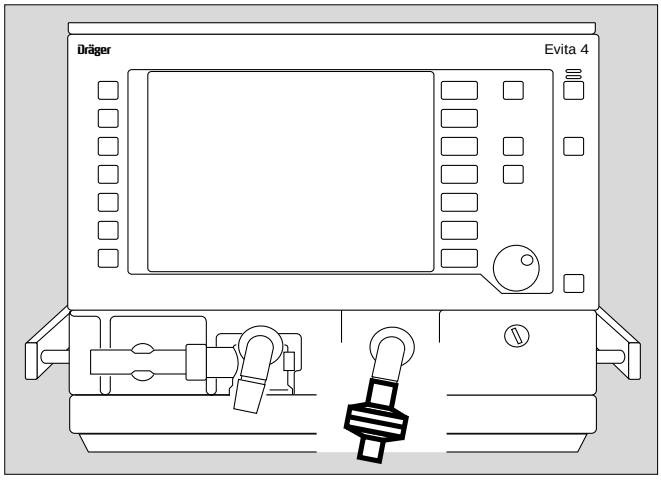


Ventilating Infants

Up to 300 mL tidal volume V_T

Patient mode »Paediatrics«

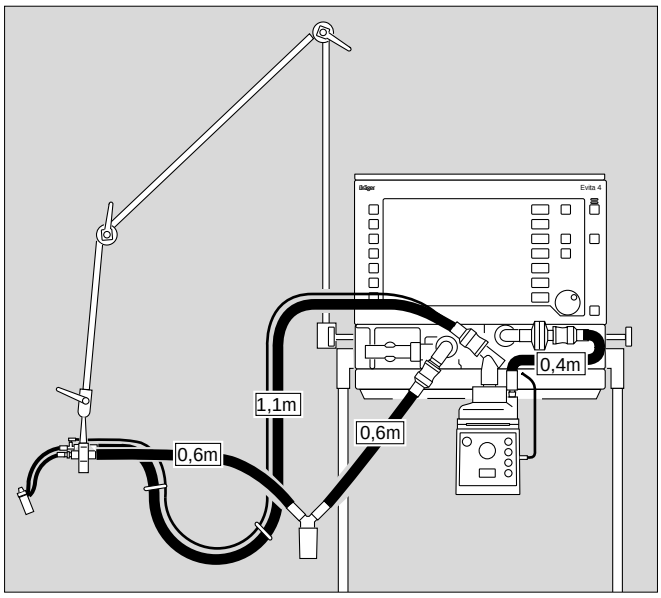
Do not use a heat and moisture exchanger at the same time as a humidifier!
Risk of increased breathing resistance because of condensation.



Fitting humidifier and ventilation hoses

- Fit the bacteria filter to the inspiratory port.

- Prepare the "Fischer & Paykel MR 730" breathing gas humidifier as specified in the Instructions for Use of the humidifier.
  Use the relevant hose set K (paediatric).
- Clamp the humidifier to the stand under the apparatus and screw firmly into place.
- Clamp the articulated arm to the left-hand rail and screw firmly into place.
- Fit the ventilation hoses.
  Check the hose lengths (metres).
- Fit the water trap in the vertical position.



Do not place any liquid containers above or on top of Evita 4!
Any leak or spill could prevent it working properly!

If using bacterial filters

The use of expiratory bacterial filters on the ventilator is not recommended.

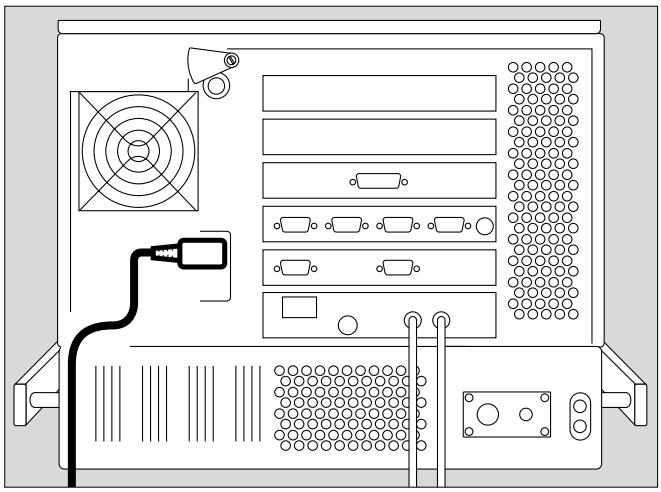
However, if bacterial filters are nevertheless used on the expiration side, an undesirable increase in breathing resistance is possible.
Especially during medicament nebulisation and humidifying, the resistance of the bacterial filter may increase gradually. For the patient, the effect may be increased breathing effort and intrinsic PEEP.

An intrinsic PEEP can be recognised by the fact that the expiratory flow does not return to "0" before the end of expiration.

If PEEP is unacceptably high, the unit signals the »**PEEP high**« alarm.

- Check the bacterial filter and replace it if it is the cause of the PEEP.

Supply and Connections



Electrical power supply

The ventilator is designed for a mains voltage of:

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

- Insert the plug in the mains socket.

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

either : 12 V
or : 24 V

- Connect the external battery by cable.

Note on the use of a socket strip for ancillary equipment

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

Temporary interruption of power supply

e.g. if hospital reserve power supply is activated.

Without the 12/24 V DC power unit:

Evita 4 tolerates power interruptions shorter than 10 milliseconds – without any effect on ventilation.
In the case of power interrupts lasting longer then 10 milliseconds, the machine restarts with a short self-test lasting about 4 seconds – ventilation is continued with the same values that were set before the power interruption.
If a lower alarm limit has been set for the minute volume, the **MV low** alarm is activated until the measured value has risen above the lower alarm limit.

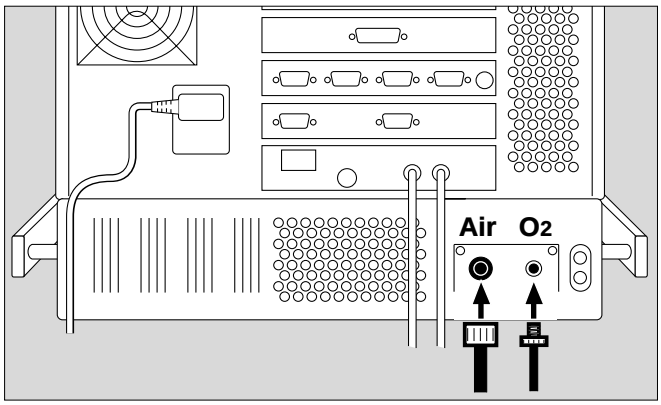
With 12/24 V DC power unit (option):

Operation continues without interruption, even if the power is interrupted for longer than 10 milliseconds.
The capacity of the batteries built into the DC power unit can bridge a voltage failure of max. 10 minutes.

Gas supply

- Screw the connecting hoses for medical air and oxygen to the back panel of Evita 4 and insert their probes into the terminal units.

  The compressed gases must be dry and free from dust and oil. Gas pressure must be 3 to 6 bar.



Before Using for the First Time

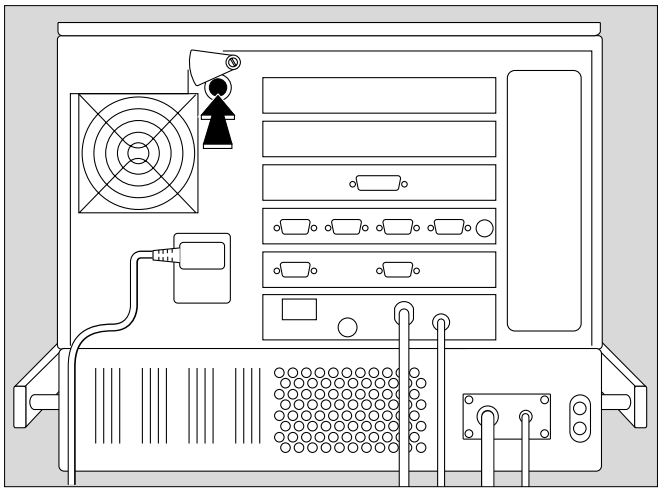
Setting the language of the screen texts

Evita 4 leaves the factory programmed with German screen texts.
The following alternative languages can be selected:
English, French, Italian, Spanish, Dutch, Swedish, American English and Japanese.

- Switch on machine =
  Press power switch on the back panel until it clicks into position.
  The flap falls over the button to protect against inadvertent switching off (to switch off, pivot the flap upwards and press the button in fully).

Evita 4 runs through its self-test procedure,

- Wait until the 10-second test phase is complete.



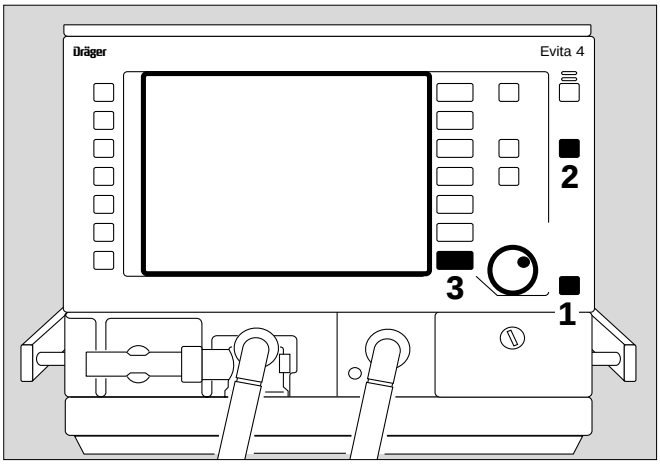
After the self-test:

1 Switch Evita 4 to Standby = hold down key »⏻ « for about 3 seconds.

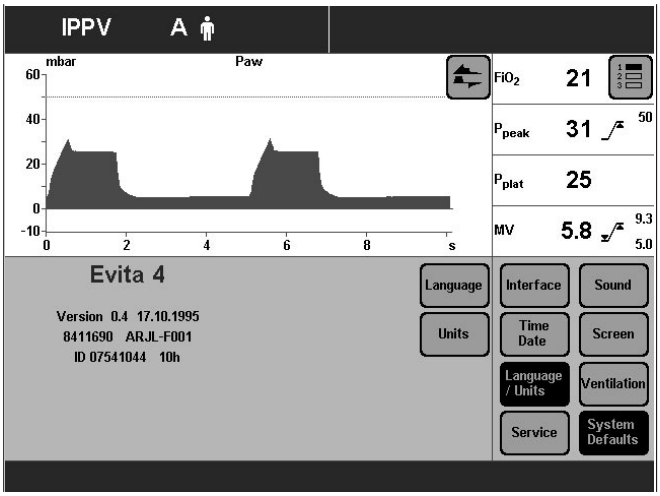
2 Switch off the standby alarm tone with the »**Alarm Reset**« key.

3 Press the »**Configuration**« key.

- Touch the »**Parameters**« screen key.
- Touch the »**Language/Units**« screen key.
- Touch the »**Language**« key.
- Select the desired language and confirm. The selected language is now active.



- Ask our specialists to change the labels on the control unit keys.



Device Check

Before use on patient

Immediately before using on the patient, check that the machine is working properly and is ready for operation. Evita 4 supports this »device check« by means of a built-in checklist that guides the user through the test in a dialogue mode.

The following functions are performed during this device check:

– Checking that the machine assembly is complete,

– Testing the alarm tone,

– Testing the air-O_2 change-over valve,

– Testing the safety valve,

– Calibrating the flow sensor,

– Calibrating the O_2 sensor,

– Calibrating the CO_2 sensor,

– Testing the leakproofing of the hose system,

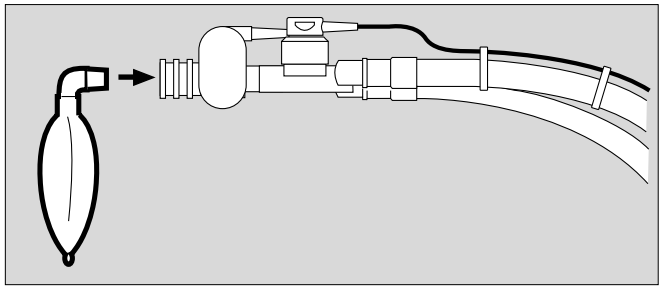
– Checking the compliance of the hose system.

The test results obtained from this device check and the calibration and zero-checking values of the sensors remain stored until the next calibration – even if the device is switched off.

If the hose system is changed after the device check, the leak test must be repeated before use.

Preparing for the device check

Preparing the adult test lung 84 03 201

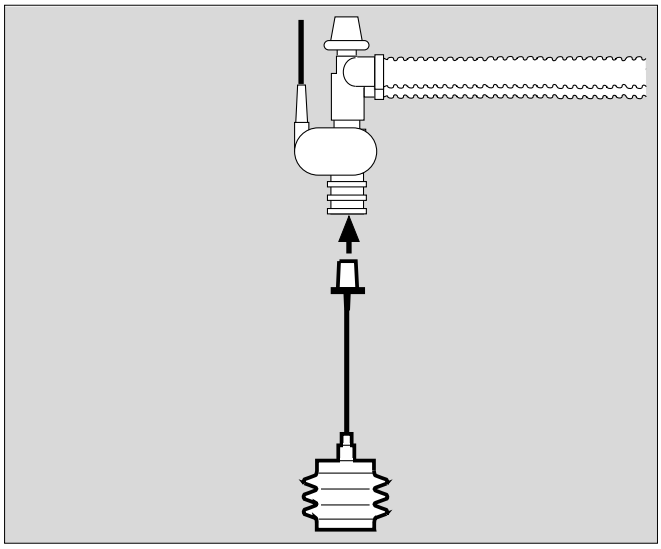


for the adult hose system

The test lung consists of an elbow connector for connection to the Y-piece, a 7 mm diameter catheter connection for simulating the resistance of the airways and a 2 litre breathing bag to simulate compliance.

- Only insert the elbow connector into the Y-piece when Evita 4 advises you to do so on the screen.

Preparing the child test lung 84 09 742



for the paediatric hose set

The test lung consists of a tracheal tube CH 12 to simulate the resistance of the airways and a small bellows to simulate compliance.

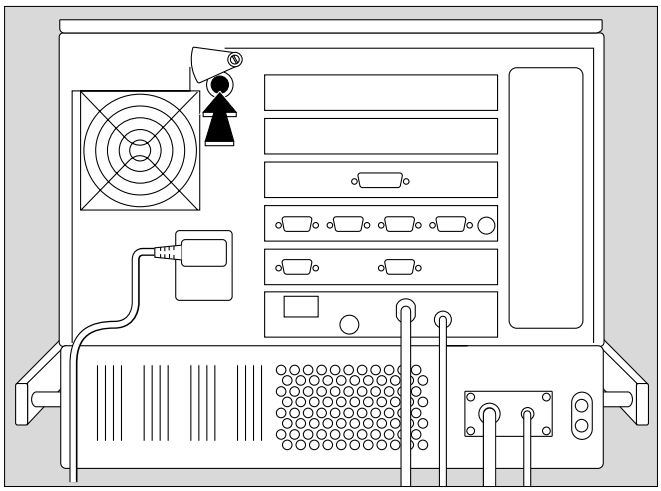
- Only insert the elbow connector into the Y-piece when Evita 4 advises you to do so on the screen.

Performing the device check

- Switch on the machine = press power switch on the back panel until it clicks into position.

Evita 4 runs through its self-test procedure.

- Wait until the 10-second test phase has been completed.



After the self-test:

1 Switch Evita 4 to standby = Hold down key »⏻ « for about 3 seconds.

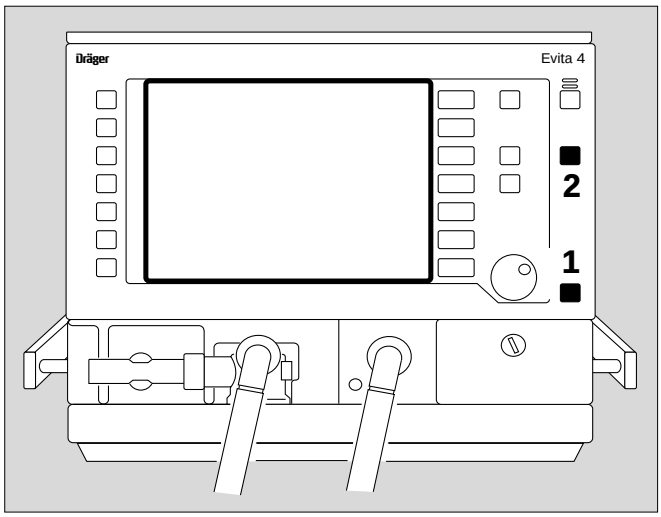
2 Switch off the standby alarm tone with the »**Alarm Reset**« key.

- Touch the »**Device check**« screen key.

Start the check procedure:

- Touch the »**Check**« screen key.

Evita 4 starts running through the dialogue-oriented check.
The check procedure is semi-automatic.
During the device check, the user is instructed by Evita 4 to perform specific actions on the device.



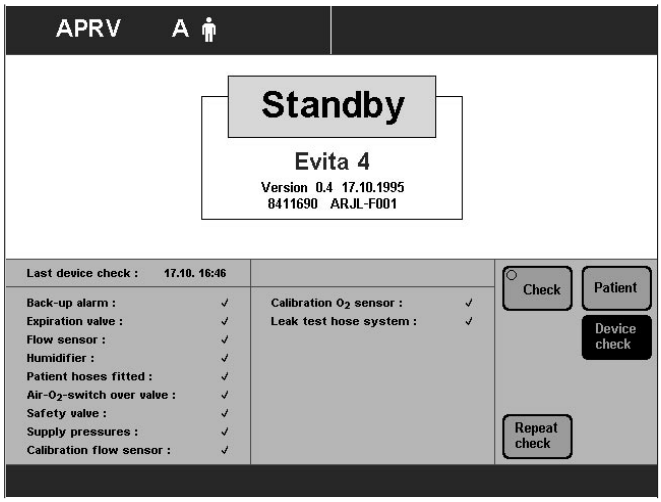
On completion of the device check, a checklist is displayed on the screen to show the results of the check.

Correct result : ✓
Incorrect result : F
Check not performed : – –

In the event of incorrect results, e.g. if the hose system is not sufficiently leakproof:

- Eliminate the cause of the fault
- Touch the »**Repeat check**« screen key

Only the tests with incorrect results are repeated.



After successful completion of the device check, Evita 4 is ready for operation.

Either:

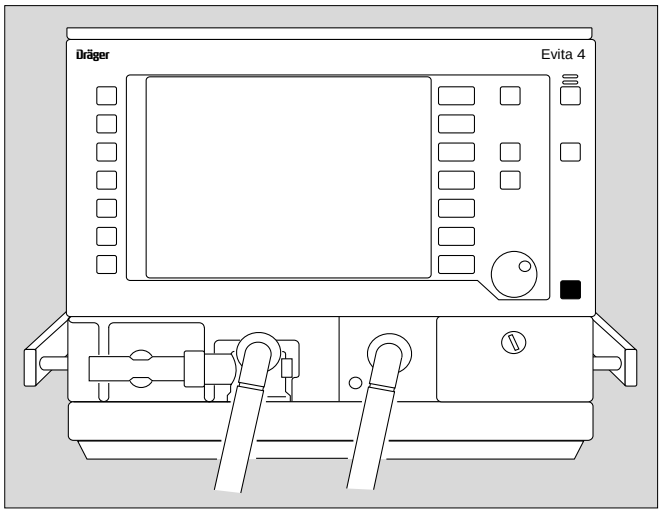
- immediately start up Evita 4 by pressing key »⏻ «

or:

- leave Evita in standby mode

or:

- switch off Evita for later use.
  Switch on back panel = pivot flap to the side and press button in fully and release.

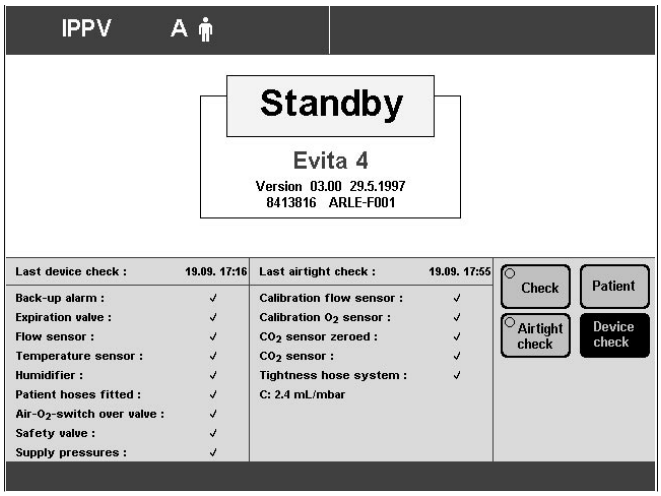


Checklist

The following tests are performed during the device check:

Test

- Expiration valve seating
- Flow sensor seating
- Thermometer seating
- Complete hose system
- CO_2 sensor seating
- Humidifier level
- Alarm tone test
- Air-O_2 test
- Safety valve test
- Gas supply pressure test
- O_2 sensor calibration
- Flow sensor calibration
- CO_2 sensor calibration
- Hose system leakproofing



Checking the hose system for leaks

The hose system is tested for leaks during the device check but must also be monitored independently of the device check, e.g. after changing the hose system.

- Touch the »**Tightness**« screen key.

During the test, the current leakage flow is continuously displayed.
A leakage flow of 300 mL/min at a pressure of 60 mbar is permitted.

After the leak test, the Evita 4 unit determines the compliance and resistance of the hose system.

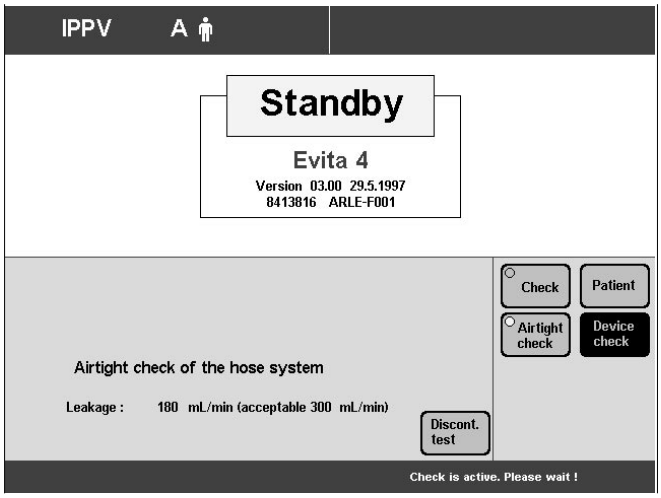
The calculated compliance of the hose system is used by Evita 4 for automatically correcting the volume controlled ventilation strokes and the measured values of the flow monitoring system, see page 150.

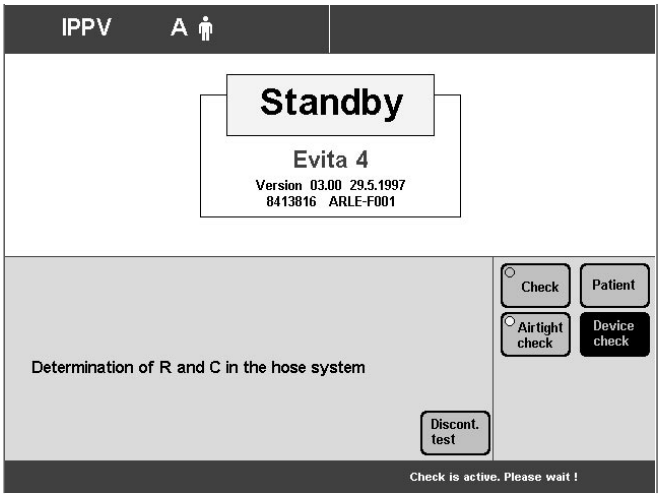
The calculated resistance of the hose system is used by Evita 4 to correct the pressure measurement in the presence of a basic flow (NeoFlow option).

When changing patient mode:
The device automatically sets the hose compliance and resistance to default values.

Therefore:
When changing patient mode or hose system:

- Always perform the leak test.





Positioning the control unit

Do not lean the control unit.
When changing, lay it on its back.

To position the control unit on the wall rail

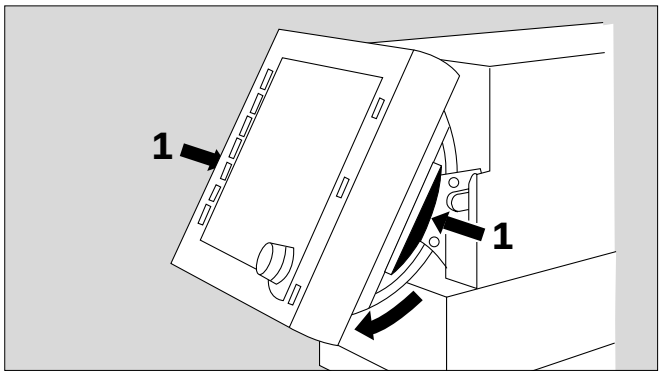
1 Hold down the segments on the right and left, and tilt the control unit fully downwards.

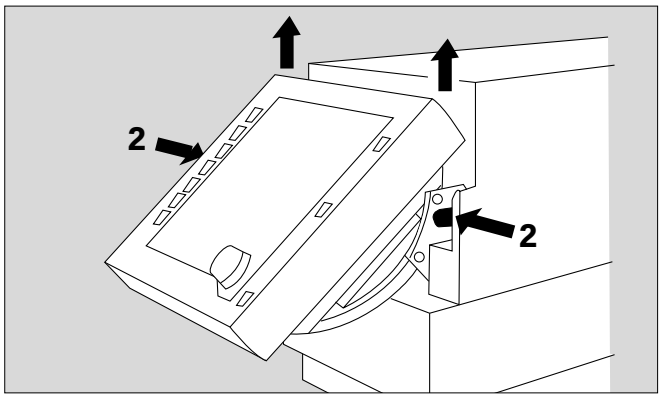
2 Hold down the release buttons on the left and right, and remove the control unit from the Evita 4 mounting.

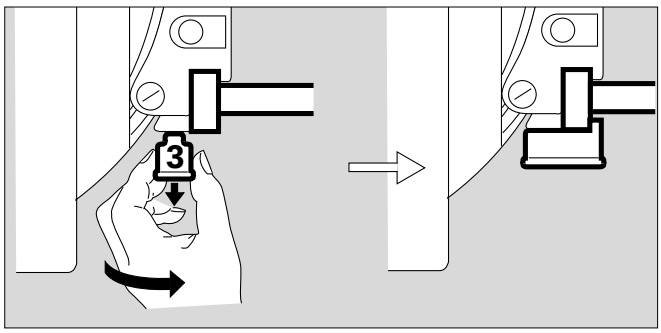
- Uncoil the cable as far as necessary.

3 Clip the control unit to the wall rail and lock in place = pull down the latch situated beneath the bracket and turn it in the direction of the wall rail.

1 Hold down the segments on the right and left and at the same time tilt the control unit to the desired position.







To position the control unit on the device

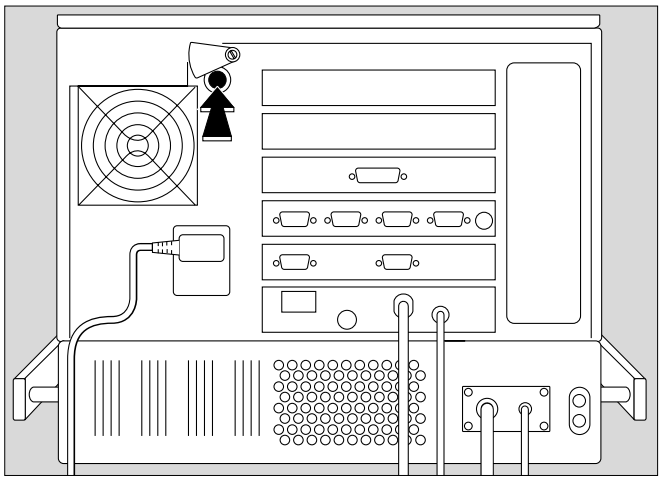
- Hold down the segments on the right and left and tilt the control unit fully downwards.
- Release the control unit = turn the latch away from the wall rail and lift the control unit off the rail.
- Coil the cable.
- Hang the control unit in the Evita 4 mounting so that it rests in position.
- Hold down the segments on the right and left, and at the same time tilt the control unit to the optimal position.

Operation

Contents

Starting up

Switching on



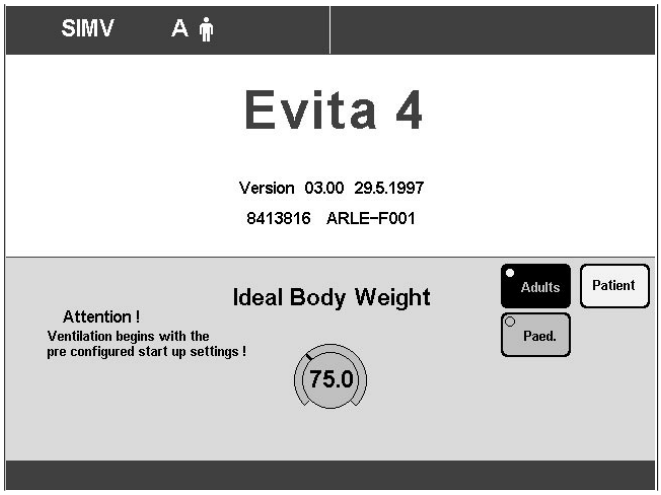
- Push in power switch on back panel until it clicks into place = ON.
  The flap comes down over the switch to prevent it being inadvertently switched off.

Evita 4 runs a self-test.

- Wait until the 10-second test phase is complete.

Evita 4 always begins ventilation with the start-up values marked by an arrow on the on-screen knobs.
To select these start-up values, please refer to pages 101 ff.
After power cuts and after standby mode, the settings valid immediately before the interruption of operation remain in use.

Selecting Adult or Paediatric Ventilation



After switching on, Evita 4 asks the user to enter the desired patient mode (Adults or Paediatrics) and the weight of the patient to be ventilated.

With this information, Evita 4 defines the adjustment ranges and the start-up values of the ventilation parameters.

The starting procedure, consisting of the prompt sequence »**Adults**« or »**Paed.**« and weight of the patient to be ventilated, can be configured by the user, see Configuration on pages 90.

Adjustment ranges

Adult ventilation:

Tidal volume V_T 0.1 litre to 2 litres
Inspiration flow 6 L/min to 120 L/min

Paediatric ventilation:

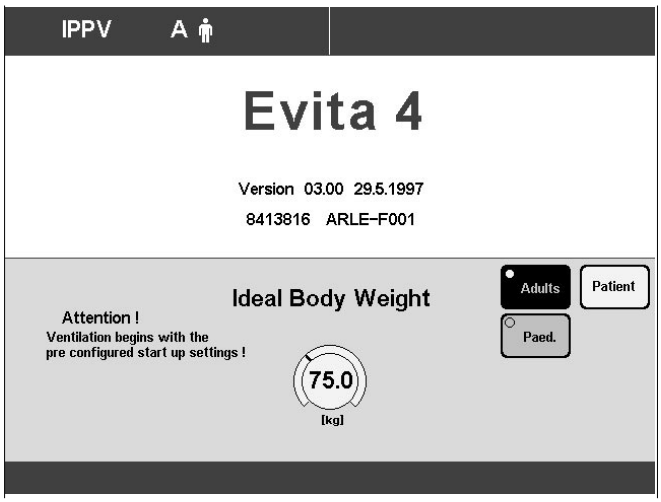
Tidal volume V_T 20 mL to 300 mL
Inspiration flow 6 L/min to 30 L/min

- Touch the appropriate screen key.
  Evita 4 then asks you to enter the ideal body weight.

Entering the ideal body weight

With the ideal body weight, Evita 4 determines the start-up settings of the ventilation parameters. The start-up value is marked on the relevant screen knob by an arrow (▶).

- Touch the screen knob.
- Enter the ideal body weight [kg] with the manual dial-knob = turn rotary knob.
- Confirm the setting = press rotary knob.

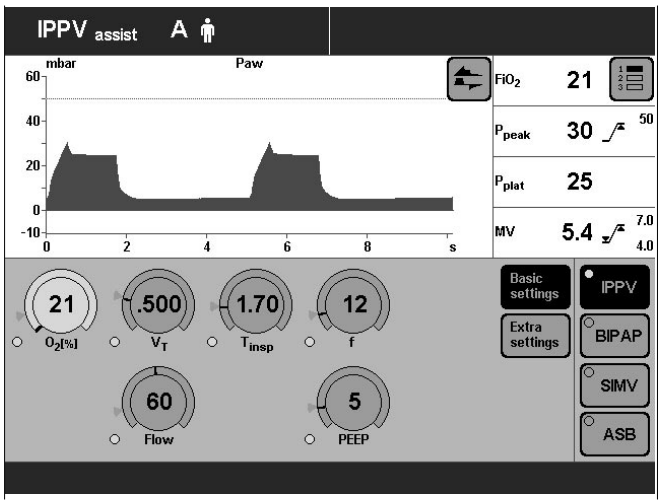


Starting ventilation

- Press the rotary knob again.
  Evita 4 starts ventilation with the ventilation mode configured by the user.

The machine is factory-set to IPPV mode.

Evita 4 displays the »**Settings**« screen page.
The user can check and correct the settings on the screen.



Setting Ventilation Modes

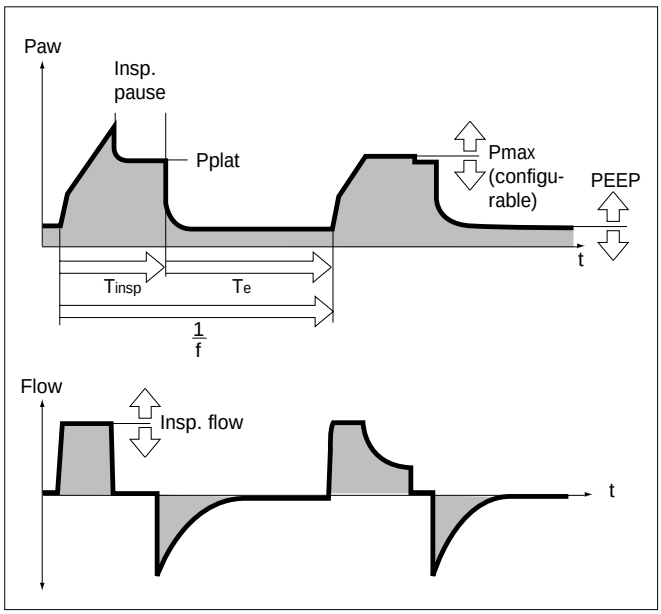
The ventilation modes IPPV, BIPAP, SIMV and ASB are already configured in the unit. If other ventilation modes are used, please refer to page 88 "Selecting ventilation modes".

IPPV

Intermittent **P**ositive **P**ressure **V**entilation

Volume-controlled ventilation with fixed, mandatory minute volume MV and user-adjusted tidal volume V_T and frequency f.

For patients having no spontaneous breathing.



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

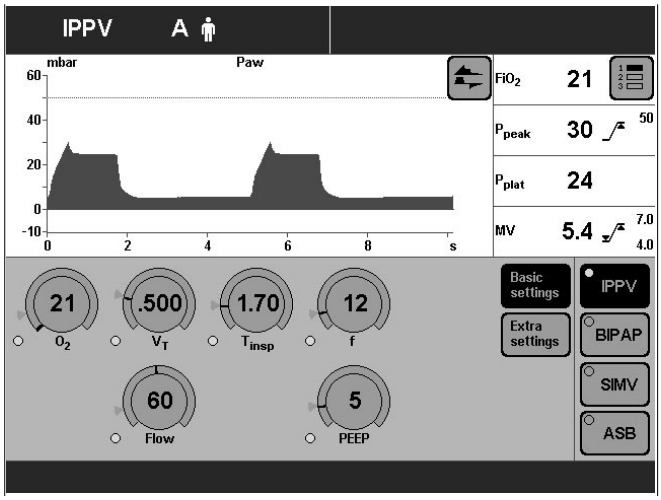
Tidal volume »**V_T**«
Insp. Flow »**Flow«**

Frequency »**f«**
Inspiration time »**T_{insp}«**

O_2 concentration »**O_2«**
Positive end-expiratory pressure »**PEEP«**

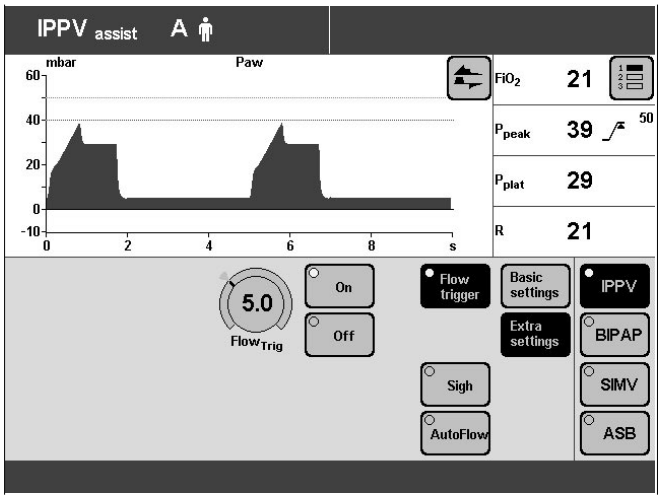
To set:

- Touch the relevant screen knob.
- Adjust value = turn rotary knob.
- Confirm setting = push rotary knob.

