

MAQUET

SERVO VENTILATOR 300/300A OPERATING MANUAL 8.1/9.1

CRITICAL CARE



Important

The Servo Ventilator 300/300A is not designed to withstand severe negative pressures. If a negative suction pressure exceeding 100 cm H₂O (-100 cm H₂O) is applied to the system, the pressure transducers may be damaged causing the system to become inoperable.

Observe the following for the Servo Ventilator 300/300A.

When using closed system suctioning:

- If the suctioning flow is higher than that which is delivered by the ventilator, a negative pressure may be generated which will be applied to the lung and the ventilator breathing system.
- Do not use the Stand by position, Inspiratory pause hold, or Expiratory pause hold during the closed suctioning procedure.

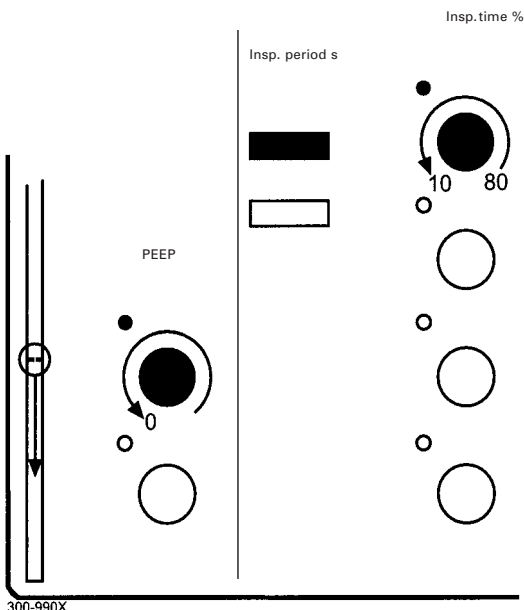
Function test for "Insp. time %" and "PEEP" potentiometers

Insp. time %

- Set "Insp. tid %" to 80 %.
- Turn the knob **slowly** counter-clockwise to 10% simultaneously watch the reading on the display "Insp.period s". The reading must decrease evenly, digit by digit, without any sudden jumps (up or down).
- Set "Insp. time %" back to 25 %.

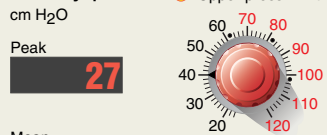
PEEP

- Set "PEEP" to 50 cm H₂O.
- Turn the knob **slowly** counter-clockwise to 0 cm H₂O. Simultaneously watch the two diodes showing preset PEEP as well as the two diodes showing actual pressure on the "Airway pressure" bargraph. The values indicated must follow each other evenly, decreasing step by step, without any sudden jumps (up or down).



- Adult
- Pediatric
- Neonate

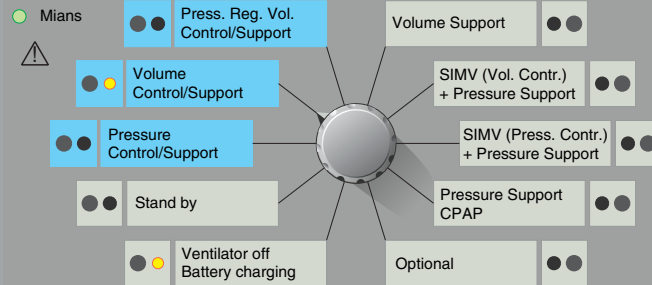
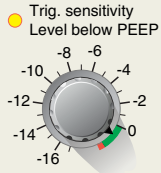
Airway press.



Mean **18**

Pause **21**

End. Exp. **5**

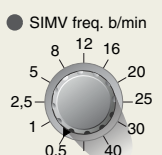


Measured freq. b/min **20**

Set freq. b/min **20**

Insp. period s **1.06**

Insp. flow l/s **0.68**



Volume

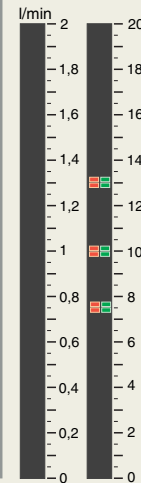
Tidal vol. ml **500**

Minute vol. l/min **10.0**

Insp. tidal vol. ml **499**

Exp. tidal vol. ml **498**

Exp. minute vol. l/min **9.9**



O₂ conc. %



● Oxygen breath running

Oxygen breaths

Start breath

Automode

● On

● Off

● Support

Alarms and messages

02 40 %

- Airway Pressure
- O₂ concentration
- Exp. minute volume
- Apnea
- Gas supply
- Battery
- Technical

Reset

2 min

Pause hold

Insp.

Exp.

SIEMENS

Servo Ventilator 300 A

General information

- The symbol \triangle on the unit means: Attention, consult accompanying documents.
- The information in this Operating Manual is valid for Servo Ventilator 300 8.1 and Servo Ventilator 300/300A 9.1 unless stated otherwise.
- The Servo Ventilator 300/300A must be operated only by authorized personnel who are well trained in its use. It must be operated according to the instructions in this Operating Manual.
- The Servo Ventilator 300 can have different software versions lower than 8.0 with corresponding versions of the Operating Manual. Before use, make sure the information on the label on the control unit corresponds to the version number on the Operating Manual.
- After unpacking, perform a function check and, if necessary, a calibration.
- All data on pressures for Servo Ventilator 300/300A are given in cm H₂O.
1 kPa (kilopascal) \approx 10 cm H₂O
100 kPa = 1 bar \approx 1 atm \approx
1 kgf/cm² (kp/cm²)
100 kPa \approx 15 psi
- Responsibility for the safe functioning of the equipment reverts to the owner or user in all cases in which service or repair has been done by a non-professional or by persons who are not employed by or authorized by MAQUET, and when the equipment is used for other than its intended purpose.
- Documentation for the Servo Ventilator 300/300A consists of:
 - Operating Manual
 - Service Manual
 - Spare Parts Catalogue
 - Circuit Diagram


Connection

- A pre-use check must always be done before connecting the ventilator to a patient.
- When connected to a patient, the ventilator must never be left unattended.
- Accessories and auxiliary equipment must not be connected or disconnected during operation or when the ventilator is connected to mains. Such connection or disconnection may interfere with the functioning of the ventilator.
- All gases must fulfill the specifications for medical grade gas. The gases supplied must be free from water, oil and particles.

Air	H ₂ O < 5 mg/m ³
	Oil < 0.5 mg/m ³
Oxygen	H ₂ O < 20 mg/m ³

Operation

- To protect the patient against high airway pressures, the "Upper press. limit" must always be set according to the operating instructions so as to provide adequate patient safety.
- The "Upper alarm limit" and "Lower alarm limit" for minute volume must always be set according to the operating instructions so as to provide adequate patient safety.
- If a Bi-Phasic Ventilation Module for SV 300 is connected to a Servo Ventilator 300A the "Automode" must be turned off.
- The "Automode" must be turned off if two SV 300A are connected with a synchronization cable for Master-Slave application.
- During operation the water traps must be checked regularly and if necessary emptied.

-  The device complies with the 0413 requirements of the Medical Device Directive 93/42/EEC.
- Regarding electromagnetic compatibility it is the responsibility of the user to take necessary measures in order to ascertain that the specified limits are not exceeded as this may impair the safety of the ventilator.

Such measures should include, but are not limited to:

- Normal precautions with regard to relative humidity and conductive characteristics of clothing in order to minimize the build-up of electrostatic charges.
- avoiding the use of radio emitting devices in close proximity to the ventilator, such as high-frequency surgery apparatus or cordless (mobile) telephones, resulting in a field level exceeding 3 V/m (IEC 601-1-2)
- Magnetic fields of MR equipment having flux densities above 20 mT may cause deactivation of the ventilator functions and may result in permanent damage to the Servo Ventilator.
- The apnea alarm is not intended to and will not monitor for disconnections.
- The apnea alarm is not functional in the modes "Volume Control/Support", "Pressure Control/Support", or "Pressure Reg. Volume Control/Support".
- As an extra safety a resuscitator must always be readily accessible.
- This lung ventilator is not intended to be used with any anesthetic agents.
- Antistatic or electrically conductive breathing tubes should not be used with this lung ventilator.

Service

- The Servo Ventilator 300/300A must be serviced at regular intervals by specially trained personnel. Any maintenance must be noted in a log book provided for that purpose in accordance with national regulations. We recommend that service is done as a part of a service contract with MAQUET.
- A 1000 hour overhaul must be performed after 1000 hours of operation or, at the latest, every six months. In addition, the ventilator shall undergo a technical safety check (Function check) twice a year, at six month intervals or according to national regulations.
- A 3000 hour overhaul must be performed after every 3000 hours of operation or, at the latest, once every year.
- The internal battery shall be replaced every 3 years according to instructions in the Service Manual. The batteries can only be guaranteed if they are used only as a back-up at mains failure approx. 30 min.
- Service and repair of the ventilator may be done only by MAQUET-authorized personnel.
- Only original parts from MAQUET must be used in the ventilator.



- Old non-functioning batteries O₂ cells must be returned to the place of purchase or to a place where they can be disposed of properly. Batteries and O₂ cells must not be disposed of with ordinary waste.

Cleaning

- The ventilator must not be gas sterilized.
- The flow transducer must not be cleaned in a dish washing machine, by ultrasonic methods or by using agents that contain aldehydes.
- Agents used for cleaning must have a pH between 4 – 8.5.
- Complete cleaning should be done after every 3000 hours of operation or, at the latest, once every year according to chapter 3000 hour overhaul with complete cleaning.

Accessories and auxiliary equipment

- Only accessories, supplies or auxiliary equipment ("Products and accessories" catalogs 64 74 725 E323E, 64 74 717 E323E and "Spare and exchange parts" catalog 90 34 570 E323E including "Supplement for Spare Parts" 64 08 822 E404E) should be connected to or used in conjunction with the ventilator.
Warning: Use of accessories and auxiliary equipment other than those specified in the documents mentioned above may result in degraded performance and safety of the ventilator.
 - If a Bi-Phasic Ventilation Module for SV 300 is connected to a Servo Ventilator 300A the "Automode" must be turned off.
 - Values measured at the signal outputs of the Servo Ventilator 300/300A and which have been processed in auxiliary equipment must not be used as a substitute for therapeutic or diagnostic decisions. Such decisions can be made only by staff with medical expertise, according to established and accepted practice. If auxiliary equipment that has not been manufactured by MAQUET is used, MAQUET denies all responsibility for the accuracy of signal processing.
- If there should be any deviation between information shown on the front panel of the ventilator and that shown by the auxiliary equipment, the ventilatory parameters shown on the front panel shall be considered the primary source for information. It is the responsibility of the user to ensure that any accessories, supplies and auxiliary equipment are compatible with the ventilator and that their use does not affect the normal functionality of the ventilator. In case of doubt, contact a MAQUET representative. Accessories, supplies and auxiliary equipment that are not compatible with Servo Ventilator 300/300A may interfere with the functioning of the ventilator.
 - If a front panel cover is used, **do not** attach anything (e.g. stickers) on the cover. Vital information can then be hidden impairing patient safety.

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The Servo Ventilator 300/300A is the main part of the **System SV 300**, a versatile system for the critically ill patient.

This system offers a wide range of products and accessories, e.g., carts, breathing systems, compressors, external power supply, humidifiers, a screen for graphical presentation of curves and loops, nebulization and CO₂ measurements.

For additional information about accessories, contact your MAQUET representative or see our catalog "Products and accessories".

To help you use the System SV 300 to its fullest potential a comprehensive series of educational materials is available. This includes a set of Pocket Guides covering clinical as well as technical aspects, a clinical workbook including cases, several video programs and scientific publications.

The educational materials are constantly being improved and extended. For more information contact your MAQUET representative.

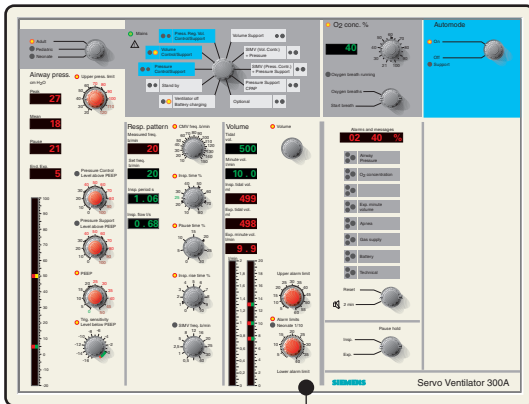
Servo Ventilator 300A

The Servo Ventilator 300A is a lung ventilator intended for adult, pediatric and neonatal patients.

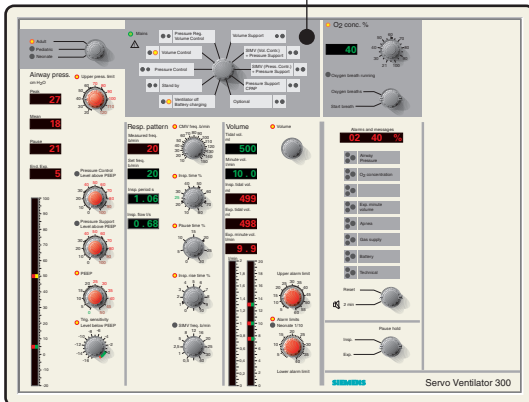
The ventilator has two main units:

- Control unit.
- Patient unit.

The control unit and the patient unit are connected with a 2.9 meter long cable, thus making possible innumerable functional arrangements.

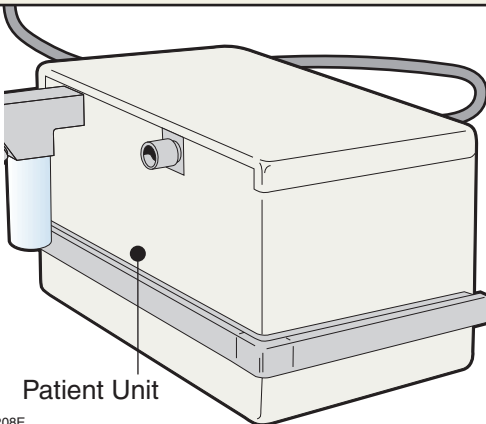


Control Unit



Servo Ventilator 300

The Servo Ventilator 300 is essentially the same as the Servo Ventilator 300A but without the "Automode" function.



Patient Unit

3000208E

General

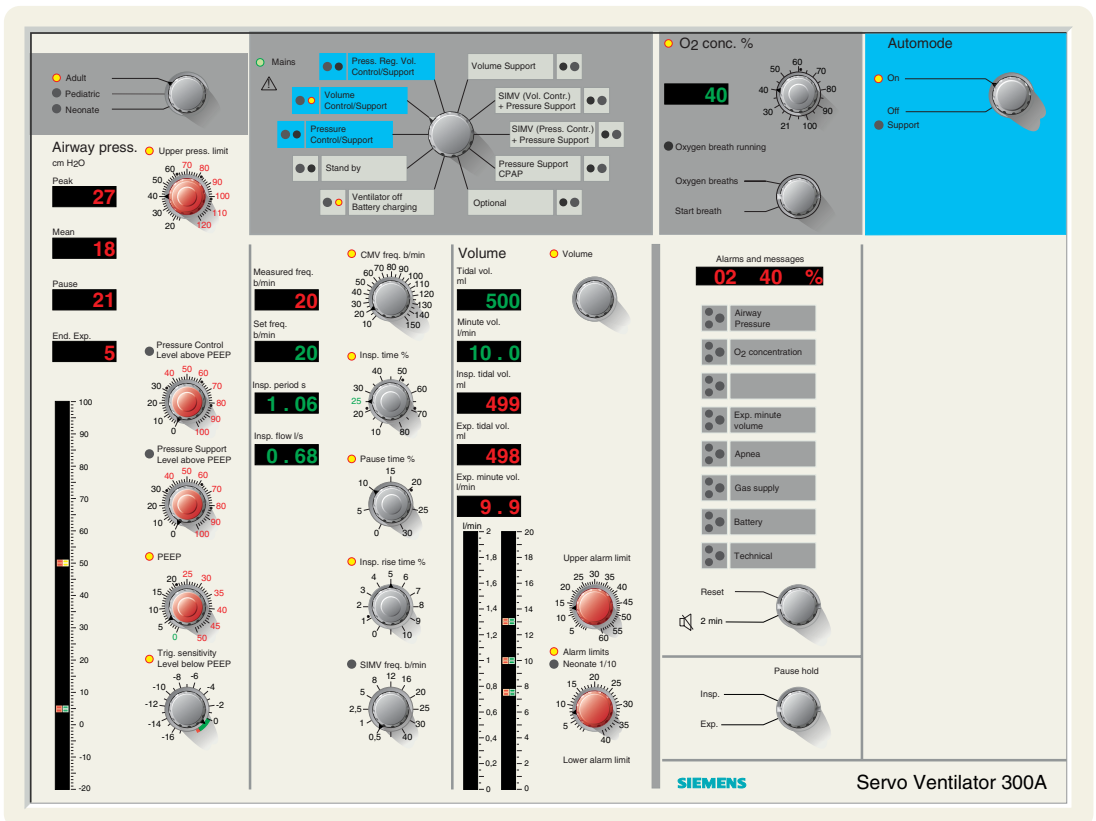
The control unit contains the electronic circuits necessary for control of ventilation.