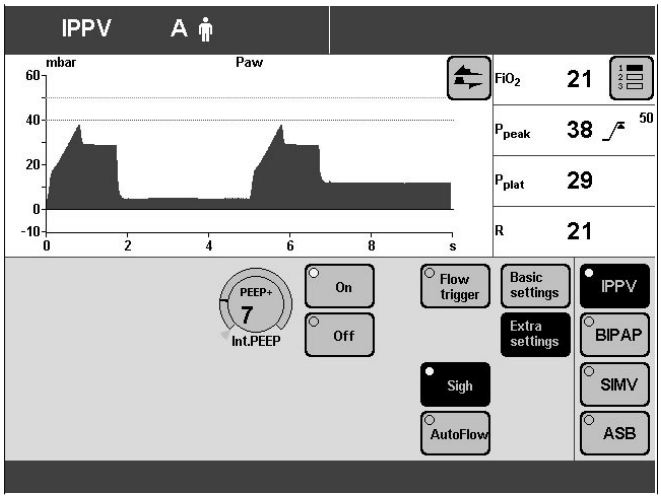


IPPV can be expanded by the following ventilation parameters:

Flowtrigger (IPPV Assist) – for synchronisation with attempted spontaneous breathing by the patient.
By switching on the flow trigger and setting the trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.



Sigh – for prophylactic treatment of atelectasis.
Atelectasis can be prevented by switching on the Sigh function and setting the sigh in the form of an intermittent PEEP.
When the Sigh function is activated, the end-expiratory pressure increases for two ventilation strokes every 3 minutes by the set value of the intermittent PEEP.



AutoFlow® – for automatic regulation of the inspiration flow.
With AutoFlow*, the inspiration flow is decelerated and regulated, so that at the selected tidal volume V_T with the current lung compliance a minimum airway pressure is reached and pressure peaks are avoided.
Evita 4 delivers additional inspiration flow if and when the patient breathes in – limited by the alarm limit V_{Ti} ⌟‾
The patient can also breathe out during the inspiratory plateau phase.
The inspiratory pressure is limited by the Paw ⌟‾ alarm limit.

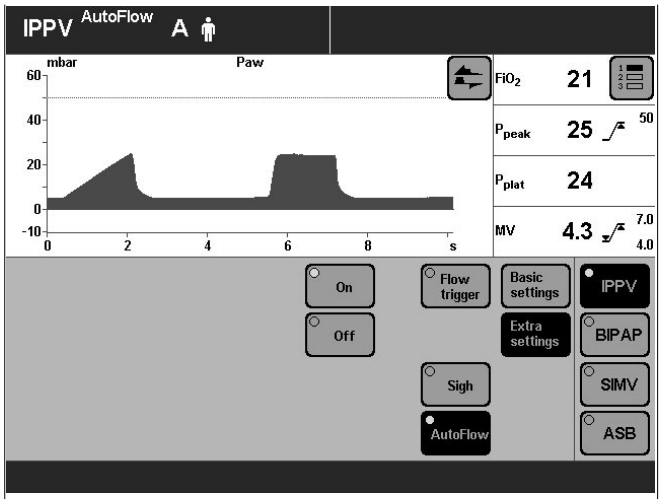
* Please refer to page 141 for a detailed description of AutoFlow and PLV.

To set:

- Touch the »**Extra Settings**« screen key.
- Touch the screen key corresponding to the desired function.

For Flow Trigger and Sigh:

- Touch the appropriate screen key.
- Adjust the desired value = turn the rotary knob
- Confirm the desired setting = press the rotary knob
- Switch on the function = touch the »**On**« screen button and press the rotary knob.



IPPV can be configured for the additional ventilation parameter Pmax.
Selecting »Pmax pressure limiting«, see page 98.

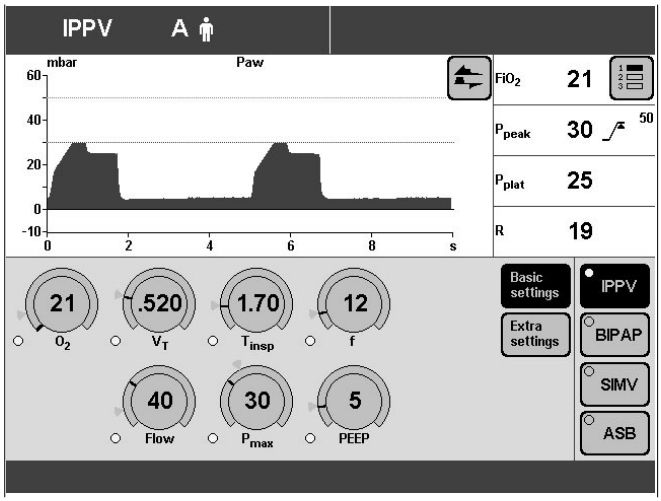
Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the inspiratory flow curve shows a brief flow pause between inspiration and expiration.

- To set the "Pmax" pressure limit, please refer to page 98.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The "Inconstant volume" alarm is always active. It is triggered automatically if the tidal volume VT can no longer be applied.

This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



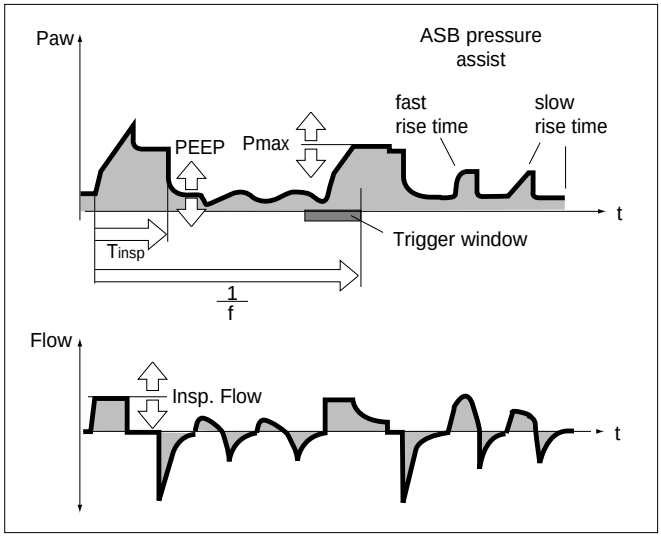
* Please refer to page 141 for a detailed description of AutoFlow and PLV.

SIMV, SIMV/ASB

Synchronized **I**ntermittent **M**andatory **V**entilation*
Assisted **S**pontaneous **B**reathing**

Fixed mandatory minute volume MV set with tidal volume VT and frequency f. Between the mandatory ventilation strokes, the patient can breathe spontaneously, thereby contributing to the minute volume. Spontaneous breathing can be supported by ASB.

For patients with insufficient spontaneous breathing or for patients who are being weaned by progressive reduction of the mandatory proportion of the total minute volume.



Set the pattern of ventilation for SIMV and SIMV/ASB with the ventilation parameters:

Tidal volume »**VT**«
Insp. flow »**Flow**«

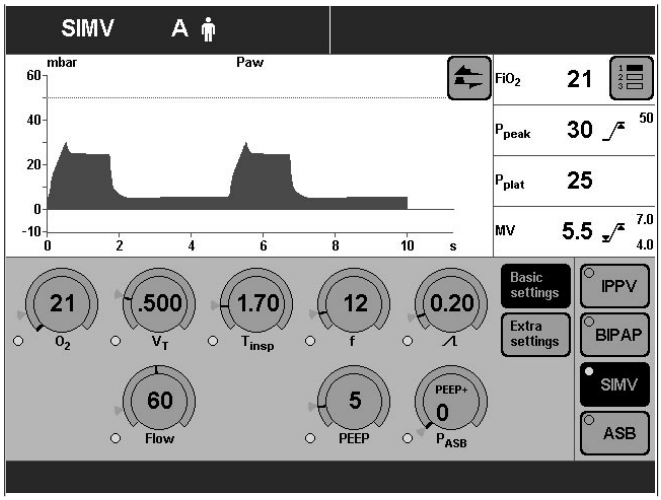
Frequency »**f**«
Inspiration time »**Tinsp**«

O2-concentration »**O2**«
Positive end-expiratory pressure »**PEEP**«

Pressure support »**PASB**«
Pressure rise time » ⩘ «

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



SIMV and SIMV/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting on the flow trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

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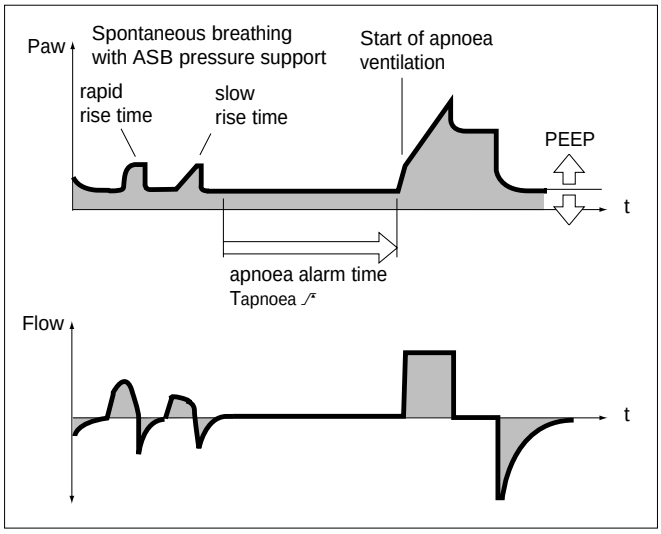
* Please refer to page 145 for a detailed description of SIMV.
** Please refer to page 146 for a detailed description of ASB.

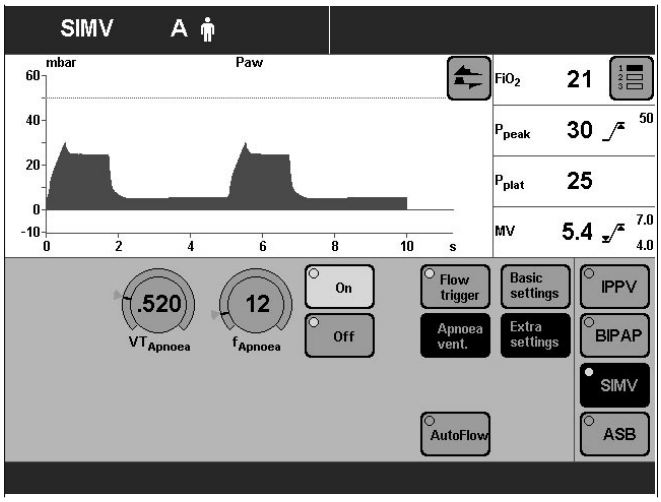
Apnoea Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.
If breathing stops, Evita 4 emits an alarm after the set alarm time (Tapnoea ⌜) and starts volume-controlled ventilation with the set ventilation parameters:
Frequency »**f apnoea**«
Tidal volume »**VT apnoea**«



AutoFlow® – for automatic optimisation of the inspiration flow.
With AutoFlow*, the inspiration flow is decelerated and regulated, so that at the selected tidal volume VT with the current lung compliance a minimum airway pressure is reached and pressure peaks are avoided.
Evita 4 delivers additional inspiration flow when the patient breathes in – limited by the alarm limit VTi ⌜
The patient can also breathe out during the inspiratory plateau phase.
The inspiratory pressure is limited by the Paw ⌜ alarm limit.

To set (Example: Apnoea Ventilation)

- Touch the »**Extra Settings**« screen key.
- Touch the screen key corresponding to the desired function , e.g. »**Apnoea vent.**«.
- Switch on the function = touch the »**on**« screen knob and press in the rotary knob.
- Set values = touch the corresponding screen knob, turn and press rotary knob.



SIMV and SIMV/ASB can be configured with the additional ventilation parameter Pmax.
Select »Pmax pressure limiting«, see page 98.

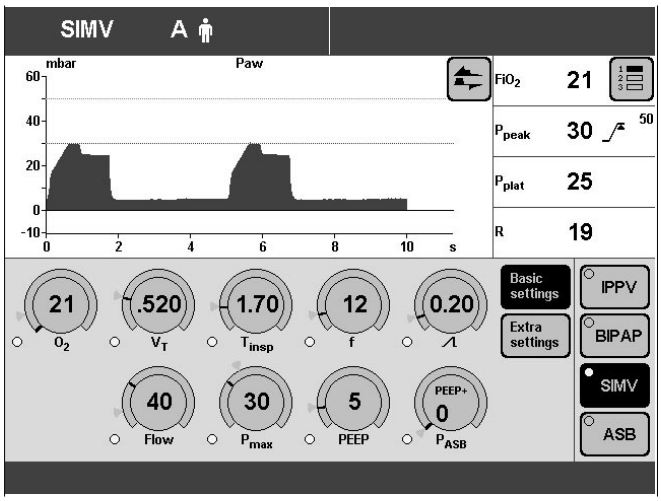
Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the inspiratory flow curve shows a brief flow pause between inspiration and expiration.

- To set the "Pmax" pressure limit, please refer to page 98.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The "Inconstant volume" alarm is always active. It is triggered automatically if the tidal volume VT can no longer be applied.

This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



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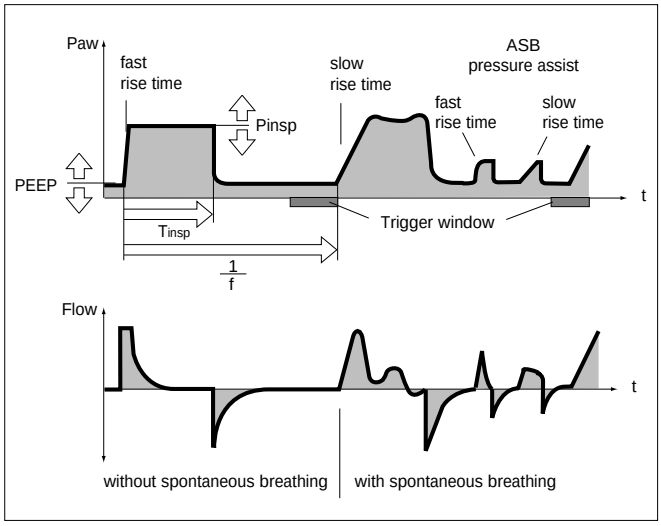
* Please refer to page 141 for a detailed description of AutoFlow and PLV.

BIPAP, BIPAP/ASB

Biphasic **I**ntermittent **P**ositive **A**irway **P**ressure
Assisted **S**pontaneous **B**reathing

Pressure-controlled ventilation combined with free spontaneous breathing during the complete breathing cycle, and adjustable pressure support at CPAP level. The mandatory proportion of the total minute volume MV is set with inspiratory pressure Pinsp above PEEP and Frequency f.

For a range of patients, from those unable to breathe spontaneously to those breathing spontaneously before extubation. Patients are weaned off the ventilator by progressive reduction of the mandatory proportion of the overall minute volume MV and reduction of the pressure support PASB.



Set the pattern of ventilation for BIPAP and BIPAP/ASB with the ventilation parameters:

Inspiration pressure »**Pinsp**«

Frequency »**f**«
Time »**Tinsp**«

O2 concentration »**O2**«
Positive end-expiratory pressure »**PEEP**«

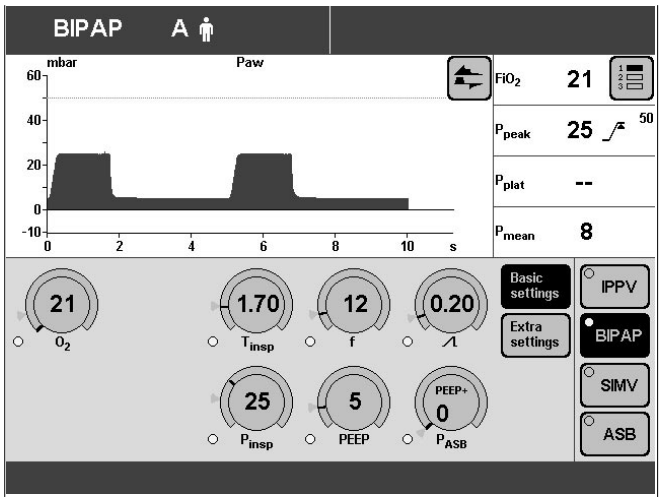
Pressure support »**PASB**«
Pressure rise time » ⩘ «

The inspiration pressure »**Pinsp**« can be reduced to the PEEP level, in which case the ventilation pattern corresponds to CPAP or CPAP/ASB.

The inspiration pressure »**Pinsp**« is set as an absolute value. Pressure support »**Pasb**« is set relative to the PEEP level.

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



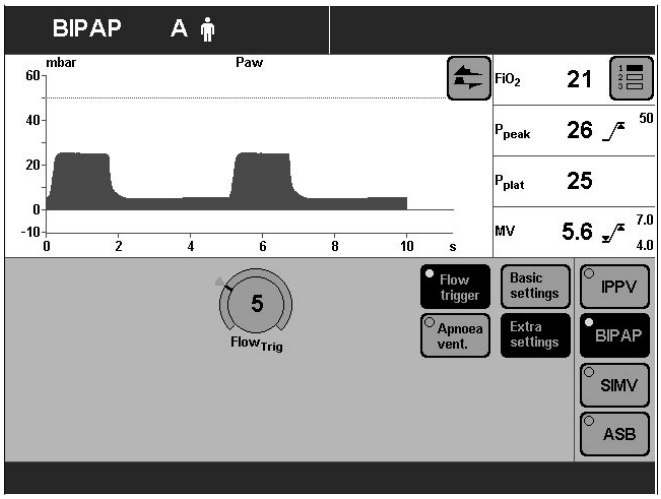
BIPAP and BIPAP/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting on the flow trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

Apnoea Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.
If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{apnoe}) and starts volume-controlled ventilation with the set ventilation parameters:
Frequency »**f apnoea**«
Tidal volume »**VT apnoea**«

To set (Example: Flowtrigger)

- Touch the »**Extra Settings**« screen key.
- Touch the screen key corresponding to »**Flowtrigger**«.
- Set values = touch the »**FlowTrig**« screen knob, and turn and press the rotary knob.

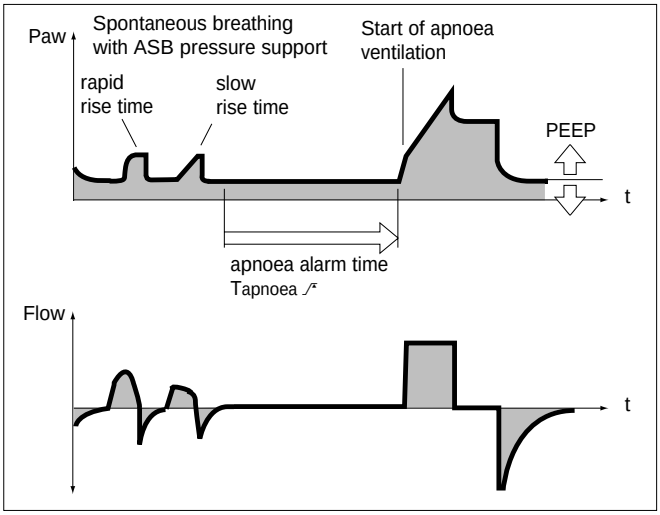


CPAP, CPAP/ASB

Continuous **P**ositive **A**irway **P**ressure
Assisted **S**pontaneous **B**reathing

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

For patients breathing spontaneously.



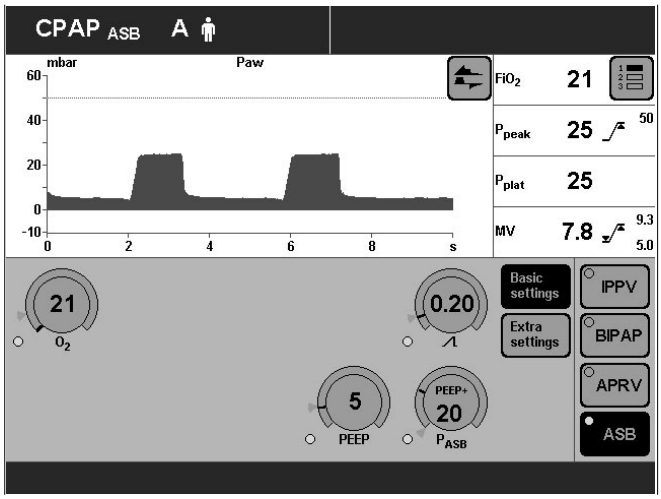
Set the pattern of ventilation for CPAP and CPAP/ASB with the following ventilation parameters:

O_2 concentration »**O2**«
Positive end-expiratory pressure »**PEEP**«

Pressure support »**PASB**«
Pressure rise time »⟋⟍«

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



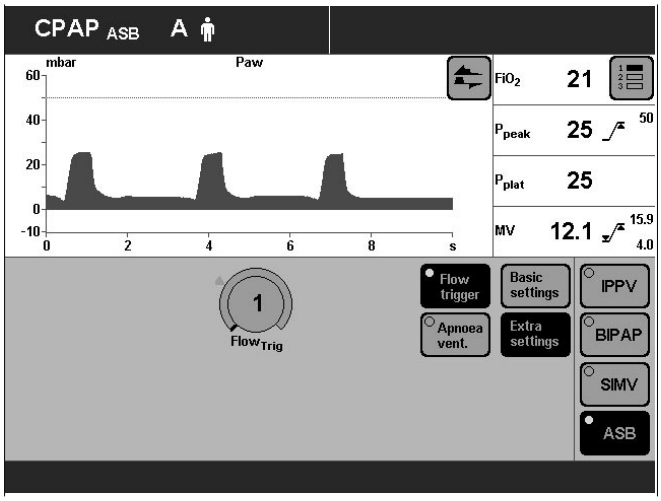
CPAP and CPAP/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting the trigger level, the mandatory ventilation strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

Apnoea Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.
If breathing stops, Evita 4 emits an alarm after the set alarm time (Tapnoea ⟋) and starts volume-controlled ventilation with the set ventilation parameters.
Frequency »**f apnoea**«
Tidal volume »**VT apnoea**«

To set (Example: Flowtrigger)

- Touch the »**Extra Settings**« screen key.
- Touch the »**Flow trigger**« screen key.
- Set the value = touch the »**Flow Trig**« screen knob, and turn and press the rotary knob.

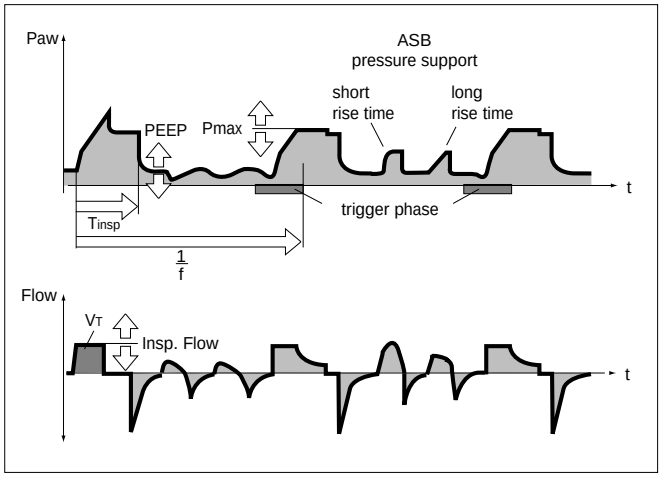


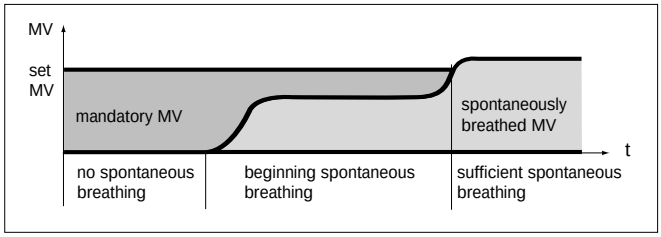
MMV, MMV/ASB

Mandatory **M**inute Volume **V**entilation
Assisted **S**pontaneous **B**reathing

The overall minute volume is preset to a mandatory level, which can be adjusted by means of the tidal volume V_T and frequency 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 covered by the mandatory ventilation strokes. Spontaneous breathing can be assisted by ASB pressure support.

This mode is intended for patients being weaned off the ventilator by progressively reducing the mandatory proportion of the overall minute volume.





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

Tidal volume »**V_T**«
Insp. flow »**Flow**«

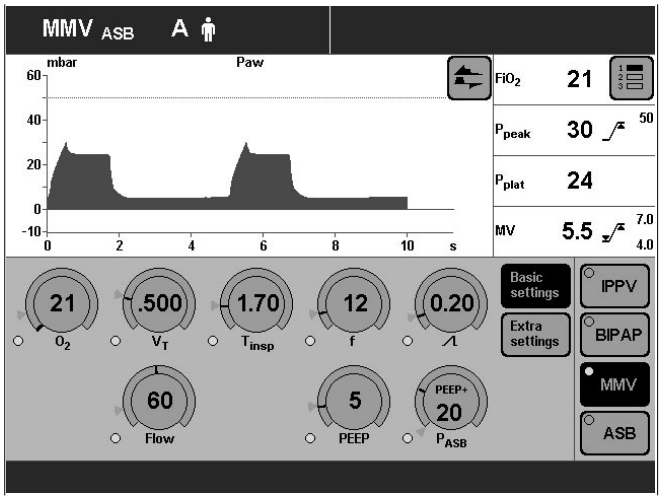
Frequency »**f**«
Inspiration time »**T_{insp}**«

O_2 concentration »**O_2**«
Positive end-expiratory pressure »**PEEP**«

Pressure support »**P_{ASB}**«
Pressure rise time » ⩘ «

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



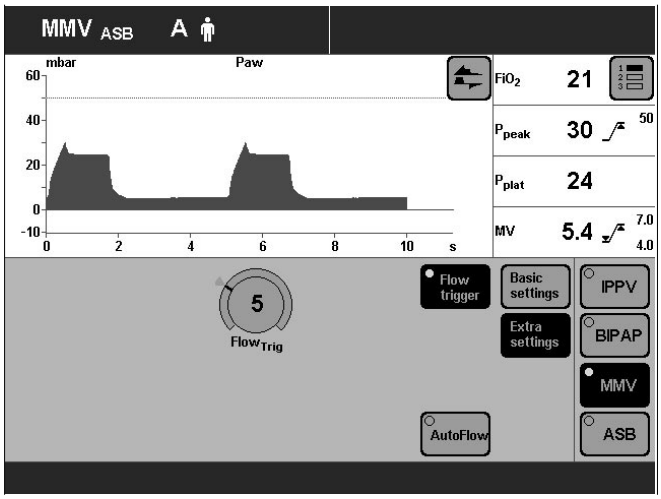
MMV and MMV/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting on the flow trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

AutoFlow® – for automatic regulation of the inspiration flow.
With AutoFlow*, the inspiration flow is decelerated and regulated, so that at the selected tidal volume VT with the current lung compliance a minimum airway pressure is reached and pressure peaks are avoided.
Evita 4 delivers additional inspiration flow when the patient breathes in – limited by the alarm limit VTi ⌜
The patient can also breathe out during the inspiratory plateau phase.
The inspiratory pressure is limited by the Paw ⌜ alarm limit.

To set (Example: Flowtrigger)

- Touch the »**Extra Settings**« screen key.
- Touch the »**Flowtrigger**« screen key.
- Set value = touch the »**FlowTrig**« screen knob, and turn and press the rotary knob.



MMV and MMV/ASB can be configured with the additional ventilation parameter Pmax.
Select »Pmax pressure limiting«, see page 98.

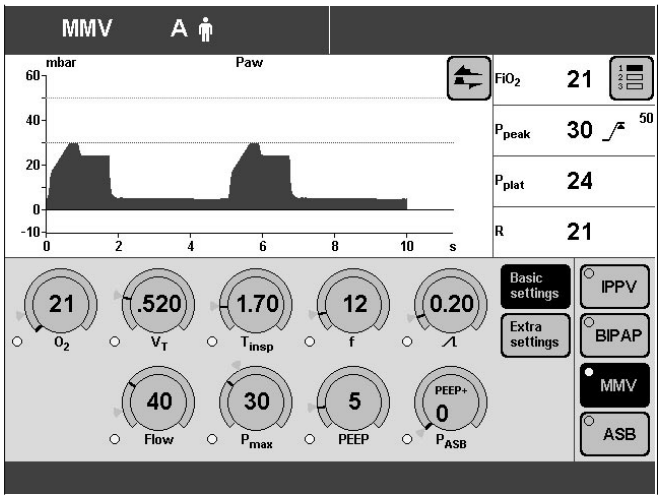
Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the inspiratory flow curve shows a brief flow pause between inspiration and expiration.

- To set the "Pmax" pressure limit, please refer to page 94.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The "Inconstant volume" alarm is always active. It is triggered automatically if the tidal volume VT can no longer be applied.

This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



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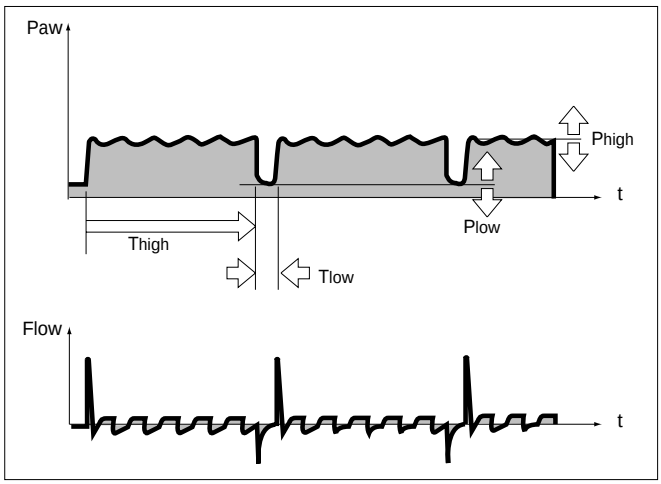
* Please refer to page 141 for a detailed description of AutoFlow and PLV.

APRV

Airway **P**ressure **R**elease **V**entilation

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

This mode is intended for patients who are breathing spontaneously but who need assistance with CO_2 removal.



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

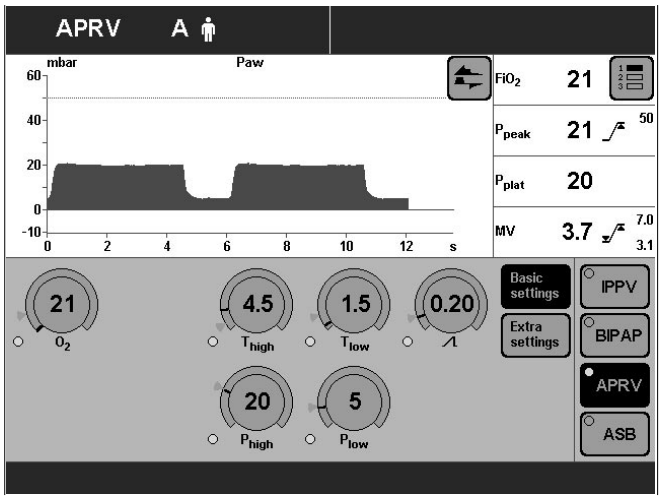
Inspiration time »**Thigh**«
Expiration time »**Tlow**«

Inspiration pressure »**Phigh**«
Positive end-expiratory pressure »**Plow**«

O_2-concentration »**O_2**«

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.

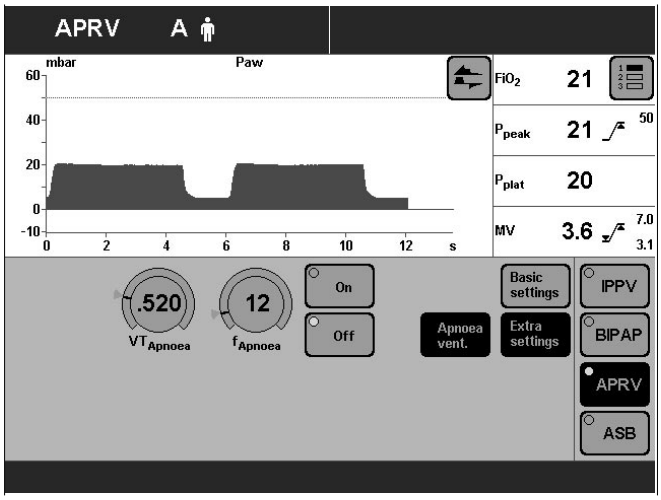


APRV can be expanded with the following ventilation parameters:

Apnoea Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.
If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{apnoea}) and starts volume-controlled ventilation with the set ventilation parameters:
Frequency »**f apnoea**«
Tidal volume: »**V_T apnoea**«

To set (Example: Apnoea Ventilation)

- Touch the »**Extra Settings**« screen key.
- Touch the »**Apnoea vent.**« screen key.
- Switch on the function = touch the »**on**« screen knob and press in the rotary knob.
- Set values = touch the corresponding screen knob, turn and press rotary knob.



ILV

Independent **L**ung **V**entilation

Separate, differentiated, synchronised ventilation with two Evita units, one for each lung. The two Evita units are connected by analogue interfaces.

The two devices operate together in master/slave mode. The master device controls the operation.

The following device combinations are possible:

– Combination of two Evita 4 units

– Combination of Evita 4 and Evita 2 dura

– Combination of Evita 4 and Evita 2

– Combination of Evita 4 and Evita.

Requirements for combinations

– Evita 2 or Evita units must be fitted with the EvitaBus analogue interface (available as option).

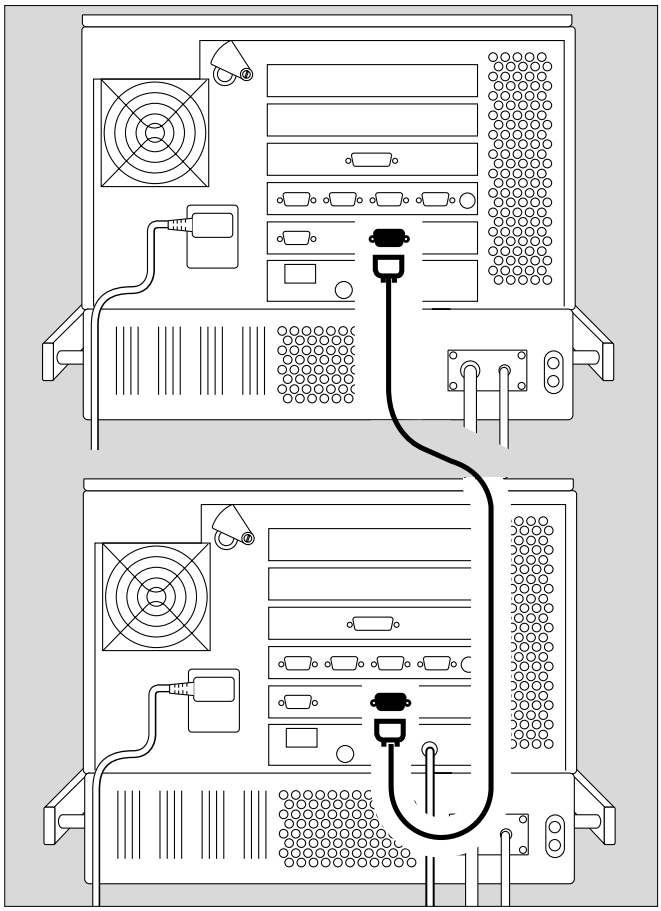
– Connecting cable 84 11 794 must be used to connect Evita 4 to another Evita 4 or with an Evita 2 dura.

– Connecting cable 84 11 794 must be used to connect Evita 4 to an Evita 2 or Evita.

Preparation

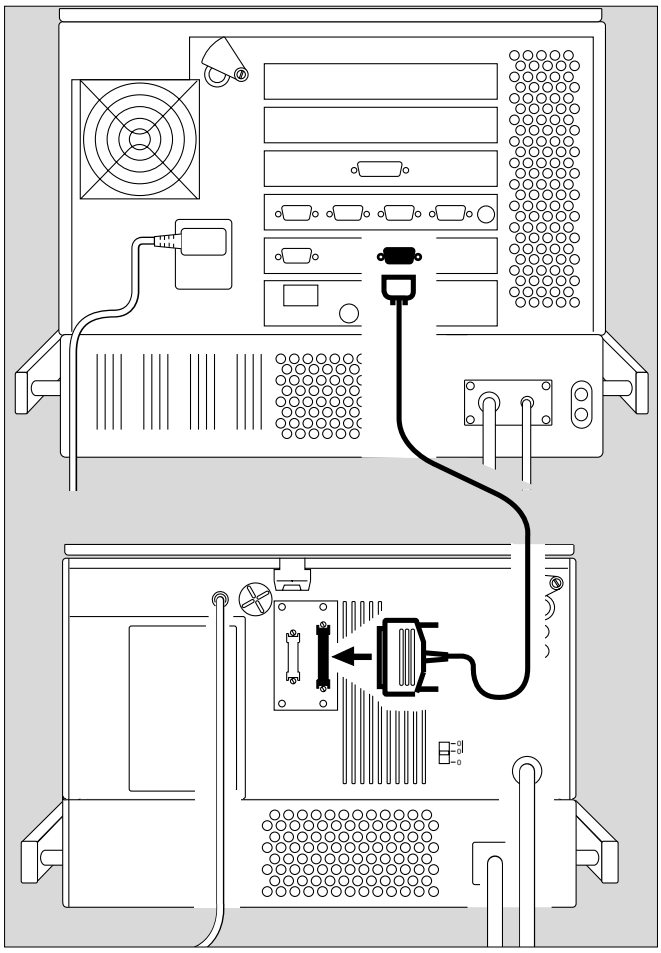
For Evita 4 - Evita 2 dura
and
Evita 4 - Evita 4:

● Connect the ILV ports of the two Evita units using connecting cable 84 11 794.



For Evita 4 - Evita 2
and
Evita 4 - Evita:

- Connect the ILV port of the Evita 4 to the analogue interface of the other Evita unit using connecting cable 84 11 793.



Setting the Master and Slave device

To perform independent lung ventilation:

- Set up one device for ILV/Master mode

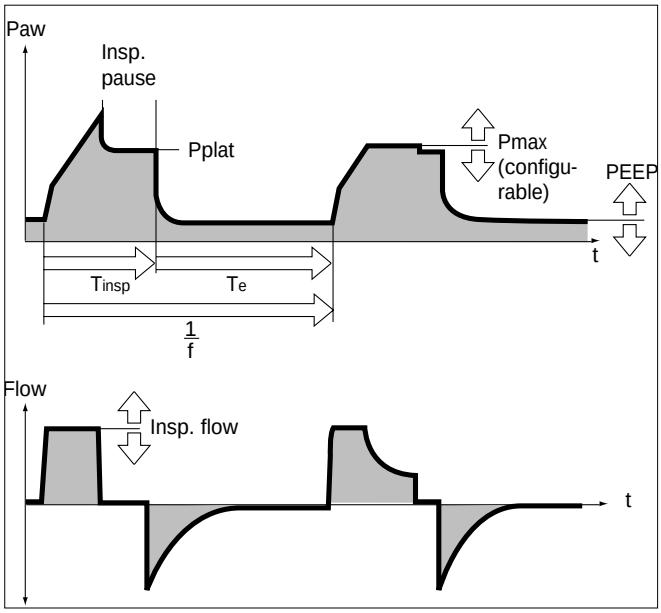
and

- the other device for ILV/Slave mode.
- Set the desired parameters – see page 19.
- **Do not activate ILV mode until all the parameters for the ILV/Master and ILV/Slave are fully set.**

Setting ILV/Master

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

For independent lung ventilation of patients with no spontaneous breathing.



Set the ILV ventilation pattern with the parameters:

Tidal volume »**V_T**«
Insp. flow »**Flow**«

Frequency »**f**«
Inspiration time »**T_{insp}**«

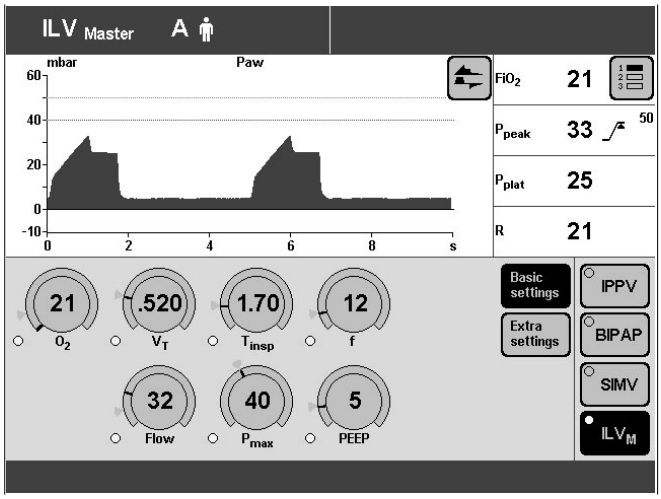
O_2 concentration »**O_2**«
Positive end-expiratory pressure »**PEEP**«

To set:

- Touch the appropriate screen knob.
- Adjust the desired value = turn rotary knob
- Confirm setting = press rotary knob.

ILV/Master can be supplemented by the following ventilation parameters:

Flowtrigger (ILV/Master Assist) – for synchronisation with attempted spontaneous breathing by the patient. By switching on the flow trigger and setting the trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts. Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.



Sigh – for prophylactic treatment of atelectasis.
Atelectasis can be prevented by switching on the Sigh function and setting the sigh in the form of an intermittent PEEP.
When the Sigh function is activated, the end-expiratory pressure is increased by the set value of the intermittent PEEP for 2 ventilation strokes every 3 minutes.

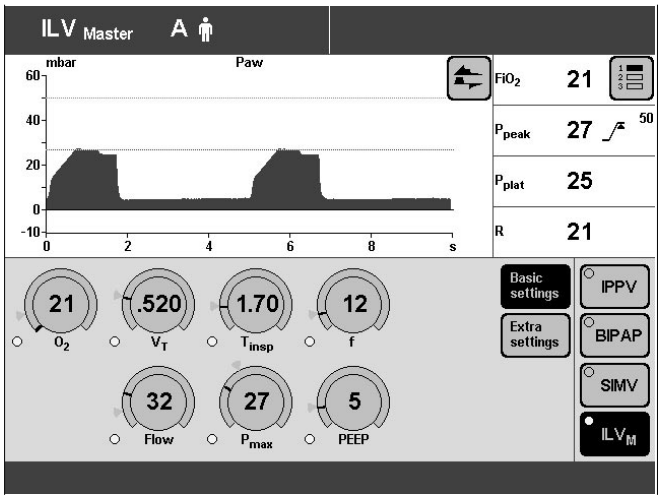
ILV/Master can also be configured with the additional ventilation parameter Pmax.
To set the »Pmax pressure limit«, please refer to page 98.

Pressure Limited Ventilation (PLV) – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the flow curve shows a brief flow pause between inspiration and expiration.

- To set the »Pmax pressure limit«, please refer to page 98.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

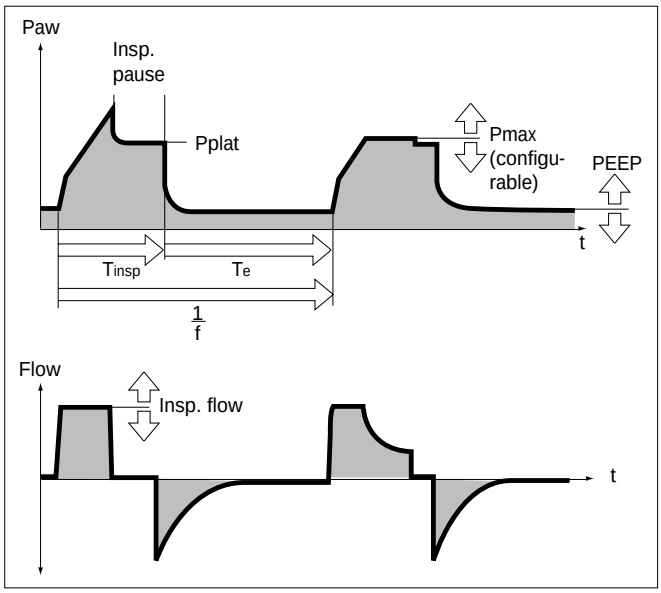
The tidal volume is constantly monitored. If the tidal volume V_T can no longer be applied, the "Inconstant volume" alarm is automatically triggered.
This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



Setting ILV/Slave

Volume-controlled ventilation with fixed, mandatory minute volume MV, set with the tidal volume V_T and frequency f of the ILV Master device and selectable Slave mode.

For independent lung ventilation of patients with no spontaneous breathing.

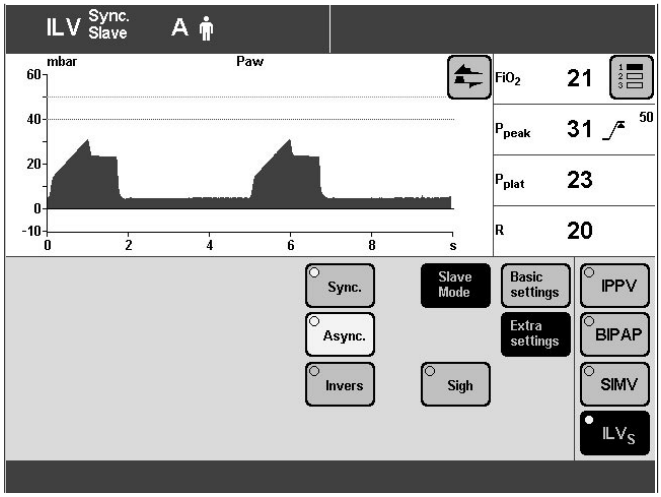


To set Slave mode:

- Touch the »**Extra Settings**« screen key.
- Touch the »**Slave Mode**« screen key.

To select the desired slave mode (e.g. »**Async.**«):

- Touch the appropriate screen key and press the rotary knob.



ILV: Master and Slave Synchronisation

Master device

I:E ratio

Slave device

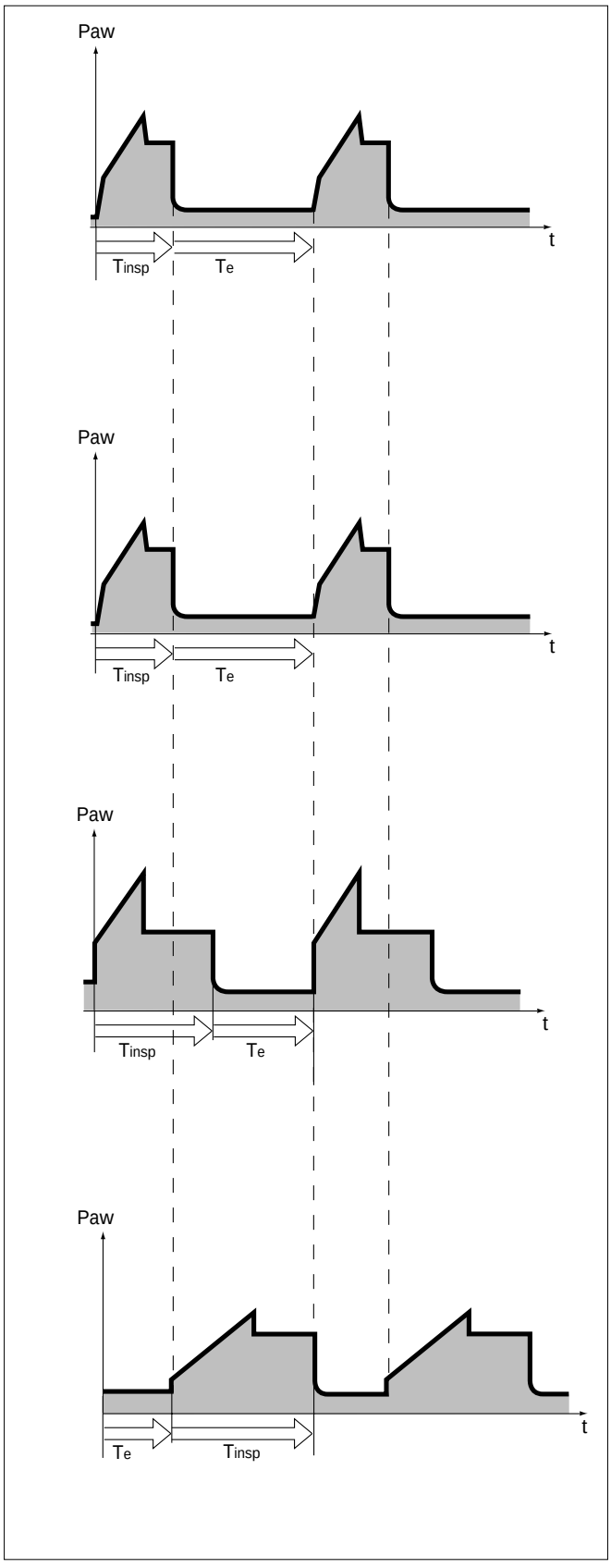
Sync. – The I:E ratio of the slave device is determined by the I:E ratio of the master device.
The start of inspiration is synchronised with the inspiration of the master device.

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 »**Tinsp**« 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 »**VT**«
Insp. flow »**Flow**«

Frequency »**f**«
Inspiration time »**Tinsp**«

O2 concentration »**O2**«
Positive end-expiratory pressure »**PEEP**«

To set:

- Touch the appropriate screen knob.
- Adjust the desired value = turn rotary knob
- Confirm setting = press rotary knob.

The »**f**« setting is not immediately effective.

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

Set »**f**« on the slave device to the same value as on the master = safety setting.

In Async. slave mode, the »**Tinsp**« setting is immediately effective.
In "Synchronised" and "Inverse" modes, "Tinsp" is only effective if the devices are inadvertently separated.

ILV/Slave can be supplemented by the following ventilation parameters:

Sigh – for prophylactic treatment of atelectasis.
Atelectasis can be prevented by switching on the Sigh function and setting the sigh in the form of an intermittent PEEP.
When the Sigh function is activated, the end-expiratory pressure is increased by the set value of the intermittent PEEP for 2 ventilation strokes every 3 minutes.

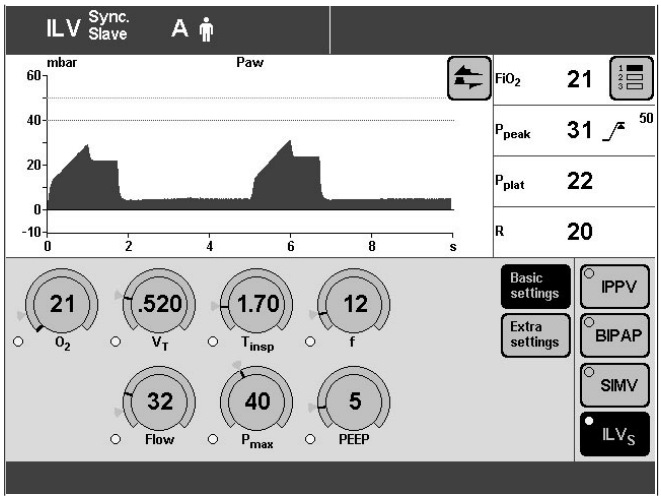
ILV/Slave can also be configured with the additional ventilation parameter "Pmax".
To set the "Pmax" pressure limit, please refer to page 98.

Pressure Limited Ventilation (PLV) – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the flow curve shows a brief flow pause between inspiration and expiration.

- To set the "Pmax" pressure limit, please refer to page 98.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The tidal volume is constantly monitored. If the tidal volume VT can no longer be applied, the "Inconstant volume" alarm is automatically triggered.
This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



Apnoea Ventilation

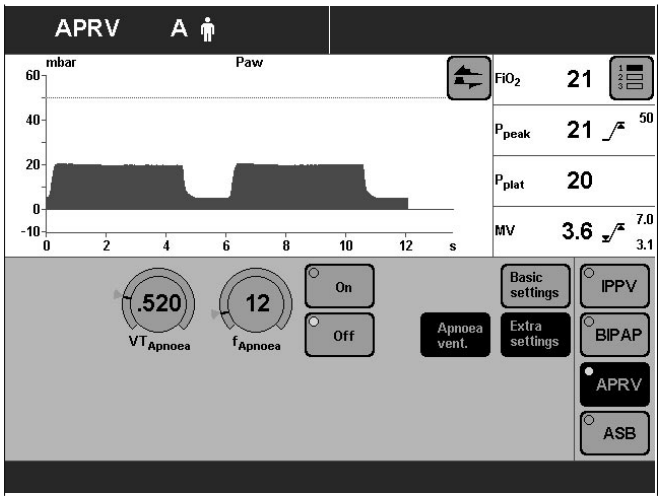
For automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.
It can be switched on in the ventilation modes SIMV, BIPAP, CPAP, APRV.
Evita 4 emits an apnoea alarm if during the set alarm period »**T apnoea**« no expiration flow is measured or insufficient inspiratory gas is delivered.
If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{apnoea}) and starts volume-controlled ventilation with the set ventilation parameters:
Frequency »**f apnoea**«
Tidal volume: »**VT apnoea**«

The ventilation parameters »**O2**« and »**PEEP**« correspond to the settings effective at the time.
The inspiration time for apnoea ventilation is determined from the set apnoea frequency »**f apnoea**« and a fixed I:E ratio of 1:2.

As in SIMV, the patient can breathe spontaneously during apnoea ventilation, and the mandatory ventilation strokes will be synchronised with the patient's spontaneous breathing. The apnoea ventilation frequency remains constant.

To set:

- Touch the »**Extra Settings**« screen key.
- Touch the »**Apnoea vent.**« screen key.
- Switch on the function = touch the screen knob marked »**on**«, and press the rotary knob.
- Set values = touch the appropriate screen knob, and then turn and press the rotary control.



To terminate Apnoea Ventilation:

- Press the Reset key: the device will continue operating in its previous ventilation mode

  or

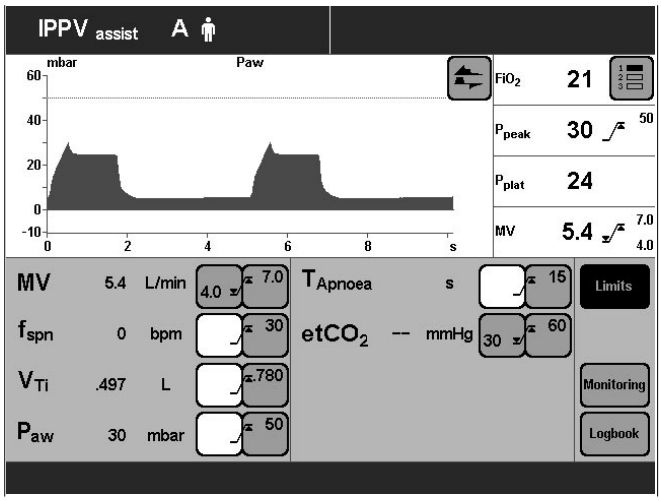
- select another ventilation mode.

Setting Alarm Limits

- Press the »**Alarm limits**« key.

  Display screen »**Alarm limits**« (example):
  This page displays all the adjustable alarm limits.

  ⌟ = lower alarm limit
  ⌜ = upper alarm limit



Example: Lower alarm limit for minute volume MV.

- Touch the screen key ⌟⌜ for MV: the key changes colour from green to yellow.
- Set the alarm limit and confirm by turning and pressing the rotary knob. The new alarm limit will now be effective.

The lower alarm limits do not have to be set for the airway pressure Paw, which is automatically coupled with the PEEP setting.

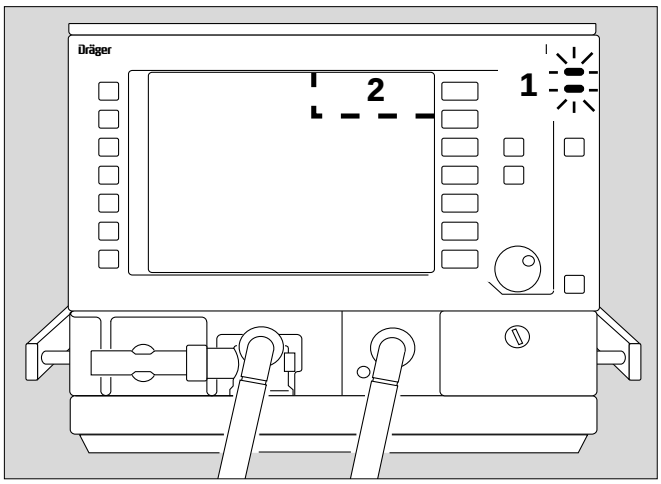
The alarm limits do not have to be set for the O_2 concentration. These limits are automatically coupled to the O_2 concentration setting.

Lower alarm limit:
Setting – 4 Vol.% (for settings up to 60 Vol.%)
Setting – 6 Vol.% (for settings from 60 to 100 Vol.%)

Upper alarm limit:
Setting + 4 Vol.% (for settings up to 60 Vol.%)
Setting + 6 Vol.% (for settings from 60 to 100 Vol.%)

Ventilation Parameter	**Adjustment Range**
MV ⌟⌜	0.5 to 41 L/min 0 to 40 L/min
fspont ⌜	0 to 120 bpm No lower alarm limit
VTi ⌜	30 to 4000 mls No lower alarm limit
Paw ⌜	10 to 100 mbar No lower alarm limit
etCO2 ⌟⌜	0 to 100 mmHg, 0 to 15 kPa 0 to 99 mmHg, 0 to 14 kPa
Tapnoea ⌜	15 to 60 seconds No lower alarm limit

In the Event of an Alarm



1 the red lamp or yellow lamp flashes.

2 the alarm message is displayed in the right-hand corner of the top line of the screen.

Evita 4 assesses the alarm message with corresponding priority, marks the text with exclamation marks and different coloured backgrounds and generates the various alarm tone sequences.

Warning = top priority message

The red lamp flashes.
The alarm messages are marked with three exclamation marks.

Example: **Apnoea !!!**

Warning messages are displayed against a red background.
Evita 4 generates a 5-tone sequence that is sounded twice and is repeated every 15 seconds.

Caution = medium priority message

The yellow lamp flashes.
Warning messages are marked with two exclamation marks.

Example: **O_2 supply pressure high !!**

Caution messages are displayed against a yellow background.
Evita 4 generates a 3-tone sequence that is repeated every 30 seconds.

Advisory = low priority message

The yellow lamp remains constantly lit.
Note messages are marked with one exclamation mark.

Example: **Malfunction fan !**

Advisory messages are displayed against a yellow background.
Evita 4 generates a 2-tone sequence that sounds only once.

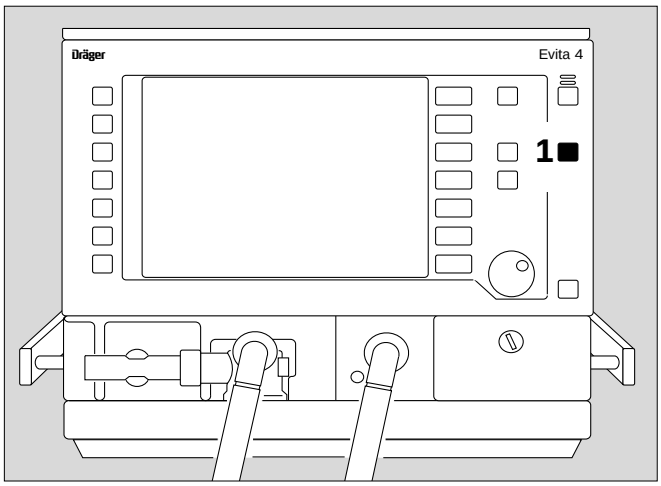
To remedy the faults, please refer to the "Troubleshooting" section starting on page 100.

Once the fault has been remedied, the alarm tone is switched off. Caution and advisory messages disappear automatically.

Warning messages (!!!) must be acknowledged:

1 Press »**Alarm Reset**« key.

The message is erased from the screen. However, it is stored in Evita 4 and can be displayed with the logbook function in the »Measured Values« screen page, see page 69.



Cancel alarm tone

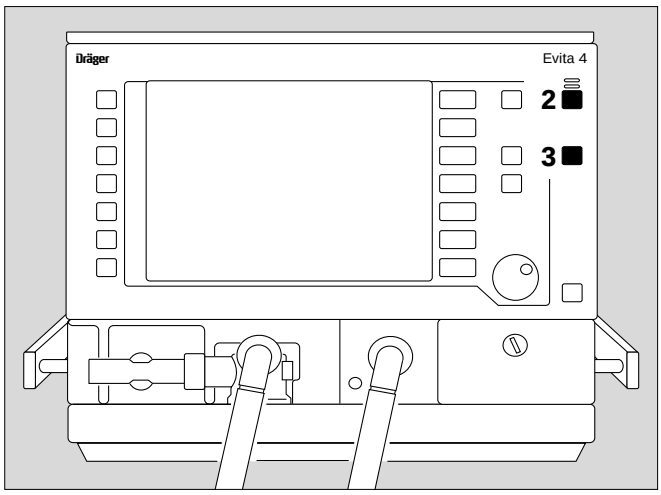
for max. 2 minutes:

2 Press the »🔕« key with the lit yellow indicator LED. The acoustic alarm will be cancelled for 2 minutes. If the fault that triggered the alarm is still not remedied, the acoustic alarm starts up again. If you wish to reactivate the acoustic alarm temporarily:

2 Press the »🔕« key (with the yellow LED now switched off) again.

Acknowledge:

3 Press »**Alarm Reset**« to acknowledge the alarms that can be suppressed with "Alarm Reset":
please refer to "Troubleshooting" on page 109.



Information ℹ

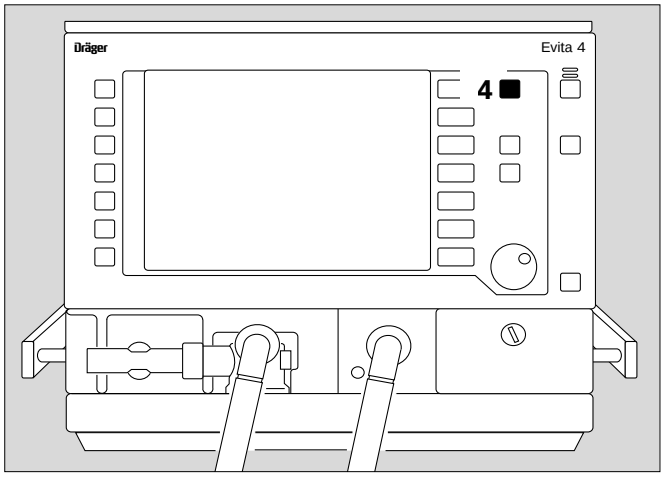
– For help in operating the system – with setting instructions.

– For help in troubleshooting.

4 Press the »ℹ« key: information is displayed in the bottom line of the screen.

To erase the message:

4 Press the »ℹ« key again.

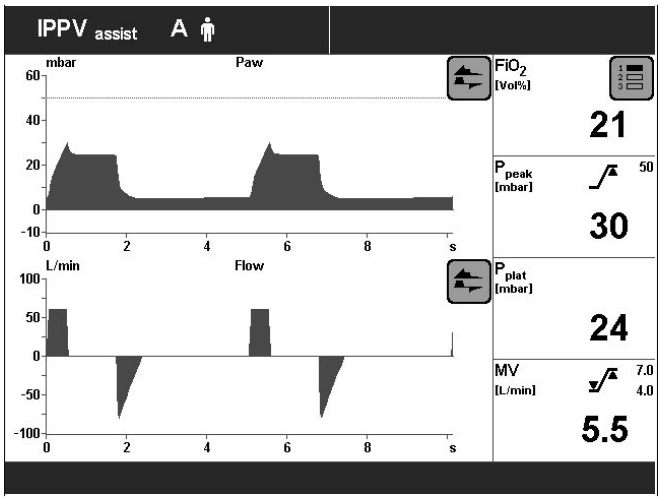


Displaying Curves and Measured Values

In the standard page

- Press » « key.

»**Standard page**« display:
In the right-hand field: 4 measured values
In the left-hand field: 2 curves



To select one of the three measured value combinations:

- Touch screen key » « repeatedly.

Select three other curves:

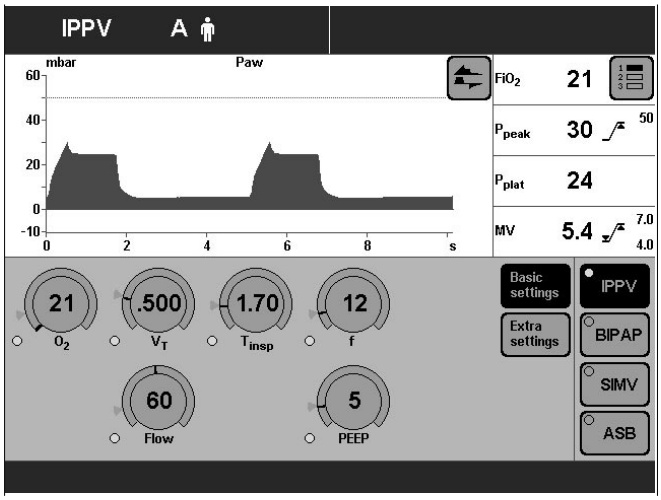
- Touch screen key » « , and touch the relevant screen key.

Measured values and curves can be selected, see configuration, page 86 or 92 onwards.

In all other screen pages
e.g. »**Settings page**«

- Press »**Settings**«.

»**Settings**« display:
Right-hand field: 4 measured values
(as in the standard page)
Left-hand field: 1 curve.



To select one of the three measured value combinations:

- Touch the screen key » « repeatedly.

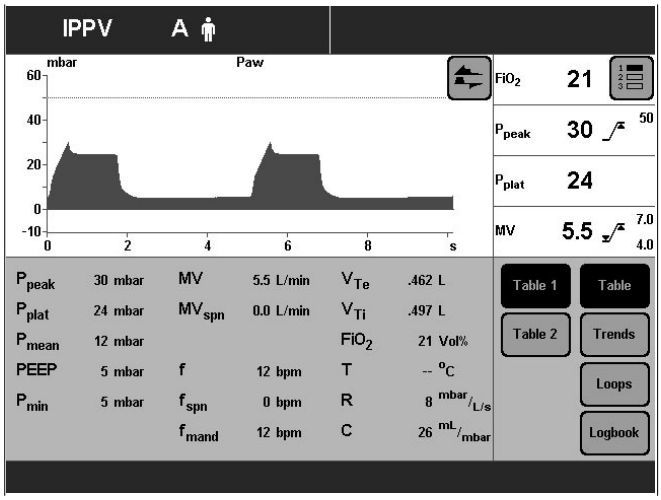
To select three other curves:

- Touch the screen key » « , and touch the relevant screen key.

Measured values and curves can be selected, see configuration, page 86 or 92 onwards.

Specific display of curves and measured values

- Press the »**Meas. values**« key.



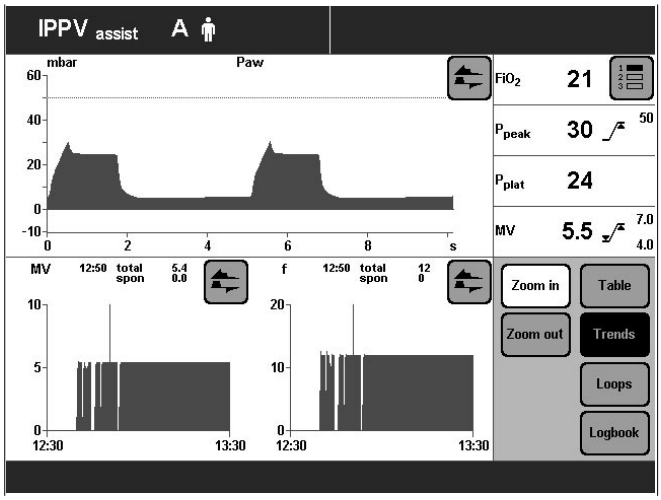
»**Table**« display:
All measured values and their measurement units are displayed in table form. The »**Table**« menu is displayed as set up in the factory.

To display measured values in other formats:

- Touch the corresponding screen knob:
  »**Trends**«, »**Loops**«, »**Logbook**«.

Trends

- Touch the »**Trends**« screen key.



»**Trend**« display:
The trend of two measured values is displayed.

To enlarge the time window (zoom function):

- Touch the »**Zoom out**« screen key.

To reduce the time window:

- Touch the »**Zoom in**« screen key.

To evaluate the measured value at a specific time

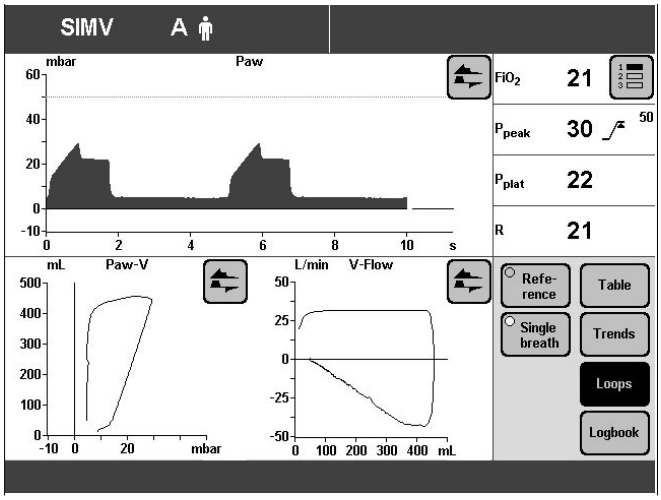
- Position the ▼ cursor on the time by turning the rotary knob.
  The time and associated measured value are displayed above the trend curve.

To display another preset measured value trend:

- Touch the » ⇄ «screen key, and touch the corresponding screen key.

To preselect measured values for the trend display, please refer to Configuration on page 95.

Loops



- Touch the »**Loops**« screen key.

»**Loop**« display:
Two pairs of measured values plotted against each other appear in the ventilation cycle as a loop, e.g. the PV loop.

To select another preset pair of measured values as a loop:

- Touch the » ⇆ «screen key in the Loop display.

Reference curve displays

To display the recorded loop of a particular breathing cycle as a permanent on-screen reference for the current loop:

- Press the »**Reference**« screen key.

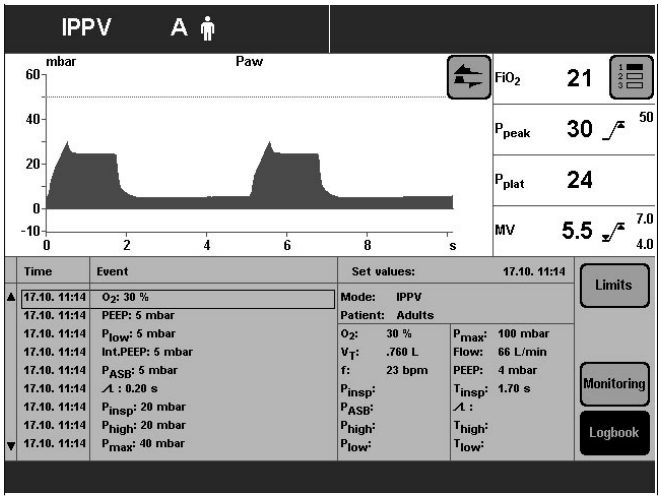
Single stroke displays

To display an individual breathing cycle in ventilation modes that have both mechanical and spontaneous components, e.g. SIMV:

- Press the »**Single stroke**« screen key.

If no single stroke is selected for display, the entire breathing activity from mandatory stroke to mandatory stroke will be recorded.

Logbook



- Touch the »**Logbook**« key.

»**Logbook**« display (example):
Alarms and settings are presented in a vertical list in chronological order.

To select an older entry:

- Turn the rotary knob clockwise and position the box cursor over the desired line.
  Example: 17.10. 11:14 O2: 30 %

To select a more recent entry:

- Turn the rotary knob counter-clockwise, and position the box cursor over the desired line.

The status of the setting at the relevant time is displayed on the right, next to the logbook.

Screen freeze

To "freeze" the curve(s):

1 Press »**Stop**« key.

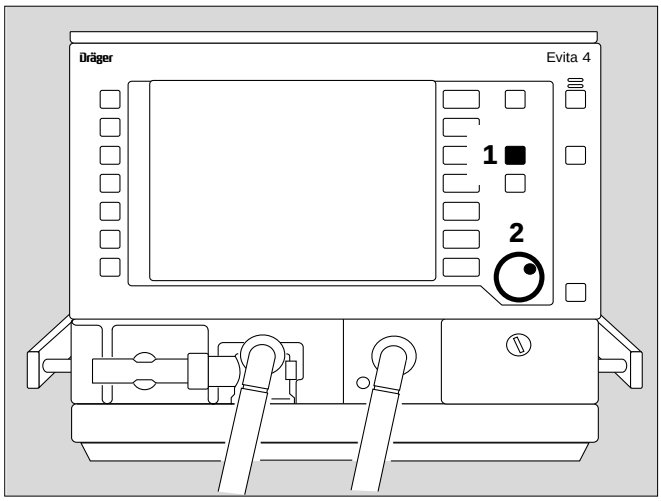
To evaluate the measured value at a particular time:

● Position the ▼ cursor on the desired time by turning the rotary knob.
The associated measured value is displayed above the curve.

Display new curve(s) again:

1 Press »**Stop**« key again.

Screen freeze mode is automatically terminated 3 minutes after the rotary control was last turned.



Special Functions

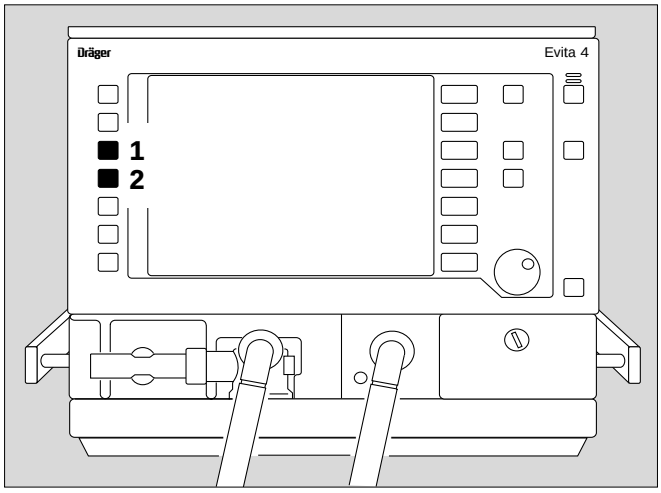
Manual inspiration

This function may be used in all modes except CPAP without ASB pressure support.
Depending on the start time, an automatic ventilation stroke is prolonged for a maximum of 15 seconds.
Or:
Between two automatic ventilation strokes, a ventilation stroke can be manually started and held for max. 15 seconds.

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

In CPAP/ASB:
a pressure-assisted ventilation stroke (defined by the PASB setting) is triggered.

1 Press »**Insp. hold**« key and hold it down for as long as inspiration is required.



Either a just activated automatic ventilation stroke will be prolonged or a new ventilation stroke will be started and appropriately prolonged – max. 15 seconds.
The next manual start of inspiration will not be possible until 15 seconds have elapsed.

Manual expiration

This function may be used in all ventilation modes.

2 Hold down the »**Exp. hold**« key.

The expiration phase remains effective as long as the key is held down.
If the key is not released, the device automatically terminates the expiration phase after 15 seconds.

Medicament nebulisation

During adult ventilation

Applicable in every ventilation mode.
Evita 4 applies the medicament aerosol in synchronisation with the inspiratory flow phase and maintains the minute volume constant.

The medicament nebuliser is supplied by the ventilator with medical air, oxygen or a mixture of medical air and oxygen according to the set O_2 concentration. Deviations in O_2 concentration are therefore kept to a minimum.

In extreme cases (with a minimum inspiration flow of 15 L/min), the deviations can be up to ± 4 % by volume*. To avoid greater deviations, medicament nebulisation is automatically switched off with inspiration flows below 15 L/min.

During paediatric ventilation

Medicament nebulisation is possible in the pressure-controlled paediatric ventilation modes.

In volume-controlled ventilation modes, medicament nebulisation is only possible with AutoFlow®.

Unlike in adult ventilation, the medicament nebuliser nebulises continuously in paediatric ventilation, but the aerosol generated during expiration does not reach the lungs.