Settings are made using different knobs on the control panel. Information about the settings as well as the patient's breathing is shown on a number of displays and bargraphs. Touchpads are used to obtain additional information.

Use of the panel settings and displays is described in the chapter Control panel.

Information necessary for the regulating systems is sent to the patient unit.

The control unit is fragile and must be handled carefully.



300-F64E



Alarm



Caution sound

Sounds

There are two different audible signals from the ventilator:

- Alarm. A signal with increasing volume.
- Caution signal. A clicking sound.

In this Operating Manual the symbols shown to the left are used for the different signals.

300-F63E



Flashing light

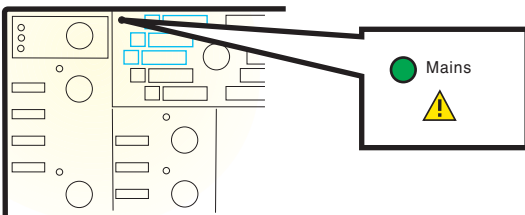


Steady light

Lights

Lights can be green, yellow or red and either steady or flashing.

In this Operating Manual the symbols to the left are used.



3000340E

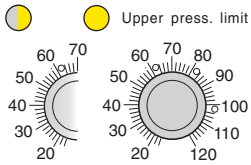
Green light

The green light "Mains" is lit when the ventilator is connected to mains.

General description – Control unit



300-130E



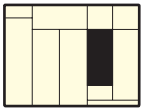
Yellow light

The yellow lights can be steady or flashing depending on the situation.

A steady yellow light at a knob is an indication that the knob is active.

When using the **Set Parameter Guide (SPG)**, the lights can be steady or flashing.

The SPG is described in detail on pp 10–12.



Alarms and messages



		Airway Pressure
		O ₂ concentration
		Exp. minute volume
		Apnea
		Gas supply
		Battery
		Technical

A steady yellow light in the “Alarms and messages” section indicates:

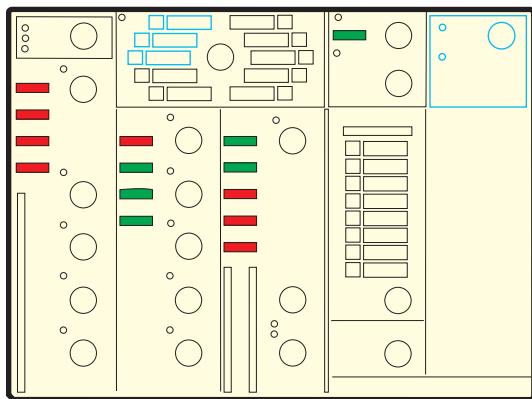
- that a previous high priority alarm condition has been corrected, and that the condition has been stored in memory.
- that certain alarm limits have been overridden and the alarm has been turned off manually. (May be accompanied by a caution signal).

(For details see chapter Patient safety).

Red light

A red flashing light indicates an alarm condition which requires immediate action.

3000235E

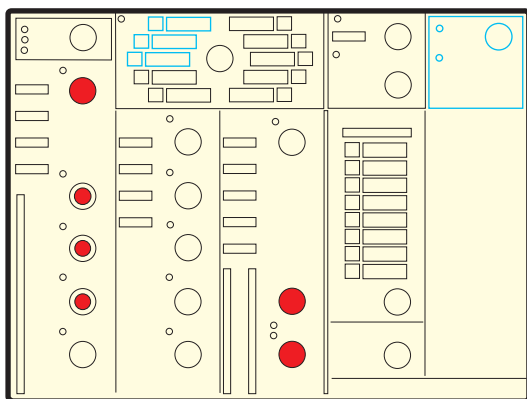


3000236X

Displays

Displays with **green** digits show **set or calculated** values.

Displays with **red** digits show **measured** values.



3000237X

Knob types

Red

Functions with red knobs are very important for patient safety. They include:

- “Upper press. limit” for airway pressure.
- “Upper alarm limit” and “Lower alarm limit” for expired minute volume.

With red tops

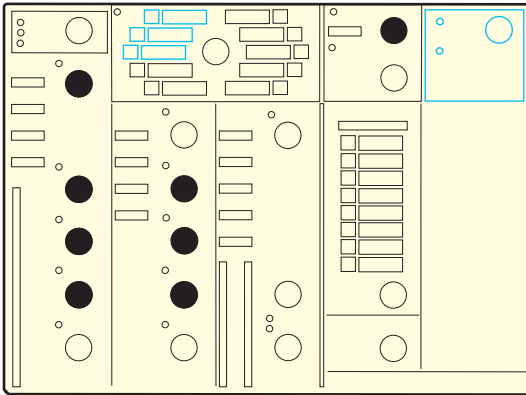
The following knobs have red tops as well as red marked areas showing that settings should be chosen with caution since they may involve certain risks for the patient.

- “Pressure Control Level above PEEP”
- “Pressure Support Level above PEEP”
- “PEEP”

With green markings

The green markings shall be seen as preliminary settings. The final settings must be made to suit each patient’s individual needs.

General description – Control unit

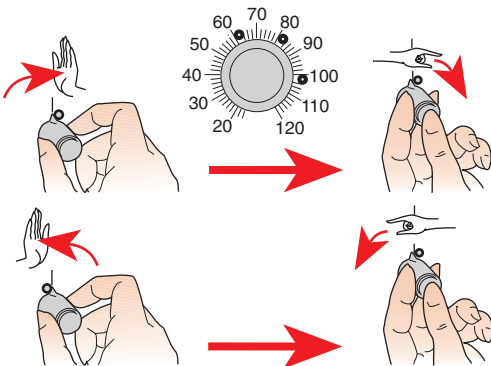


3000238X

With safety catches

For safety reasons the following knobs have safety catches:

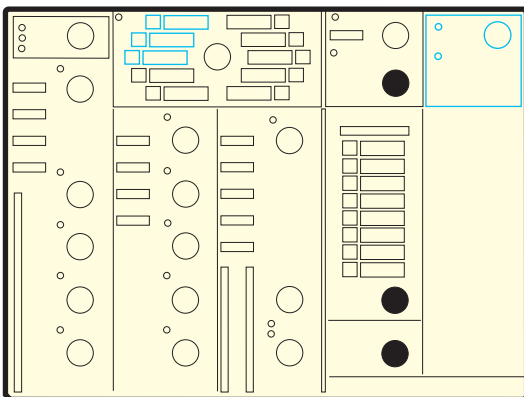
- “Upper press. limit”.
- “Pressure Control Level above PEEP”.
- “Pressure Support Level above PEEP”.
- “PEEP”.
- “Insp. time %”.
- “Pause time %”.
- “Insp. rise time %”.
- “O₂ conc. %”.



300-184X

To pass a safety catch:

- Turn the knob to a black marking.
- Press the center of the knob to pass the safety catch.

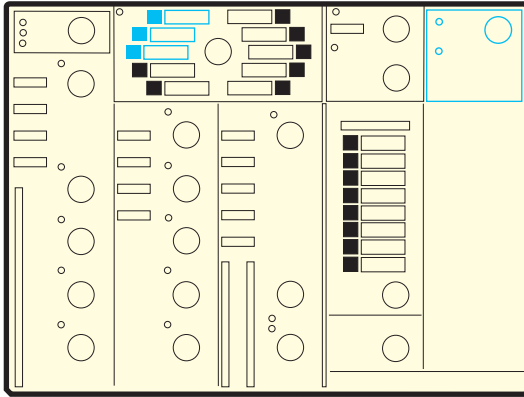


3000239X

Spring-loaded

The following knobs will automatically go back to their middle, neutral position when released:

- “Oxygen breaths” / “Start breath”.
- “Reset” / “2 min”.
- “Pause hold”.



3000240X

Touchpads

The touchpads are used:

- for reading of alarm messages stored in the memory. See chapter Patient safety.
- for the **Set Parameter Guide** (SPG). See next page.
- for alternative information on the respiratory pattern displays. See chapter Control panel.
- during the calibration procedure. See chapter Calibration.

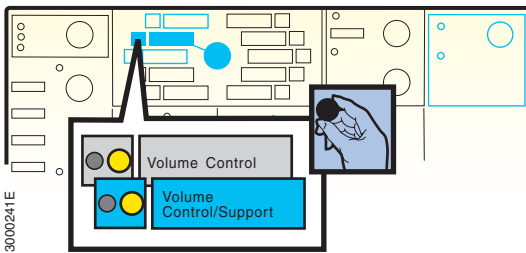
Touch one or two touchpads depending on what you want to do.



Set Parameter Guide

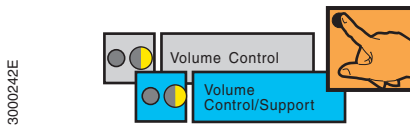
The **Set Parameter Guide** (SPG) is an electronic aid to help the user make all settings in a fast and safe way. Yellow lights and an audible signal indicate which knobs are active in the different modes.

Note! The “Automode” control on the SV 300A is **not** included in the SPG.



Setting an active mode using SPG.

- Set mode selector to the selected mode. Yellow lights will now show all active knobs. This example shows “Volume Control” mode.

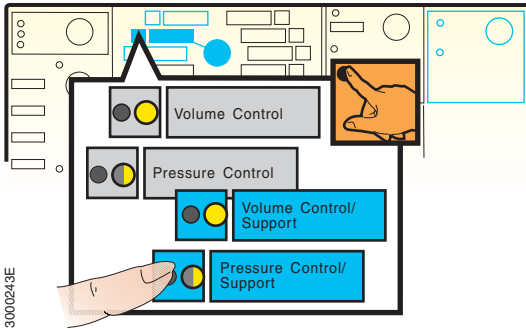


- Touch the “Volume Control” touchpad. The yellow light at “Volume Control” will start flashing.
- The light at the first knob to be set (always the patient range selector) will now be flashing. The lights at all other knobs will be dark.
- Set the patient range.
- Touch the touchpad at “Volume Control” again to continue to the next setting. Repeat until all active knobs have been set. The yellow lights at all active knobs will then be lit and three audible signals will be heard.

Investigating an inactive mode using SPG

When using a selected mode of ventilation, it is possible to see which knobs would be active in another mode.

This example shows which knobs would be set in “Pressure Control” while using “Volume Control”.



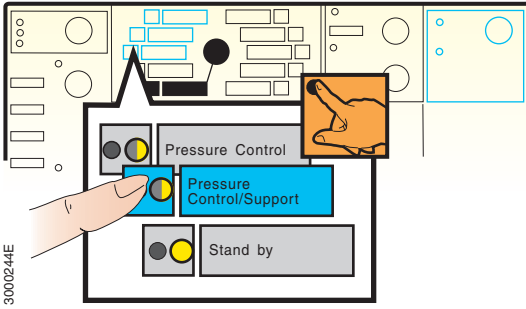
- Set to “Volume Control”.
- Touch the “Pressure Control” touchpad. The light at “Pressure Control” will start flashing.

At the first activation of the touchpad, all lights at the knobs active in “Pressure Control” will be lit and the lights at the knobs unique for “Volume Control” will be dark.

At the next activation, all lights which would be active in “Pressure Control” are lit.

The difference is that the yellow lights at the knobs common for both modes will be flashing at a higher frequency.

The lights for the knobs unique to the inactive mode (“Pressure Control”) will be flashing at the normal frequency.

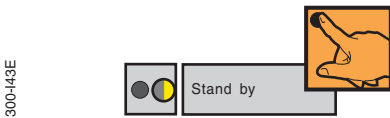


Stand by mode using SPG

In the “Stand by” mode it is possible to see the knobs which would be active in any mode.

- Touch the touchpad for the desired mode and follow the procedure described for the active mode (page 10).

Note! Only the display or bargraph for the parameter to be set will be lit, one at a time.



Cancelling of SPG

To cancel the SPG without completing the full sequence:

- Touch the touchpad at “Stand by”.

The SPG will also be cancelled if no touchpad has been activated within 1 minute of the previous activation.

Conversion of flow and volume to get reference to ambient pressure

In the SV 300/300A flow measurements and all preset and indicated volumes (as well as all flow or volume output signal values on connectors N 77, N 78, N 81, N 82, N 83 and N 84) are referenced to standard pressure (1013 mbar, 760 mm Hg).

If any flow or volume is to be referenced to ambient pressure:

1. Read the actual barometric pressure.
See Use of touchpads in chapter Calibration.
2. Use the table on the next page to find the closest conversion factor for the read value.

To convert ventilator settings

To set a volume referenced to ambient pressure:

- Multiply the intended value by the conversion factor for ventilator settings.

To convert ventilator readings

To get a read value referenced to ambient pressure:

- Multiply the read value by the conversion factor for ventilator readings.

See table and examples on next page.



General description – Control unit



Barometric pressure		Conversion factor	Conversion factor
mbar	mm Hg	for ventilator settings	for ventilator readings
700	525	0.69	1.45
720	540	0.71	1.41
740	555	0.73	1.37
760	570	0.75	1.33
780	585	0.77	1.30
800	600	0.79	1.27
820	615	0.81	1.24
840	630	0.83	1.21
860	645	0.85	1.18
880	660	0.87	1.15
900	675	0.89	1.13
920	690	0.91	1.10
940	705	0.93	1.08
960	720	0.95	1.06
980	735	0.97	1.03
1000	750	0.99	1.01
1013	760	1.00	1.00
1020	765	1.01	0.99
1040	780	1.03	0.97
1060	795	1.05	0.96
1080	810	1.07	0.94
1100	825	1.09	0.92

Examples for a ventilator used at an altitude of 1500 m (4500 feet)

To convert ventilator settings

Actual barometric pressure: 637 mm Hg

Intended values referenced to ambient pressure:

- Insp. flow: 0.40 l/s
- Tidal volume: 500 ml
- Minute volume: 10 l/min.
- Read the conversion factor for ventilator setting at 630 mm Hg. The conversion factor is 0.83.
- Multiply the intended values by 0.83.
- This gives the following settings:
 - Insp. flow: $0.40 \times 0.83 = \mathbf{0.33 \text{ l/s}}$
 - Tidal volume: $500 \times 0.83 = \mathbf{415 \text{ ml}}$
 - Minute volume: $10 \times 0.83 = \mathbf{8.3 \text{ l/min.}}$

To convert ventilator readings

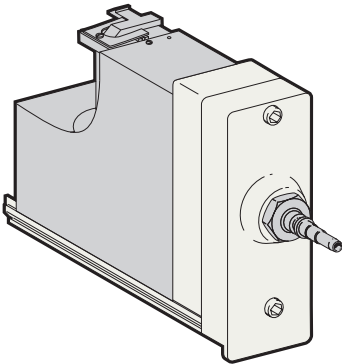
Actual barometric pressure: 637 mm Hg

Displayed values:

- Insp. flow: 0.33 l/s
- ...tidal volume: 415 ml
- ...minute volume: 8.3 l/min.
- Read the conversion factor for ventilator reading at 630 mm Hg. The conversion factor is 1.21.
- Multiply the displayed value by 1.21.
- This gives the following results:
 - Insp. flow: $0.33 \times 1.21 = \mathbf{0.40 \text{ l/s}}$
 - ...tidal volume: $415 \times 1.21 = \mathbf{500 \text{ ml}}$
 - ...minute volume: $8.3 \times 1.21 = \mathbf{10 \text{ l/min.}}$

General

In the patient unit flow and pressure are controlled by a feed-back system. Transducers continually measure the flow and pressures. The information is compared with the front panel settings, and a difference between the actual and the preset values results in correction signals to the control valves.



300-F67X

Gas modules

The Servo Ventilator 300/300A has two gas modules, one for air and one for O₂.

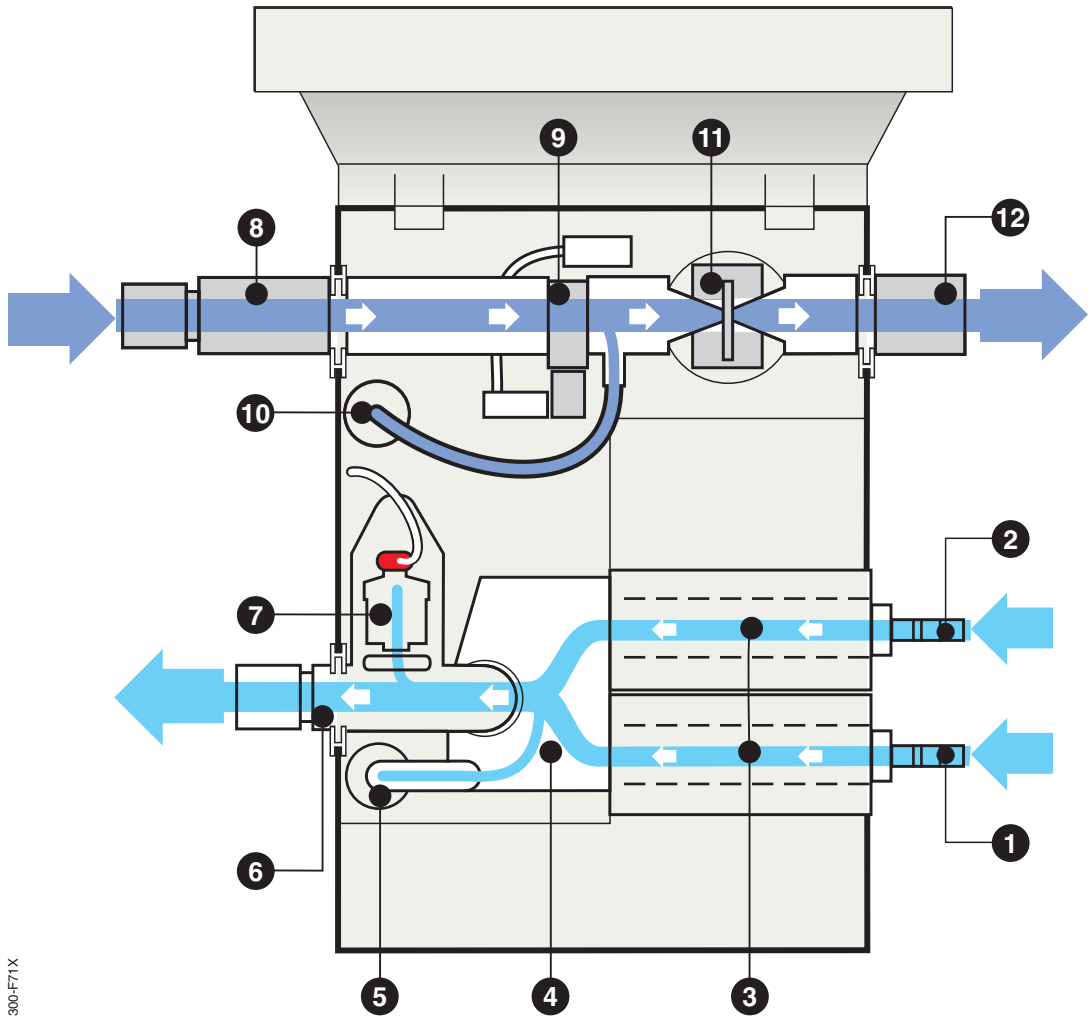
The modules have a mechanical pin coding system so that they cannot be put in the wrong slot.

The modules shall be connected to a medical pipeline system, an air compressor or to gas tanks with an outlet pressure between 2 and 6.5 bar.

Each module has a bacteria filter at the gas inlet to protect the ventilator from particulate matter as well as bacteria coming from the pipeline system.

General description – Patient unit

Gas flow through the patient unit



300-F71X


General description – Patient unit

1. Gas inlet for air. The connected air must have a pressure between 2 and 6.5 bar.
2. Gas inlet for O₂. The connected O₂ must have a pressure between 2 and 6.5 bar.
3. The gas flow is regulated by the gas modules.
4. The gases are mixed in the inspiratory mixing part.
5. The pressure of the mixed gas delivered to the patient is measured by a pressure transducer. The transducer is protected by a bacteria filter.
6. The inspiratory pipe leads the mixed gas to the patient system. The inspiratory pipe also contains a safety valve, a holder for an O₂ cell and the inspiratory outlet.
7. The oxygen concentration is measured by an O₂ cell. The O₂ cell is protected by a bacteria filter.
8. The patient system's expiratory gas tube is connected at the expiratory inlet. The expiratory inlet also contains a moisture trap.
9. The gas flow through the expiratory channel is measured by the expiratory flow transducer. For flow triggering the patient's breathing efforts are sensed as a decrease in a continuous expiratory flow.
10. The expiratory pressure is measured by the expiratory pressure transducer. The transducer is protected by a bacteria filter. For pressure triggering the patient's breathing efforts are sensed by this pressure transducer.
11. The pressure (PEEP pressure) in the patient system is regulated by the expiratory valve.
12. The gas from the patient system leaves the ventilator via the expiratory outlet. The outlet contains a non-return valve.



General description – Technical specifications

General

Dimensions	Control unit: W 431 x D 150 x H 325 mm Patient unit: W 242 x D 370 x H 240 mm
Weight	Approx. 24 kg
Classification	Class I equipment  according to IEC 601-1/EN 60 601-1 Type B
Patient range	Adult/Pediatric/Neonate
Method of triggering	Flow and pressure
Flow range	0.1 ml/s – 3 l/s

Operating conditions

Operating temperature range	+15 to +35°C (60 to 90°F)
Relative humidity	30 to 75%
Atmospheric pressure	700 to 1060 hPa

Non-Operating conditions

Impact	In accordance with IEC 68-2-29Eb Peak acceleration: 15 g Pulse duration: 6 ms Number of impacts: 1000
Storage temperature range	-25 to +70°C (-13 to 158°F)

In the Servo Ventilator 300/300A flow measurements and all preset and indicated volumes are referenced to standard pressure (1013 mbar, 760 mm Hg).

Gas and power supply

Inlet gas pressure	2 – 6.5 bar (29 – 94 PSI), air and O ₂
Gas delivery system	Microprocessor controlled valves
Power supply	100, 120, 220 and 240 V AC ±10%, 50 – 60 Hz
Battery back-up	2 built-in rechargeable 12 V, 1.9 Ah
Battery back-up time	Approx. 30 min. The batteries can only be guaranteed if they are used only as a back-up at mains failure.

General description – Technical specifications

Recharge time	Approx. 10 h			
External battery input	24 V DC			
Power consumption		A	VA	W
	100V/120V	2	190	140
	220V/240V	1	190	140

Communication/Interface (optional)

Serial port	RS-232C
Analog terminal	For analog outputs
Master/slave connection	For ILV (Independent Lung Ventilation) synchronization
Auxiliary equipment	For optional equipment

Modes

SV 300/SV 300A

Controlled ventilation:

Pressure Control (PC)	Pressure controlled ventilation
Volume Control (VC)	Volume controlled ventilation
Pressure Reg. Volume Control (PRVC)	Pressure regulated volume controlled ventilation

Supported ventilation:

Volume Support (VS)	Volume supported ventilation
Pressure Support (PS)	Pressure supported ventilation
CPAP	Continuous Positive Airway Pressure ventilation

Combined ventilation:

SIMV (Vol. Contr.) + Pressure Support	Synchronized Intermittent Mandatory Ventilation based on volume controlled ventilation with pressure support
SIMV (Press. Contr.) + Pressure Support	Synchronized Intermittent Mandatory Ventilation based on pressure controlled ventilation with pressure support

Combined ventilation SV 300A

Pressure Control/Support (PC/S)	Automode
Volume Control/Support (VC/S)	
Pressure Reg. Volume Control/Support	
	After two consecutive patient trigs the ventilator shifts from controlled to supported ventilation and remains in the support mode as long as the patient keeps triggering. If the patient stops breathing, the ventilator shifts back to the control mode after: Adult 12 s, Pediatric 8 s, Neonatal 5 s.

General description – Technical specifications



Other settings	Ventilator off Battery charging
	Stand by
	Optional (On present ventilators the selector cannot be set in this position)

Knob settings

CMV frequency	5 – 150 breaths/minute
SIMV frequency	0.5 – 40 breaths/minute
Inspiration time	10 – 80% of breath cycle time (stepless)
Pause time	0 – 30% of breath cycle time (stepless)
Pressure control	0 – 100 cm H ₂ O
Pressure support	0 – 100 cm H ₂ O
PEEP	0 – 50 cm H ₂ O
Trigger sensitivity	Flow 3 – 32 ml/s (green marked area) Pressure -17 – 0 cm H ₂ O
Trigger bias flow	Neonate 8 ml/s (0.5 l/min) Pediatric 16 ml/s (1 l/min) Adult 32 ml/s (2 l/min)
Inspiration rise time	0 – 10% of breath cycle time (stepless)
Preset tidal volume	Adult range: 50 – 4000 ml Pediatric range: 10 – 400 ml Neonate range: 2 – 40 ml
Preset minute volume	0.2 – 60 l/min \pm 6% or \pm 0.15 l/min
Oxygen breaths	100% for 20 breaths or max 1 minute
Start breath	Initiation of 1 breath in all modes
Pause hold	Insp. or exp.
Alarm silence	2 minute or reset
O ₂ concentration	21 – 100 \pm 3% O ₂
Automode (SV 300A)	Automode On/Off

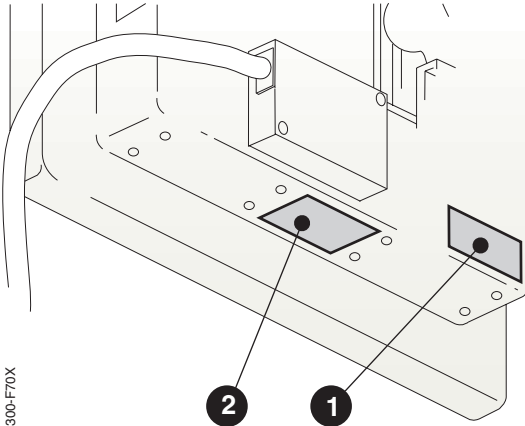
General description – Technical specifications

Alarms

Airway pressure (upper)	15 – 120 cm H ₂ O
High continuous pressure	Set PEEP-level +15 cm H ₂ O for more than 15 seconds
O ₂ concentration	Set value ±6%. Lower alarm limit cannot go below 18% or exceed 90%
Expired minute volume (Upper alarm limit)	Adult/Pediatric range: 0 – 60 l/min Neonate range: 0 – 6 l/min
Expired minute volume (Lower alarm limit)	Adult/Pediatric range: 0.3 – 40 l/min Neonate range: 0.06 – 4 l/min
Apnea	Adult: 20 s. Pediatric: 15 s. Neonates: 10 s
Gas supply	Outside the range 2 (-5%) to 6.5 (+5%) bar
Battery	Limited battery capacity: <23 V No battery capacity: <21 V High battery: >33.5 V
Technical	See table in chapter Patient safety.

Monitoring

Frequency (breath cycle time)	CMV or SIMV frequency ±1% or ±0.5 b/min
Pressures	Peak, Pause, Mean and End exp. ±5% or ±2 cm H ₂ O
Airway pressure	Measured
Insp. tidal volume	Adult range: 50 – 3999 ml ±6% or ±3 ml Pediatric range: 10 – 399 ml ±6% or ±0.5 ml Neonate range: 2.0 – 39 ml ±6% or ±0.5 ml
Exp. tidal volume	Adult range: 50 – 3999 ml ±6% or ±3 ml Pediatric range: 10 – 399 ml ±6% or ±0.5 ml Neonate range: 2.0 – 39 ml ±6% or ±0.5 ml
Exp. minute volume	Adult range: 4.0 – 60 l/min ±6% or ±0.1 l/min Pediatric range: 1.0 – 5.0 l/min ±6% or ±0.05 l/min Neonate range: 0.20 – 1.50 l/min ±6% or ±0.02 l/min
Flow rate	0.00 – 3.00 l/s or 0.00 – 180 l/min (alt SPG) ±1% or ±1 digit
O ₂ concentration	±5% of read value
Supply pressure	Measured
Battery voltage	Measured (internal and external)

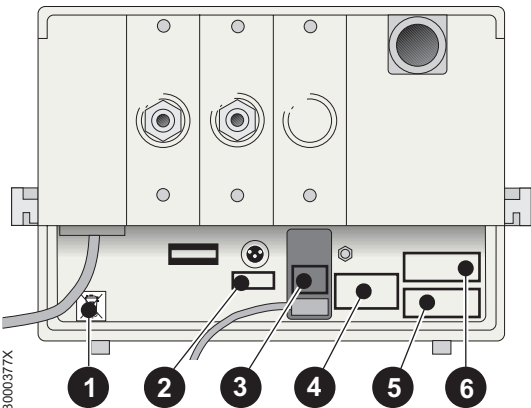


300-F70X

Control unit

There are labels on the control unit with the following information:

1. Label with model number and serial number.
Make sure this information is also found on the cover of this Operating Manual.
2. Labels with version number for the software incorporated on the different PC-boards.

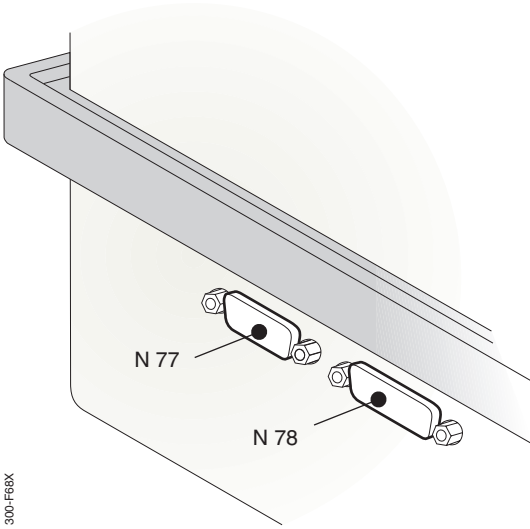


3000377X

Patient unit

There are labels on the patient unit with the following information:

1. Label showing that the equipment contains components that must be disposed of according to certain rules.
2. Information about the external battery inlet.
3. Information about the two fuses at the mains inlet.
4. CE-marking.
Information about the grounding terminal.
5. Information about the mains voltage.
6. Information about model number and serial number.