Depending on the set O_2 concentration, the medicament nebuliser is supplied by the ventilator with medical air, oxygen or a mixture of medical air and oxygen. Deviations in O_2 concentration are therefore kept to a minimum.

We recommend that you do not use the medicament nebuliser at breathing rates of less than 12 bpm.

For breathing rates above 12 bpm, please refer to the graph on page 156.

The maximum possible deviations in O_2 concentration are ± 4 % by volume.

For breathing rates of less than 12 bpm, the deviations in O_2 concentration may be much greater.

These deviations cannot be detected by the device's internal O_2 concentration monitor.

* For a detailed description of the inspiratory O_2 concentration during medicament nebulisation, please refer to the Appendix, page 156.

The medicament nebuliser is automatically switched off after 30 minutes.
After administration of the aerosol, the flow sensor is automatically cleaned and calibrated in order to prevent malfunctions in flow measurement.

Only use medicament nebuliser 84 12 935 (white central body).
Prepare the medicament nebuliser in accordance with its Instructions for Use.

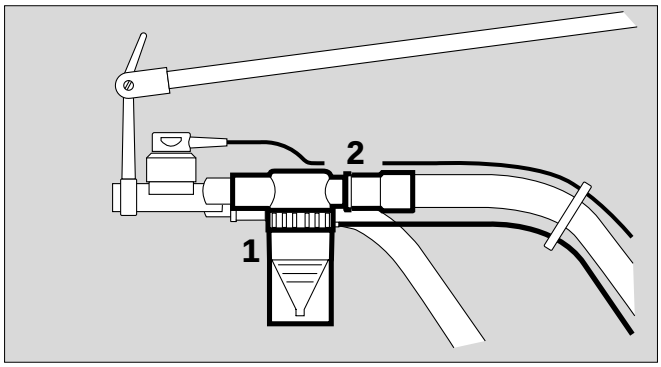
If other pneumatic medicament nebulisers are used, there may be major deviations in tidal volume and inspiratory O_2 concentration.

For use during adult ventilation

1 Connect the nebuliser to the inspiratory side (temperature sensor side) of the Y-piece.

2 Connect the inspiration hose to the medicament nebuliser.

- Place the medicament nebuliser in the vertical position.
- Using clamps, route the nebuliser hose back to the ventilator along the expiratory hose.

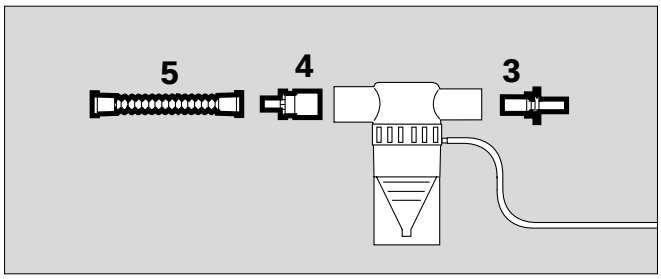


For use during paediatric ventilation

3 Insert the catheter connector (ISO cone Ø15 / Ø11) in the inlet of the medicament nebuliser.

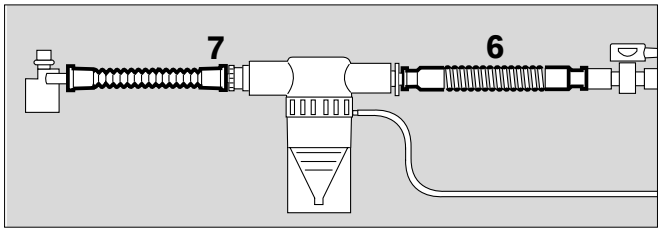
4 Insert the adapter (ISO cone Ø22 / Ø11) in the outlet.

5 Fit the corrugated hose (0.13 m long) to the outlet adapter.



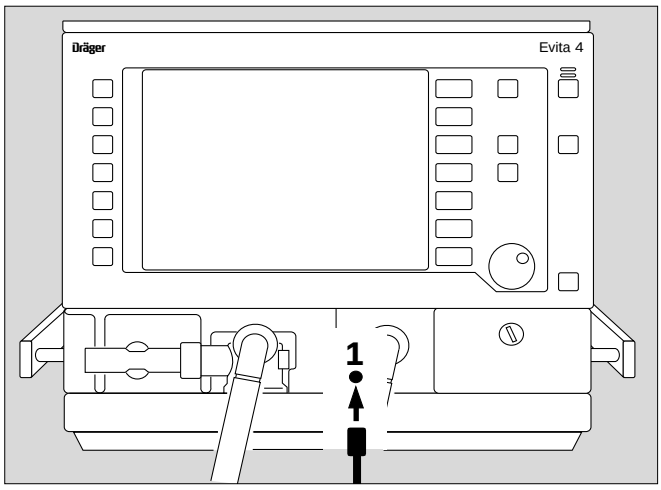
6 Remove the corrugated hose of the hose set from the inspiratory adapter of the Y-piece and connect it to the inlet adapter of the medicament nebuliser.

7 Connect the free end of the corrugated hose at the outlet of the medicament nebuliser to the inspiratory adapter of the Y-piece.



1 Connect the nebuliser hose to the port on the front panel of the Evita 4.

- Fill the medicament nebuliser in accordance with the specific Instructions for Use.



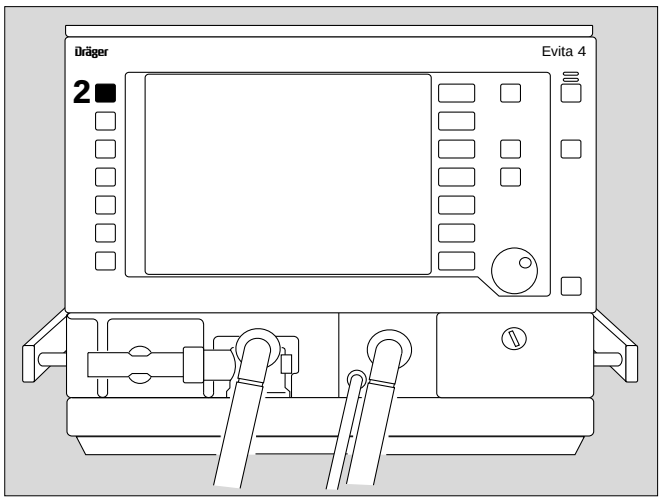
Warning: the effect of aerosols on sensors, filters and heat and moisture exchangers must be taken into account.

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 place a microbial filter on the nebuliser outlet during nebulisation.

During medicament nebulisation, do not use a heat and moisture exchanger at the Y-piece. Risk of increased breathing resistance!

2 Hold down » ☜ « key until the yellow LED lights up.



- Note message on-screen:

  Nebuliser on!

  The nebuliser operates for 30 minutes.

If medicament nebulisation needs to be stopped prematurely:

2 Press » ☜ « key again. The yellow LED goes out, and the nebuliser is switched off.

The flow sensor is then automatically cleaned and calibrated.

- Screen display:

  Flow Calibration

- Remove any left-over medicament. Rinse out lower part of nebuliser with distilled water.

Oxygen enrichment for bronchial suction

To avoid any risk of hypoxia during bronchial suction, Evita 4 offers a program for oxygen enrichment during the removal of secretions.

After the program is started, Evita 4 ventilates the patient in the selected ventilation mode for an initial oxygen enrichment phase of 180 seconds. In adult mode, the ventilator supplies 100 % oxygen by volume, and in paediatric mode it delivers the set O_2 concentration plus 25% (for example: setting = 60 % by vol.; administered = 75 % by vol.)

When the ventilator is disconnected for suction, Evita 4 interrupts ventilation. During the suction phase, the audible alarms are suppressed so that the suction routine is not disturbed.

After suction and automatically recognised reconnection, Evita 4 delivers an increased O_2 concentration for the final oxygen enrichment phase of 120 seconds. In adult mode, the O_2 concentration is 100 % by volume. In paediatric mode, the enriched concentration is 25 % higher than the set concentration.

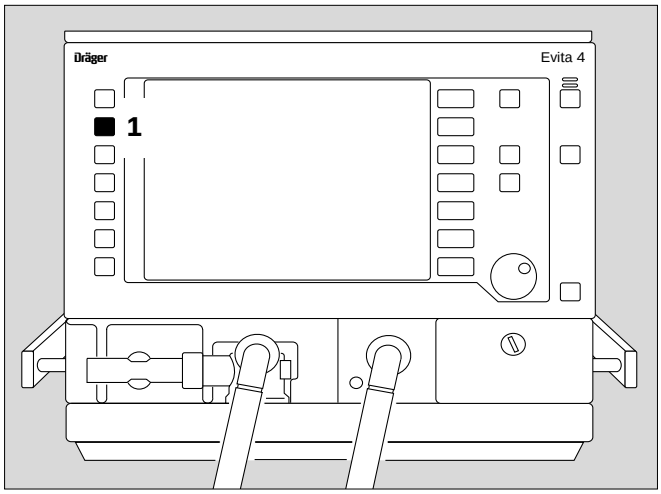
During suction and for 2 minutes afterwards, the lower alarm limit for the minute volume is switched off.

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

Oxygen enrichment is only possible with a fully functioning flow sensor and if flow monitoring is switched on.

Before suction

1 Hold down the »**O2 suction**« key until the yellow LED comes on.
Evita 4 ventilates the patient in the set ventilation mode with increased O_2 concentration: 100 % O_2 by volume in adult mode, and 25 % higher O_2 concentration than the set value in paediatric mode.
If PEEP is not set to more than 4 mbar, PEEP will be applied automatically at 4 mbar. This PEEP will enable Evita 4 to detect any subsequent disconnection.
The other ventilation parameters remain unaffected.



- Display in the help line at the bottom edge of the screen:

  O_2 enrichment 180 s

The remaining time is counted down continuously. This initial oxygen enrichment lasts for a maximum of 180 seconds. During this time, Evita 4 waits for a disconnection for suction.
If there is no disconnection after expiry of the 180 seconds, the oxygen enrichment program is terminated.

After disconnection for suction

Evita 4 delivers a minimal flow for the duration of suction in order to detect automatically the end of the disconnection phase. In the help line at the bottom edge of the screen, the time available for suction is displayed continuously in seconds (example):

Execute suction and reconnect 120 s

If suction is ended and the system is reconnected within the displayed time, Evita 4 terminates the disconnection phase.

Automatic interruption of oxygen enrichment

If there is still no reconnection after 120 seconds, the oxygen enrichment program is interrupted. All alarms are immediately reactivated. Evita 4 continues ventilating in the set ventilation mode.

After reconnection

After reconnection, Evita 4 continues ventilating in the set ventilation mode, except that for 120 seconds the increased oxygen concentration of 100 % by volume for adults and 25 % above the set concentration for paediatric ventilation will continue to be delivered for final (post-suction) oxygen enrichment.

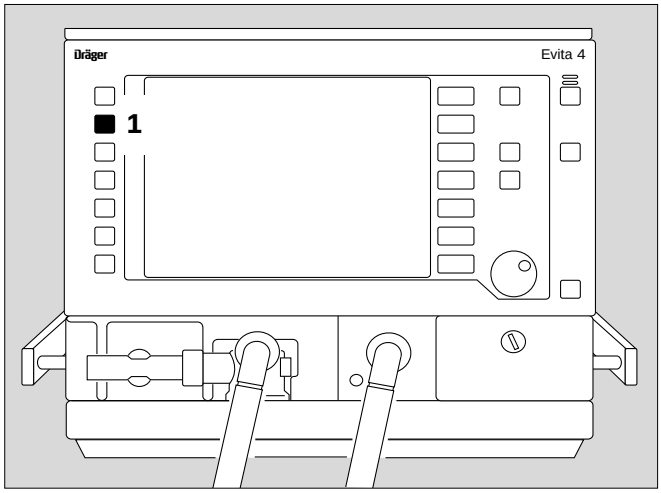
- Display in the help line at the bottom of the screen:

  Final O_2 enrichment 120 s

The remaining time is counted down continuously.

If you need to interrupt oxygen enrichment:

1 Press the »**O2 ↑ suction**« key again.



Special measuring procedure: Intrinsic PEEP

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 ventilation setting parameters, the intrinsic PEEP differs from the PEEP in the upper airways.

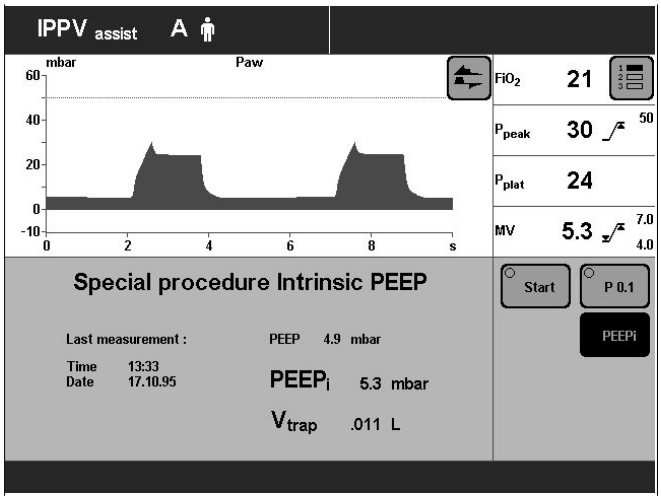
The Intrinsic PEEP measuring procedure also measures the trapped volume resulting from the different PEEP values, i.e. the amount of air trapped in the lungs and not taking part in the gas exchange process.

This special procedure can be performed in all ventilation modes.

Activity by the patient during this procedure can distort the measured values.

Select the Intrinsic PEEP special procedure:

- Press the »**Special proc**« key and touch the »**PEEPi**« screen key.



Display (example):
The measured values and the time of the last measurement are displayed on the screen.

To start the Intrinsic PEEP measurement:

- Touch the »**Start**« screen key.

The Intrinsic PEEP measurement runs automatically.

At the end of the procedure, the new measured values PEEPi and Vtrap are displayed.

The displayed curve is automatically stopped.

To evaluate the measured value at a particular time:

- Position the ▼ cursor on the time by turning the dial-knob.
  The associated measured value is displayed above the curve.

* For detailed description, see Appendix, page 149.

Special procedure: Occlusion pressure P 0.1

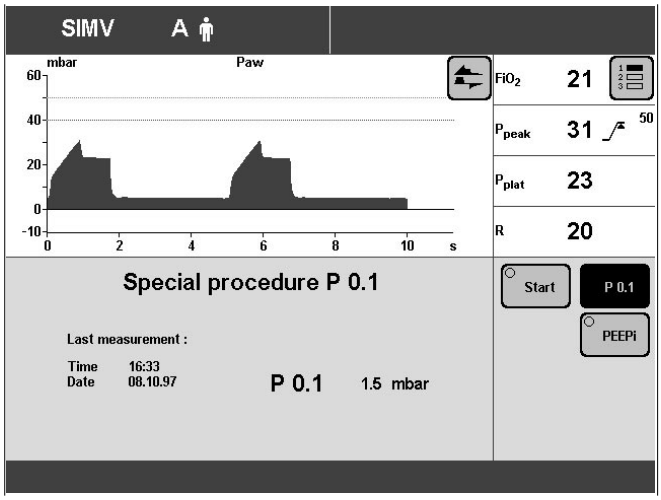
The occlusion pressure P0.1 characterises the negative pressure during a short occlusion (0.1 s) at the start of spontaneous inspiration.
It is a direct measure of the neuro-muscular breathing drive.
For patients with healthy lungs and regular breathing, a pressure drop of –3 to –4 mbar = P0.1.
High values represent a high breathing drive which can only be maintained for a short time.
Values greater than –6 mbar for a patient with chronic obstructive pulmonary disease indicate impending exhaustion (respiratory muscle fatigue).

This special measuring procedure 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.

To select the P0.1 occlusion pressure measuring procedure:

- Press the »**Special proc.**« key and touch screen key »**P0.1**«.

Display (example):
The measured value and time of the last measurement is displayed on the screen.



To start the P0.1 occlusion pressure measuring procedure:

- Touch the »**Start**« screen key.

The P0.1 special procedure runs automatically.

At the end of the procedure, the displayed curve is automatically stopped.

To evaluate the measured value at a particular time:

- Position the ▼ cursor on the time by turning the dial-knob.
  The relevant measured value is displayed above the curve.

  Evita 4 displays the P 0.1 value as a negative pressure without the minus sign.

Switching off the monitor functions

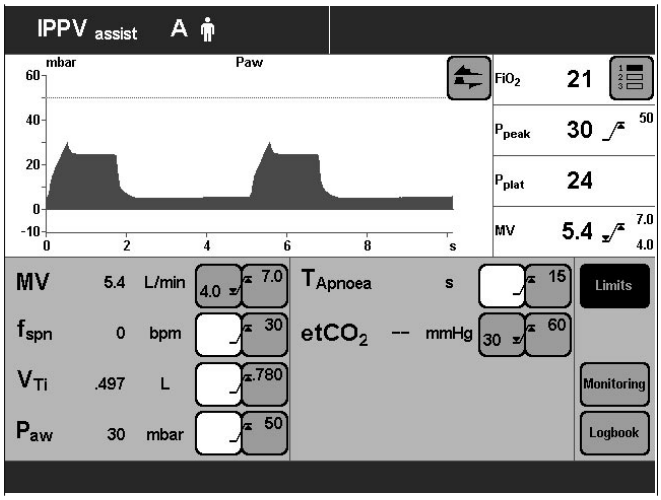
e.g. if a spent sensor cannot be replaced.

Immediately make sure there is an adequate external monitor backup!

Example: Switching off Flow Monitoring.

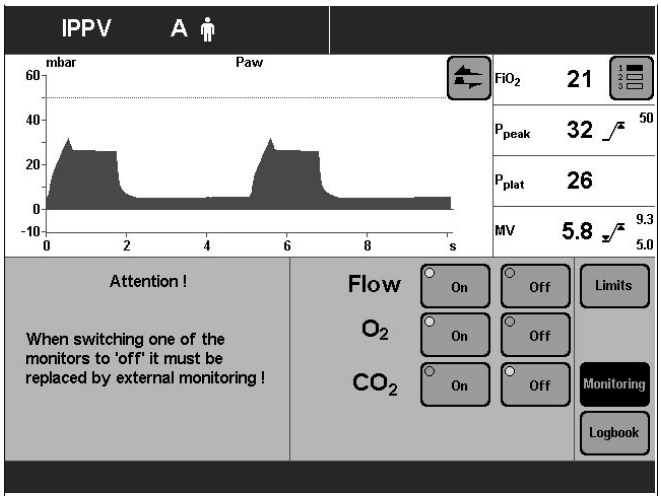
- Press »**Alarm limits**« key.

Display (example):



- Touch »**Monitoring**« screen key.

Display (example):



For the example of switching off flow monitoring:

- Touch the »**Flow off**« screen key.
  The key changes colour from green to yellow.

To confirm that you wish to switch off Flow Monitoring:

- Press rotary knob. Flow Monitoring is switched off, and the corresponding measured values disappear. The alarm function is switched off.

After replacing the sensor:

- Switch the monitor function back on.

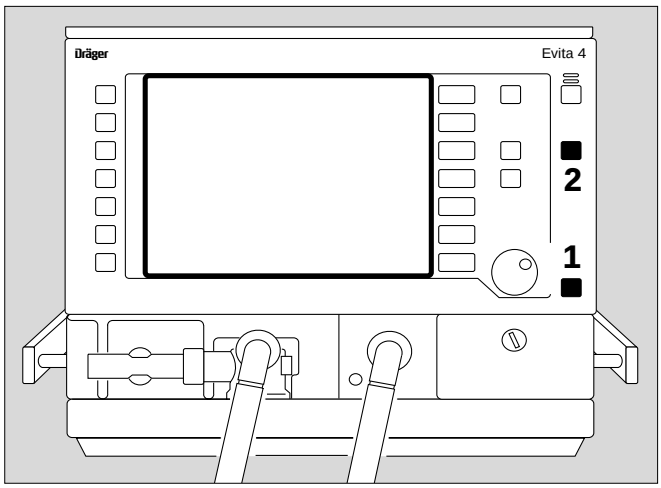
Selecting Standby Mode

When to use.

– to perform the device check

– to maintain Evita 4 ready for operation while the patient is absent.

– to change patient mode.



1 Hold down the »⏻ « key for about 3 seconds.

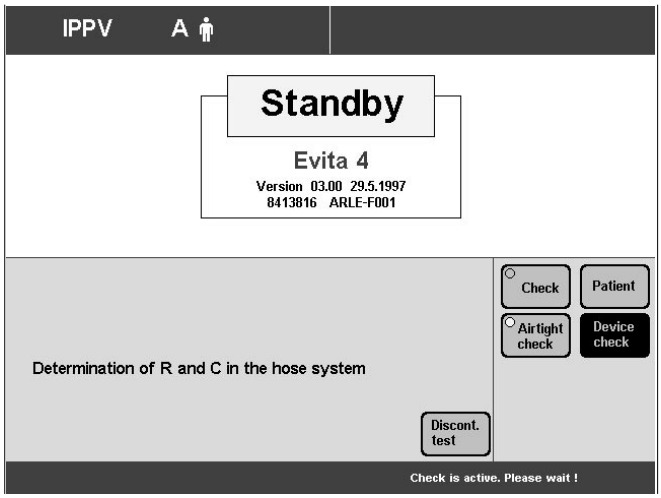
An alarm tone sounds after switching on standby.

To switch off the standby alarm tone:

2 Press »**Alarm Reset**« key.

The standby alarm tone cannot be cancelled with the »🔔 « key.

Display (example):



If the patient mode or ideal body weight should be changed during Standby, Evita 4 will determine new start values for ventilation, see page 42.

Terminating standby mode

– to continue ventilation.

1 Press »⏻ « key.
The LED goes out, and the current ventilation parameters are again effective.

Calibrating

The last calibration/zeroing values remain stored until the next calibration/zero calibration, even when the machine is switched off.

Calibration of the pressure sensors for measuring the airway pressure is automatic.

There is an automatic calibration of flow and O_2 sensor daily.

Manual calibration of the flow sensor can be performed at any time, even during ventilation.

Manual calibration of the O_2 sensor can be performed at any time, even during ventilation. The applied O_2 concentration is not affected by calibration.

The calibration of the CO_2 sensor can be checked during ventilation.

Calibrating the O_2 sensor

– Before operation, during the device check.

– After replacing the O_2 sensor
(wait for the 15-minute warm-up time of the O_2 sensor).

– If the measured value and set value deviate from each other by more than 2 Vol.%.

The O_2 sensor can be calibrated during ventilation.

Start calibration:

- Press »**Calibration**« key.

Display (example):

- Touch the »**O_2**« screen key.
The »LED« in the screen key changes colour to yellow.

Message in the help line at the bottom of the screen:

O_2 calibration

After calibration is complete, the yellow »LED« in the screen key goes out.

Calibrating the Flow Sensor

– Before operation, during the device check.

– After replacing the flow sensor.

Before each calibration, the flow sensor is automatically cleaned.

After using the medicament nebuliser, the flow sensor is automatically cleaned and calibrated.

To start calibration:

● Press »**Calibration**« key.

Display (example):

● Touch the »**Flow**« screen key.
The »LED« in the screen key changes colour to yellow.

Evita 4 uses the next inspiration phase for the calibration. Short inspiration times are prolonged to about 1 second.

Message in the help line at the bottom of the screen:

Flow Calibration

After calibration is complete, the yellow »LED« in the screen key goes out.

Checking/calibrating CO_2 sensor

The CO_2 sensor is works-calibrated and can be used without further calibration on any Evita 4 unit.
A CO_2 zero calibration is performed as part of the device check.

Calibration of the CO_2 sensor is only required if:

– on checking the calibration with a test filter or with test gas, the specified test values are not met and
– on half-yearly device inspections.

The calibration check or calibration can be performed during ventilation.

CO_2 zero calibration

– if the device requests CO_2 zero calibration with the screen message: **CO_2 zero calibration?**

– if the CO_2 curve no longer returns to zero after each inspiration

– before each calibration test, page 81 or 82

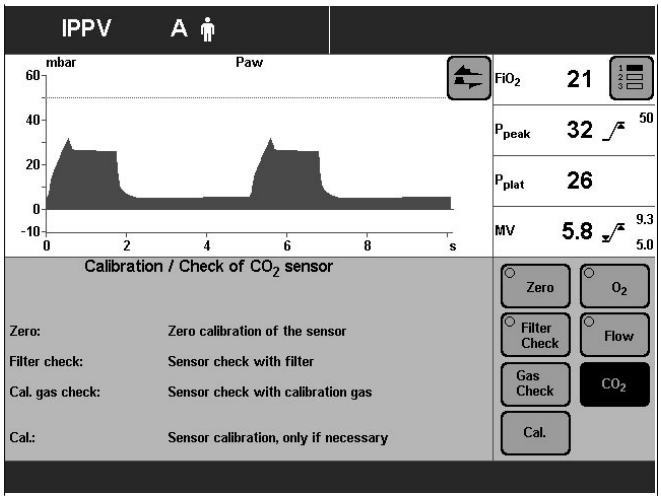
– before each CO_2 calibration, page 84.

- Switch on Evita 4. Wait about 3 minutes for completion of the warm-up phase of the CO_2 sensor.

After about 3 minutes, the measured values will be within the specified accuracy.

- Press the »**Calibration**« key.

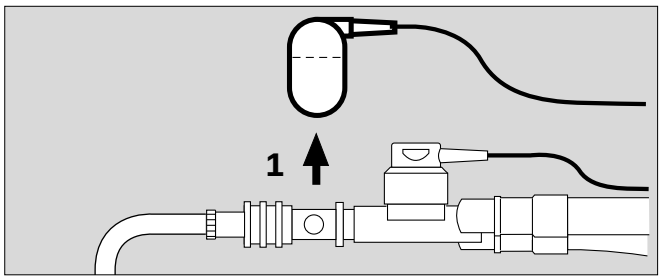
Display (example):



- Touch the »**CO_2**« screen key.
- Touch the »**zero**« screen key.

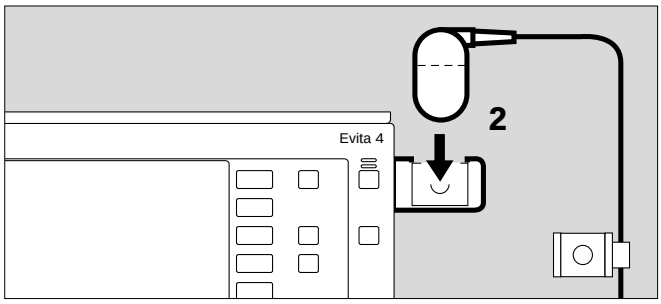
  Message:
  Park CO_2 sensor

1 Remove CO_2 sensor from the cuvette,



2 place the sensor on its park bracket,

- confirm with dial-knob:
  CO_2 zero calibration will now be performed.



Display:

CO_2 zero calibration

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

CO_2 zero ok

- Fit the sensor back on the cuvette.

A failed zero calibration is indicated by the device with the message:

CO_2 sensor not zeroed

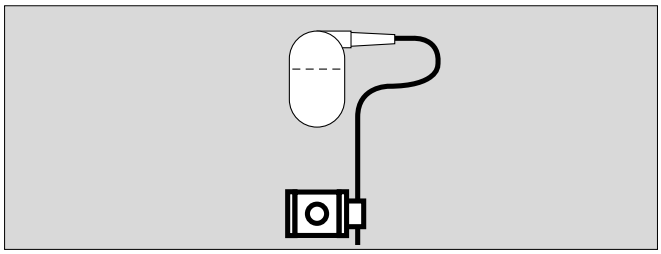
See "Troubleshooting" on page 109.

- Repeat CO_2 zero calibration.

Checking CO_2 calibration with test filter

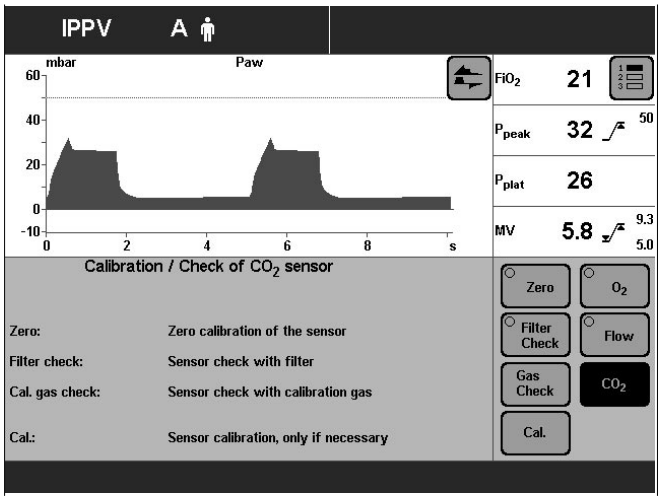
Use the test filter on the cable of the CO_2 sensor.

- Switch on Evita 4, and wait for about 3 minutes for the CO_2 sensor to complete its warm-up phase.



- Press the »**Calibration**« key.

Display (example):



- Touch the »**CO_2**« screen key.

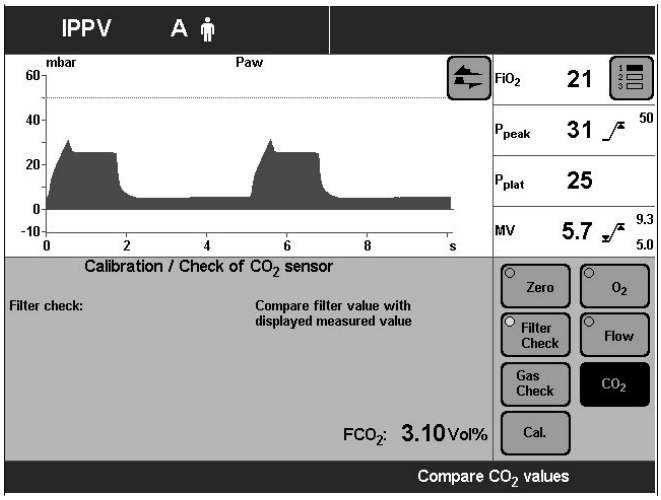
Display (example):

- Carry out CO_2 zero calibration, see page 83.

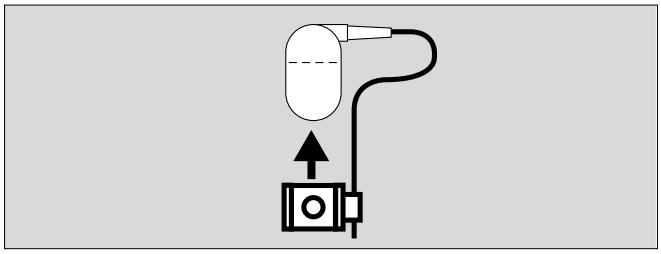
After CO_2 zero calibration:

- Touch the »**Filter check**« screen key.

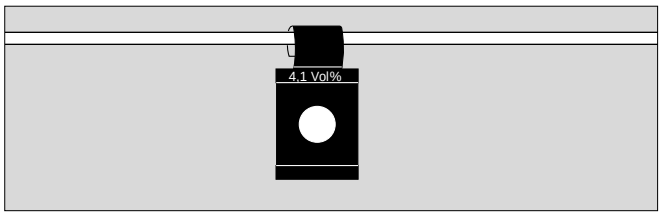
Display (example):



- Place the test filter in the CO_2 sensor.



The screen displays the test value of the CO_2 concentration FCO_2.
This value must agree to within ±3 Vol.% with the specification on the test filter.
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 test gas must be checked or calibrated.

- Push the CO_2 sensor back on to the cuvette.

Checking CO_2 calibration with calibration gas

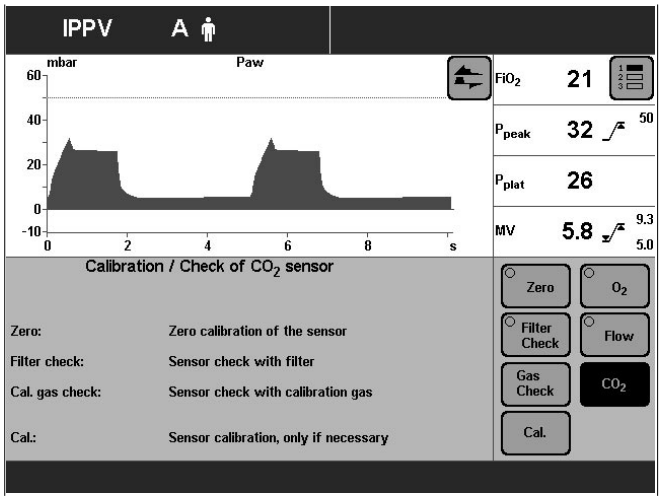
– if the specified calibration value was not met when testing with the test filter

– at least once per half-year.

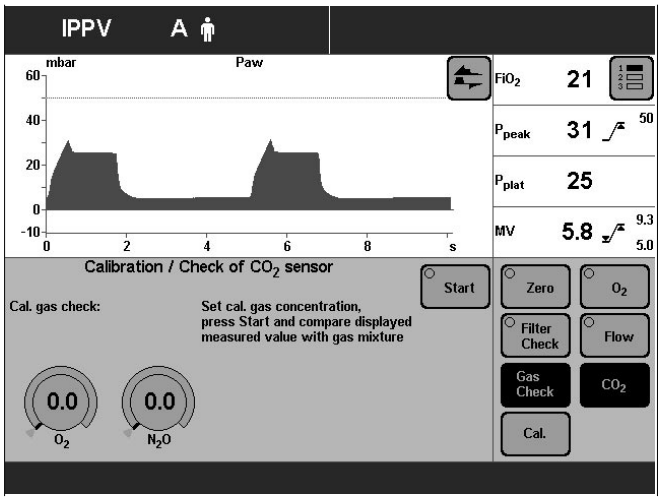
- Switch on Evita 4. Wait about 3 minutes for the CO_2 sensor to complete its warm-up phase.
- Press the »**Calibration**« key.

Display (example):

- Touch the »**CO_2**« screen key.



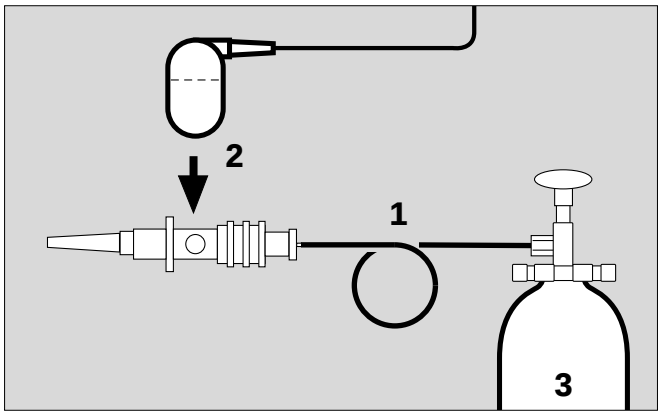
Display (example):



- Carry out CO**2** zero calibration, see page 79.

After completing CO2 zero calibration:

- Touch the »**Gas Check**« screen key.



- Connect the calibration gas supply.
  Use the cuvette from the calibration set!

1 Connect the calibration gas cylinder and cuvette of the calibration set to the hose.

2 Remove the CO2 sensor from its park bracket and fit it to the calibration set cuvette.

- Read the CO2, O2 and N2O concentrations (Vol.%) of the calibration gas from the test cylinder.

3 Calibration gas e.g.: 5 Vol.% CO2
95 Vol.% N2

- Enter these concentration values with the on-screen parameter setting knobs.
  Touch the relevant screen knob.
  Enter the concentration = turn rotary knob.
  If the calibration gas consists only of CO2 and N2, set the O2 and N2O concentrations to 0.
- Touch the »**Start**« screen key.

The CO2 concentration **FCO**2 is displayed on-screen.

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

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

- Push CO2 sensor back on the cuvette.

Calibrating the CO_2 sensor

The CO_2 sensor must be calibrated:

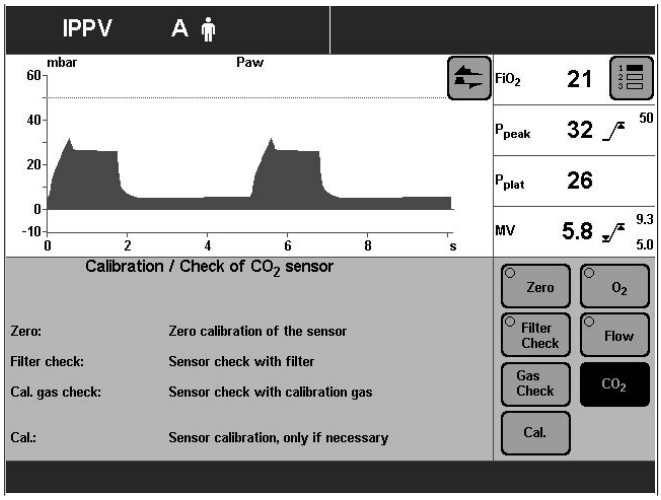
– if the check values are not met on checking calibration with filter or calibration gas.

– as part of the half-yearly inspection of Evita 4.

- Switch on Evita 4. Wait about for 3 minutes for the machine to complete its warm-up phase.
- Press the »**Calibration**« key.

Display (example):

- Touch »**CO_2**« screen key.

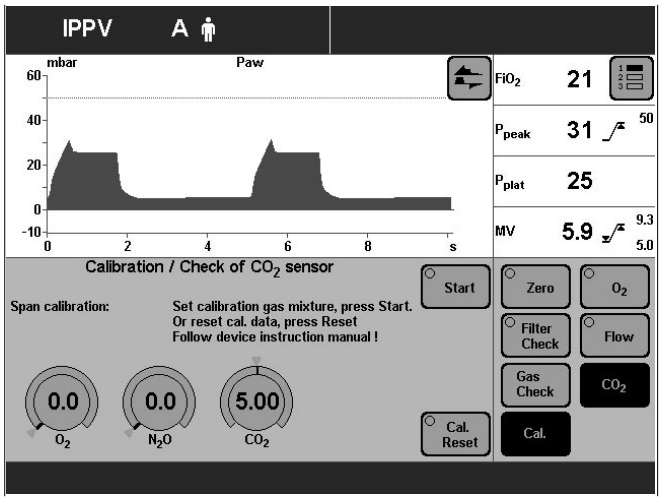


Display (example):

- Carry out CO_2 zero calibration, page 79.