300-F68X

Patient unit

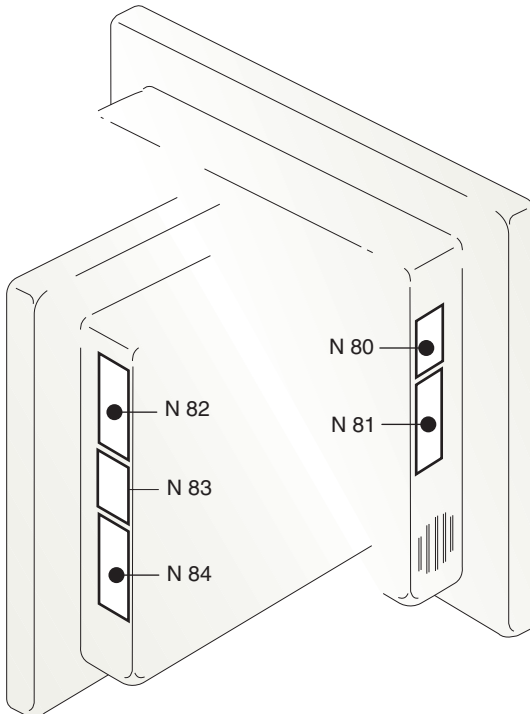
- Mains inlet.
- External battery inlet.
- **N77** and **N78**. For auxiliary equipment.

The pin configuration is described in the Service Manual.

Control unit

As an option a Communication Interface (CI)-board with five connectors is available:

- **N80**. For synchronization of two Servo Ventilator 300.
Note! If a SV 300A is used the "Automode" must be turned Off.
- **N81**. For connection of monitoring/ recording equipment.
- **N82**. For data communication.
- **N83**. For data communication.
- **N84**. Optional input interface.



300-F66X

Only accessories supplies or auxiliary equipment ("Products and accessories" catalogs 64 74 725 E323E, 64 74 717 E323E, and "Spare and exchange parts" catalog 90 34 570 E323E including "Supplement for Spare Parts" 64 08 822 E404E) should be connected to or used in conjunction with the ventilator.

Warning: Use of accessories and auxiliary equipment other than those specified in the documents mentioned above may result in degraded performance and safety of the ventilator.

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Control panel – Design and symbols

Front panel

For easy and safe operation, the front panel is divided into different fields. The Set Parameter Guide is an additional help when making necessary settings.

Patient range selection

- Adult
- Pediatric
- Neonate

Mode selection

- Mains
- Press. Reg. Vol. Control/Support
- Volume Control/Support
- Pressure Control/Support
- Volume Support
- SIMV (Vol. Contr.) + Pressure Support
- SIMV (Press. Contr.) + Pressure Support
- Pressure Support CPAP
- Optional
- Stand by
- Ventilator off Battery charging

O2 concentration

- O2 conc. %
- Oxygen breath running
- Oxygen breaths
- Start breath

Automode

- Automode
- On
- Off
- Support

Airway pressure

- Airway press. Upper press. limit cm H₂O
- Peak: 40
- Mean: 14
- Pause: 30
- End. Exp.: 5
- Pressure Control Level above PEEP
- Pressure Support Level above PEEP
- PEEP
- Trig. sensitivity Level below PEEP

Respiratory pattern

- Measured freq. b/min: 20
- Set freq. b/min: 20
- Insp. period s: 1.06
- Insp. flow l/s: 0.68
- CMV freq. b/min
- Insp. time %
- Pause time %
- Insp. rise time %
- SIMV freq. b/min

Volume

- Volume
- Tidal vol. ml: 500
- Minute vol. l/min: 10.0
- Insp. tidal vol. ml: 582
- Exp. tidal vol. ml: 498
- Exp. minute vol. l/min: 9.9
- Upper alarm limit
- Lower alarm limit
- Alarm limits
- Neonate 1/10

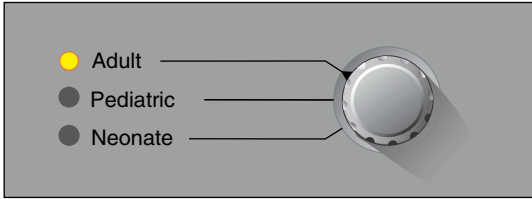
Alarms and messages

- Alarms and messages
- 02 40 %
- Airway Pressure
- O2 concentration
- Exp. minute volume
- Apnea
- Gas supply
- Battery
- Technical
- Reset
- 2 min

Pause hold

- Pause hold
- Insp.
- Exp.

3000226E



300-140E

Patient range selector

With this knob the patient range is selected. It has three different positions:

- “Adult”
- “Pediatric”
- “Neonate”

The setting affects the:

- continuous flow during expiration.
- maximum inspiratory peak flow.
- maximum measured tidal volume.
- apnea alarm time.

Continuous flow

“Adult”	.....	32 ml/s (2 l/min)
“Pediatric”	.....	16 ml/s (1 l/min)
“Neonate”	.....	8 ml/s (0.5 l/min)

Max inspiratory peak flow

“Adult” range	.....	200 l/min
“Pediatric” range	.....	33 l/min
“Neonate” range	.....	13 l/min

Max measured tidal volume

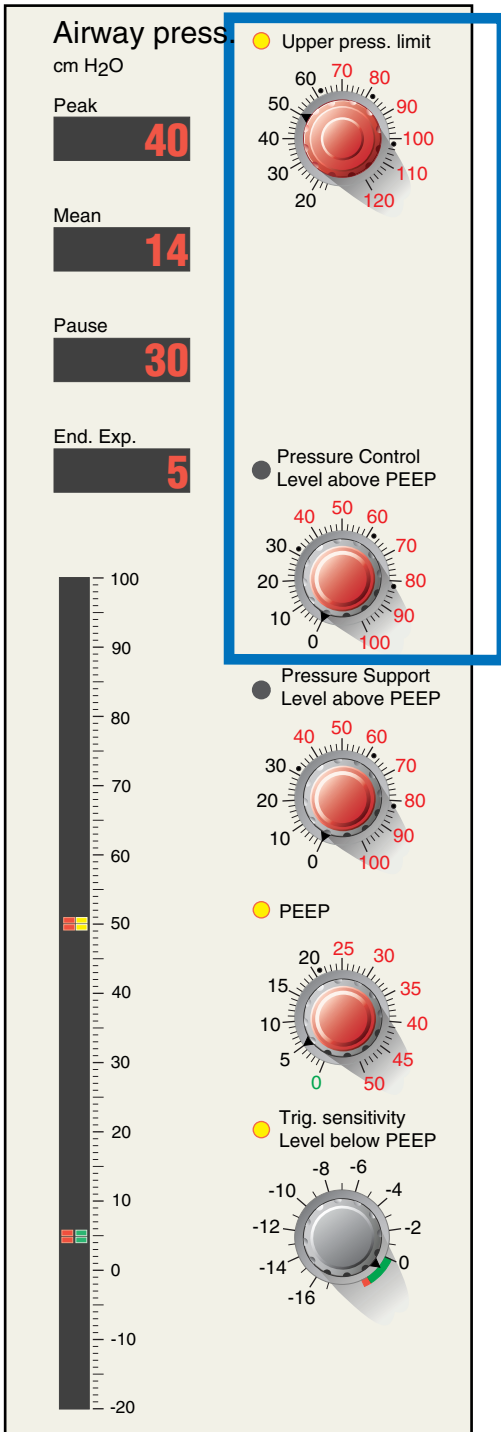
“Adult”	.....	3999 ml
“Pediatric”	.....	399 ml
“Neonate”	.....	39 ml

Apnea alarm time

“Adult”	.....	20 s
“Pediatric”	.....	15 s
“Neonate”	.....	10 s



Control panel – Airway pressure



The airway pressure section of the control panel has knobs for settings, displays and a bargraph for monitoring.

Knobs

“Upper press. limit”

With this knob the upper limit for airway pressure is set. For patient safety the “Upper press. limit” should always be set as low as possible in all modes.

The range is 16 – 120 cm H₂O. There are safety catches at 60, 80 and 100 cm H₂O.

If the set upper limit is reached, the alarm is activated, inspiration is immediately stopped and expiration started.

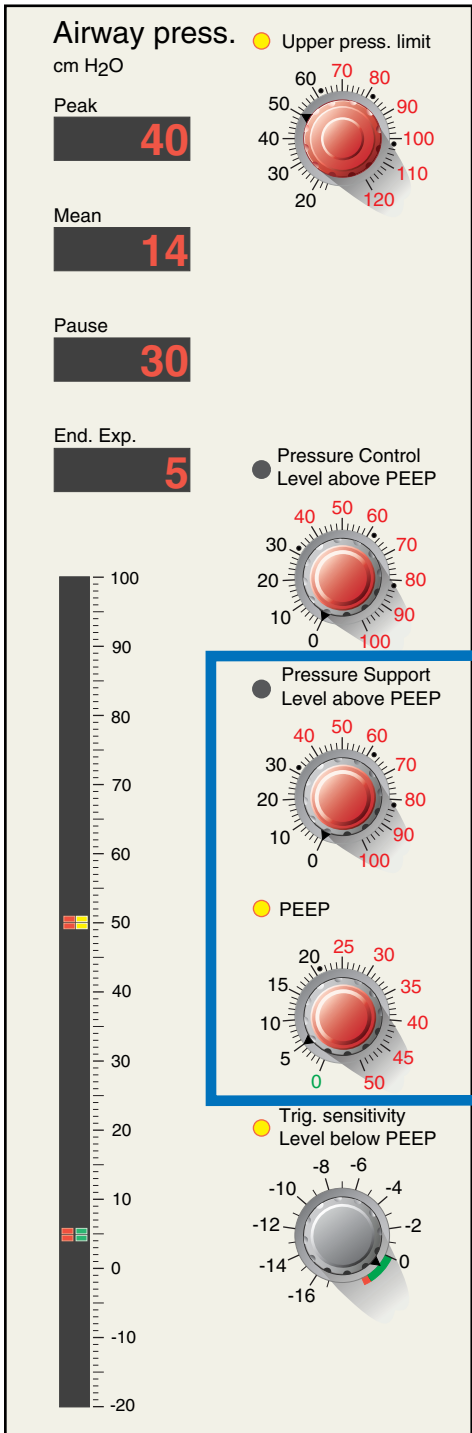
“Pressure Control Level above PEEP”

With this knob the pressure control level for the pressure controlled breaths is set. It is active in:

- “Pressure Control”
- “SIMV (Press. Contr.) + Pressure Support”

The range is 0 – 100 cm H₂O. There are safety catches at 30, 60 and 80 cm H₂O.

Control panel – Airway pressure



“Pressure Support Level above PEEP”

With this knob the pressure support level for the pressure supported breaths is set. It is active in:

- “Pressure Support”
- “SIMV (Vol. Contr.) + Pressure Support”
- “SIMV (Press. Contr.) + Pressure Support”
- SV 300A Automode “Pressure Control/Support”

The range is 0 – 100 cm H₂O. There are safety catches at 30, 60 and 80 cm H₂O.

“PEEP”

With this knob the positive end expiratory pressure level is set. It is active in all modes.

The range is 0 – 50 cm H₂O. There is a safety catch at 20 cm H₂O.

Control panel – Airway pressure

Triggering system

The SV 300/300A has a triggering system where flow or pressure triggering can be used.

Normally flow triggering is preferable and the sensitivity is set as high as possible without self-triggering.

Flow triggering

The flow triggering system is based on changes in a continuous flow delivered from the ventilator during the entire expiratory phase.

The flow is automatically set according to the selected patient range.

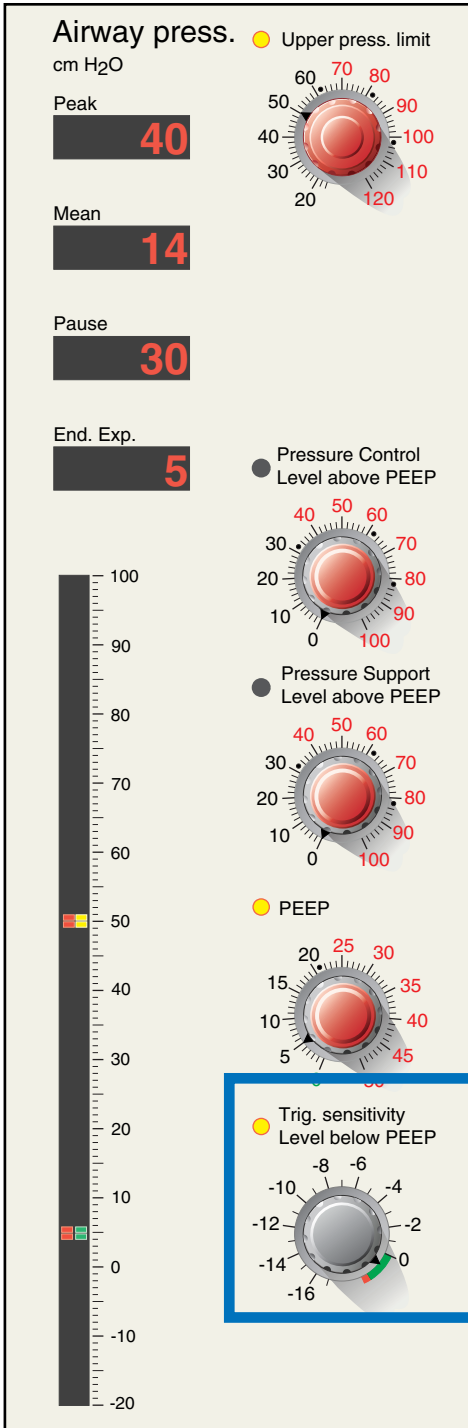
A breath is delivered when the patient has inhaled a certain part of the continuous flow measured by the expiratory flow transducer.

Pressure triggering

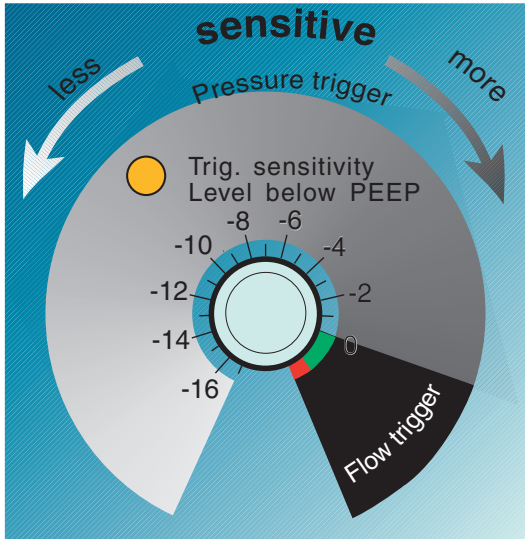
A breath is delivered when the patient has inhaled the continuous flow and created a certain negative pressure below PEEP.

“Trig. sensitivity Level below PEEP”

With this knob the trigger sensitivity, that is the strength of the effort the patient must make to trigger a breath, is set. It is active in all modes.



Control panel – Airway pressure



300-A77E

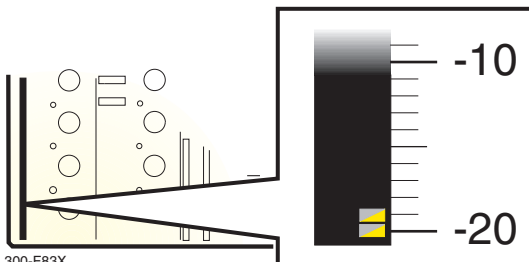
How to set the trigger sensitivity

The normal setting for flow triggering is within the green range on the knob scale. Depending on the set patient range and the set sensitivity the patient has to inhale a certain part of the continuous flow to get a breath.

With settings closer to 0 the risk for self-triggering is decreased but it also means that the patient has to inhale more of the continuous flow to get a breath.

In the red range the patient only has to inhale a very small part of the continuous flow to get a breath. The risk for self-triggering is increased.