After the CO_2 zero calibration:

- Touch the »**Cal.**« screen key.



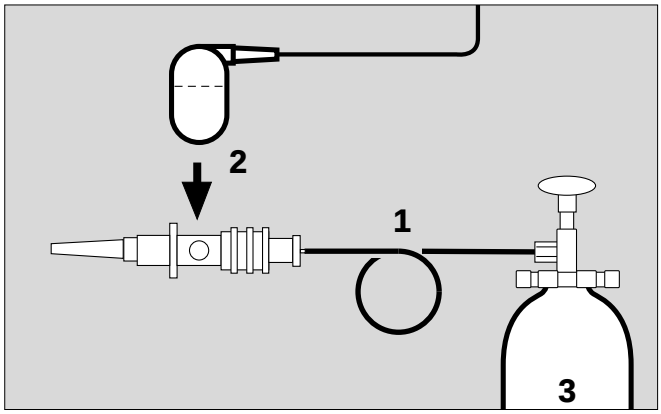
- Connect the calibration gas supply.
  Use the cuvette from the calibration set!

1 Connect the calibration gas cylinder and the cuvette of the calibration set to the hose.

2 Remove the CO_2 sensor from its park bracket and fit it to the cuvette of the calibration set.

- Read the CO_2, O_2 and N_2O concentrations (Vol.%) of the calibration gas from the test cylinder.

3 Calibration gas e.g.: 5 Vol.% CO_2
95 Vol.% N_2



- Enter these concentration values with the screen knobs.
  Touch the relevant screen knob.
  Enter the concentration = turn rotary knob.
  If the calibration gas consists only of CO_2 and N_2, set the O_2 and N_2O concentrations to 0.
- Touch the »**Start**« screen key.

During calibration, the following message is displayed on the screen:

CO_2 calibration. Please wait

Evita 4 carries out calibration and confirms with the message:

CO_2 calibration ok

Failed calibration is indicated by the device with the message:

CO_2 calibration interrupted
or
CO_2 calibration not ok

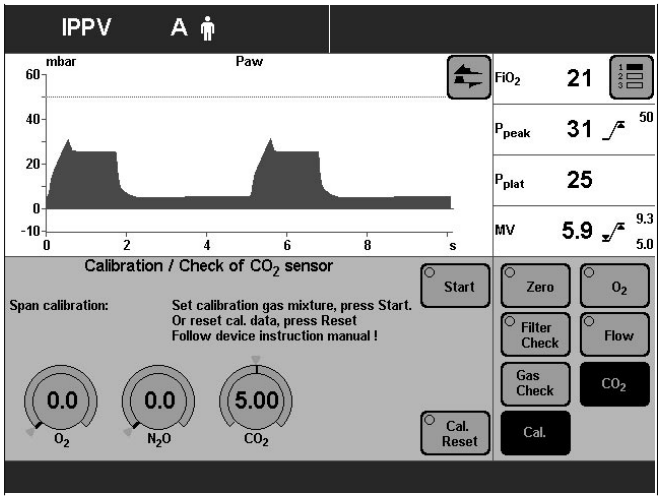
Repeat the calibration of the CO_2 sensor.

Resetting CO_2 calibration

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

- Press the »**Calibration**« key.
- Touch the »**CO_2**« screen key.
- On the CO_2 calibration side, touch the »**Cal.**« screen key and then touch the »**Reset**« screen key.

After about 5 seconds, resetting is complete, and the factory-set calibration value is active.



Recover the correct calibration as soon as possible!

Configuration

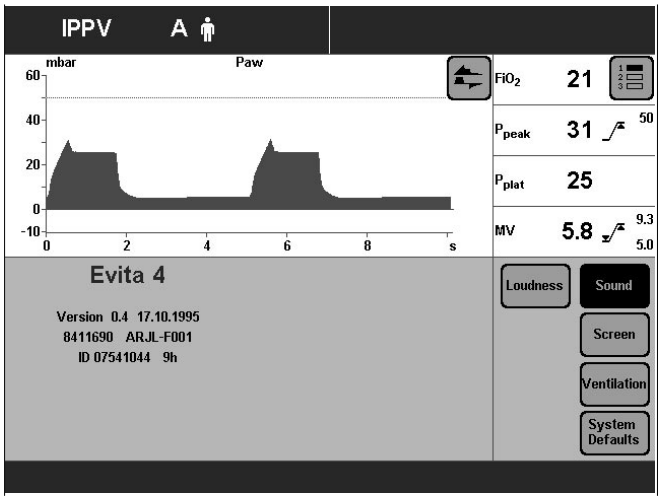
Contents

Sound

Adjusting the volume of the alarm tone

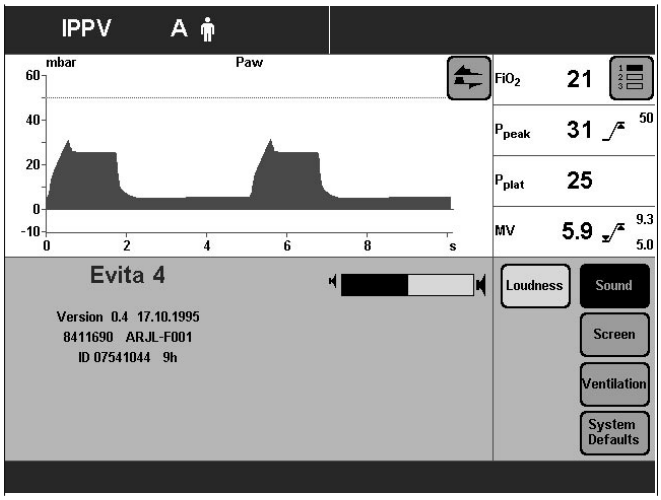
- Press the »**Configuration**« key.
- Touch the »**Sound**« screen key.

Display (example):



- Touch the »**Loudness**« screen key.

Display (example):



- Adjust volume = Turn rotary knob.
  The band displayed on the screen shows the current setting between minimum and maximum.
- Confirm setting = press rotary knob.

  After confirmation, the alarm tone is sounded to test the volume.

Screen

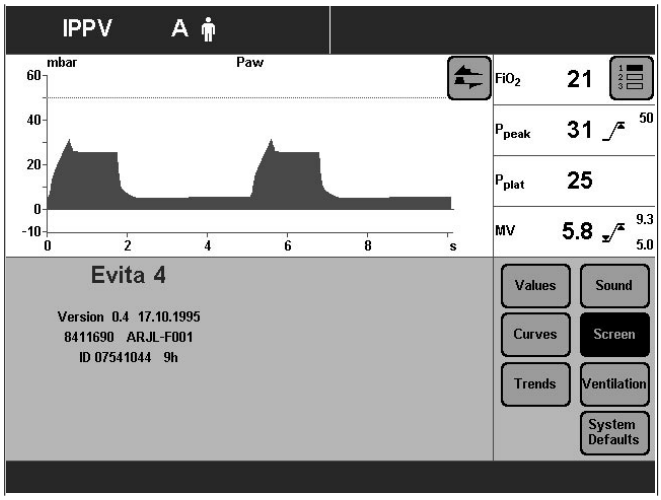
Selecting displayed measured values

Evita 4 displays a group of 4 measured values in the right-hand field of each screen page.

A second or third group can be displayed by touching the » ☰ « key. These groups can be put together in the configuration page.

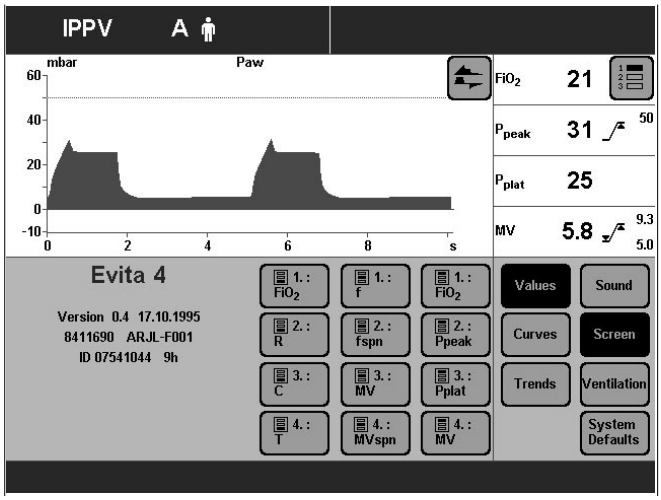
- Press the »**Configuration**« key.
- Touch the »**Screen**« screen key.

Display (example):



- Touch the »**Meas. values**« screen key.

Display (example):

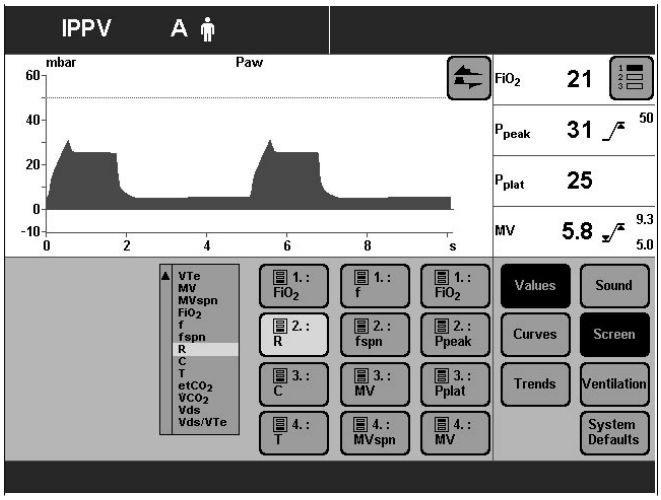


To replace one displayed measured value by another:

- Touch the corresponding screen key.

The selection list with all available measured values is displayed next to the screen keys.

- Select the other measured value, e.g. »**R**« (Resistance) = turn rotary knob.
- Confirm selection = press rotary knob.

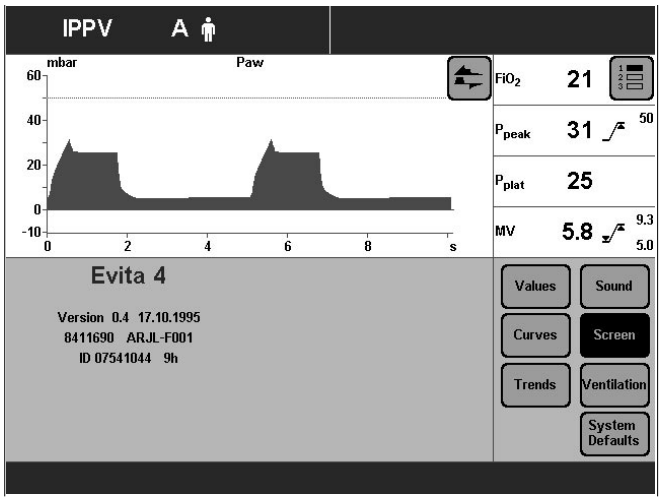


Selecting displayed curves

This function serves to combine the two displayed curves on the standard page.

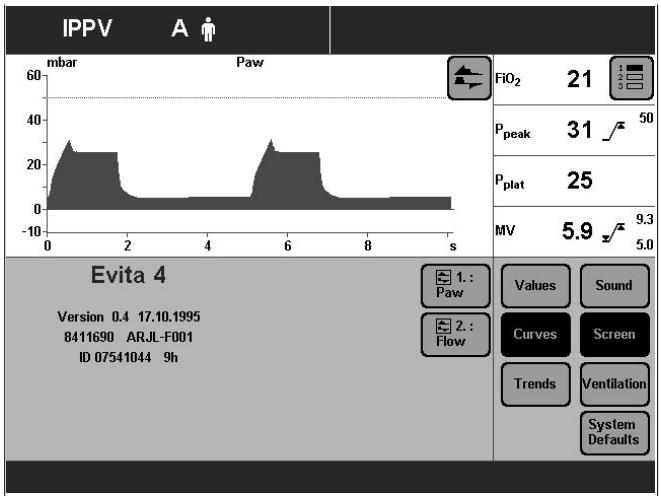
- Press the »**Configuration**« key.
- Touch the »**Screen**« screen key.

Display (example):



- Touch the »**Curves**« screen key.

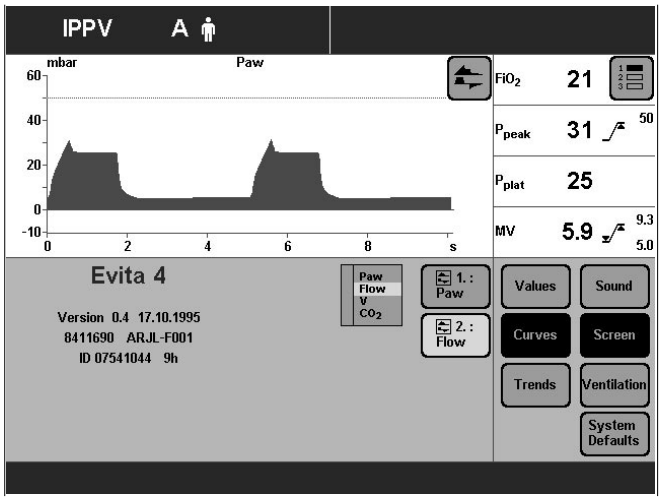
Display (example):



Replace one displayed curve by another:

- Touch the corresponding screen key.

Display (example »**Flow**«):



The selection list containing all available curves is displayed next to the screen keys.

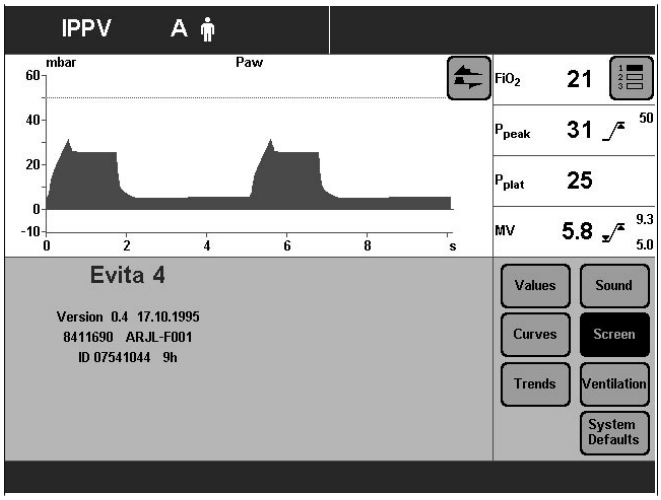
- Select the other curve (»**CO2**«) = turn rotary knob.
- Confirm selection = press rotary knob.

Selecting displayed trends

This function serves to select 8 measured values that are stored by Evita 4 as a trend.

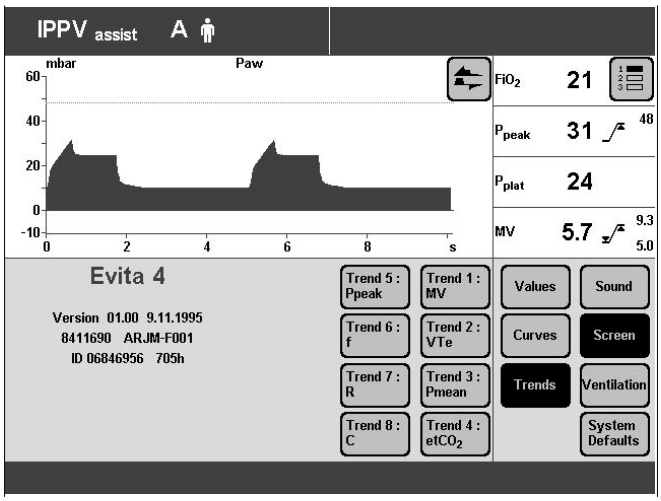
- Press the »**Configuration**« key.
- Touch the »**Screen**« key.

Display (example):



- Touch the »**Trends**« screen key.

Display (example):

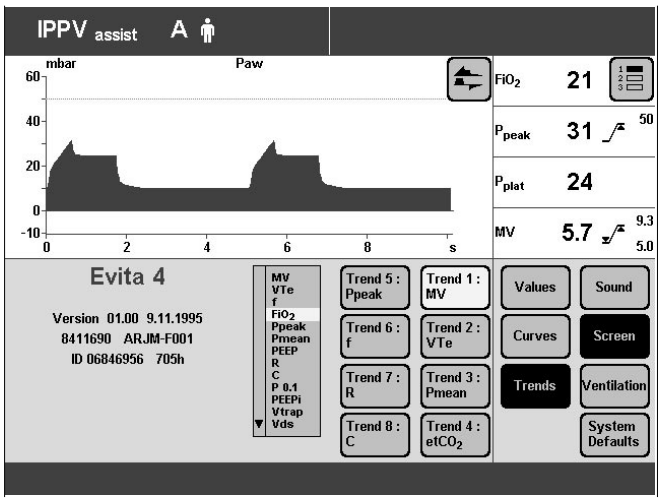


To replace one displayed trend by another:

- Touch the relevant screen key.

Display (example: »**Trend 1:MV**«):

The selection list containing all available measured values is displayed next to the screen keys.



- Select the other measured value, e.g. »**FiO2**« for the trend display = turn rotary knob.
- Confirm selection = press rotary knob.

Ventilation

This page is used:

– To select the available ventilation modes for the »**Settings**« screen page and to select the initial ventilation mode.

– To select the patient mode active on switching on the device.

– To set the ventilation parameters and alarm limits active on switching on the device.

The configuration menu for the ventilation criteria can only be opened after entering access code 3032.
This precaution is intended to prevent unauthorised modifications to the ventilation criteria.

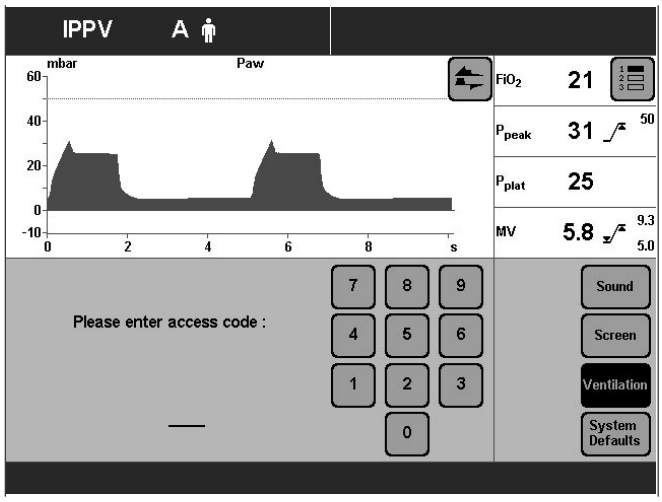
Selecting ventilation modes

To select the ventilation modes on the »**Settings**« screen page.

- Press the »**Configuration**« key.

Display:

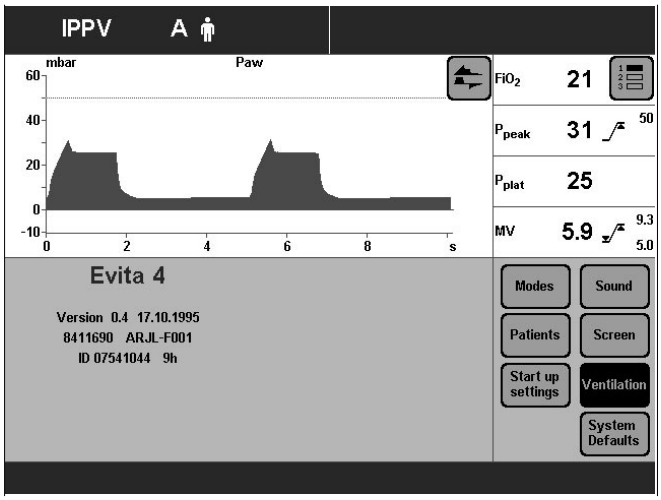
- Touch the »**Ventilation**« screen key.



Enter access code **3032**:

- Touch the corresponding screen keys.

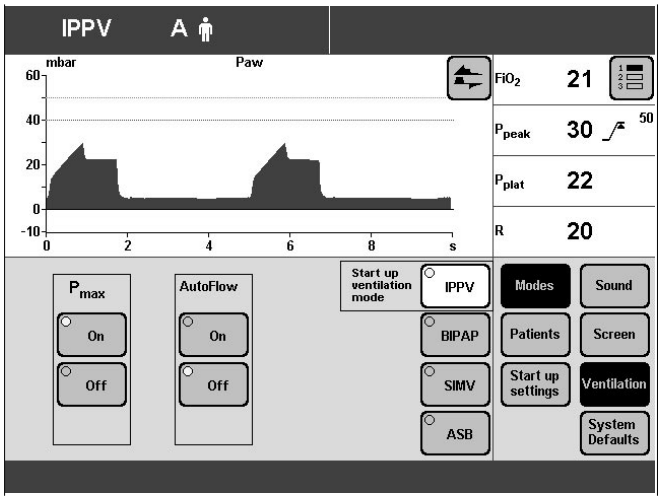
Display (example):



- Touch the »**Modes**« screen key.

Display (example):

The ventilation mode displayed in the top screen key is the factory-set start-up ventilation mode (in this example: »**IPPV**«). Evita 4 starts in this ventilation mode immediately after being switched on.

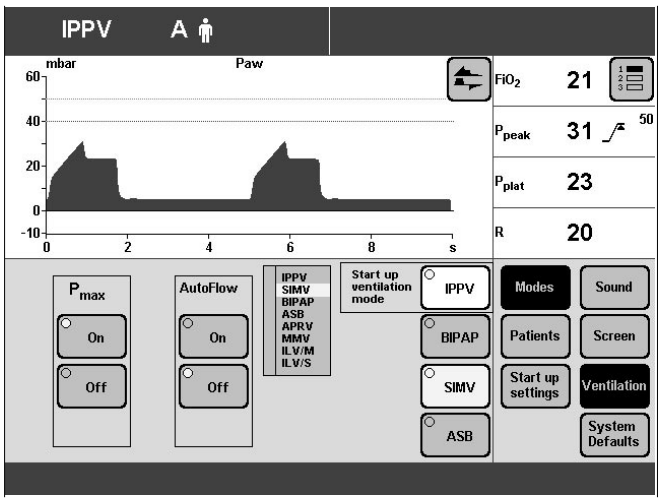


To replace one displayed mode by another:

- Press the corresponding screen key.

Display (example »**SIMV**«):

The selection list with all available ventilation modes is displayed next to the screen keys.



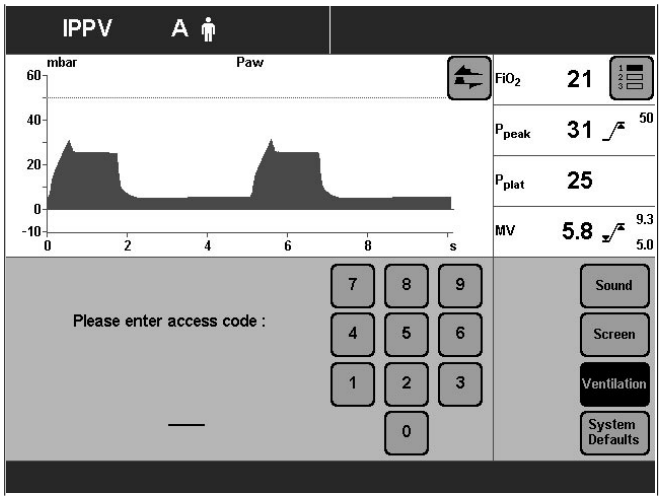
- Select another mode = turn rotary knob.
- Confirm selection = press rotary knob.

Selecting Pmax pressure limit

– This function serves to limit the ventilation pressure in ventilation modes IPPV, SIMV, MMV.

● Press »**Configuration**« key.

Display (example):

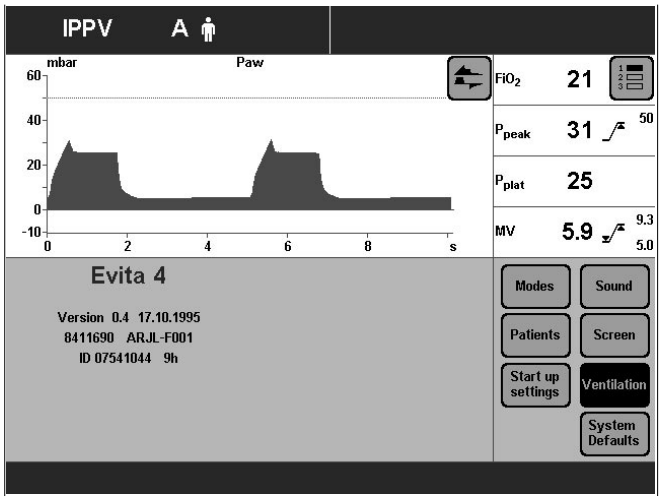


● Touch »**Ventilation**« screen key.

Enter access code **3032**:

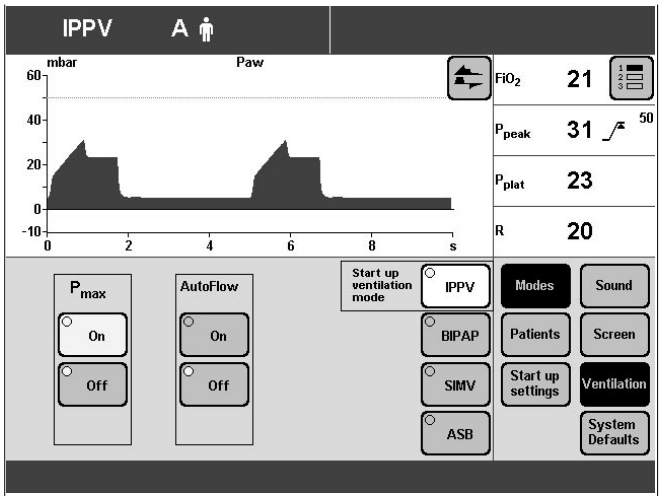
● Touch the corresponding screen keys.

Display (example):



● Touch the »**Modes**« screen key.

Display (example):



● Touch the screen key Pmax »**on**«.

● Confirm selection = press rotary knob.
Pmax pressure limiting is selected.

The »**Pmax**« screen knob is displayed on the »Settings« screen page.

Selecting AutoFlow® as start-up ventilation mode

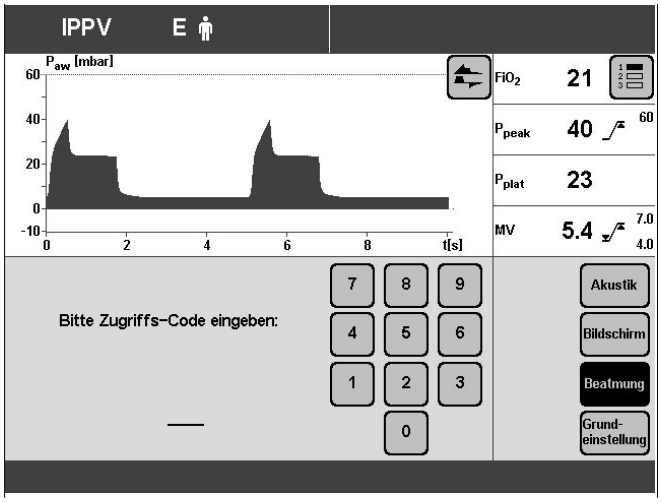
– For automatically setting the AutoFlow® ventilation option after switching on the apparatus.

  The user can define whether the additional AutoFlow® option is active or not after switching on.

- Press »**Configuration**« key.

- Touch »**Ventilation**« screen key.

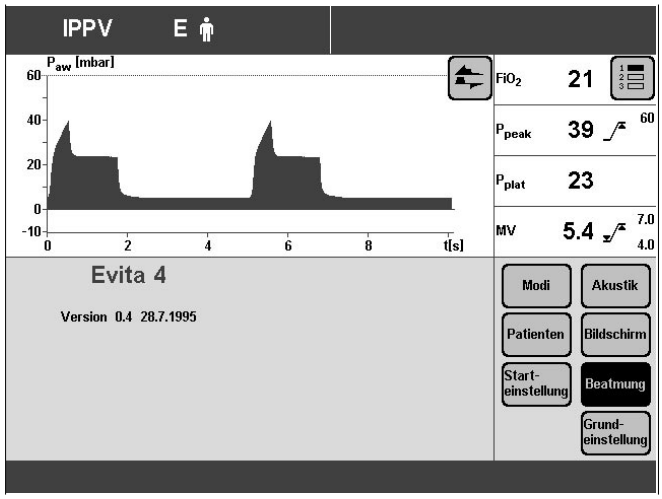
Display (example):



Enter access code **3032**:

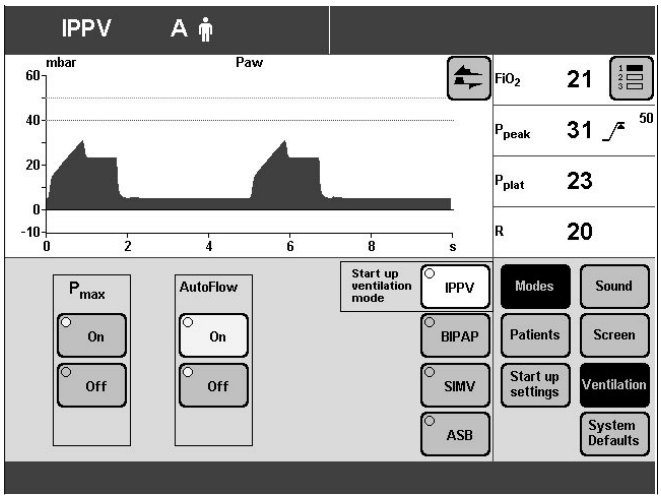
- Touch the corresponding screen keys.

Display (example):



- Touch the »**Modes**« screen key.

Display (example):



To activate AutoFlow® in the start-up ventilation mode:

- Touch the »**On**« screen key
- Confirm selection = press rotary knob.
  The AutoFlow® option will be automatically activated the next time the apparatus is switched on.

Selecting patient mode

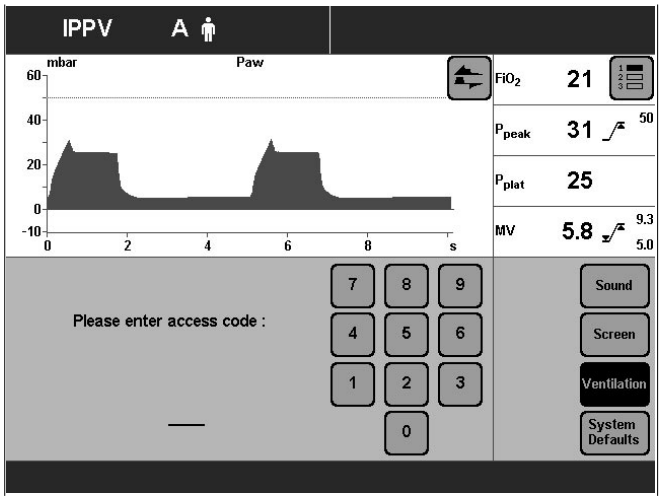
Adult/Paed

– To select the patient mode you would like automatically activated on switching on, or

– To select whether the device should first ask for the patient mode.

- Press the »**Configuration**« key.
- Touch the »**Ventilation**« screen key.

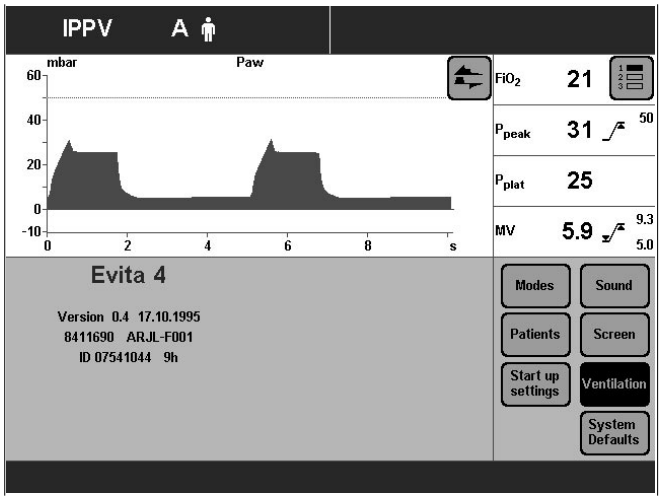
Display (example):



Enter access code **3032**:

- Touch the corresponding screen keys.

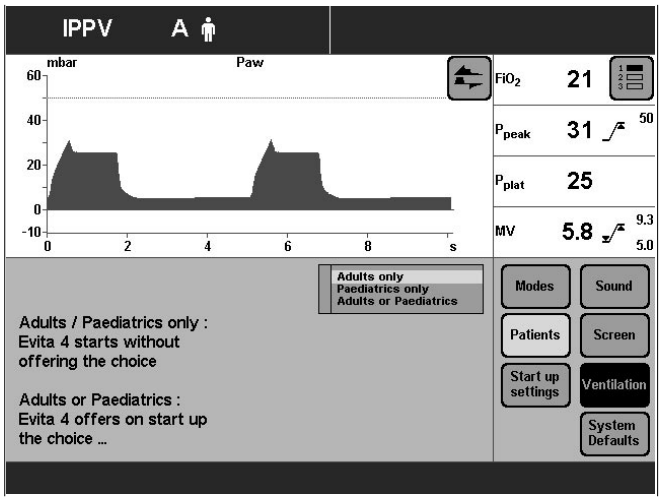
Display (example):



- Touch the »**Patients**« screen key.

Display (example):

The selection list with the two patient modes appears next to the screen keys.



- Select the corresponding patient mode = turn rotary knob.
- Confirm the patient mode = press rotary knob.

Start-up values for ventilation parameters and alarm limits

– To set the ventilation parameters and alarm limits you would like to be activated on switching on the device.

Setting start-up values for ventilation parameters »VT, frq.«

The start-up values for the tidal volume (VT) and frequency (frq.) required for the patient are determined by Evita 4:

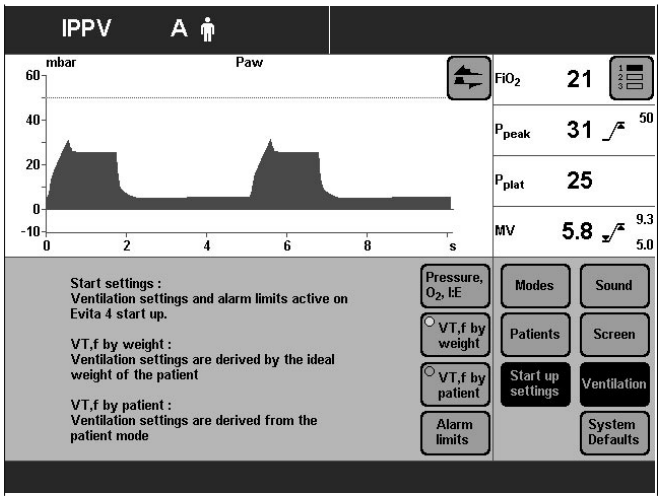
either as a function of the ideal body weight
or
as a function of the patient mode
(paediatrics or adults).

- Press »**Configuration**« key.
- Touch the »**Ventilation**« screen key.

Enter access code **3032**:

- Touch the corresponding screen keys.
- Touch the »**Start up settings**« screen key.

Display (example):



To determine the start-up values of the ventilation parameters VT, frq. on the basis of the ideal body weight:

- Touch the screen key »**VT, frq. by weight**« and confirm with the rotary knob.

To determine the start-up values of the ventilation parameters VT, frq. on the basis of the patient mode:

- Touch the screen key »**VT, frq. by patient**« and confirm with the rotary knob.

Start-up values »**VT, frq.**« dependent on ideal weight.
The values are selected with reference to the Radford nomogram:

Weight	Factory settings		Hospital-specific settings	
kg	Tidal volume VT mL	Ventilation frequency f bpm	Tidal volume VT mL	Ventilation frequency f bpm
3	20	30	.....	.....
15	110	26	.....	.....
65	450	13	.....	.....
100	700	10	.....	.....

The hospital-specific start-up values can be entered in the table.

Start-up values »**VT, frq.**« dependent on patient mode.

Patient mode	Factory settings		Hospital-specific settings	
	Tidal volume VT mL	Ventilation frequency f bpm	Tidal volume VT mL	Ventilation frequency f bpm
Paed.	50	29	.....	.....
Adults	500	12	.....	.....

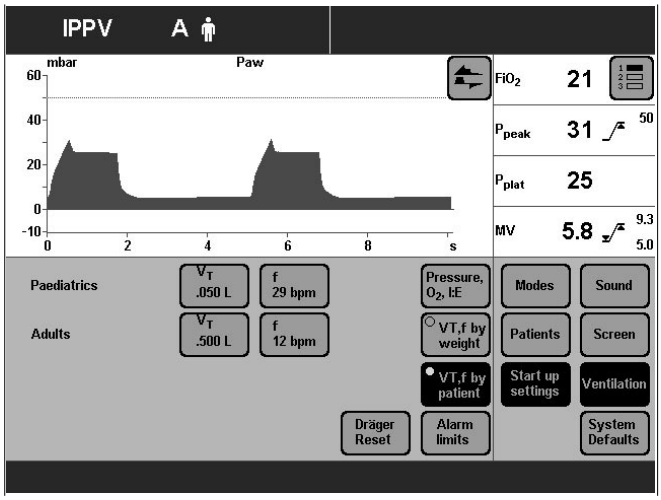
The hospital-specific start-up values can be entered in the table.

To change the start-up values of »**VT, frq.**«:

- Touch the screen key of the parameter to be changed.
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

If you wish to return to the factory settings:

- Touch »**Dräger Reset**« screen key.