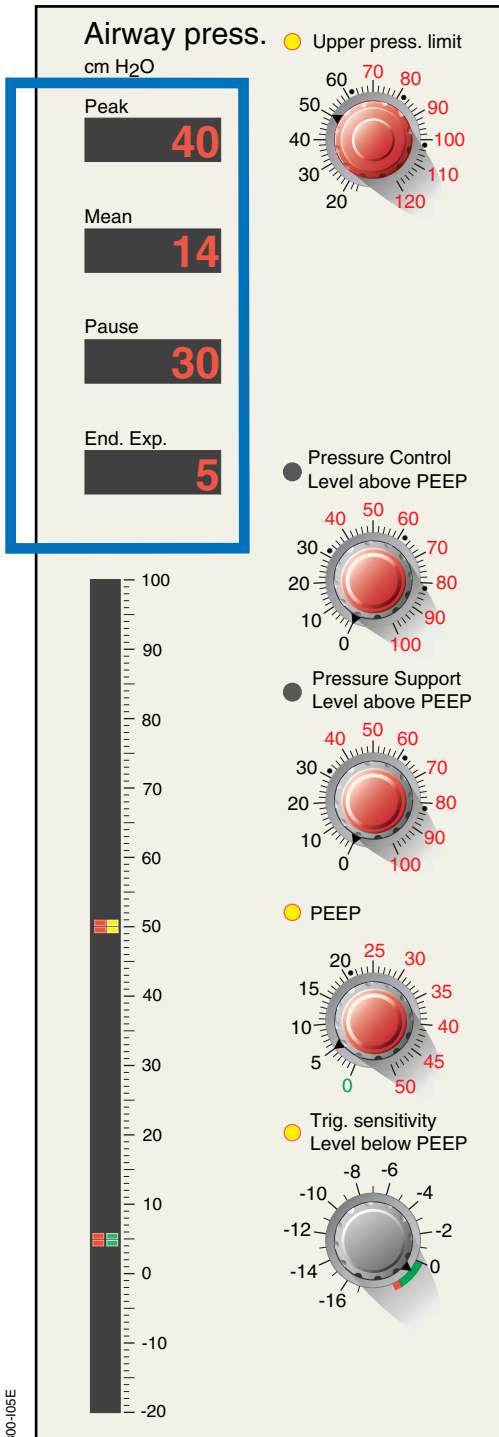
If pressure triggering is required the knob is set within the 0 to -17 cm H₂O range. Then the patient has to inhale the continuous flow and create a pressure below PEEP according to the set trigger sensitivity (cm H₂O) to get a breath.



300-F83X

A triggered breath is indicated by two yellow flashing diodes at the bottom end of the airway pressure bargraph.

Control panel – Airway pressure



Displays

“Peak”

This display shows the measured value of the peak pressure at the end of inspiratory time for each breath. The display value corresponds to the right peak pressure indicating diode on the airway pressure bargraph.

“Mean”

This display shows the calculated mean pressure value in the breathing system, based on the actual pressures for each complete breath cycle.

“Pause”

This display shows the pressure at the end of the inspiration pause time period for each breath. When “Pause hold” is set at “Insp.” during “Volume Control” and “SIMV (Vol. Contr.) + Pressure Support”, the display shows the actual airway pressure measured by the exp. pressure transducer.

“End exp.”

This display shows the pressure at the end of expiration for each breath.

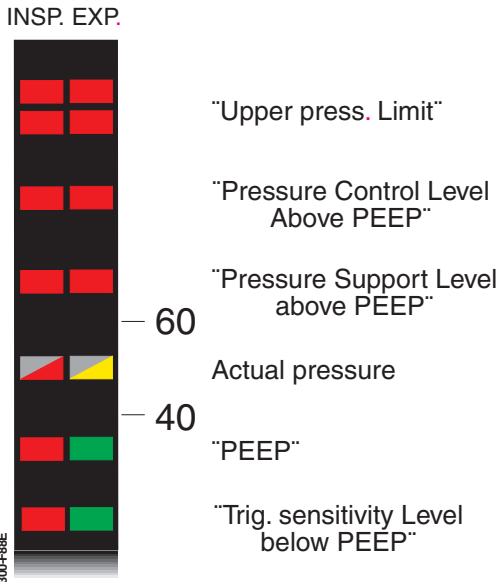
When “Pause hold” is set at “Exp.”, the display shows the total static end exp. lung pressure, including intrinsic PEEP (auto-PEEP), and the set PEEP, that is, total PEEP.

Control panel – Airway pressure

Bargraph

The measured airway pressure and control knob settings are shown by red, yellow and green diodes on the bargraph.

The diodes on the left are always red. Those on the right are red from 100 to 60, yellow from 60 to 40, green from 40 to 0 and yellow below 0.



Airway pressure bargraph indications

Preset "Upper press. limit" is shown by four diodes. The set limit should be read at the two lower diodes. These two diodes start flashing when the set upper pressure limit is reached or when the limit is set above 100 cm H₂O.

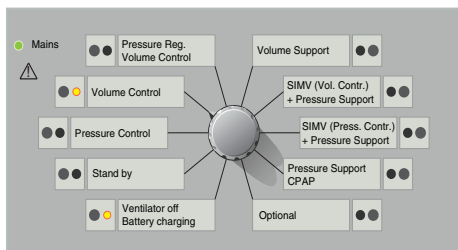
Preset "Pressure Control Level above PEEP" is shown by two diodes.

Preset "Pressure Support Level above PEEP" is shown by two diodes. If "Pressure Support Level above PEEP" is set higher than "Pressure Control Level above PEEP", the diodes indicating both knobs will start flashing.

The actual pressure is shown by two flashing diodes, the left showing the pressure on the inspiratory side and the right showing the pressure on the expiratory side.

Two diodes show preset "PEEP".

Two diodes show preset "Trig. sensitivity Level below PEEP".



Ventilation modes

The mode selector can be set in 9 different positions, providing 8 different modes of ventilation.

A yellow light shows which mode has been selected.

When any mode is set from “Ventilator off Battery charging” or “Stand by” these alarms are muted for 20 seconds:

- Expired minute volume.
- Overrange.
- Apnea.

Controlled ventilation

- “Pressure Control”. Pressure controlled ventilation.
- “Volume Control”. Volume controlled ventilation.
- “Pressure Reg. Volume Control”. Pressure regulated volume controlled ventilation.

Supported ventilation

- “Volume Support”. Volume supported ventilation.
- “Pressure Support”. Pressure supported ventilation.
- “CPAP”. Continuous Positive Airway Pressure ventilation.

Combined ventilation

- “SIMV (Vol. Contr.) + Pressure Support”. SIMV based on volume controlled ventilation with pressure support added.
- “SIMV (Press. Contr.) + Pressure Support”. SIMV based on pressure controlled ventilation with pressure support added.

SV 300A – Ventilation modes

On the SV 300A the function of the mode selector is exactly the same as on the SV 300 as long as the knob “Automode” is in position “Off”.

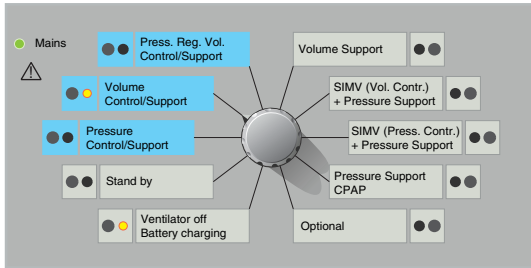
When the “Automode” is active (“On”) and the patient triggers, the ventilator shifts to supported ventilation in the following modes:

- “Volume Control/Support”.
- “Pressure Control/Support”.
- “Pressure Reg. Volume Control/Support”.

These modes are marked in blue on the mode selector.

The ventilator will remain in the support mode as long as the patient triggers. If he stops breathing the ventilator shifts back to the control mode again.

For a detailed description see chapter Ventilation modes.



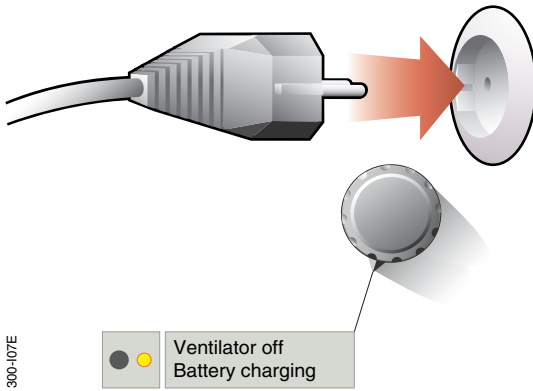
3000227E

Other positions

“Ventilator off Battery charging”

When the ventilator is not used, it should always be connected to mains and the mode selector should be set to “Ventilator off Battery charging” to ensure charging of the internal battery.

If mains is not available, an external battery can be connected. The internal battery will then be charged from the external battery. The external battery should only be connected by means of a cable delivered by MAQUET.



“Stand by”

In this position all electronic circuits are power supplied for warming up and the ventilator is ready for use.

All necessary settings for a specific patient can be made in this position, using the SPG system.

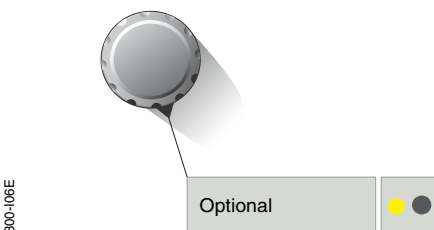
In position “Stand by”:

- the inspiratory valve is closed
- the expiratory valve is closed
- the safety valve is closed
- the caution sound will be heard
- all displays are off except the “Alarms and messages” display which shows STAND BY if no active alarms exist.



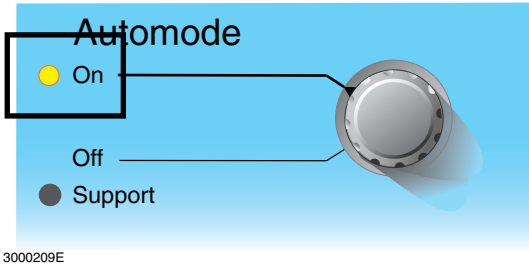
“Optional”

This position is intended for future upgrades. The selector cannot be set in this position on today’s ventilators.



Control panel – Automode

The control “Automode” has two positions “On” and “Off”.

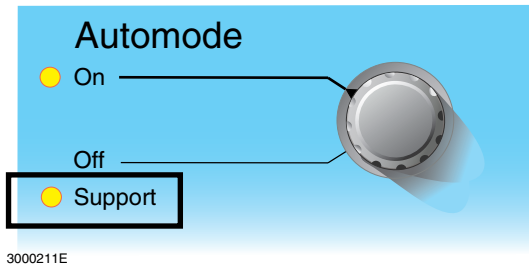


“On”

When set to this position and with the mode selector set to “Volume Control/Support”, “Pressure Control/Support” or “Pressure Reg. Volume Control/Support” the automode is active. That is:

- the ventilator switches to a support mode when the patient triggers breaths and remains in this mode as long as the patient keeps triggering. If he stops triggering, the ventilator shifts back to the control mode again.

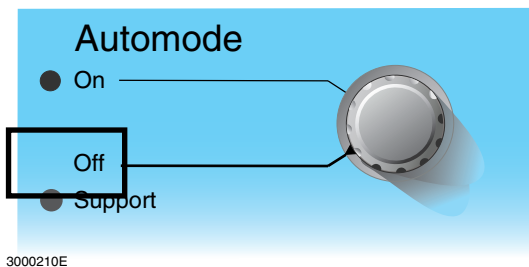
A yellow light shows that “Automode” is active.



“Support”

A yellow light shows that the patient has triggered breaths and that the ventilator has switched from controlled to supported ventilation.

For a detailed description, see chapter Ventilation modes.



“Off”

In this position the ventilator operates as an SV 300.

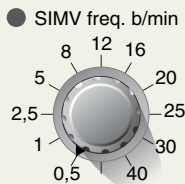
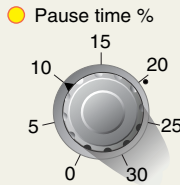
Resp. pattern

Measured freq.
b/min
20

Set freq.
b/min
20

Insp. period s
1.06

Insp. flow l/s
0.68



Knobs

The respiratory pattern section of the control panel has knobs for settings, displays, and a bargraph for monitoring.

“CMV freq. b/min”

With this knob the number of ventilator breaths/minute during **C**ontrolled **M**echanical **V**entilation (CMV) is set.

It must be set in all modes, even in spontaneous modes in which the knob setting determines the breath cycle time and frequency reference.

The range is 5 – 150 breaths/minute.

“Insp. time %”

With this knob the inspiration time is set.

It must be set in all modes except “Pressure Support/CPAP”.

The range is 10 - 80% of the breath cycle time. There are safety catches at 20, 50 and 70%.

If the “Insp. time %” is set for shorter times than 80 ms, the yellow light at the knob will start flashing.

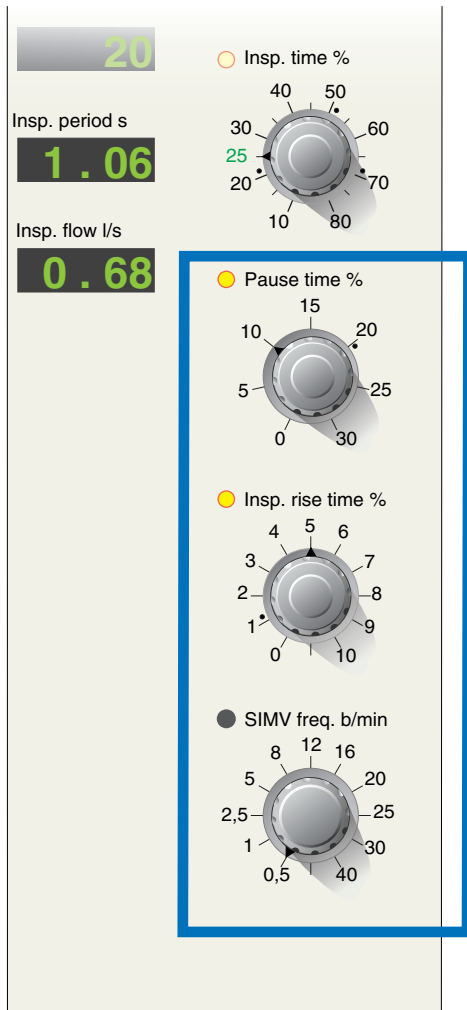
Control panel – Respiratory pattern

Example 1

“Insp. time %” = 60% = 60% inspiration
 “Pause time %” = 30% = 20% pause
 20% expiration

Example 2

“Insp. time %” = 80% = 80% inspiration
 “Pause time %” = 30% = 0% pause
 20% expiration



“Pause time %”

With this knob the pause time is set. It is active in “Volume Control” and “SIMV (Vol. Contr.) + Pressure Support”.

The range is 0 - 30% of the breath cycle. There is a safety catch at 20%.

Note! The expiration can never be less than 20% of the breath cycle. If the result of the “Insp. time %” and “Pause time %” settings is more than 80% of the breath cycle, the pause time is reduced. See examples. The reduced pause time is shown by a flashing yellow light at the knob.

“Insp. rise time %”

With this knob the time period under which flow/pressure shall increase to its preset level in the beginning of the inspiration is set. It is active in all modes.

The range is from 0 – 10% of the preset breath cycle time. There is a safety catch at 1%.

If the knob is set to 0, the flow/pressure will increase to its preset level instantly at the start of inspiration.

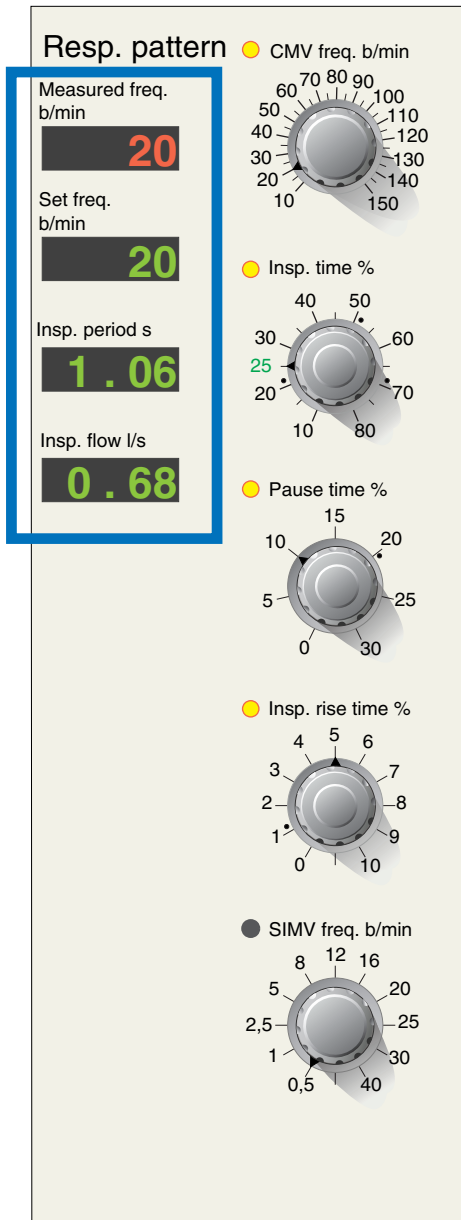
For better patient comfort, the start of inspiration can be made softer by increasing the setting.

“SIMV freq. b/min”

With this knob the number of mandatory breaths/minute in the SIMV-modes is set.

The range is 0.5 – 40 breaths/minute.

If the “SIMV freq. b/min” is set to a value higher than or equal to “CMV freq. b/min”, the yellow light at “SIMV freq. b/min” will start flashing.



Displays

“Measured freq. b/min”

This red display shows the measured breathing frequency.

The displayed value is the **total** number of breaths, i.e. the preset respiratory rate plus spontaneous breaths.

“Set freq. b/min”

This green display normally shows the set “CMV freq. b/min”. In the SIMV modes the set mandatory frequency is shown.

For alternative display information, see next page.

“Insp. period s”

This green display normally shows the resulting calculated time in seconds for the “CMV freq. b/min”, “Insp. time%”, and “Pause time%” setting.

For alternative display information, see next page.

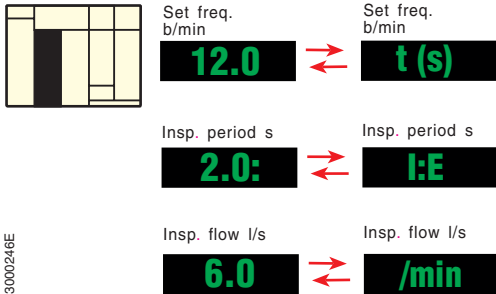
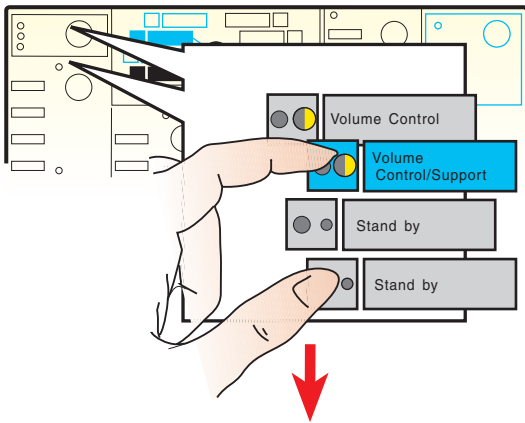
“Insp. flow l/s”

This green display normally shows the calculated flow rate in l/second related to the “Insp. time%”, “Volume” and “Insp. rise time%” settings.

The display is only active in volume controlled modes (“Volume Control” and “SIMV (Vol. Contr.) + Pressure Support”).

Control panel – Respiratory pattern

In the SV 300/300A flow measurements and all preset and indicated volumes are referenced to standard pressure (1013 mbar, 760 mm Hg), see page 13 in General description.



Alternative use of resp. pattern displays

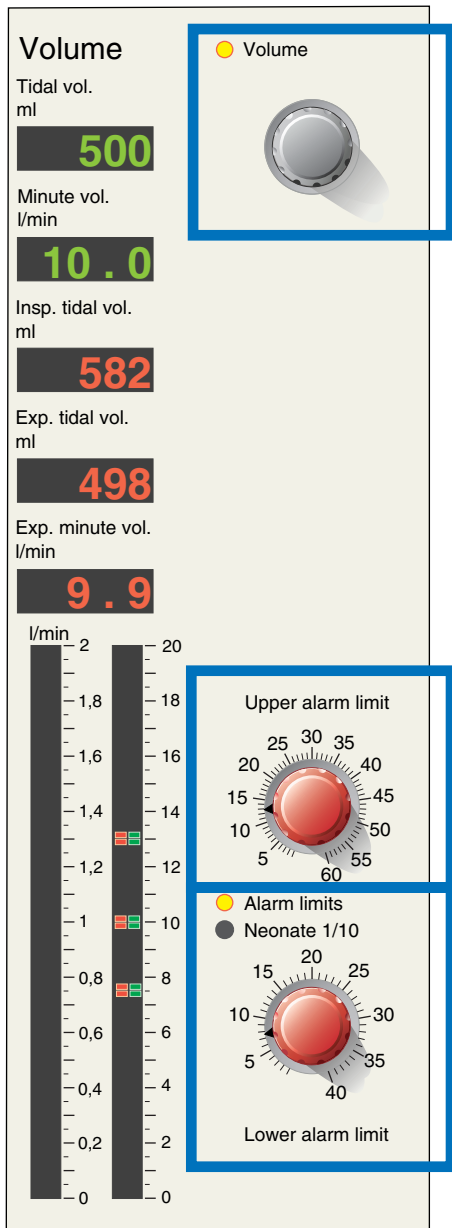
If the “Stand by” touchpad and a touchpad for an actual mode are activated simultaneously, the displays change to show:

- Breath cycle time in seconds alternating with the text **t(s)**.
- I:E ratio alternating with the text **I:E**.
- Flow rate in l/min alternating with the text **/min**.

The values shown on displays with a flashing light can be adjusted.

If the “Stand by” touchpad is activated again, the display will change back to normal operation. This will also occur automatically after 1 minute.

3000246E



The Volume section of the control panel has knobs for settings, displays, and two bargraphs for monitoring.

Knobs

“Volume”

With this knob the minute and tidal volumes are set. It is active in:

- “Volume Control”
- “Pressure Reg. Volume Control”
- “Volume Support”
- “SIMV (Vol. Contr.) + Pressure Support”

The tidal volume is calculated from the “Volume” and “CMV freq. b/min” settings.

“Alarm limits”

During the Set Parameter Guide sequence this light flashes to indicate when the alarm limits shall be set.

“Upper alarm limit”

The upper alarm limit must always be set at a suitable value for each patient.

The range is:

- “Adult” 0 – 60 l/min.
- “Pediatric” 0 – 60 l/min.
- “Neonate” 0 – 6 l/min.

“Lower alarm limit”

The lower alarm limit must always be set at a suitable value for each patient.

The range is:

- “Adult” 0.3 – 40 l/min.
- “Pediatric” 0.3 – 40 l/min.
- “Neonate” 0.06 – 4 l/min.

Control panel – Volume

In the SV 300/300A flow measurements and all preset and shown volumes are referenced to standard pressure (1013 mbar, 760 mm Hg), see page 13 in General description.

Displays, set values

“Tidal vol. ml”

This green display shows the preset tidal volume in milliliters as related to the set minute volume and set CMV frequency.

The range is 2 – 4000 ml.

“Minute vol. l/min”

This green display shows the set minute volume in liters/minute.

In “SIMV (Vol. Contr.) + Pressure Support”, the mandatory minute volume corresponding to set tidal volume and set SIMV rate is shown.

Displays, measured values

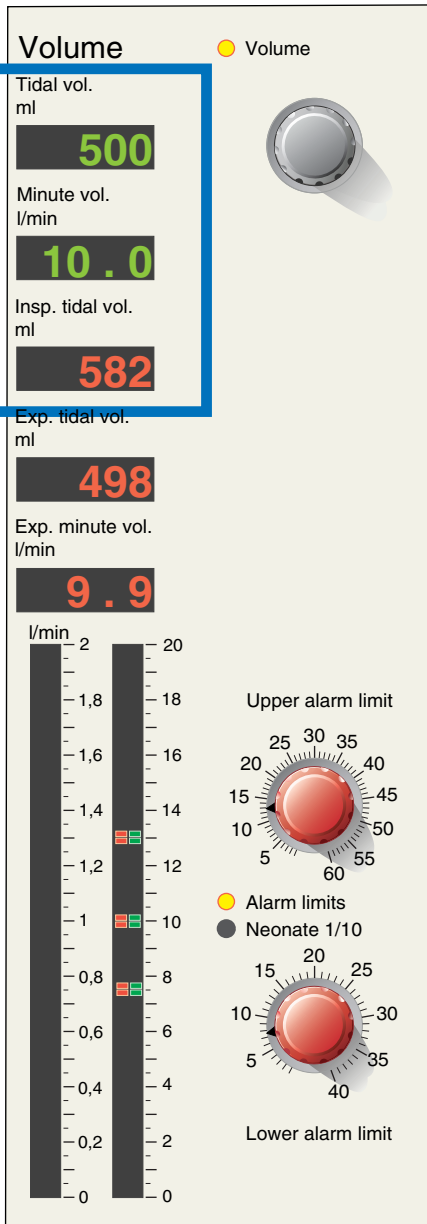
“Insp. tidal vol. ml”

This red display shows the measured inspired tidal volume value for each breath.

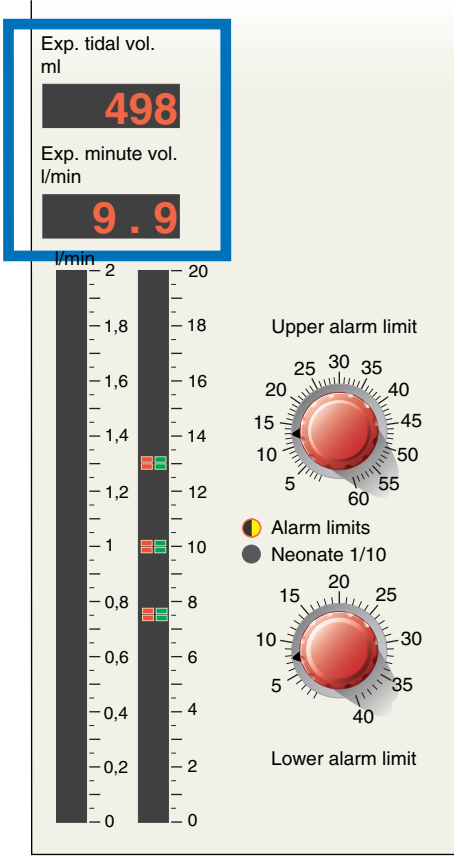
The capability to measure tidal volume is based on the selected patient range. The maximum measurable tidal volume is:

- “Adult” 3999 ml.
- “Pediatric” 399 ml.
- “Neonate” 39 ml.

The display flashes and the OVERRANGE alarm is activated whenever these levels are exceeded. See chapter Patient safety.



Control panel – Volume



“Exp. tidal vol. ml”

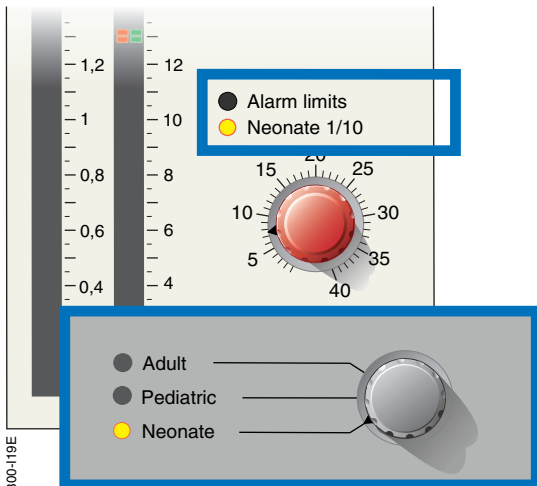
This red display shows the measured exp. tidal volume for each breath.

The display flashes when the maximum levels, as described for “Insp. tidal vol. ml”, are exceeded.

“Exp. minute vol. l/min”

This red display shows the measured expired minute volume.

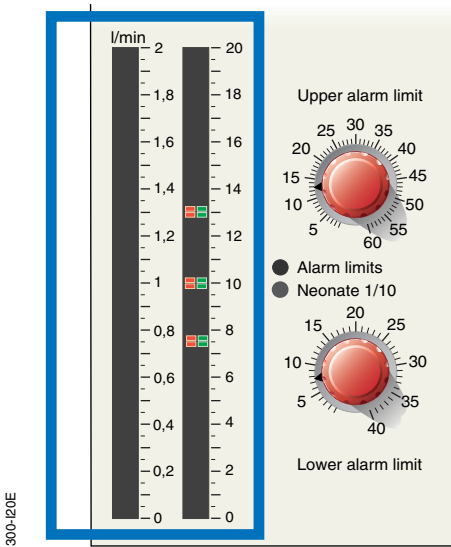
The display flashes at the same time as “Exp. tidal vol. ml” flashes if the maximum measurable exp. tidal volume is exceeded.



“Neonate 1/10”

This light is lit when the “Neonate” range has been selected, indicating that the scales on the alarm limit settings have been changed.

Control panel – Volume



Volume bargraph

There are two volume bargraphs, the left showing readings from 0 to 2 l/min and the right showing readings from 2 to 20 l/min.

Volume bargraph indications

Preset upper alarm limit



Preset "Upper alarm limit" is shown by two red and two green diodes. The set limit should be read at the two lower diodes. The two lower diodes flash when the limit is set above 20 l/min and all four diodes flash if the set upper alarm limit is exceeded.

Measured minute volume



The measured expired minute volume is shown by one red and one green flashing diode.

Preset minute volume



Preset "Minute volume" is shown by one red and one green diode. When the measured and preset minute volumes are equal, this indication will be hidden behind the measured minute volume indication.

Preset lower alarm limit



Preset "Lower alarm limit" is shown by two red and two green diodes. The set limit should be read at the two lower diodes. The diodes flash when the limit is set at the lower end position or if the set lower alarm limit is exceeded.

Control panel – O₂ concentration

Knobs

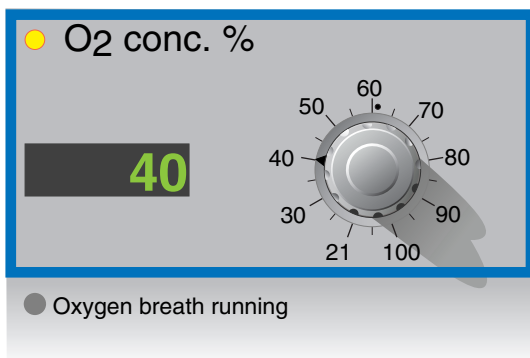
“O₂ conc. %”

With this knob the O₂ concentration and the alarm limits are set at the same time.

The setting range for the gas mixer is 21 to 100% O₂. There is a safety catch at 60% O₂.

The alarm limits are automatically set at approximately 6% O₂ above and below the set concentration value.

There is also an absolute minimum alarm limit of 18% O₂ which is independent of operator settings.



300-I21E

“Oxygen breaths”

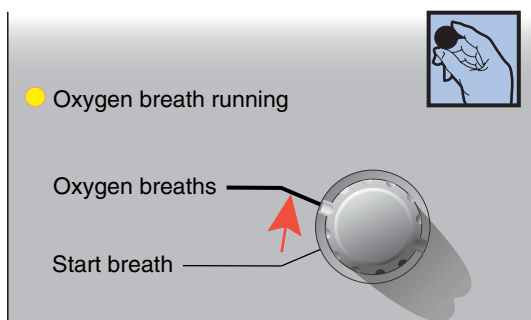
Before or after suctioning it may be necessary to give the patient extra oxygen. By setting this knob to “Oxygen breaths”, 100% O₂ will be given during 20 breaths or during max. 1 minute.