Setting the start-up values for the »Pressure, O2, I:E« ventilation parameter

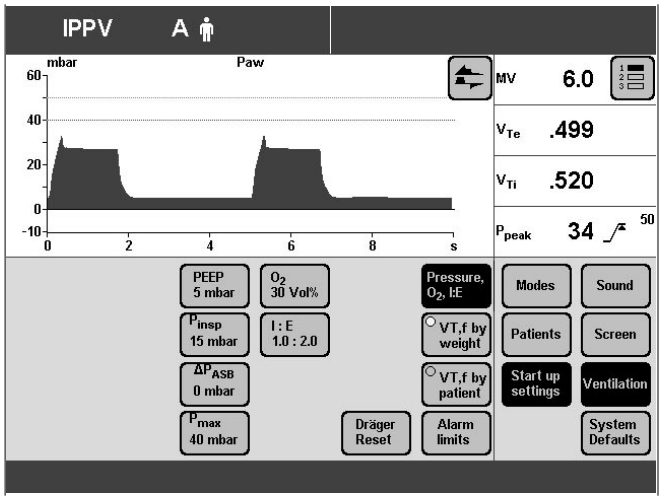
- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

Enter access code **3032**:

- Touch the corresponding screen key.

- Touch the »**Start-up settings**« screen key.

Display (example):



- Touch the »**Pressure, O2, I:E**« screen key.

Starting values of »**Pressure, O2, I:E**«

	PEEP mbar	Pinsp mbar	ΔPASB[1)] mbar	Pmax mbar	O2 Vol.%	I:E
Factory settings	5	15	0	40	30	1:2
Hospital-specific settings	.....	.....	.....	.....	.....	.....

1) ΔPASB = PASB - PEEP

The hospital-specific start-up settings can be entered in the table.

To change the start-up values of »**Pressure, O2, I:E**«:

- Touch the screen key for the parameter to be changed.
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

Setting the start-up values of the alarm limits

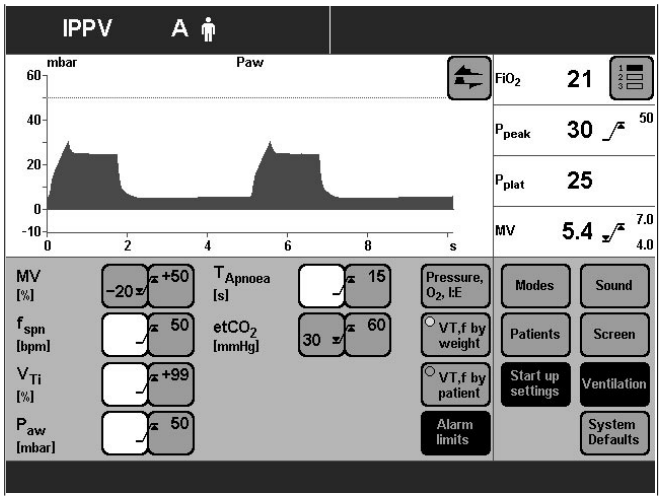
- Press the »**Configuration**« key.
- Touch the »**Ventilation**« screen key.

Enter the access code 3032:

- Touch the corresponding screen keys.

- Touch the »**Start-up settings**« screen key.
- Touch the »**Alarm limits**« screen key.

Display (example):



Start-up values of the alarm limits:

Alarm limit	Factory settings	Hospital-specific settings
Paw high [mbar]	50	.....
MV low [L/min]	(V_T • f) –20 %	.....
MV high [L]	(V_T • f) +20 %	.....
V_T high [mmHg]	V_T +100 %	.....
$etCO_2$ low [mmHg]	30	.....
$etCO_2$ high [mmHg]	60	.....
f_{spon} [1/min]	50	.....
T_{apnoea} [s]	15	.....

The factory-specific start-up settings can be entered in the table.

To change the start-up values of the alarm limits:

- Touch the screen key of the alarm limit you wish to change.
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

System Defaults

Setting the external interface

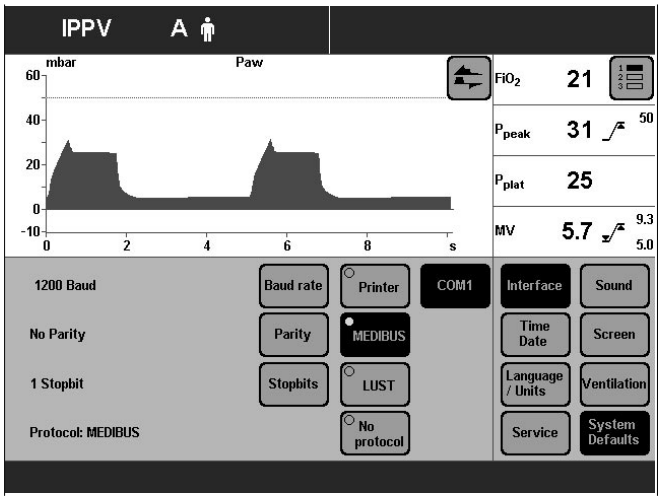
Evita 4 offers the following interface protocols:

– Printer

– MEDIBUS (Dräger communications protocol for medical equipment)

– LUST (list-driven universal interface driver program, compatible with the Evita RS 232 interface from software version 7.n)

- Press the »**Configuration**« key.
- Touch the »**System Defaults**« screen key.
- Select the required port with screen keys »**COM1**«, »**COM2**«, »**COM3**« (COM2 and COM3 are optional).
- Select the required interface protocol with the screen keys »**Printer**«, »**MEDIBUS**« and »**LUST**«
- Display (example):



Select the interface parameters for the selected interface protocol:

- Touch the screen key for the parameter, e.g. »**Baudrate**«
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

For MEDIBUS protocol:
Baud rate
Parity check bits (see Operating Manual of the connected device)
Number of stop bits (see Operating Manual of the connected device)

For LUST protocol:
Baud rate

For printer protocol:
Baud rate (see Operating Manual of the printer)
Print interval (set in accordance with protocol requirement)

To connect a printer to Evita 4
(HP Deskjet 500 and compatible printers with serial interface)

At a programmable regular interval (0 to 60 minutes), all important measured values of the Evita 4 and all settings modified since the last printout are automatically printed out. If the print time interval is set to 0 no printout occurs.

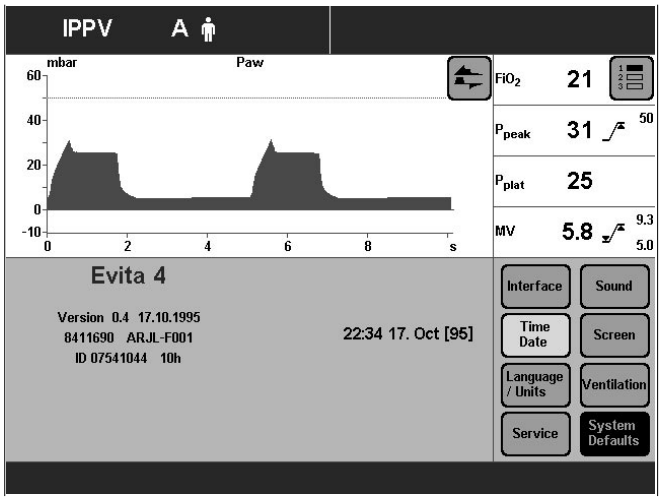
Regardless of the selected time interval, all alarms are printed out when the alarm conditions occur.

In addition, printout can be manually started by pressing the "Printer" key. The time interval in progress will remain unaffected.

Setting time and date

- Press »**Configuration**« key.
- Touch »**Defaults**« screen key and
- touch »**Time Date**« screen key.

Display (example):



- Change value in cursor (Example **[95]**) = turn rotary knob.
- Confirm value = press rotary knob.

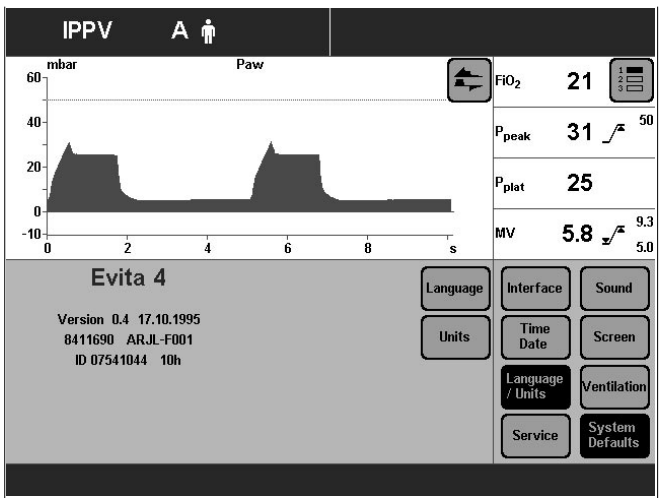
Selecting language and units

– To select the desired language for the screen texts,

– To select the units for pressure and CO_2 concentration:

- Press »**Configuration**« key.
- Touch the »**Defaults**« screen key.

Display (example):



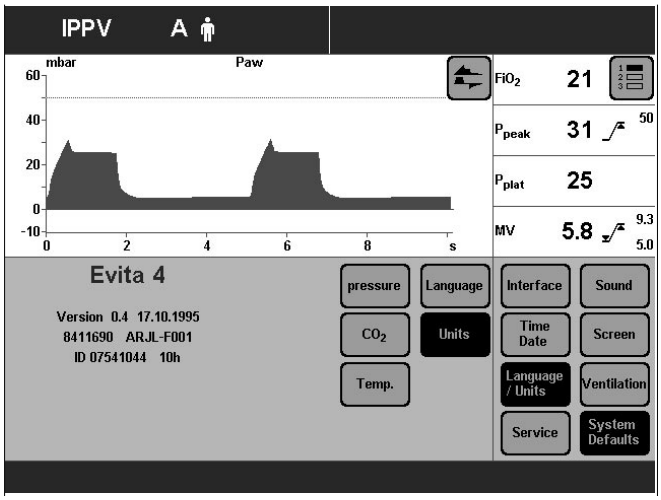
Select language:

- Touch the »**Language/Units**« screen key.
- Touch the »**Language**« screen key.
- Select language = turn rotary knob.
- Confirm language = press rotary knob.

Select unit:

- Touch the »**Units**« screen key.

Display (example):



- Touch the relevant screen key, e.g. »**pressure**«
- Select unit = turn rotary knob.
- Confirm unit = press rotary knob.

Service diagnosis

Only for trained personnel with the appropriate servicing documentation.

Troubleshooting

Contents

Troubleshooting

Alarm messages in the alarm display field are displayed in hierarchical order.
If, for example, two faults are detected at the same time, the more critical of the two is displayed.

The priority for alarm messages is marked by exclamation marks:
Warning = Message with top priority **!!!**
Caution = Message with medium priority **!!**
Advisory = Message with low priority **!**

In the table below, the messages are listed in alphabetical order.
The table should help you identify the cause of any alarm, and to ensure rapid remedy of the problem.

Message		Cause	Remedy
Air supply down	**!!!**	Air supply pressure too low.	Make sure pressure is greater than 3 bar.
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.
Air supply pressure high	**!!**	Air supply pressure too high.	Ensure pressure is less than 6 bar.
Air supply pressure high	**!**	Air supply pressure too high. Air supply is not needed for FiO_2 = 100 Vol.%.	Ensure pressure is less than 6 bar.
Airway pressure high	**!!!**	The upper alarm limit for the airway pressure has been exceeded. The patient is »fighting« the ventilator, cough.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
Airway pressure low	**!!!**	Leaking cuff.	Inflate cuff and perform leak test.
		Leak or disconnection.	Check hose system for tight connections. Check that the expiration valve is properly engaged.
Apnoea	**!!!**	Patient's spontaneous breathing has stopped.	Apply controlled ventilation.
		Stenosis	Check condition of patient. Check tube.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor. Replace if necessary.
Apnoea ventilation	**!!**	Due to detected apnoea, the system has switched over automatically to mandatory ventilation.	Check ventilation procedure. To return to the original ventilation procedure, press the Reset button. Check condition of patient. Check tube.
ASB > 1.5 s	**!**	Only appears in paediatric mode. The ASB cycle has been switched off 3 times due to time limitation.	Test ventilation system for leaks.
ASB > 4 s	**!!!**	Only appears in adult mode. The ASB cycle has been switched off 3 times due to time limitation.	Test ventilation system for leaks.

Message		Cause	Remedy
Check Frequency ILV Slave Message on slave device	!	The frequency (breathing rate) of the master and slave devices differ by more than 12%.	Adjust the frequency of the slave device to that of the master.
Check settings	!!	Power interruption while setting a ventilation pattern or the alarm limits.	Check pattern of ventilation and alarm limits. Confirm message with reset.
Clean CO_2 cuvette	!!!	Cuvette window dirty.	Use clean cuvette.
CO_2 measurement inop	!!!	CO_2 sensor faulty.	Replace faulty CO_2 sensor.
		CO_2 measurement incorrect.	Call DrägerService.
CO_2 monitoring off	!	CO_2 monitoring is switched off.	
CO_2 sensor	!!!	Probe of CO_2 sensor withdrawn during operation.	Reinsert probe.
		CO_2 sensor not positioned on cuvette.	Place CO_2 sensor on cuvette.
		CO_2 sensor faulty.	Replace defective CO_2 sensor.
CO_2 zero?	!!!	Zero outside the permitted tolerance.	Perform zero calibration, page 83.
Device failure	!!!	Device faulty.	Call DrägerService.
etCO_2 high	!!!	End-expiratory CO_2 concentration above upper alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
etCO_2 low	!!!	End-expiratory CO_2 concentration below lower alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
Execute device check	!!	Equipment check not performed.	Perform equipment check, page 34. Confirm message with »**Alarm Reset**« key.
Exp. hold interrupted	!	The »**Exp. hold**« key was held down longer than 15 seconds.	Release »**Exp. hold**« key.
Exp. valve inop.	!!!	Expiration valve not properly connected to socket.	Push expiration valve firmly into socket until it clicks into place.
		Flow sensor not calibrated or defective.	Calibrate flow sensor, page 82, and replace if necessary.
		Expiration valve faulty.	Replace expiration valve.
Fan failure	!!!	Fan failure.	Call DrägerService.
FiO_2 high	!!!	O_2 sensor not calibrated.	Calibrate O_2 sensor, page 81.
		Faulty mixer function.	Call DrägerService.
FiO_2 low	!!!	O_2 sensor not calibrated.	Calibrate O_2 sensor, page 81.
		Faulty mixer function.	Call DrägerService.

Message		Cause	Remedy
Flow measurement inop.	**!!!**	Flow sensor faulty.	Calibrate flow sensor, page 82, and replace if necessary.
		Flow measurement malfunction.	Call DrägerService.
Flow monitoring off	**!**	Flow monitoring is switched off.	Switch on CO_2 monitoring again, as described on page 79, or immediately ensure an adequate external monitor function.
Flow sensor?	**!!!**	Flow sensor not fully inserted in rubber lip of expiration valve.	Insert flow sensor correctly.
Hard key xx failed	**!!**	Key xx (e.g. »🔔 «) can no longer be pressed.	Call DrägerService.
High frequency	**!!!**	Patient is breathing at a high spontaneous frequency	Check condition of patient, Check pattern of ventilation, Correct alarm limit if necessary.
ILV Sync. inop. Message on both devices	**!!!**	Frequency on master device less than 4 breaths per minute. Device defective.	Set a higher frequency. Call DrägerService.
Insp. hold interrupted	**!**	The »**Insp. hold**« key was held down longer than 15 seconds.	Release »**Insp. hold**« key.
Insp / Exp cycle failure	**!!!**	The device does not deliver any gas.	Check the Pmax/PEEP setting. Set an IPPV frequency of at least 4/min. Increase TApnoea/ alarm time.
Key xx overused ?	**!!**	Key has been pressed several times in a short period (e.g. »🔔 «).	Confirm message with key »**Alarm Reset**« If this message occurs repeatedly, call DrägerService.
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**«. If this message occurs again, call DrägerService.
Leakage	**!**	The measured leakage minute volume MV_{leak} is 20% higher than the minute volume measured on the expiration side.	Check that the hose connection is leakproof. Check that the tube is correctly fitted.
Loss of data	**!!!**	Lithium battery discharged.	Call DrägerService.
Malfunction fan	**!**	Temperature in machine too high.	Check fan function, clean cooling-air filter or call DrägerService.

Message		Cause	Remedy
MEDIBUS COM. inop.	!	The connector of the MEDIBUS cable was unplugged during operation.	Plug the connector in again and secure it against disconnection with the two screws.
		MEDIBUS cable defective.	Use a new MEDIBUS cable.
		Interface defective.	Call DrägerService.
Mixer inop.	!!!	Mixer malfunction. FiO_2 can deviate considerably.	**Immediately ventilate with separate manual ventilation device!** Call DrägerService.
MV high	!!!	The minute volume has exceeded the upper alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 82, and replace if necessary.
		Water in flow sensor.	Drain water trap in hose system.
		Machine malfunction.	Call DrägerService.
MV low	!!!	The minute volume has fallen below the lower alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary
		Stenosis.	Check condition of patient. Check tube.
		Leak in breathing system.	Establish leakproof breathing system.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 82, replace if necessary.
		Machine malfunction.	Call DrägerService.
Nebulisation interrupted	!!	Only in paediatric mode. Nebulisation is only possible in pressure-controlled ventilation or with AutoFlow.	Select the patient mode. Restart nebulisation. Acknowledge the alarm with »**Alarm/Reset**».
		Only in paediatric mode, only for ventilation with AutoFlow. Flow sensor not ready for measurement.	Switch on flowmonitoring or calibrate sensor or select sensor or select the patient mode. Restart nebulisation. Acknowledge the alarm with »**Alarm/Reset**»
Nebulizer on	!	The medicament nebuliser is switched on, page 72.	Switch off the medicament nebuliser if necessary, page 74.
O_2 measurement inop.	!!!	O_2 sensor provides invalid measured values.	Calibrate O_2 sensor, page 81, replace if necessary.
		O_2 measurement malfunction.	Call DrägerService.

Message		Cause	Remedy
O_2 monitoring off	**!**	O_2 monitoring switched off.	Switch on O_2 monitoring again, as described on page 75, or immediately ensure an adequate monitor function.
O_2 supply down	**!!!**	O_2 supply pressure too low.	Make sure pressure is greater than 3 bar.
O_2 supply down	**!**	O_2 supply pressure too low. O_2 supply pressure is not required when FiO_2 = 21 Vol.%.	Make sure pressure is greater than 3 bar.
O_2 supply pressure high	**!!**	O_2 supply pressure too high.	Make sure pressure is less than 6 bar.
O_2 supply pressure high	**!**	O_2 supply pressure too high. O_2 supply pressure is not required when FiO_2 = 21 Vol.%.	Make sure pressure is less than 6 bar.
PEEP high	**!!!**	Expiratory system obstructed.	Check hose system and expiration valve.
		Expiratory resistance is increasing.	Check bacterial filter. Replace if necessary.
		Machine faulty.	Call DrägerService.
PEEP valve inop.	**!!!**	Internal PEEP valve faulty.	Call DrägerService.
Pressure limited	**!**	Pmax pressure limit is active.	
Pressure meas. inop.	**!!!**	Fluid in expiration valve.	Replace expiration valve, then clean and dry, page 119.
		Pressure measurement malfunction.	Call DrägerService.
Standby activated	**!!!**	Evita 4 has been switched to standby.	Confirm standby with »**Alarm Reset**« key.
Temperature high	**!!!**	Breathing gas temperature higher than 40 ºC.	Switch off humidifier.
Temperature meas. inop.	**!!!**	Temperature sensor faulty.	Fit new temperature sensor.

Message		Cause	Remedy
Temperature sensor?	**!!!**	Temperature sensor probe has been disconnected during operation.	Reconnect probe.
		Sensor cable broken.	Fit new temperature sensor.
Tidal volume high	**!!!**	The upper alarm limit of the applied inspiratory tidal volume has been exceeded during three consecutive ventilation strokes.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
		Leak or disconnection.	Check that hose system connections are leakproof.
Tidal volume high	**!**	The inspiratory tidal volume VT has exceeded the upper alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
		Leak or disconnection.	Check that hose system connections are leakproof.
Volume not constant	**!!**	Due to pressure limit or time limit, the set tidal volume VT has not been applied.	Prolong inspiratory time »Tinsp« Increase inspiratory flow »Flow« Increase pressure limit »Pmax«. Press the »**Alarm Reset**« key to suppress the visual and acoustic alarm until the cause of the alarm is remedied.

Preparing

Contents

Dismantling

Clean and prepare the machine after each patient.

Recommendation:
Change the hose system and expiration valve every 24 hours. Keep the replacement systems ready.

Observe the hospital hygiene regulations!

Removing parts

- Switch off the ventilator and humidifier, and remove their power plugs.
- Drain the water traps and ventilation hoses.
- Drain the water container of the humidifier.

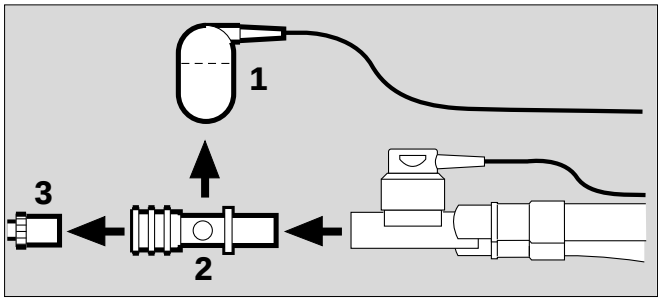
CO_2 sensor

1 Remove from the cuvette. Unplug the connector from the back of the unit.

2 Remove the cuvette of the CO_2 sensor from the Y-piece.

3 Remove the catheter cone from the cuvette.

- Prepare the CO_2 sensor for wipe disinfecting.
- Prepare the cuvette for disinfecting and cleaning in the autoclave.

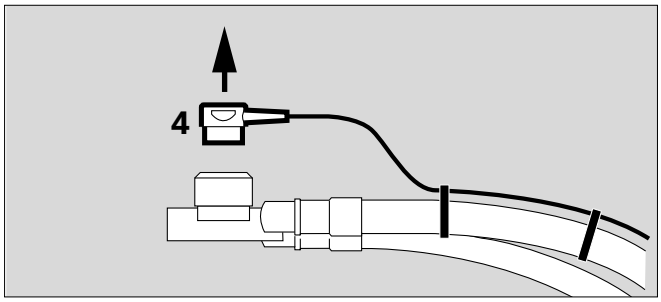


Temperature sensor

4 Remove from the Y-piece or from the mounting of hose set K. Do not pull the cable.

- Unplug the connector from the back of the Evita 4.
- Prepare the temperature sensor for wipe disinfecting.

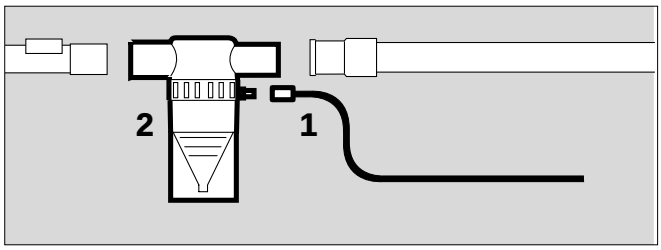
  The temperature sensor is not suitable for autoclaving or immersion in a disinfectant bath.



Medicament nebuliser (option)

1 Remove the nebuliser hose from the nebuliser and from the port on the device.

2 Remove the medicament nebuliser from the hose system or

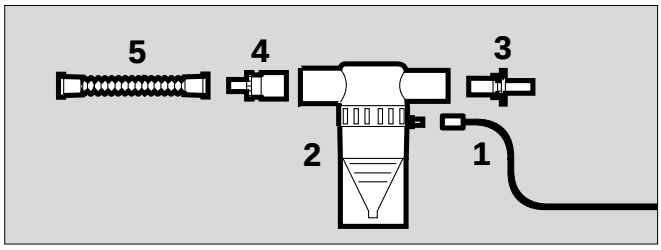


2 Dismantle the medicament nebuliser from the paediatric hose system.

3 Remove the catheter connector (ISO cone ø15 / ø11) from the inlet.

4 Remove adapter (ISO cone ø22 / ø11) from the outlet.

5 Remove corrugated hose from the adapter.



- Dismantle the medicament nebuliser in accordance with its specific Instructions for Use.
- Prepare the individual parts of the medicament nebuliser and the adapting components for disinfecting and cleaning in the autoclave.

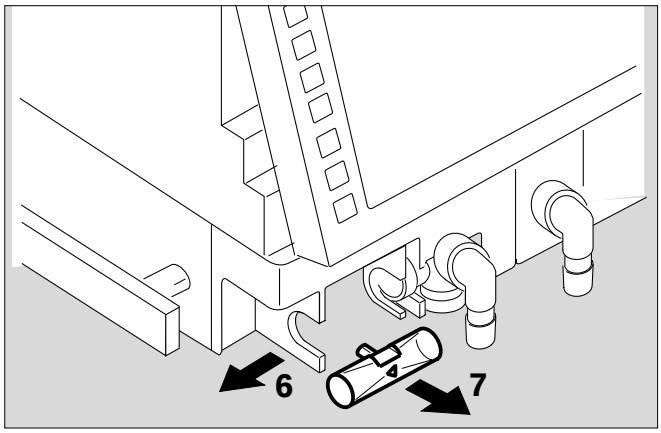
Ventilation hoses

- Remove from the adapters and ports.
- Remove the water traps from the ventilation hoses. Remove the collecting jars from the water traps.
- Prepare the ventilation hoses, water traps and their collecting jars and the Y-piece for cleaning in the autoclave.

Flow sensor

- Tilt the control unit upward.

6 Push the flow sensor to the left as far as it will go and
7 pull out.

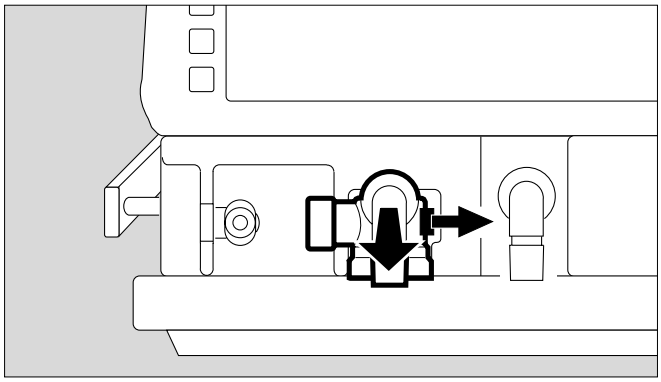


The flow sensor cannot be disinfected/cleaned by autoclaving and cannot be sterilised by the hot steam method.

- Disinfect the flow sensor for about 1 hour in 70% ethanol solution.
  Expose the sensor to air for at least 30 minutes to allow the alcohol to evaporate.
  Otherwise, residual alcohol could damage the sensor beyond control during calibration.
- The flow sensor may be re-used as long as calibration can be carried out successfully.

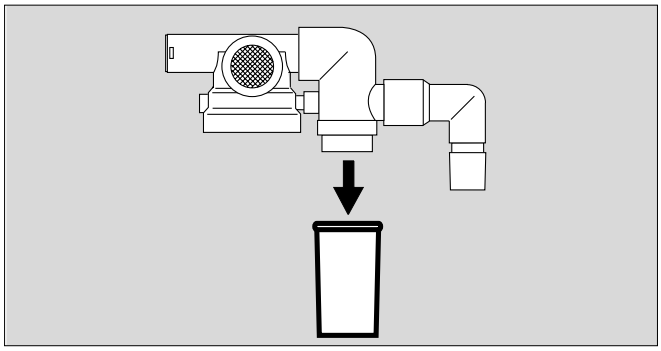
Expiration valve

- Push the catch to the right while at the same time pulling out the expiration valve.



If the expiration valve is fitted with an optional water trap:

- Pull off the collecting jar.

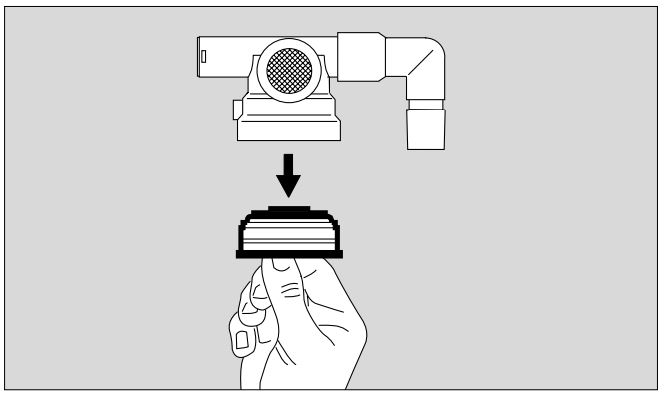


Only strip down the expiration valve if badly soiled.

- Unscrew the stopper by hand and remove together with the diaphragm.
- Do not disassemble the expiration valve any further.
- Prepare the expiration valve for disinfecting and cleaning by autoclave

and

- prepare the expiration valve for hot steam sterilisation.
- Place the open expiration valve in the basket so that it cannot be damaged by other parts.



Humidifier

- Dismantle in accordance with the specific Instructions for Use and prepare for disinfecting/sterilising.

Disinfecting/Cleaning

Use surface disinfectants. For surface compatibility, use disinfectants based on:
– aldehydes,
– quaternary ammonium compounds.

To avoid the possibility of damage to material, **do not use any disinfectants based on**:
– alkylamine-based compounds
– phenol-based compounds,
– halogen-releasing compounds,
– strong organic acids,
– oxygen-releasing compounds.

For users in the Federal Republic of Germany, we recommend that only disinfectants on the current DGHM list are used (DGHM: German Society for Hygiene and Microbiology).
The DGHM list (published by mhp-Verlag, Wiesbaden) also classifies each disinfectant by its active agents. For countries where the DGHM list is not available, we recommend the types of disinfectant given above.

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.

A list of substances used is given on page 139.

Do not sterilise parts in ethylene oxide!

The screen of the control unit is made of Plexiglas. Do not handle with alcohol or agents containing alcohol. Danger of cracking.

CO_2 Cuvette

- Wipe off dirt, in particular inside and outside the windows, with disposable tissue and cotton buds.
- Disinfect with moist heat (93 °C/10 minutes) in a cleaning and disinfecting machine. Use only cleaning agent.

Or:

- Disinfect in bath of disinfectant based on the listed active substances, e.g. Cidex, Johnson & Johnson, Norderstedt.

  Or:

- Steam-sterilise at 134 °C.

CO_2 Sensor

- Wipe off dirt with cotton buds, in particular on the windows of the CO_2 sensor.
- Disinfect by wiping, e.g. with 70% Ethanol.

Basic device without ventilation hoses, gas connection hoses and temperature sensor

Wipe disinfect

- e.g. with Buraton 10 F or Terralin (Schülke & Mayr, Norderstedt).
  Comply with the manufacturer's instructions.

Ventilation hoses, water traps and associated jars, Y-piece, expiration valve (or, in the event of severe fouling, their individual parts)

- Disinfect with moist heat (93 °C/10 minutes) in cleaning and disinfecting machine. **Use only cleaning agent**.
- After disinfecting with moist heat, steam-sterilise the **expiration valve and its individual parts at 134 °C**. Make sure that no liquid remains in the pressure measuring line, since it might cause malfunction.

Or

If no washing machine is available:

- **Bath disinfecting** e.g. with Sekusept (Henkel). Comply with manufacturer's instructions.

  Then rinse with clean water, preferably from a soft water supply. Shake water out thoroughly, and leave the products to dry.

Expiration valve and individual parts

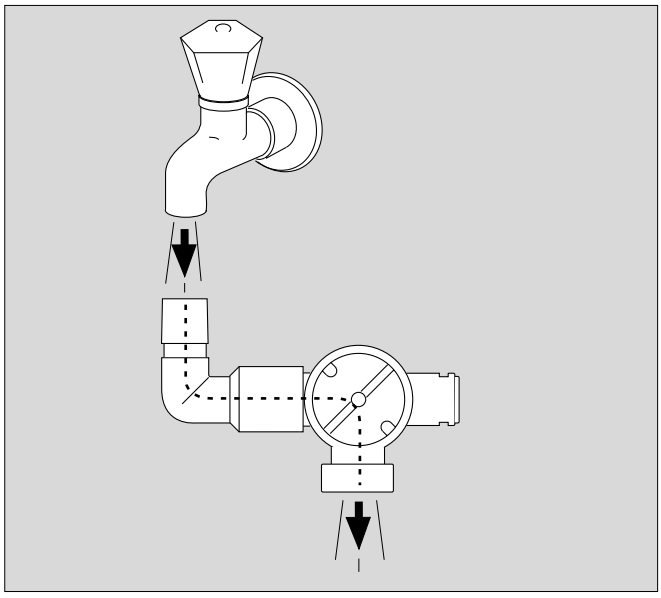
after rinsing

- steam-sterilise **at 134 °C**.

Or

Expiration valve

- Rinse thoroughly with clear water, preferably from a soft water supply.
  Shake water out thoroughly.
- After rinsing thoroughly, dry expiration valve.
- After drying, steam-sterilise at 134 °C.



Ventilation hoses, water traps and associated water jars, Y-piece, expiration valve, temperature sensor

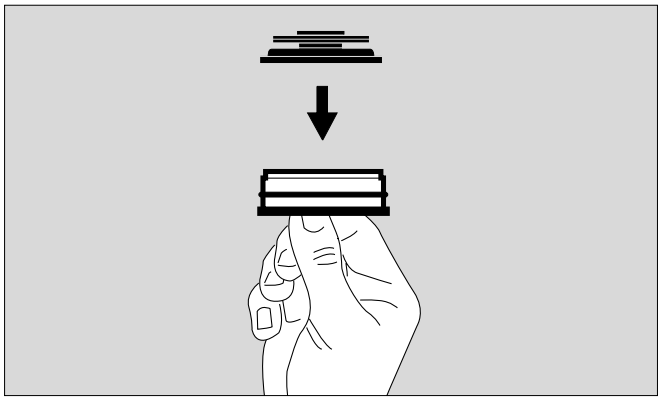
- These parts can be steam-sterilised at 134 °C.

Assembling

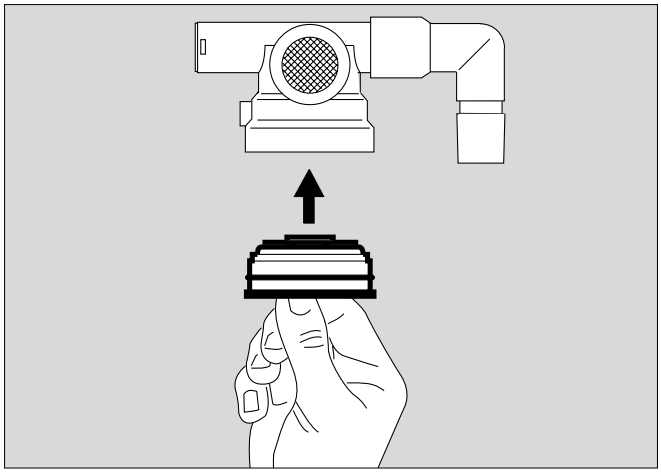
Mounting the expiration valve

The parts must be entirely dry to prevent malfunctioning.

- Hold stopper by the flange and place diaphragm on the collar of the stopper.
  Be careful to fit the diaphragm properly.

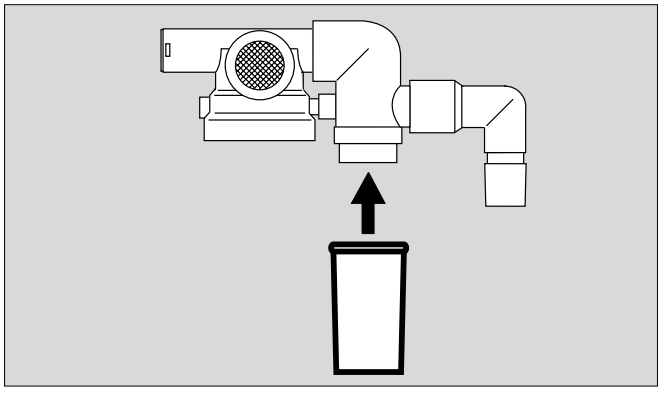


- Insert stopper with diaphragm on top into the housing from below and screw in tightly.



If the expiration valve has an optional water trap:

- Fit the collecting jar.



Mount the medicament nebuliser - see page 118.

Before Reusing on Patient

- Assemble machine as described under "Preparation" on page 25.
- Carry out checks to ensure readiness for operation, see "Equipment Check" on page 34.

Maintenance Intervals

Clean and disinfect equipment and/or components before any maintenance procedures* – and before returning for repair!

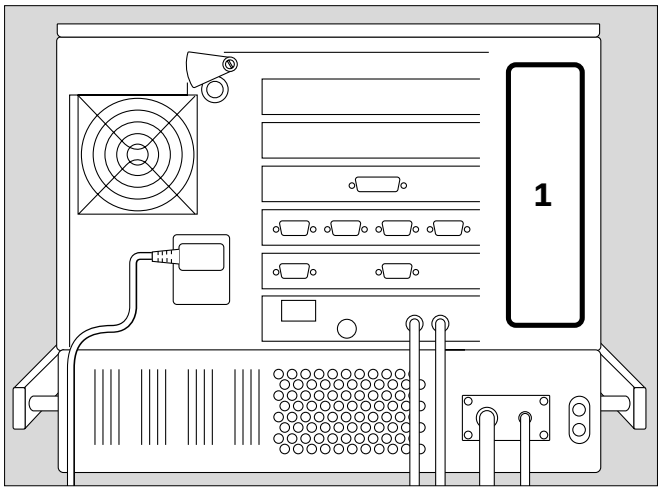
O_2 sensor capsule	Replace sensor capsule in event of display message: **O_2 measurement inop** and if calibration is impossible. Disposal, see page 125.
Ambient-air filter Cooling-air filter	Clean or replace after 4 weeks, see page 125. Replace every year. Dispose of with normal domestic waste.
Filters in the compressed gas inlets	To be replaced by trained service personnel every 2 years.
Lithium battery for data protection	To be replaced by trained service personnel every 2 years. Disposal, see page 125.
Clock module	To be replaced by trained service personnel every 2 years.
Pressure reducer	Complete overhaul every 6 years by Dräger Service.
Equipment inspection and service	Every 6 months by trained service personnel.
Technical safety inspections	Every 6 months by trained service personnel.