After one minute breaths with the previously set O₂ concentration will be given again even if 20 oxygen breaths have not been delivered.

To cancel before 20 oxygen breaths are given, set the knob to “Oxygen breaths” again.

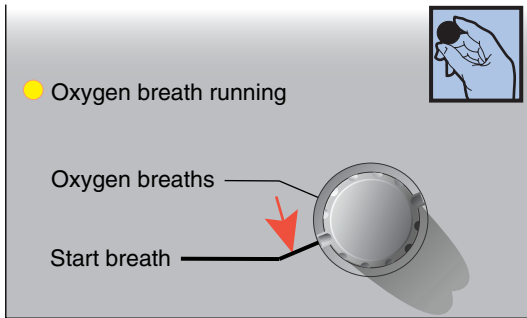
Oxygen breaths are shown by the yellow light “Oxygen breath running” and the display “O₂ conc.%” showing 100%.

When oxygen breaths are activated the O₂ concentration alarm is muted for a maximum time of 55 seconds. The alarms for expired minute volume, apnea and overrange will be muted during the oxygen breaths.



300-I23E

Control panel – O₂ concentration



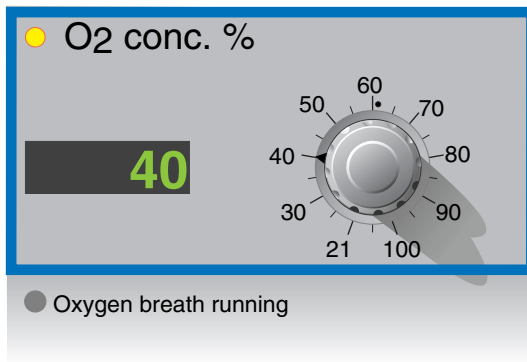
300-124E

“Start breath”

With this knob it is possible to give the patient a breath with preset values at any time.

In the SIMV modes, turning the knob to “Start breath” will start a mandatory breath.

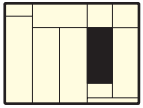
At repeated activation, make sure the patient has sufficient time to expire between breaths.



300-121E

Displays

This green display shows the set O₂ conc. value.



Alarm



Caution sound



Flashing light



Steady light

3000247E

General

This section is described in more detail in chapter “Patient safety”.

Alarm signals

Audible

There are two different audible signals:

- alarm with increasing volume.
- caution signal, a “ticking” sound.

Visual

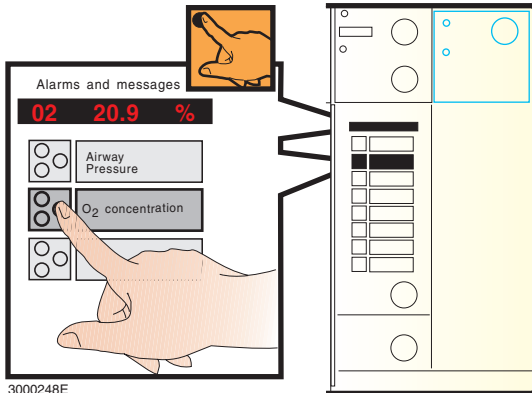
A flashing red light indicates a high priority alarm.

A steady yellow light indicates that:

- an alarm condition has been stored in memory or
- an alarm has been reset and changed to a caution situation.

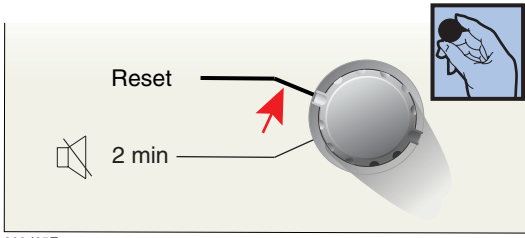
Touchpads

By touching the pad to the right of the alarm lamps, different messages will be displayed.



3000248E

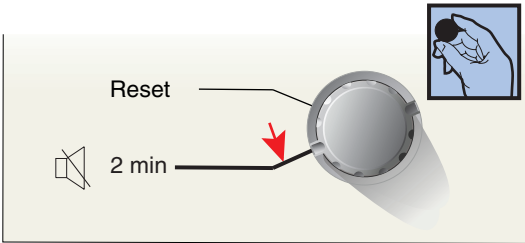
Control panel – Alarms and messages



300-125E

“Reset”

Some alarms are manually reset by turning the knob to “Reset”. See details on each alarm in chapter Patient safety.



300-126E

“2 min”

Most audible alarms can be silenced for 2 minutes by turning the knob to “2 min”.

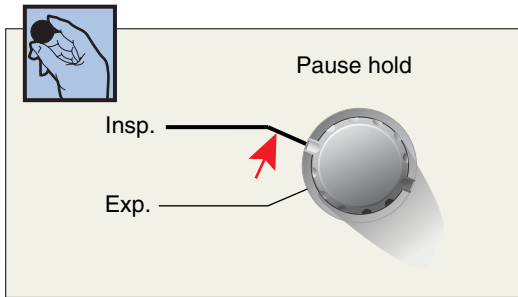
Alarm muting before disconnect

Audible alarms for expired minute volume, apnea and overrange, can be cancelled in advance for 2 minutes by holding the knob at “2 min” for more than 2 seconds.

A short beep indicates that the alarms have been muted. The display “Alarms and messages” also shows **ALARMS MUTED**.

A detailed description of all alarms and safety devices is found in chapter Patient safety.

Control panel – Pause hold

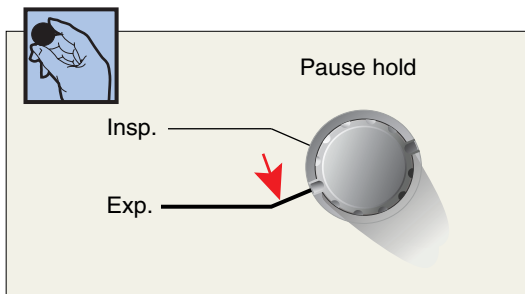


300-127E

"Insp."

In position "Insp." the inspiratory and expiratory valves close after inspiration. The pause is prolonged as long as the knob is kept in this position but with a built-in limit of 5 seconds.

This allows for an exact static measurement of the end inspiratory pause pressure.



300-128E

"Exp."

In position "Exp.", the inspiratory and expiratory valves are closed after expiration as long as the knob is kept in this position but with a built-in limit of 30 seconds.

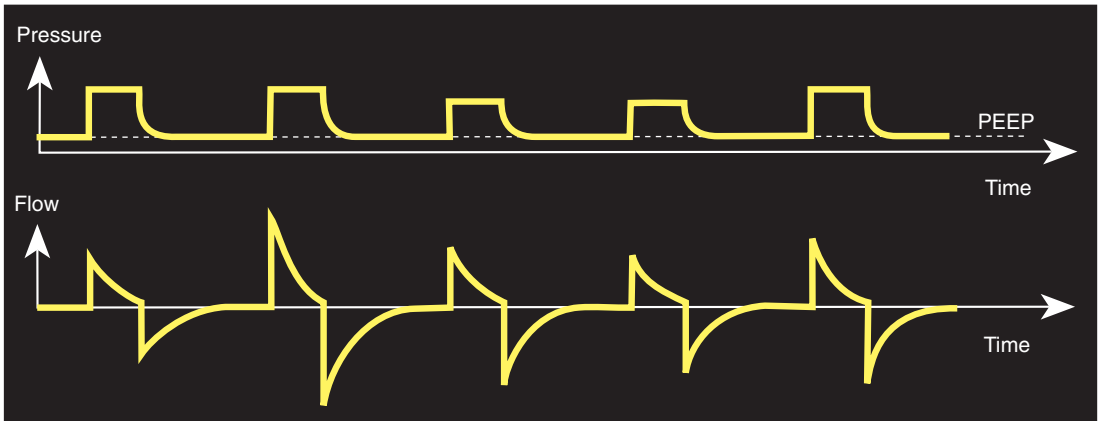
This gives an exact static measurement of the end expiratory lung pressure, and also makes it possible to measure intrinsic PEEP (auto-PEEP).

Contents

Pressure Regulated Volume Control	2
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Pressure Control	16
Volume Control	22
Pressure Support/CPAP	28
SIMV (Vol. Contr.) + Pressure Support	34
SIMV(Pressure Contr.) + Pressure Support	42
Automode SV 300A	50

The curves in this chapter can be obtained from, e.g., a Servo Screen 390. The suggestions made in the troubleshooting sections are only examples of some symptoms and solutions. The symptoms mentioned can be caused by several other reasons.

Pressure Regulated Volume Control



300-H00E

In this **control mode** the breaths are delivered with preset tidal volume and frequency during the preset inspiratory time.

The ventilator will automatically, breath by breath, adapt the inspiratory pressure control level to changes in the mechanical properties of the lung/thorax to ensure that the lowest possible level is always used to deliver the preset tidal and minute volume.

The inspiratory pressure is kept constant during the whole preset inspiratory time.

The inspiratory flow is decelerating.

Aim of mode

The aim of this mode is to:

- deliver a preset tidal/minute volume with a preset frequency and with a constant pressure during the entire inspiration.
- deliver a decelerating inspiratory flow.
- deliver a controlled respiratory rate and I:E ratio.
- deliver a set tidal volume at the minimum pressure level necessary.

Ventilation modes – PRVC

Applicable patients

This mode can be suitable for:

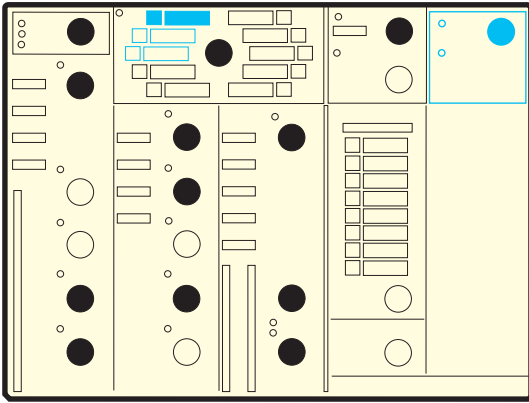
- patients with lung injury.
- patients with asthma.
- patients with chronic obstructive bronchitis.
- pediatric patients.
- postoperative patients.
- patients with no breathing capacity.
- patients who initially need high initial flow rates to open up closed lung compartments.
- patients in whom unnecessary high airway pressures should be avoided.
- patients in whom you need to control the volume during pressure controlled ventilation when alveolar improvement occurs, e.g., during surfactant therapy.

Important considerations

- Ensure that minute volume alarms are appropriately set.
- The upper pressure limit setting has two functions in this mode:
 1. If the upper pressure limit is reached, the ventilator will immediately shift to expiration and give alarm for high airway pressure.
 2. A deterioration in the patient's compliance/resistance can lead to an increased pressure necessary to deliver the set volume. If the peak airway pressure rises to 5 cm H₂O below the set upper pressure limit a "Limited pressure" alarm is given. The breath will still be delivered but the tidal volume will be lower than preset.
- Maximum allowed inspiratory time is 80% of the respiratory cycle.
- Inspiratory rise time can be set to adjust the time during which the pressure rises to its preset level.
- The patient can initiate breaths depending on the trigger sensitivity setting. The breaths will be delivered according to the set parameters.
- If the patient is disconnected for any reason and then reconnected, the return to the set tidal volume is accomplished by a reactivation of a test breath sequence. Target tidal volume will thus be restored within a few breaths.

For patient safety, always set "Upper press. limit" as low as possible.

Ventilation modes – PRVC



3000249X

Settings

The following knobs shall be used.

- Patient range selector
- “Upper press. limit”
- “PEEP”
- “Trig. sensitivity Level below PEEP”
- “CMV freq. b/min”
- “Insp. time %”
- “Insp. rise time %”
- “Volume”
- “Upper alarm limit” / “Lower alarm limit”
- “O₂ conc. %”

SV 300A

- “Automode”

Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting and for alarms and other safety issues, see Patient safety.

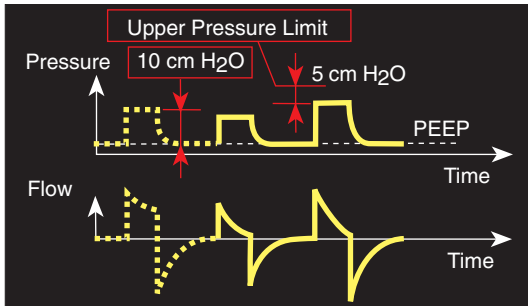
Symptom	Cause	Solution
Inspiratory pressure increase.	Increased resistance or decreased compliance.	<p>Reevaluate the patient and act according to findings.</p> <p>If resistance increases because of:</p> <p>Secretions → suctioning.</p> <p>Bronchospasm → bronchodilators.</p> <p>If compliance decreases:</p> <p>Increase PEEP if cycling on the low part of the Volume-Pressure curve.</p> <p>Decrease PEEP if cycling on the high part of the Volume-Pressure curve.</p>

Technical mode description

The first breath is a test breath with a pressure level of 10 cm H₂O (5 cm H₂O in earlier software versions) above PEEP.

After a few breaths the target volume will be achieved.

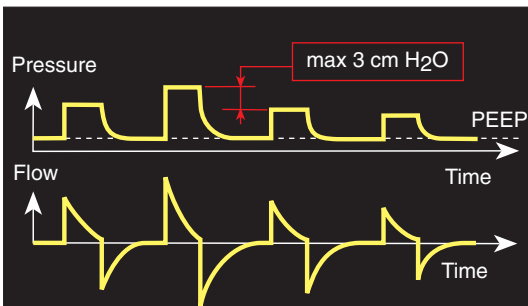
Maximum available pressure level is 5 cm H₂O below preset upper pressure limit.



300-H47E

The ventilator is continuously, breath by breath, adapting the inspiratory pressure to changes in the volume/pressure relationship.

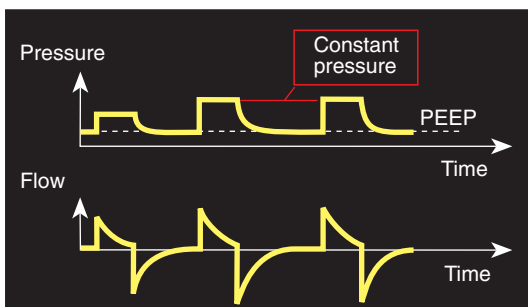
When the target volume has been achieved and the measured volume increases above or decreases below the preset tidal volume, the pressure level is regulated in small steps of max 3 cm H₂O until preset volumes are delivered.



300-H48E

When measured tidal volume corresponds to preset value, the pressure level remains constant.

When the ventilator regulates the inspiratory pressure the displayed set and measured tidal volumes can differ.



300-H05E

Curves and loops obtained from Servo Screen 390



300-H06E

Curves from a patient with moderate lung injury.