Replacing cooling-air filter

– Clean or replace after 4 weeks.
  Replace after 1 year at the latest.

1 Remove cooling-air filter from its slot on the back of machine.

- Replace or clean in warm water with detergent added; dry well.
- Insert cooling-air filter in slot, taking care not to crease it.
- Dispose of used cooling-air filter with domestic waste.



Correct disposal of batteries and O_2 sensors

Batteries and O_2 sensors:

- do not throw in a fire; risk of explosion!
- do not open using force; risk of corrosion!
- do not re-charge batteries.

Batteries and O_2 sensors must be disposed of as special waste:

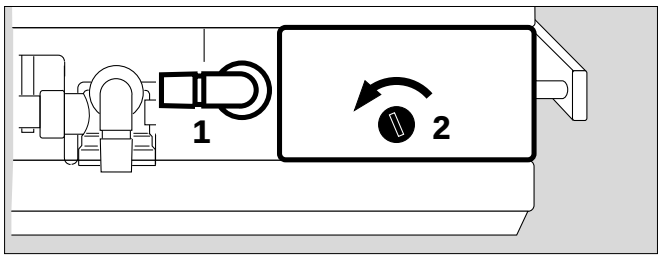
- Disposal must conform to local waste disposal regulations.
  Information may be obtained from the local environmental and public health authorities and from approved waste disposal companies.

Removing and reinserting ambient-air filter

– Clean or replace after 4 weeks.
  Replace filter every year.

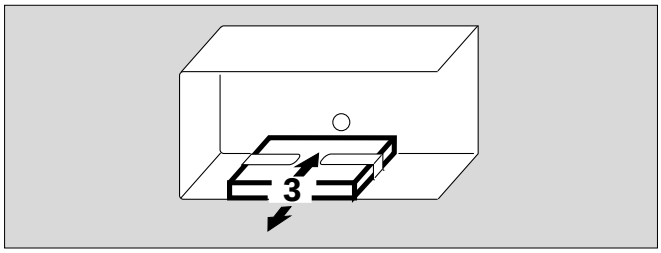
1 If necessary, swivel port to the left.

2 Loosen screw with a coin, and remove the protective cover.



3 Remove the ambient-air filter from the protective cover.

- Push ambient-air filter under the lugs.
- Replace protective cover, and tighten screw with a coin.
- Dispose of used ambient-air filter with domestic waste.



Correct disposal of apparatus

– at the end of its useful life

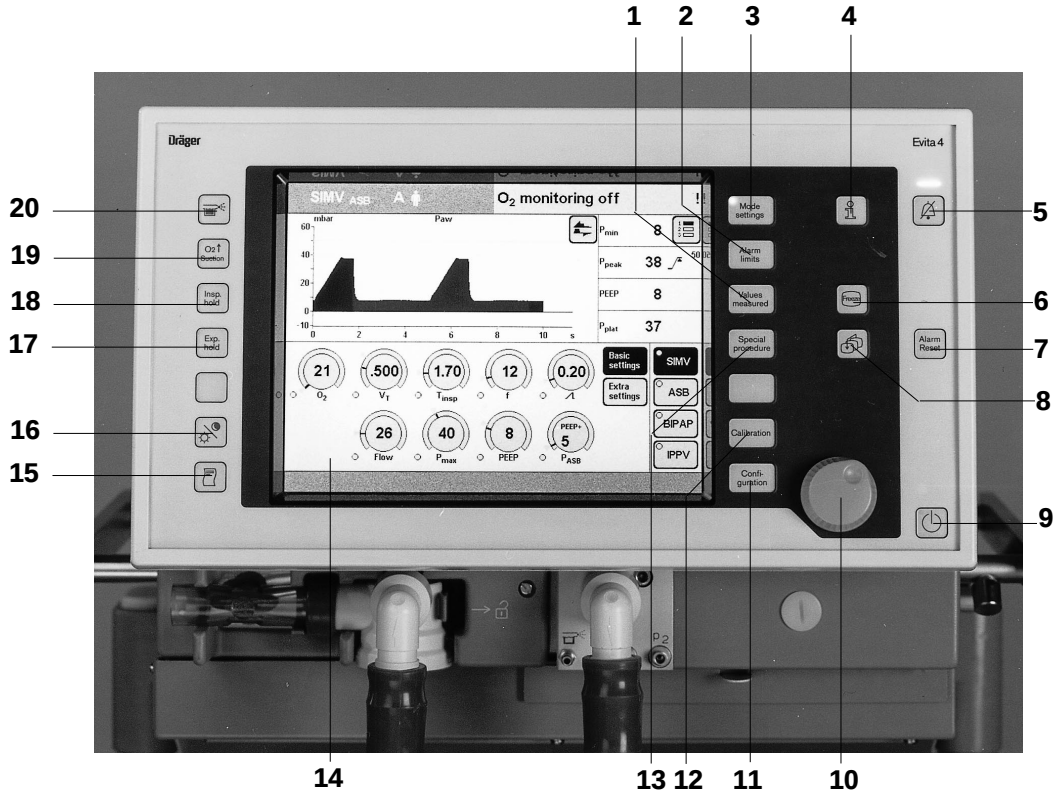
After contacting the competent waste disposal company, hand over Evita 4 for appropriate disposal.
The applicable legal regulations must be observed.

What is what

Contents

What's what

Control unit



1 Key for displaying the »Measured Values« screen page.

2 Key for displaying the »Alarm Limit« screen page. For displaying the measured values and alarm limits, and for setting the alarm limits.

3 Key for displaying the »Settings« screen page. For setting the ventilation modes and ventilation parameters.

4 »🛈« key for displaying help information for settings.

5 »🔕 « key for cancelling the acoustic alarm for 2 minutes.

6 »**Stop**« key for "freezing" curves.

7 »**Alarm Reset**« key for acknowledging alarm messages.

8 »🖵« key for selecting the standard screen page.

9 »⏻ « key for switching between operating and standby mode.

10 Central rotary dial-knob for selecting and confirming settings.

11 Key for displaying the »Configuration« screen page.

12 Key for displaying the »Calibration« screen page.

13 Key for displaying the »Special Procedures« screen page. For measuring PEEPi and Occlusion Pressure.

14 Touch-sensitive screen for displaying application-specific screen pages.

15 »🖹« key for manual printer logging.

16 » ☼/● « key for switching the screen to bright or dark.

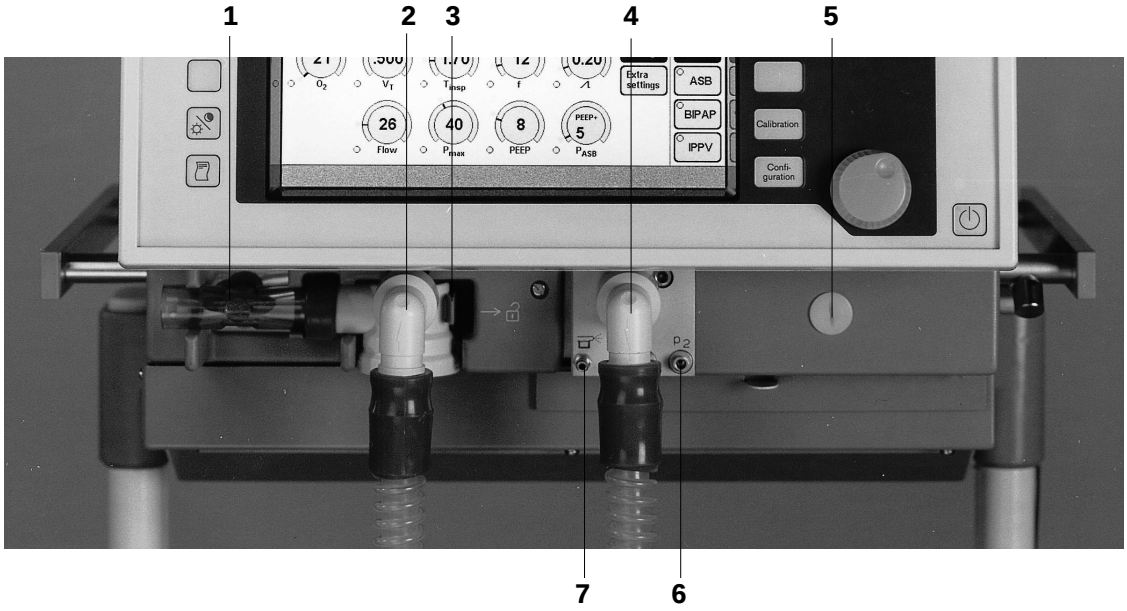
17 »**Exp. hold**« key for prolonging/holding expiration.

18 »**Insp. hold**« key for manual inspiration.

19 »**O2↑ suction**« key for oxygenation for bronchial suction.

20 » « key for switching on the medicament nebuliser.

Front connections



1 Flow sensor

2 Expiration valve with expiration port

3 Latch for expiration valve

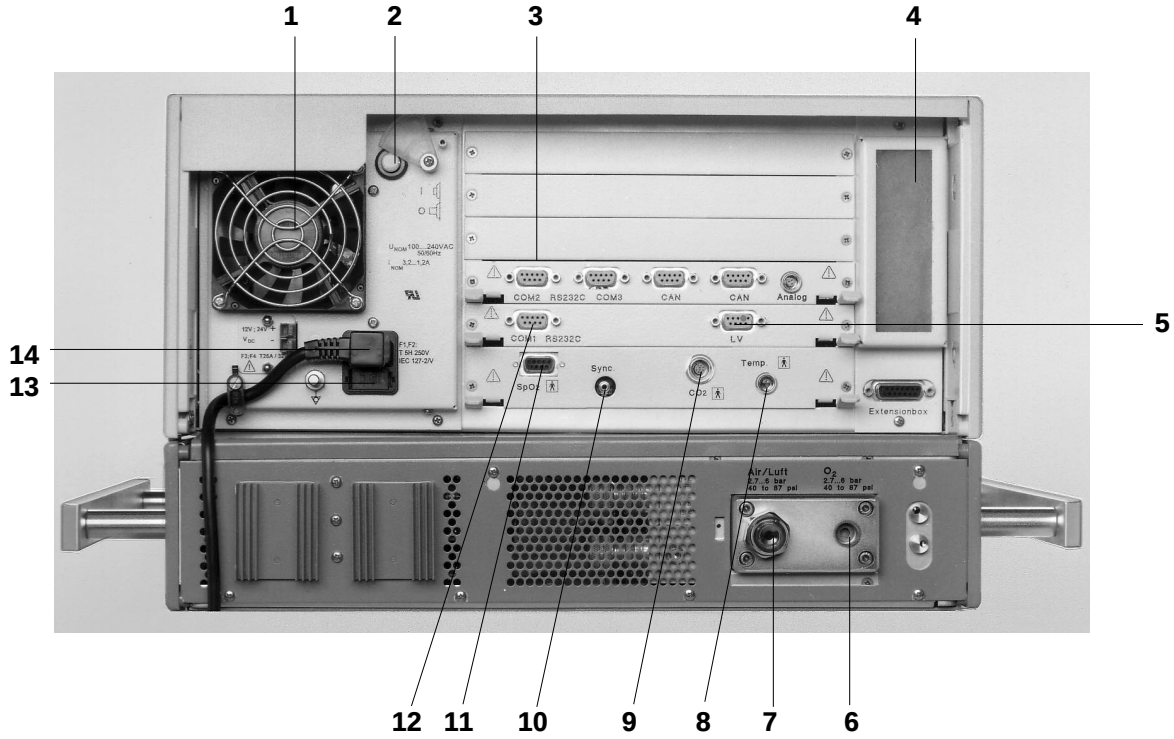
4 Inspiratory port

5 Locking screw for protective cover (behind it: O_2 sensor and ambient-air filter)

6 Connections for optional pressure measurement (not yet used)

7 Gas supply port for the medicament nebuliser

Back panel



1 Fan

2 Power switch with protective flap

3 Sockets for RS 232 and analogue interfaces (optional)

4 Cooling-air filter

5 ILV socket

6 Connection for oxygen

7 Connection for medical air

8 Temperature sensor socket

9 CO_2 sensor socket

10 Socket for the C-Lock-ECG synchronisation for optional SpO_2 measurement

11 Socket for SpO_2 measurement, optional

12 Socket for RS 232 interface, e.g. printer

13 Mains fuses

14 Connector for power cord

Technical Data

Contents

Technical Data

Environmental conditions

In operation	
Temperature	10 to 40 °C
Atmospheric pressure	700 to 1060 hPa
Rel. humidity	0 to 90 %
In storage	
Temperature	–20 to 60 °C
Atmospheric pressure	500 to 1060 hPa
Rel. humidity	0 to 100 %

Settings

Ventilation frequency f	0 to 100/min
Inspiration time T_{insp}	0.1 to 10 s
Tidal volume V_T	
Paediatrics	0.02 to 0.3 L, BTPS*
Accuracy	±10 % of set value, or ±10 mL, whichever is greater.
Adults	0.1 to 2.0 L, BTPS*
Accuracy	±10 % of set value, or ±25 mL, whichever is greater.
Inspiratory Flow	
Paediatrics	6 to 30 L/min
Adults	6 to 120 L/min
Inspiratory pressure P_{insp}	0 to 80 mbar
Inspiratory pressure limit P_{max}	0 to 100 mbar
O_2 concentration	21 to 100 Vol.%
Accuracy	±5 % of set value, or ±2 Vol.%, whichever is greater.
Positive end-expiratory pressure PEEP or interm. PEEP	0 to 35 mbar
Trigger sensitivity	1 to 15 L/min
Pressure assist P_{ASB}	0 to 80 mbar
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 ºC, steam-saturated gas, ambient pressure.

Performance Data

Control principle	time-cycled, volume-constant
Intermittent PEEP frequency	2 cycles every 3 minutes
Medicament nebulisation	for 30 minutes
Bronchial suction	
disconnection detection	automatic
reconnection detection	automatic
oxygen enrichment	max. 3 minutes
active suction phase	max. 2 minutes
final oxygen enrichment	2 minutes
Valve response time $T_{0...90}$	≤5 ms
Supply system for spontaneous breathing and ASB	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 humidifier Aquapor and patient tubing system for adults)	≤2 mL/mbar
Insp. Resistance	≤2.3 mbar/L/s
Exp. Resistance	≤3.8 mbar/L/s
Dead Space Volume incl. CO_2-cuvette	≤16 mL
Equipment compliance (with Fisher & Paykel MR 730 humidifier and tubing system paediatric)	≤1 mL/mbar
Insp. Resistance	≤4.1 mbar/L/s
Exp. Resistance	≤4.1 mbar/L/s
Dead Space Volume incl. CO_2-cuvette	≤6 mL
Additional functions	
Inspiratory relief valve	opens if medical air supply fails (pressure < 1.2 bar), enables spontaneous breathing with filtered ambient air.
Safety valve	opens the breathing system at 100 mbar.

Measured value displays

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 mbar
Resolution	1 mbar
Accuracy	±2 mbar

O_2 measurement in main flow (inspiratory side)

Inspiratory O_2 concentration FiO_2	
Range	15 to 100 Vol.%
Resolution	1 Vol.%
Accuracy	±3 Vol.%

Flow Measurement

Minute Volume MV
Spontaneously breathed minute volume MV_{spon}

Range	0 to 99 L/min, BTPS*
Resolution	0.1 L/min
Accuracy	±8 % of measured value
$T_{0...90}$	approx. 35 s

Tidal volume VTe
Spontaneously breathed tidal volume VT_{spon}

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Frequency Measurement

Breathing frequency f_{tot}
Spontaneous breathing frequency f_{spon}

Range	0 to 150 /min
Resolution	1 /min
Accuracy	±1 /min
$T_{0...90}$	approx. 35 s

Breathing gas temperature measurement

Range	18 to 51 ºC
Resolution	1 ºC
Accuracy	±1 ºC

CO_2 measurement in main flow

End-expiratory CO_2 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	
for 0 to 40 mmHg	±2 mmHg
for 40 to 100 mmHg	±5 % of measured value
$T_{10...90}$	≤ 25 ms
Warm-up time	max. 3 minutes

CO_2 production $\dot{v}CO_2$

Range	0 to 999 mL/min, BTPS*
Resolution	1 mL/min
Accuracy	±9 % of measured value
$T_{10...90}$	12 minutes

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1) BTPS = Body Temperature, Pressure, Saturated
Measured values based on the conditions of the patient lung:
body temperature 37 °C, steam-saturated gas, ambient pressure.

2) STPD = Standard Temperature, Pressure, Dry
Measured values based on normal physical conditions
0 °C, 1013 hPa, dry

Serial dead space Vds	
Range	0 to 999 mL, BTPS
Resolution	0.1 mL
Accuracy	±10 % of measured value or ±10 mL, whichever is greater
Dead space ventilation Vds/V_T	
Range	0 to 99 %
Resolution	1 %
Accuracy	±10 % of measured value
Computed value displays	
Compliance C	
Range	0 to 250 mL/mbar
Accuracy	±10 % of measured value
Resistance R	
Range	0 to 99 mbar/L/s
Accuracy	±10 % 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
$T_{0...90}$	approx. 35 s
Curve displays	
Airway pressure Paw (t)	–10 to 100 mbar
Flow 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	when MV exceeds the upper alarm limit.
Setting range	41 to 0.5 L/min, in 0.1 L/min steps
Lower alarm limit alarm	when MV falls below the lower alarm limit.
Setting range	0.1 to 40 L/min, in 0.1 L/min steps
Airway pressure P_{aw}	
Upper alarm limit alarm	if the "Paw high" value is exceeded.
Setting range	10 to 100 mbar
Lower alarm limit alarm	if the value "PEEP +5 mbar" (coupled with the PEEP set value) is not exceeded for at least 96 ms in 2 successive ventilation strokes.
Insp. O_2 concentration FiO_2	
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 allocated to the set value: under 60 Vol.% with ±4 Vol.% 60 Vol.% and over: ±6 Vol.%
Endexspiratory CO_2-concentration etCO_2	
Upper alarm limit alarm	if the upper alarm limit has been exceeded
Adjustment range	0 to 100 mmHg or 0 to 15 kPa
Lower alarm limit alarm	if the lower alarm limit fell below
Adjustment range	0 to 99 mmHg or 0 to 14 kPa
Insp. breathing gas temperature	
Upper alarm limit alarm	when temperature reaches 40 ºC. (Evita 4 can also be used without temperature sensor if the sensor is not connected on switching on).
Tachypnoea monitoring	
Alarm	during spontaneous breathing, when the spontaneous breathing frequency has been exceeded.
Adjustment range	5 to 120/min
Volume monitoring	
Lower alarm limit alarm	if the set tidal volume V_T (coupled with the set value V_T) has not been supplied.
Upper alarm limit alarm	if the applied tidal volume exceeds the value of the alarm limit, inspiration is interrupted and the expiration valve is opened.
Adjustment range	30 to 4000 mL
Apnoea alarm time	
Alarm	if no breathing activity is detected
Adjustment range	15 to 60 s, adjustable in 1 second steps.

Operating data

Mains power connection	100 V to 240 V 50/60 Hz
Current	
at 230 V	max. 1.3 A
at 100 V	max. 3.2 A
Power consumption	typically approx. 125 W
Machine fuses	
Range 100 V to 240 V	F 5 H 250 V IEC 127-2 (2x)

Protection class	
Machine	I
CO_2 sensor	Type BF
Temperature sensor	Type BF
Gas supply	
O_2 gauge pressure	3 bar –10 % to 6 bar
O_2 connection thread	M 12 x 1, female
air gauge pressure	3 bar –10 % to 6 bar
air connection thread	M 20 x 1.5, male The gases must be dry and free from oil and dust.
Gas consumption of control system	Medical air or O_2 approx. 3.5 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 < 1.5 bar), 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 machine	530 x 290 x 450 mm
Machine with trolley	580 x 1335 x 660 mm
Weight	
Basic machine	approx. 27 kg
Basic machine with trolley incl. cabinet 8H	approx. 69 kg

Machine outputs

Digital output	Output and reception via an RS 232 C interface
Digital output	Output for independent lung ventilation (ILV)
Digital output (optional)	for output and reception via two RS 232 C interfaces
Digital output (optional)	for output and reception via a CAN interface
Analogue output (optional)	for output and reception via a CAN interface

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 Annex IX	II b
UMDNS-Code Universal Medical Device Nomenclature System – Nomenclature for medical products	17-429

Materials used

Part	Appearance	Material
Ventilation hose	milky, transparent	silicone rubber
Water traps	yellow, transparent	polysulphone
Y-piece with connector for temperature measurement	yellow, transparent milky, transparent	polysulphone silicone rubber
Expiration valve housing, closure	white	polyamide
Diaphragm	whitish and grey	silicone rubber and aluminium
CO_2 cuvette	yellow, transparent	polysulphone with glass windows
Temperature sensor / cable	milky / green	silicone rubber
CO_2 sensor / cable	grey / grey	polyurethane

Description

Contents

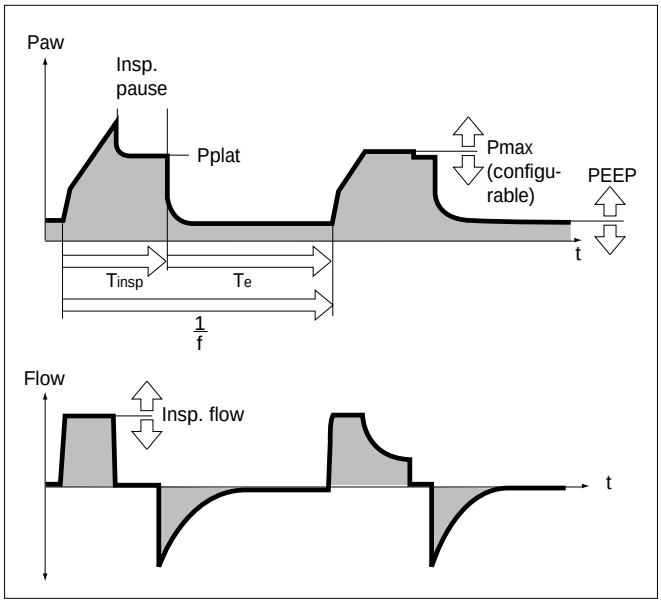
Ventilation Modes

Volume-controlled ventilation with PLV and AutoFlow®

AutoFlow is a new additional function that regulates inspiratory flow during the mandatory ventilation stroke in the constant-volume ventilation modes IPPV, SIMV and MMV. To explain the improvement achieved by this function, the conventional methods are explained first:

Classic volume constant mandatory ventilation stroke

In mandatory ventilation strokes without AutoFlow, the »Insp.Flow« parameter restricts the inspiration flow. If the inspiration flow is so high that the set tidal volume V_T is attained before the inspiration time Tinsp has fully elapsed, the inspiration valve closes, and the breathing gas supply stops. The expiration valve remains closed until the end of the inspiration time Tinsp. This phase, the inspiratory pause, can be identified in the curve Paw (t) as the plateau Pplat.



This type of mandatory ventilation stroke, 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 inspiration flow and closed inspiration and expiration valves during the inspiratory pause can cause the patient to »fight« the machine, unless the pattern of ventilation is regularly adapted to the needs of the spontaneously breathing patient.

Manual pressure limiting with Pmax

Evita 4 can prevent pressure peaks, while maintaining the set tidal volume V_T, by means of the pressure limit Pmax. The tidal volume V_T remains constant as long as a pressure plateau Pplat is still detectable and the flow curve shows a brief zero flow between inspiration and expiration.

Evita 4 performs this function by reducing the Insp. Flow on reaching the set Pmax value. If the tidal volume V_T can no longer be attained with the selected pressure Pmax, due to reduced compliance, the alarm "Volume not constant" is automatically generated.
Manual pressure limiting can be performed with all Evita models.

AutoFlow®

The AutoFlow function can be activated in the »Extra Settings« menu. AutoFlow takes over the task of setting both »Insp.Flow« and »Pmax«: the screen knobs for these parameters are no longer displayed.

With AutoFlow, the inspiration flow is automatically adjusted to changes in lung conditions (C, R) and to the spontaneous breathing demand of the patient.

Always set the alarm limit »Paw ⁄!« in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.

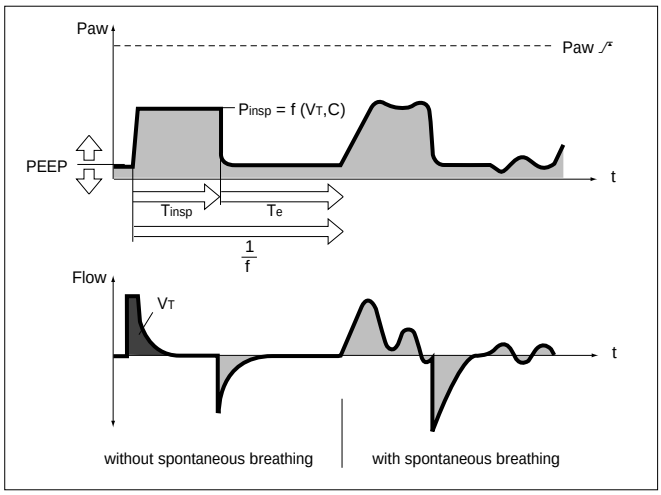
Typically, the selected inspiration time Tinsp is much longer than the lung filling time. The inspiration pressure Pinsp corresponds to the minimum value calculated from the tidal volume VT and compliance C of the lung.

The inspiration flow is automatically controlled so that there is no pressure peak caused by the resistances of the tube and the airways. The plateau pressure Pplat varies with changes in compliance C, as is normal in all constant-volume ventilation strokes. With AutoFlow, these variations occur in maximum steps of 3 mbar between ventilation strokes.

If the tidal volume VT is reached (inspiration flow = 0) before the inspiration time Tinsp has fully elapsed, the control system for the inspiration and expiration valves ensures that the patient can breathe in and out during the remaining inspiration time, even during a constant pressure plateau Pplat.

If the patient breathes in or out during mandatory inspiration, the plateau pressure Pplat is not changed for this ventilation stroke: only the inspiration and expiration flow are adapted to the patient's demand. The individually applied tidal volume VT may differ from the set tidal volume VT in specific ventilation strokes, but on average over time a constant tidal volume VT is supplied.

Any overstepping of the tidal volume VT can be limited by the alarm limit »VTi ⁄!«. If the set alarm limit is exceeded once, Evita 4 generates an advisory (!); if the alarm limit is exceeded three times, Evita 4 generates a warning (!!!). In the above examples the volume is actively limited to the alarm limit value »VTi ⁄!« by switching over to the PEEP level.

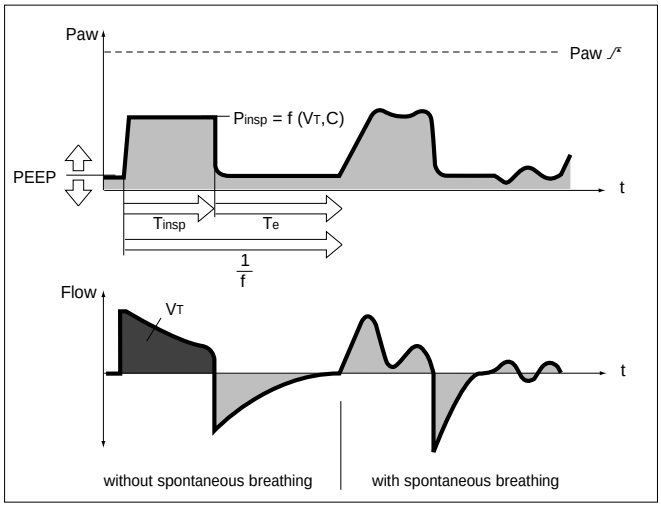


A set inspiration time Tinsp shorter than the lung filling time can be recognised from the flow curve: the flow at the end of the inspiration time has not dropped to zero. Here, it must be decided whether the current condition of the patient permits prolongation of the inspiration time in order to reduce the peak pressure even further.

This effect can also be caused during ventilation, e.g. due to a build-up of secretion. In this situation, the pressure is limited by the alarm limit »Paw ⩘«. The pressure rise stops 5 mbar below the alarm limit »Paw ⩘«, and the alarm »Volume not constant« is only given when the set tidal volume V_T is not longer applied.

The start of mandatory inspiration can be synchronised with the patient's own efforts with the aid of the variable Flowtrigger. Only in IPPV mode can Flowtrigger be fully switched off (IPPV Assist -> IPPV).

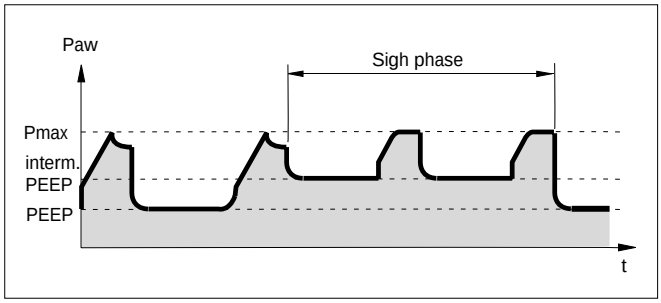
The steepness of the pressure rise from the PEEP level to the inspiration level can be even more closely adapted to the needs of the patient in SIMV and MMV modes by means of the pressure rise time »⩘«.



Start-up procedure with AutoFlow

On switching on the AutoFlow function, Evita 4 applies a volume-controlled ventilation stroke with subsequent inspiratory pause.
The plateau pressure Pplat calculated for this ventilation stroke serves as start-up inspiration pressure for the AutoFlow function.

Sigh



"Sigh« is operative in the form of intermittent PEEP in IPPV, IPPV 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 bronchioles – increased airway pressure maintained over a longer period is required to open them.

In many cases, the sigh function is achieved by increasing the ventilation stroke; however, due to the short time available, the filling of the »slow« alveoli is only marginally improved.

In Evita 4, the sigh operates during expiration with an intermittent PEEP for two ventilation strokes every 3 minutes.

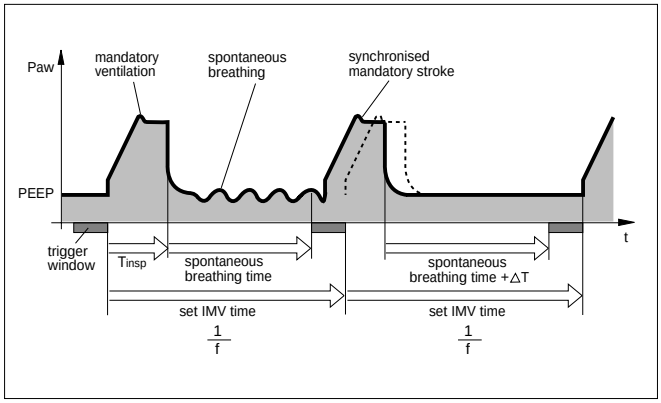
The average airway pressure is higher, and a longer filling time is normally available.

To avoid overinflation of the lung, the pressure peaks during the sigh phase can be limited by pressure limitation, Pmax, without impairing the sigh function.

During the sigh phase, the "Volume not constant" alarm is disabled.

SIMV

Synchronised **I**ntermittent **M**andatory **V**entilation



Combination of machine ventilation and spontaneous breathing.

SIMV enables the patient to breathe spontaneously in regular prescribed cycles, with the mechanical mandatory ventilation strokes providing a minimum ventilation during the remaining cycles.
The minimum ventilation is controlled by the two set values tidal volume (V_T) and ventilation frequency (f) and is determined from the product of V_T x f.

The ventilation pattern results from the set values V_T, Insp. Flow, frequency f and inspiration time T_{insp}.
To prevent the mandatory ventilation stroke being applied during spontaneous expiration, the Flowtrigger of the machine ensures that the ventilation stroke is triggered in synchrony with the patient's spontaneous inspiratory effort within a "trigger window".

The trigger window is 5 seconds long in adult mode and 1.5 seconds long in paediatric mode. If the expiration times are less than 5 seconds or 1.5 seconds, the trigger window covers the entire expiration time.

Since the synchronisation of the mandatory ventilation stroke reduces the effective SIMV time, which would result in an undesirable increase in effective IMV frequency, Evita 4 prolongs the subsequent breathing time by the missing time difference ΔT – thus preventing an increase in SIMV frequency. The frequency parameter f remains constant. This parameter, in combination with the tidal volume V_T, sets the minimum ventilation.
If the inspiratory volume of the patient is considerable at the beginning of the trigger window, the machine reduces the subsequent mandatory ventilation stroke by shortening the time for the inspiratory flow phase and the inspiration time. In this way, the 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 by ASB pressure support.

In the further weaning process, the frequency f on the ventilation unit is further reduced, thereby prolonging the spontaneous breathing time, until finally the required minute volume is entirely covered by spontaneous breathing.

ASB

Assisted **S**pontaneous **B**reathing

Pressure support for insufficient spontaneous breathing.

The function of the machine in assisting insufficient spontaneous breathing is similar to that of the anaesthetist who manually assists and monitors the patient's spontaneous breathing by feeling the breathing bag.

The machine takes over part of the inhalation function, with the patient maintaining control of spontaneous breathing.

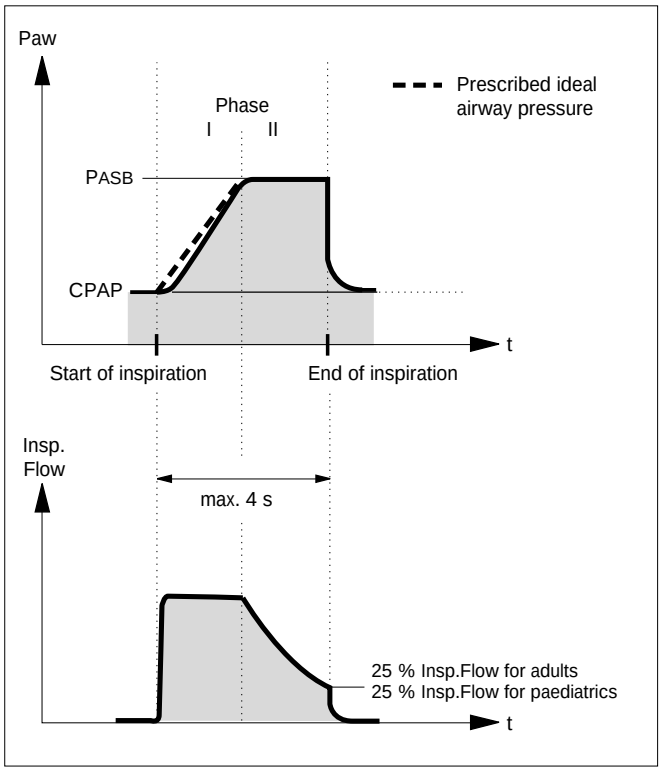
The CPAP system supplies the spontaneously breathing patient with the breathing gas, even if the inspiration effort is weak.

The pressure support of the ASB system is started:

– when the spontaneous inspiration flow reaches the set value of the Flowtrigger, or at the latest
– when the spontaneous inspired volume exceeds 25 mL (12 mL in paediatric mode).

The machine then produces an increase in pressure up to the preselected ASB pressure PASB, which is adjustable to the breathing requirement of the patient.

The time for this pressure increase is adjustable from 64 milliseconds to 2 seconds.



With a rapid increase in pressure ⟋⌞
Evita 4 supports the insufficient spontaneous breathing of the patient with a high peak flow.

With a slow increase in pressure ⟋⌞
Evita 4 begins gently with regular inspiratory flow. The patient has to take over more breathing effort, and tone of breathing muscles improves.

With the patient adjusted pressure increase ⟋⌞ and the present ASB level, the patient's own breathing activity defines the required inspiration flow, which can rise in 8 ms to 2 L/s.

ASB is terminated:

– when the inspiration flow returns to zero during phase I, i.e. when the patient exhales or fights the ventilator,
  or
– when the inspiration flow in phase II falls below a certain ratio of the maximum value previously supplied:
  for adult ventilation: 25 % Insp.Flow
  for paediatric ventilation: 25 % Insp.Flow
  or
– at the latest after 4 seconds (1.5 seconds in paediatric ventilation) if the two other criteria have not come into operation.
  If this 4-second criteria occurs three times in succession, Evita 4 sounds an alarm and warns of a possible leak in the ventilation system.

BIPAP

Biphasic **P**ositive **A**irway **P**ressure

The BIPAP ventilation mode is a pressure/time-cycled ventilation mode in which the patient can always breathe spontaneously. BIPAP is therefore often described as a time-cycled alternation between two CPAP levels.*

The time-cycled change of pressure gives controlled ventilation, which corresponds to pressure-controlled ventilation PCV. However, the constant option of spontaneous breathing allows the transition from controlled breathing to independent spontaneous breathing to take place smoothly via the weaning phase, without requiring any change the ventilation mode. To adapt easily to the patient's spontaneous breathing pattern, the change-over from expiratory pressure level to inspiratory pressure level, and also the change-over from inspiratory pressure level to expiratory pressure level, are synchronised with the patient's spontaneous breathing.

The frequency of the change-over is kept constant, even when synchronisation occurs via a trigger window with fixed time constant.

The trigger window is 5 seconds long in adult mode and 1.5 seconds long in paediatric mode. For expiration times shorter than 5 seconds or 1.5 seconds, the trigger window covers the entire expiration time.
At P_{insp} level, the trigger window is $1/4 \cdot T_{insp}$ seconds long.

As recent clinical research** has shown, this smooth adaptation to the patient's spontaneous breathing requires less sedation, so that the patient returns to spontaneous breathing more rapidly.

As in all pressure-controlled ventilation modes, the patient is not prescribed a fixed tidal volume (V_T). The tidal volume results principally from the pressure difference between the settings for PEEP and Pinsp.

Changes in lung compliance and airways, as well as active breathing by the patient can lead to changes in tidal volume. This is a desired effect in this ventilation mode.

With the knowledge that the tidal volume, and therefore the minute volume, are not constant, the alarm limits for minute volume must be adjusted with care.

The display of the expiratory measured tidal volume V_{Te} must be used to set the required difference between the two pressure levels. Any increase in differential will cause an increased BIPAP ventilation stroke.

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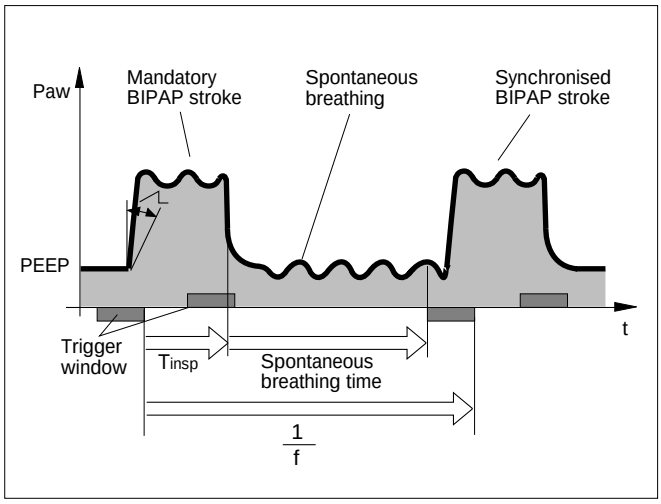
* Bibliography (3), (4), (7), (11), (12), page 160

** Bibliography (8), page 160

Using BIPAP

As with SIMV, the time pattern is set using the basic setting parameters of frequency f and T_I.
The resulting inspiration and expiration times are calculated by Evita 4 and displayed in the lower half of the screen below the curve setting. The lower pressure level is set with the PEEP parameter, while the upper level is set with Pinsp.
When switching over from IPPV to BIPAP mode, only the Pinsp setting needs to be changed.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the setting ⟋⌞. The effective time for the increase in pressure cannot become greater than the set inspiratory time Tinsp.
This precaution ensures that the upper pressure level Pinsp is reached safely during inspiration. The transition from controlled ventilation via the weaning phase to fully spontaneous breathing is achieved by a gradual reduction of inspiratory pressure Pinsp and/or frequency f.



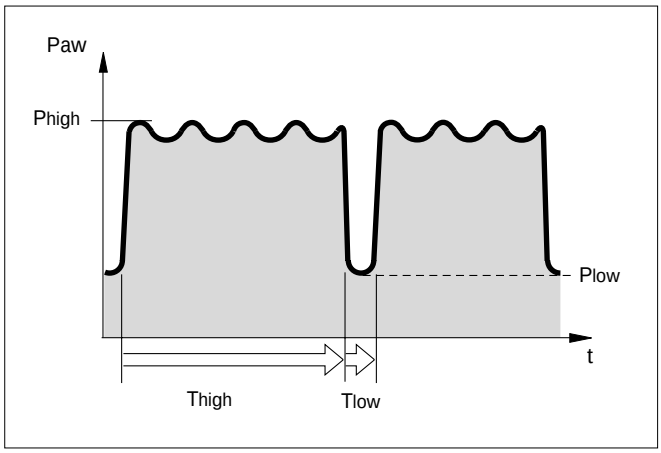
APRV

Airway **P**ressure **R**elease **V**entilation

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 Phigh for an adjustable length of time Thigh. For very short expiration times Tlow, Evita 4 switches to a low pressure level Plow. 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 setting ⟋⌞. The effective time for the increase in pressure cannot become greater than the set time Thigh.



* Bibliography (6), (7), (8), (9), page 160

MMV

Mandatory **M**inute **V**entilation

In contrast to SIMV, the MMV ventilation mode gives mandatory breathing only if spontaneous breathing is not yet sufficient and has fallen below a pre-selected minimum ventilation.
This minimum ventilation is controlled by the two set values tidal volume V_T and frequency f, and results from the product V_T x f.

Unlike SIMV, the mandatory strokes are not given regularly but only in cases of insufficient ventilation.

The frequency of mandatory strokes is determined by the level of spontaneous breathing: if spontaneous breathing is sufficient, mandatory strokes are not used.
If spontaneous breathing is not sufficient, intermittent mandatory strokes of the set tidal volume V_T are applied.
If there is no spontaneous breathing at all, the mandatory strokes are applied at the set frequency f.

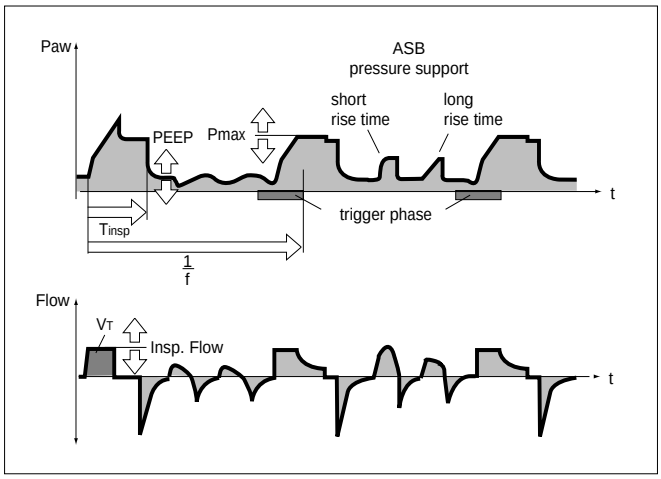
Evita 4 continuously balances the difference between spontaneous breathing and the set minimum ventilation. As soon as the balance becomes negative, because spontaneous breathing is no longer sufficient, Evita 4 applies a mandatory ventilation stroke at the set tidal volume V_T, so that the balance is again positive.

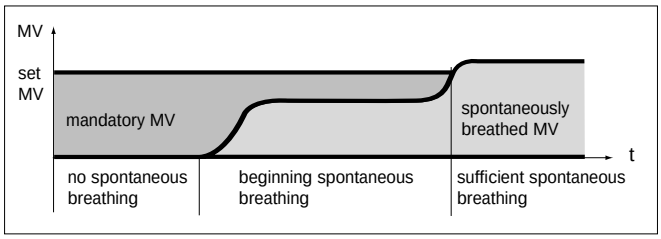
Experience shows, patients breathe very irregularly. Phases of weak breathing alternate with phases of heavy breathing. In order to allow for these individual fluctuations, the balancing process also takes account of the extent by which the set minimum ventilation has been exceeded.
This positive allowance is progressively reduced to zero by Evita 4 within a maximum of 7.5 seconds after apnoea.

In other words, the response time of Evita 4 before activating mandatory ventilation is automatically adapted to the preceding cycle of spontaneous breathing:

If this spontaneous breathing was close to the minimum ventilation, the machine responds rapidly within the IMV time. By contrast, if the patient's spontaneous breathing was much higher than the set minimum ventilation, Evita 4 tolerates a longer breathing pause. In extreme cases of sudden apnoea after a phase of heavy 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, Evita 4 triggers an apnoea alarm that is cancelled again as soon as the mandatory ventilation strokes have been applied. If the IMV is set to a longer period than the T_{apnoea} alarm limit, and if there is no spontaneous breathing between the mandatory ventilation strokes, the apnoea alarm will be regularly triggered.

Example: f = 3/min ≙ IMV time = 20 seconds
T_{apnoea} ≙ 15 seconds

This system is designed to prevent mandatory ventilation being prematurely triggered in the event of irregular spontaneous breathing, whilst at the same time giving an alarm for any long period of low ventilation.

Flow measurement

Regardless of whether ventilation is volume-controlled or pressure-controlled, positive pressures are generated in both the breathing system and patient lung during the inspiration phase.
Depending on the ratio of lung compliance to hose system compliance, the volume delivered by the ventilator is distributed to the patient's lung and to the hose system installed between the ventilator and patient.
Deviations in the measured expiration flow and derived values, such as the minute volume and breath volume, are low for adult patients, due to their relatively high lung compliance in relation to the much lower compliance of the ventilation hoses.

However, since only the volume attained and surrendered by the lung is relevant to the efficiency of ventilation, and since higher differences are possible during paediatric ventilation, Evita 4 provides basic compensation for hose compliance during ventilation.

Compensation of the effect of hose system compliance

During the device check before ventilation, Evita 4 determines the compliance of the ventilation hoses, and then, during ventilation, compensates for the effect of compliance on volumetric flow measurement.

Depending on the airway pressure, Evita 4 increases the tidal volume by the amount that remains in the ventilation hoses.

In addition to hose system compliance, flow/volume measurement is influenced by the environmental factors of temperature and humidity and by leaks in the hose system.
Evita 4 takes these factors into account and corrects the settings and measured values accordingly.

Conversion according to ambient conditions

The volume occupied by a gas depends on the ambient conditions of temperature, pressure and humidity.
In lung physiology, the minute volume and tidal volume are related to the ambient conditions in the lung:
37 °C body temperature, pressure in the lung,
100 % relative humidity.

The flow and volume values measured under these conditions are marked with BTPS*. On the other hand, medical gases from cylinders or from the central supply are dry (approx. 0 % r.h.) and are delivered by the ventilator at 20 °C. The flow and volume values measured under these conditions are marked NTPD**. The difference between measured values under NTPD and BTPS conditions is typically approx. 12 %.

Example: a tidal volume of 500 mL NTPD is increased to 564 mL BTPS by heating to 37 °C and humidifying to 100 % r.h..
Evita 4 delivers the tidal volume after conversion, so that the set tidal volume is effective in the lung under BTPS conditions.

Compensation for leakage

Evita 4 determines the difference between the delivered flow on the inspiration side and the measured flow on the expiration side.
This difference provides a measure of the amount of leakage and is displayed by Evita 4 as the leakage minute volume MV_{Leak}. Evita 4 can compensate for this leakage in volume controlled ventilation.

Example:
Tidal volume setting V_T = 500 mL, 10 % leakage in tube.

Without leakage compensation:
Evita 4 delivers 500 mL. 50 mL escape as leakage during inspiration, and 450 mL reach the lung. 450 mL are expired, and 45 mL again escape as leakage.
A tidal volume of 405 mL is measured on the expiration side.
With a ventilation rate of 10 strokes per minute, a minute volume of 5.0 L/min is delivered on the inspiration side and a minute volume of 4.05 L/min is measured on the expiration side. The lung is ventilated with an MV of 4.5 L/min.

With leakage compensation:
With automatic leakage compensation, Evita 4 does not deliver 500 mL but, on the basis of the measured leakage minute volume, 555 mL. 500 mL enters the lung, and the inspiratory tidal volume V_{Ti} is 500 mL.
The volume of 450 mL measured on the expiration side is corrected by the leakage volume. The displayed tidal volume VTE is 500 mL. The minute volume measured on the expiration side is 4.5 L/min. It is deliberately not compensated.
Otherwise, the alarm for a low minute volume could be inhibited by the expiratory leakage compensation. Evita 4 must always emit an alarm if the minute volume is too low.

* BTPS = Body Temperature, Pressure, Saturated.

** NTPD = Normal Temperature Pressure Dry.

The above example has been simplified:
In fact, the calculated leakage correction takes into account the pressures in the hose system. A higher percentage volume is lost on the inspiration side than on the expiration side because the pressure during inspiration is higher. The displayed leakage minute volume MV_{Leak} is based on the mean pressure P_{mean}. The leakage minute volume MV_{Leak} also takes the inspiratory leaks into account. Consequently, the sum of the minute volume MV + the leakage minute volume MV_{Leak} is greater than the inspiratory minute volume delivered to the patient.

Unlimited volume compensation is inappropriate. The effective range for automatic volume compensation differs for adults and paediatric mode:
In adult ventilation, Evita 4 compensates for losses of up to 25 % of the set tidal volume VT. In paediatric mode, Evita 4 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 if the hose system is leakproof.

Special Procedures

Occlusion pressure

Breathing drive can be measured at the start of inspiration by measuring the mouth pressure during a short-term occlusion: within 100 ms, the pressure is not influenced by physiological compensation reaction (e.g. reflected breathing stop or increased breathing drive). This pressure is always dependent on 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 mbar. A higher P 0.1 signifies a high breathing drive which can only be maintained for a limited period. P 0.1 values about –6 mbar, e.g. for a COPD** patient, indicate impending exhaustion (RMF – respiratory muscle fatigue).

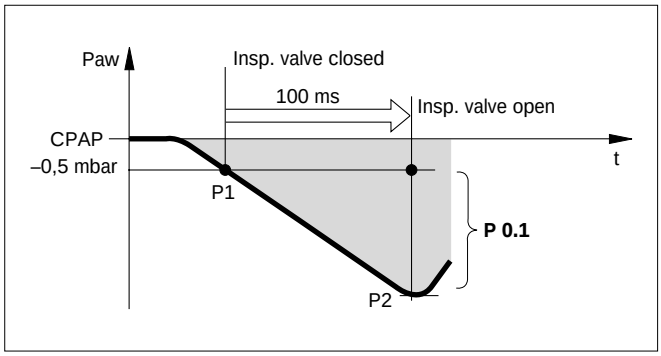
When weaning COPD patients off the Ventilator, measurement of P 0.1 can define the weaning point.

To measure P 0.1, Evita 4 keeps the inspiratory valve closed after one expiration and measures the airway pressure produced by the inspiratory effort during 100 ms (P1).

The 100 ms time interval starts when a negative pressure of –0.5 mbar 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 normally again.

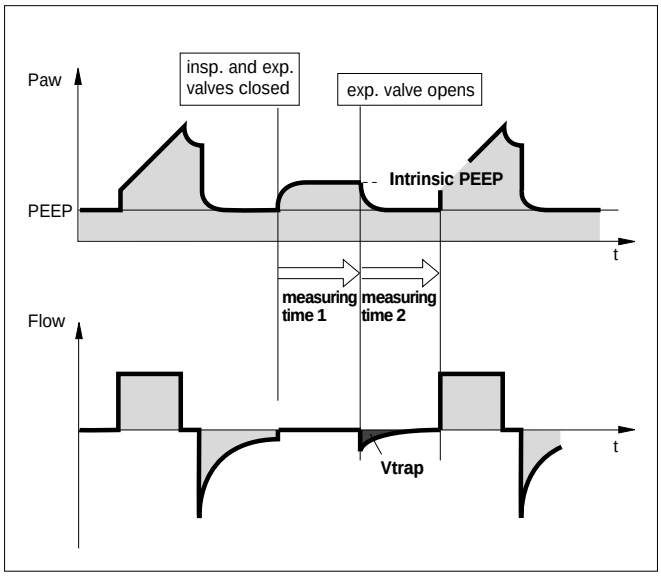
The occlusion pressure P 0.1 is the difference between the pressure values P2 – P1.



* Bibliography (10), (15), page 160

** COPD = Chronic Obstructive Pulmonary Disease

Intrinsic PEEP



Evita 4 keeps the inspiratory valve and expiratory valve closed during measuring time 1, so that it is impossible for gas either to flow into the ventilation system from inspiration or to escape from it. During this closed phase, pressure is equalised between the lungs and the ventilation system. Evita 4 measures the pressure curve. Measuring phase 1 is ended:

– when there is no further change in the pressure curve but at the earliest after 0.5 seconds.
– at the latest after 3 seconds in adult mode and after 1.5 seconds in paediatric mode.

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 time 1, Evita 4 opens the expiration valve and measures the expiratory flow generated by Intrinsic PEEP during a defined measuring time 2. During this period, the lung is depressurised to PEEP. Measuring phase 2 is ended:

– when the expiration flow has returned to 0 but at the earliest after 0.5 seconds.
– at the latest after 7 seconds in adult mode or after 3.5 seconds in paediatric mode.

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 paediatric ventilation	max. 1.5 seconds

Measuring times of the measuring phase 2 for V_{trap}:

For adult ventilation	max. 7 seconds
For paediatric ventilation	max. 3.5 seconds

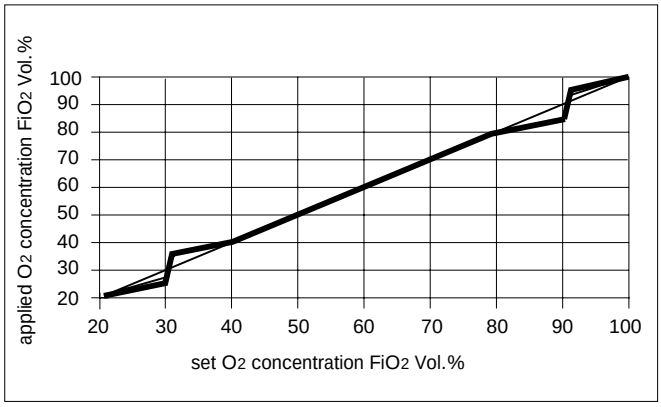
Insp. O_2 concentration during medicament nebulisation

Use only medicament nebuliser 84 12 935 (white central section).

If other medicament nebulisers are used, considerable deviations may occur in the tidal volume and the inspiratory O_2 concentration.

To minimise the deviation from the set O_2 concentration, Evita 4 uses a mixed gas to drive the medicament nebuliser.
In adult ventilation, this mixed gas is generated by switching over between compressed gases (medical air and oxygen) in synchronisation with inspiration.
In paediatric ventilation, the nebuliser is operated continuously, with medical air or oxygen in alternation. The drive gas of the medicament nebuliser therefore roughly corresponds to the set FiO_2.

The graph shows the possible deviations of the applied O_2 concentration as a function of the set FiO_2 with a minimal inspiratory flow (15 L/min) in adult ventilation or at ventilation frequencies above 12 bpm in paediatric ventilation.



Abbreviations and Symbols

Abreviation	Definition
APRV	**A**irway **P**ressure **R**elease **V**entilation Spontaneous breathing at continuous positive airway pressure with short-term pressure release
ASB	**A**ssisted **S**pontaneous **B**reathing Pressure supported spontaneous breathing
BIPAP	**BI**phasic **P**ositive **A**irway **P**ressure Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
bpm	breaths per minute
BTPS	**B**ody **T**emperature, **P**ressure. **S**aturated Measured values based on the condition of the patient's lungs, with body temperature 37 ºC, steam-saturated gas, atmospheric pressure
C	Compliance
CPAP	**C**ontinuous **P**ositive **A**irway **P**ressure Breathing with continuous positive pressure in the airways
etCO_2	End-expiratory CO_2 concentration
FeCO_2	Expiratory CO_2 concentration
f	Frequency
f_{apnoea}	Frequency setting for apnoea ventilation
f_{mand}	Mandatory mechanical portion of overall breathing frequency
f_{spn}	Spontaneous breathing portion of overall breathing frequency
Fail to cycle	Breathing cycle failure. Machine detects no inspiration
FiO_2	Inspiratory O_2 concentration
Flow	Set value of the maximum inspiratory flow
$Flow_{Trig}$	Set value of the flow trigger threshold
ILV	**I**ndependent **L**ung **V**entilation Ventilation with 2 ventilators, 1 for each lung
Int. PEEP	Intermittent Positive End-Expiratory Pressure = Sigh
IPPV	**I**ntermittent **P**ositive **P**ressure **V**entilation
$IPPV_{Assist}$	Trigger Assist Intermittent Positive Pressure Ventilation
IRV	**I**nversed **R**atio **V**entilation Ventilation with inversed inspiration/expiration ratio
ISO 5369	International standard for mechanical ventilators – "Lung Ventilation"
I:E	Ratio of Inspiration to Expiration

Abreviation	Definition
body Wt	Body weight (kg)
MMV	**M**andatory **M**inute Volume **V**entilation
MV	**M**inute **V**olume
MV_{Leak}	Leakage minute volume
MV_{spn}	Spontaneous breathed minute volume
O_2	Set value for inspiratory oxygen concentration [Vol.%]
P 0.1	100 ms occlusion pressure
P_{ASB}	Set value of ASB pressure support
P_{aw}	Airway pressure
PEEP	**P**ositive **E**nd-**E**xpiratory **P**ressure
$PEEP_i$	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 BIPAP
P_{low}	Set value of the lower pressure level in BIPAP
P_{max}	Set value for pressure limited ventilation
P_{Mean}	Mean airway pressure
PLV	**P**ressure **L**imited **V**entilation
P_{peak}	Peak pressure
P_{Plat}	End-inspiratory airway pressure
R	Resistance
SIMV	**S**ynchronized **I**ntermittent **M**andatory **V**entilation
T	Inspiratory breathing gas temperature
T_e	Expiration time
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
$\dot{V} CO_2$	CO_2 production [L/min]
V_{ds}	Serial dead space
V_{ds}/V_T	Fraction of dead space to
V_T	Setting for tidal volume
VT_{apnoea}	Setting for tidal volume of apnoea ventilation
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.

Symbol	Definition
	Switch medicament nebuliser on / off
	Switch oxygen enrichment for bronchial suction on / off
	Manual expiration
	Manual inspiration
	Manual printer logging
	Switch help function on / off
	"Freeze" curves in screen
	Back to standard page
	Cancel acoustic alarm for 2 minutes
	Alarms
	Standby / Operation
	Select other measured value combination
	Select other curve(s)
	Time setting for pressure increase during PASB
	Lower / upper alarm limit
	Observe Instructions for Use!
	Protection class I, Type B
	Type BF
	Insert flow sensor
	Unlocking expiration valve
A 	patient mode adults
P	patient mode paediatric
	spontaneous breathing activity by the patient

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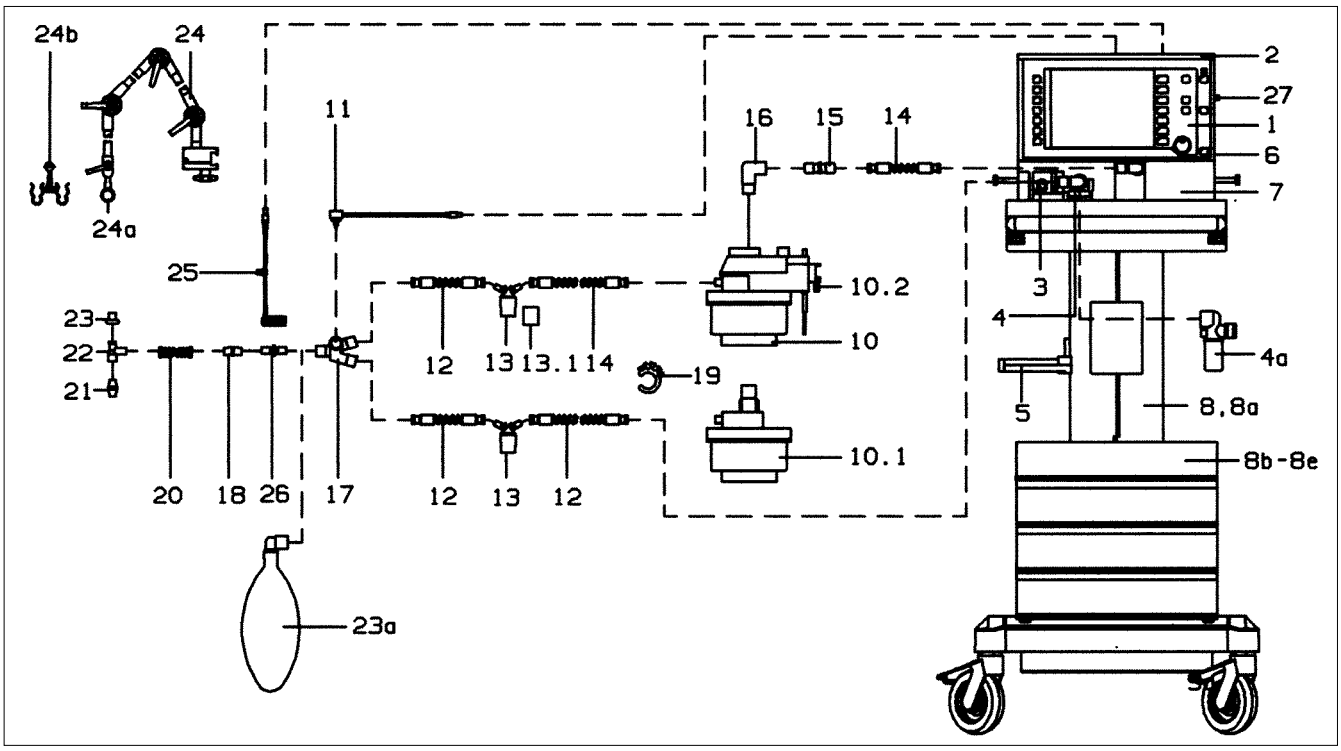
Parts List

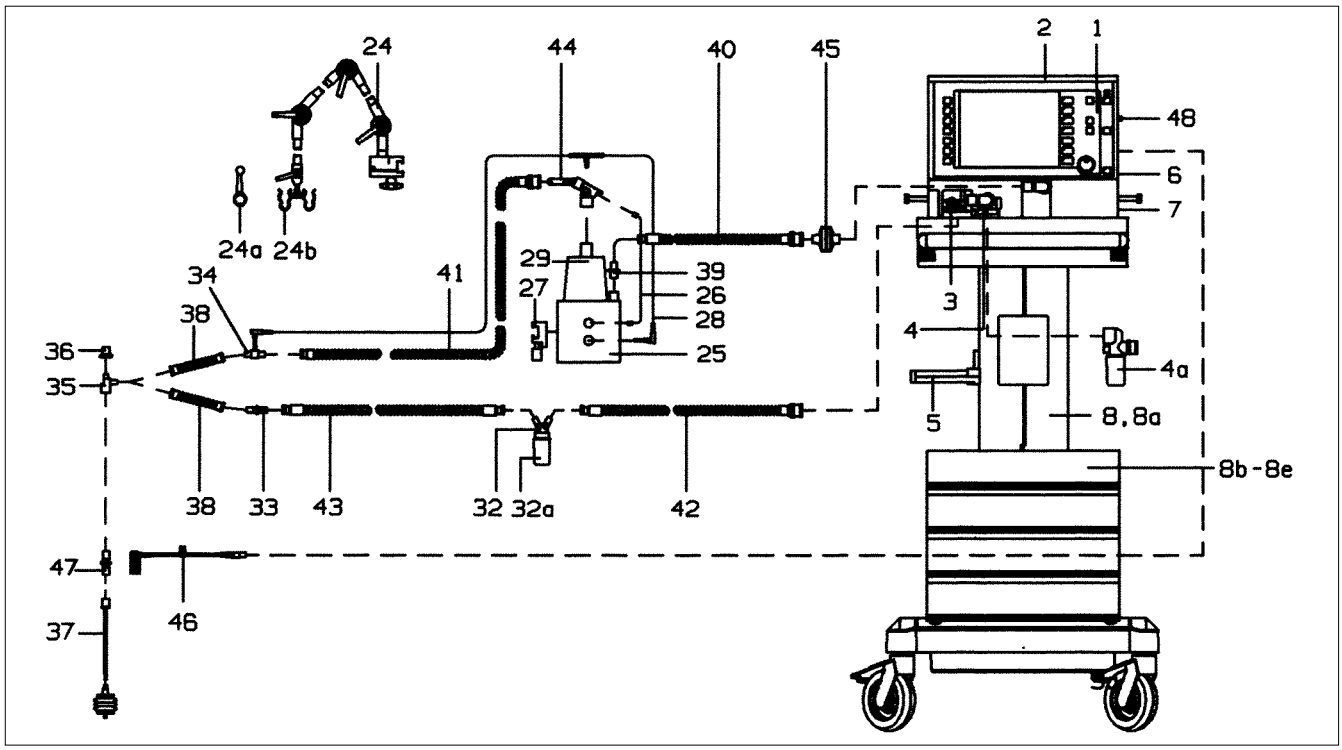
For adults ventilation



Item No.	Name/Description	Order No.
1	Evita 4	84 11 900
2	Instrument tray	84 12 723
3	Flow sensor (set of 5)	84 03 735
4	Expiration valve (patient system)	84 10 580
5	Bracket (for Aquapor)	84 11 956
6	O_2 sensor housing	68 50 645
7	Ambient-air filter	84 12 384
7a	Cooling-air filter (back of Evita 4, not illust.)	84 12 384
8	"EvitaMobil" trolley (high)	84 11 950
8a	"EvitaMobil" trolley (low)	84 11 965
8b	Cabinet 8H, 360 mm high (4 drawers)	M 31 796
8c	Cabinet 4H (2 drawers) (not illust.)	M 31 795
8d	"EvitaMobil" cylinder holder set (not illust.)	84 11 970
8e	Breathing air compressor (not illust.)	84 13 890
10	Aquapor (220 – 240 V)	84 05 020
	Aquapor (110 V)	84 05 199
10.1	Patient part, Aquapor	84 05 029
10.2	Set of spare brackets	84 03 345
11	Temperature sensor	84 05 371
12-23	Hose set, adult (blue socket)	84 12 092
12	Spiral hose adult, silicone 0.6 m	21 65 627

Item No.	Name/Description	Order No.
13-13.1	Water traps	84 04 985
13.1	Water container	84 03 976
14	Spiral hose adult, silicone 0.35 m	21 65 619
15	Connector	M 25 647
16	ISO elbow connector	M 25 649
17	Y-piece, straight	84 05 435
18	Catheter connector, straight, size 12.5 (set of 10)	M 23 841
19	Hose clamp	84 03 566
20	Corrugated hose	84 02 041
21	Catheter connector, adult Set of catheter connectors, adult Sizes 6 to 12 (set of 12)	84 03 685
22	Adaptor, adult	84 03 076
23	Cap (set of 5)	84 02 918
23a	Adult test lung (bag)	84 03 201
24-24b	Hinged arm	84 09 609
or	Quick-fix hinged arm 2	2M 85 706
24a	Bracket	84 09 746
24b	Hose clamp	84 09 841
25	CO_2 main flow sensor	68 70 300
26	Cuvette, adult	68 70 279
27	Holder for parking CO_2 sensor	84 12 840

For paediatric ventilation



Item No.	Name/Description	Order No.
1	Evita 4	84 12 800
2	Instrument tray	84 12 723
3	Flow sensor (set of 5)	84 03 735
4	Expiration valve (patient system)	84 10 580
5	Bracket (for Aquapor)	84 11 956
6	O_2 sensor housing	68 50 645
7	Ambient-air filter	84 12 384
7a	Cooling-air filter (back of Evita 4, not illust.)	84 12 384
8	"EvitaMobil" trolley (high)	84 11 950
8a	"EvitaMobil" trolley (low)	84 11 965
8b	Cabinet 8H, 360 mm high (4 drawers)	M 31 796
8c	Cabinet 4H (2 drawers) (not illust.)	M 31 795
8d	"EvitaMobil" cylinder holder set (not illust.)	84 11 970
8e	Breathing air compressor (not illust.)	84 13 890
24-24b	Hinged arm	84 09 609
or	Quick-fix hinged arm 2	2M 85 706
24a	Bracket	84 09 746
24b	Hose clamp	84 09 841
26-28	Humidifier, basic unit MR 730 (Fisher & Paykel)	84 11 046
26	Hose heater adapter	84 11 097
27	Mounting set (clamps for rail)	84 11 074
28	Double temperature sensor	84 11 048
29-30	Humidifier chamber MR 340	84 11 047

Item No.	Name/Description	Order No.
30	Filter paper (set of 200, not illustr.)	84 11 073
31	Single-strand wire 1.5 m (not illustr.)	84 11 050
32-43	Hose set, paediatrics (Fisher & Paykel)	84 12 081
32-32a	Condensation trap, expiration	84 09 627
32	Water container	84 03 976
33	Double conical connector	84 09 897
34	Temperature sensor mounting	84 11 044
35	Adapter K90	84 03 075
36	Cap	84 01 645
37	Bellows, paediatric, complete	84 09 742
38	Corrugated hose, flex, 0.13 m	84 09 634
39	Catheter connector, size 11	M 19 351
40	Spiral hose, paediatric, silicone 22/10, 0.40 m	21 65 856
41	Spiral hose, paediatric, silicone 22/10, 1.10 m	21 65 651
42	Spiral hose, paediatric, silicone 10/10, 0.60 m	21 65 821
43	Spiral hose, paediatric, silicone 10/10, 0.60 m	21 65 848
44	Hose heater 1.10 m	84 11 045
45	Bacterial filter	84 09 716
46	CO_2 main flow sensor	68 70 300
47	Cuvette, paediatrics	68 70 280
48	Holder for parking CO_2 sensor	84 12 840

Order List

Name/Description	Order No.
Basic unit	
Evita 4	84 11 900
Accessories required for operation	
Hinged arm or	84 09 609
Quick-fix hinged arm 2	2M 85 706
O_2 connecting hose 3 m, blue or	M 29 231
O_2 connecting hose 5 m, blue or	M 29 251
O_2 connecting hose 3 m, neutral colour or	M 34 403
O_2 connecting hose 5 m, neutral colour	M 34 404
Medical air connecting hose 3 m, yellow or	M 29 239
Medical air connecting hose 5 m, yellow or	M 29 259
Med. air connect. hose 3 m, neutral colour or	M 34 408
Med. air connect. hose 5 m, neutral colour	M 34 409
Trolley	84 11 680
For adult ventilation	
Temperature sensor	84 05 371
Aquapor humidifier	84 05 020
Set of spare brackets	84 03 345
Hose set, adult consisting of: patient hoses, water traps, Y-piece, catheter connectors	84 12 092
For paediatric ventilation	
Humidifier, basic unit, MR 730 (Fisher & Paykel), incl. adaptor, hose heater	84 11 097
Mounting set (rail brackets)	84 11 074
Humidifier chamber, MR 340	84 11 047
Double temperature sensor	84 11 048
Single-strand wire, 1.5 m	84 11 050

Name/Description	Order No.
Hose set, paediatric (Fisher & Paykel) consisting of: hose heater 84 11 045, patient hoses, water traps, Y-piece, catheter connectors	84 12 081
Bacterial filter	84 09 716
For CO_2 measurement	
Test filter	68 70 281
Calibration set	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 trolley	84 08 613
Pneumatic medicament nebuliser	84 12 935
For manual ventilation:	
Resutator 2000	21 20 046
Child Resutator 2000	21 20 984
Baby Resutator	21 20 941
Hook for Resutator	M 26 349
Adult test lung	84 03 201
"EvitaMobil" trolley (high)	84 11 950
"EvitaMobil" trolley (low)	84 11 965
For trolley:	
Cabinet 8H, 360 mm high (4 drawers)	M 31 796
Cabinet 4H (2 drawers)	M 31 795
"EvitaMobil" cylinder holder set	84 11 970
Set of cabinet mountings for trolley	84 09 018
Modification set – socket strip	84 11 969
Breathing air compressor for supplying Evita 4 with medical air	84 13 890
MEDIBUS cable	83 06 488
Printer cable	83 06 489
Water trap for expiration valve	84 13 125

Name/Description	Order No.
Options	
Modification set – communications	84 11 735
Modification set – SpO_2 measurement	84 13 035
Modification set – DC power unit	84 13 034
Modification set – NeoFlow	84 13 563
Modification set – Breathing Support Package	84 13 562
Spare set for sterilisation	
Expiration valve (patient system)	84 10 580
Water trap for expiration valve	84 13 125
For adult ventilation:	
Hose set, adult	84 06 550
Patient part for Aquapor	84 05 029
Temperature sensor	84 05 371
Pneumatic medicament nebuliser	84 12 935
Cuvette, adult	68 70 279
For paediatric ventilation:	
Hose set, paediatric (Fisher & Paykel)	84 12 082
Humidifier chamber MR 340	84 11 047
incl. filter paper for humidifier chamber (set of 100)	
Cuvette, paediatric	68 70 280
Replacement parts	
For Evita 4:	
O_2 sensor capsule	68 50 645
Flow sensor (set of 5)	84 03 735
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
For adult ventilation:	
Temperature sensor	84 05 371
Replacement set of lids for Aquapor	84 06 135
Aquapor bowl	84 05 739
Float for Aquapor	84 04 738
Spiral hose, adult, silicone 0.6 m	21 65 627
Spiral hose, adult, silicone 0.35 m	21 65 619
Water traps	84 04 985
Water container	84 03 976
Hose clamp	84 03 566
Connector	M 25 647
Y-piece	84 05 435

Name/Description	Order No.
Catheter connector, straight, size 12.5 (set of 10)	M 23 841
Corrugated hose	84 02 041
Adaptor, adult	84 03 076
Set of catheter connectors, adult	84 03 685
Set of caps (set of 5)	84 02 918
ISO elbow connector	M 25 649
Cuvette, adult	68 70 279
For paediatric ventilation:	
Spiral hose, paediatric, silicone, 22/10, 1.10 m	21 65 600
Spiral hose, paediatric, silicone, 22/10, 0.60 m	21 65 821
Spiral hose, paediatric, silicone, 10/10, 0.60 m	21 65 848
Spiral hose, paediatric, silicone, 10/10, 0.40 m	21 65 856
Corrugated hose flex 0.13 m	84 09 634
Catheter connectors, size 11 (set of 10)	M 19 490
Cap	84 01 645
Adaptor, paediatric 90°	84 03 075
Double conical connector	84 09 897
Temperature sensor mounting	84 11 044
Condensation trap, expiration	84 09 727
Water container	84 03 976
Hose heater 1.10 m	84 11 045
Double temperature sensor	84 11 048
Adaptor for hose heater	84 11 097
Single-strand wire, 1.5 m	84 11 050
Humidifier chamber MR 340 incl. filter paper (set of 100)	84 11 047
Filter paper for humidifier chamber (set of 100)	84 11 073
Bacterial filter	84 09 716
Cuvette, paediatric	68 70 280

Technical documentation available on request

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These Instructions for Use apply only to
Evita 4
with Serial No.:

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

CE 0123
Directive 93/42/EEC
concerning Medical Devices

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