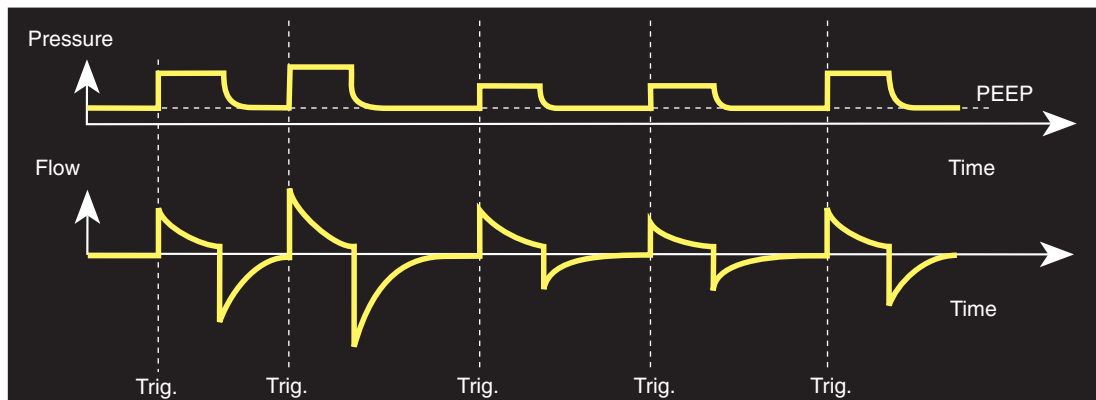
Dynamic characteristics are low compared to static compliance due to moderate bronchospasm.

Ventilation modes – PRVC

Notes



Volume Support



300-H07E

In this support mode **the patient triggers each breath**. If he can breathe without support, true spontaneous breathing with monitoring of achieved volumes is possible. If he needs support the ventilator will automatically, breath by breath, adapt the inspiratory pressure support level to changes in the mechanical properties of the lung/thorax to ensure that the lowest possible pressure level is always used to deliver the preset tidal and minute volumes.

The inspiratory pressure is kept constant.

The inspiratory flow is decelerating.

In case of apnea there is an automatic back-up with PRVC.

Aim of mode

The aim of this mode is:

- to get ventilation in which every breath is patient initiated.
- to achieve a desired tidal/minute volume for the patient.
- to have variable support depending on the patient's requirements for each breath.
- to allow for variations in both breathing capacity and work of breathing.
- to provide adequate support for patients who can trigger the ventilator but do not have sufficient capacity to breathe by themselves.
- to facilitate the weaning process.
- to ensure a back-up ventilation in the event of apnea.

Ventilation modes –VS

Applicable patients

This mode can be suitable for:

- patients with some but not enough breathing capacity.
- patients requiring breath by breath variations in inspiratory pressure support.
- patients ready to be weaned.
- patients requiring prolonged phases of weaning from ventilator dependence.
- postoperative patients with intact respiratory drive.
- patients requiring some level of pressure support but with a minimum volume guarantee.
- patients recovering from lung injury.
- patients not requiring full ventilation but only partial support.

Important considerations

- Initial values for expected “spontaneous” tidal volumes should be set.
- Inspiration stops and expiration starts when the peak flow drops to 5% of the generated initial flow.
- CMV rate and inspiratory time (time or I:E ratio) must be set.
- Maximum allowed inspiratory time for the back-up rate is 80% of the respiratory cycle.
- The upper pressure limit setting has two functions in this mode:
 1. If the upper pressure limit is reached, the ventilator will immediately shift to expiration and give alarm for high airway pressure.
 2. A deterioration in the patient’s compliance/resistance can lead to an increased pressure necessary to deliver the set volume. If the peak airway pressure rises to 5 cm H₂O below the set upper pressure limit a “Limited pressure” alarm is given. The breath will however still be delivered but the tidal volume will be lower than preset.

contd.

Ventilation modes –VS

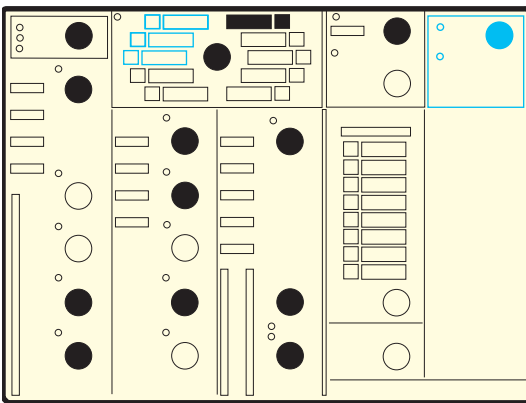
Important considerations, continued

- Maximum allowed inspiratory time is 80% of the respiratory cycle.
- Inspiratory rise time can be adjusted to change the onset of the inspiratory flow to the patient.
- If the patient is disconnected for any reason and then reconnected, the return to the set tidal volume is accomplished by a reactivation of a test breath sequence. Target tidal volume will thus be restored within a few breaths.

- If the specified apnea delay time is exceeded, the ventilator will automatically revert to the PRVC mode at the set CMV rate, inspiratory time and with the same tidal volume as in the volume support mode.

The ventilator will remain in this mode until the alarm is reset by the operator. When the apnea alarm has been reset the ventilator switches back to “Volume Support”.

- The patient triggers every breath. Mandatory breaths are only provided in the event of apnea.
- The patient determines the breath rate and the inspiratory time.



3000250X

Settings

Note that all parameters used in PRVC must be preset for the apnea ventilation!

The following knobs shall be used.

- Patient range selector
- “Upper press. limit”
- “PEEP”
- “Trig. sensitivity Level below PEEP”
- “CMV freq. b/min”
- “Insp. time %”
- “Insp. rise time %”
- “Volume”
- “Upper alarm limit” and “Lower alarm limit”
- “O₂ conc. %”

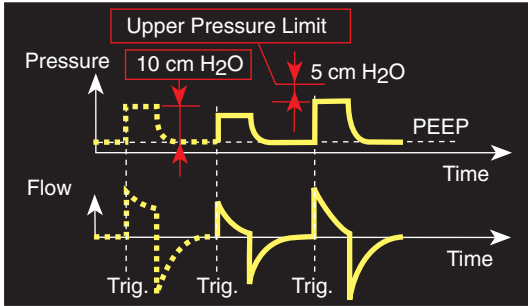
Ventilation modes –VS

Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting, and for alarms and other safety issues see Patient safety.

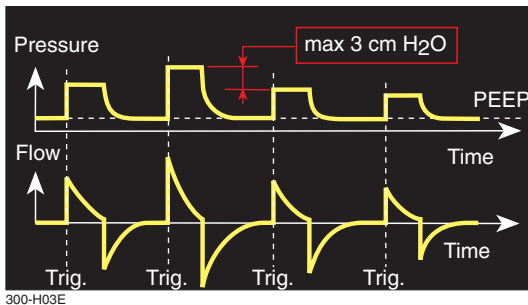
Symptom	Cause	Solution
Apnea and shift to PRVC.	Hyperventilation. (CO ₂ level too low). No drive.	Decrease ventilation. Reevaluate patient. Sedation? CNS status?
Irregular breathing.	Mismatch between set frequency and patient frequency. CNS malfunction.	If patient frequency is within 50-150% of preset – OK! If outside that range, readjust set frequency and volume. Depends on problem.
Increase in support pressure.	Decreased compliance. Increased resistance. Decreased patient effort.	Clinical evaluation. Action according to findings.
No decrease in support pressure.	Usually undetected secondary problem in patient. Very seldom that the patient is too comfortable.	Find the cause and treat secondary problem. Decrease to lowest possible volume.
Low support pressure.	Normal when patient is able to breathe on his own.	Consider extubation if extubation criteria are fulfilled.

Technical mode description



The first trig during start up initiates a test breath with a pressure level of 10 cm H₂O (5 cm H₂O in earlier software versions) above PEEP.

Maximum available pressure support is 5 cm H₂O below preset upper pressure limit.



The ventilator is continuously, breath by breath, adapting the inspiratory pressure to changes in the volume/pressure relationship.

If the measured volumes decrease below the set volumes the pressure support level is increased in small steps of max. 3 cm H₂O until preset volumes are delivered.

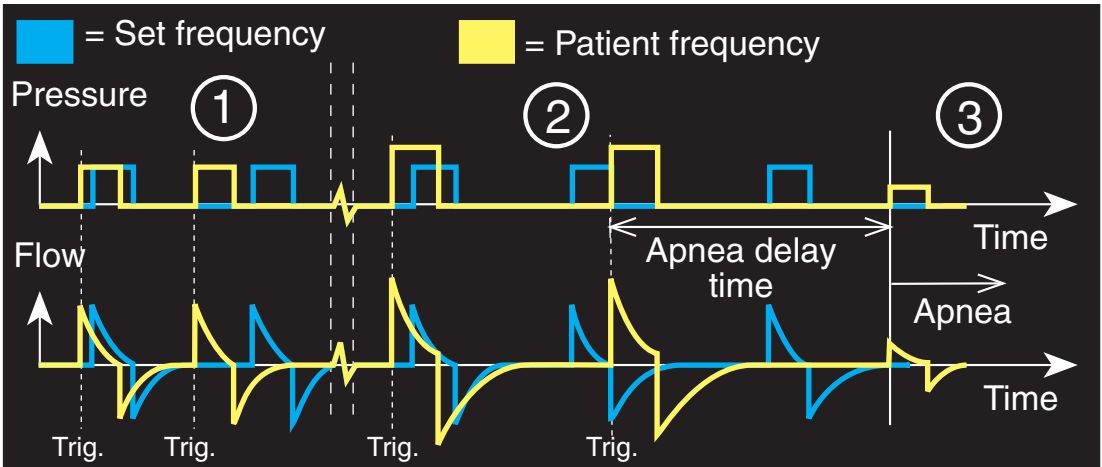
The following applies as long as the patient's breathing frequency is lower than the preset CMV-frequency:

If the support pressure level causes larger **minute** volumes than preset, the support pressure is lowered in small steps of max. 3 cm H₂O until preset **minute** volume is delivered.

The following applies as long as the patient's breathing frequency is higher than preset CMV-frequency:

If the support pressure level causes larger **tidal** volume than preset the support pressure is lowered in small steps of max. 3 cm H₂O until the preset **tidal** volume is delivered.

Ventilation modes –VS



300-H11E

1. If the patient increases his respiratory rate above the set rate, the preset tidal volume will still be maintained and the minute volume will increase.
2. If the patient breathes at a lower than set (expected) frequency, a new target volume based on preset minute volume is calculated by the ventilator. The calculated target volume will be the ventilator's reference for regulation of the inspiratory support pressure. The maximum tidal volume is 150% of the preset.

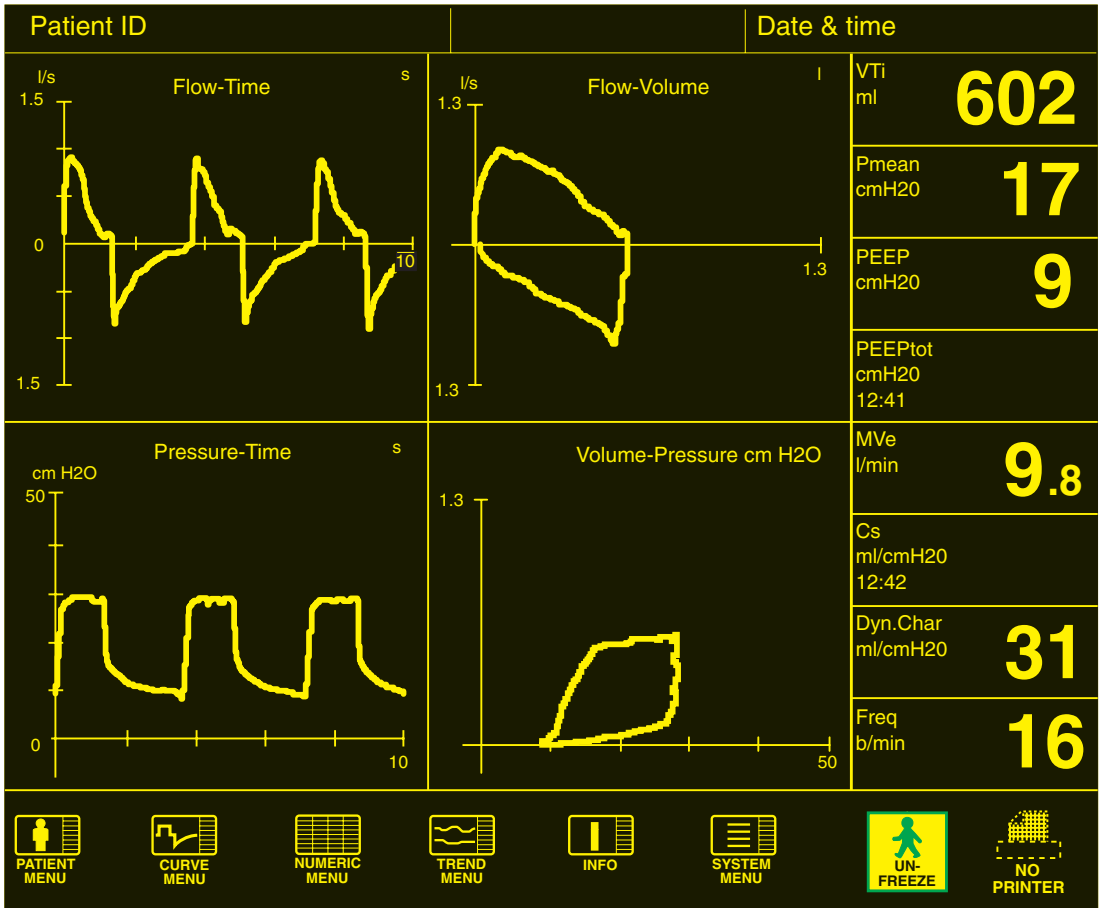
Example

Set (expected) frequency = 10 breaths/min.
Set tidal volume = 500 ml (5 l/min.)
If the patient's frequency drops below 10 breaths/min. the tidal volume will increase to meet preset minute. (max. 1.5×500 ml = 750 ml.) Under certain conditions the patient can actively breathe more than this volume.

3. Exceeded apnea alarm limit results in alarm and automatic switch to PRVC.

Ventilation modes –VS

Curves and loops obtained from Servo Screen 390



300-H12E

Curves from a patient with lung injury. There is no static compliance due to difficulty in taking measurements in a spontaneously breathing patient.

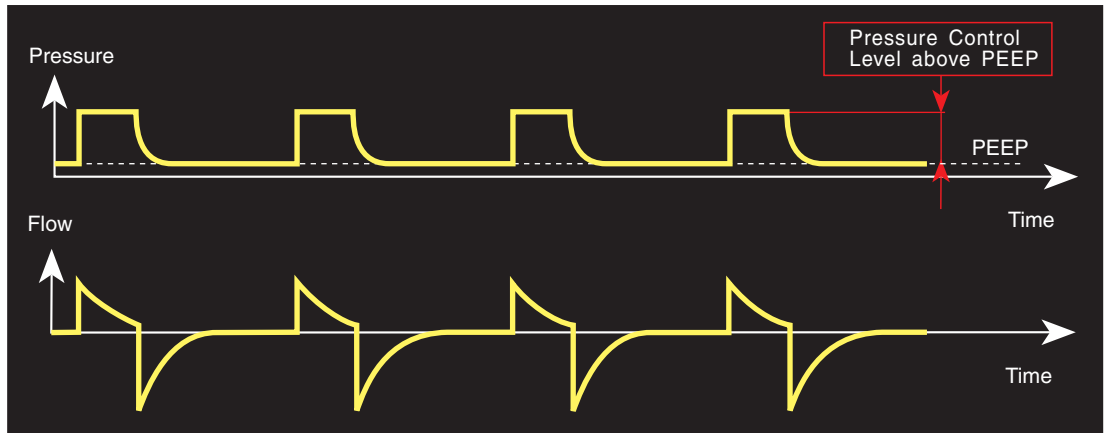
Since flow triggering is used there is no deflection at the beginning of the Volume-Pressure curve.

Ventilation modes –VS

Notes



Pressure Control



300-H13E

In this **control mode** the ventilator delivers breaths with a constant preset pressure, with a decelerating flow during a preset inspiratory time, and at a preset frequency.

Aim of mode

The aim of this mode is to:

- provide a constant pressure level during the entire inspiration.
- avoid unnecessarily high peak airway pressures.
- provide a decelerating flow pattern.
- enable controlled respiratory rate and I:E ratio.

Ventilation modes – PC

Applicable patients

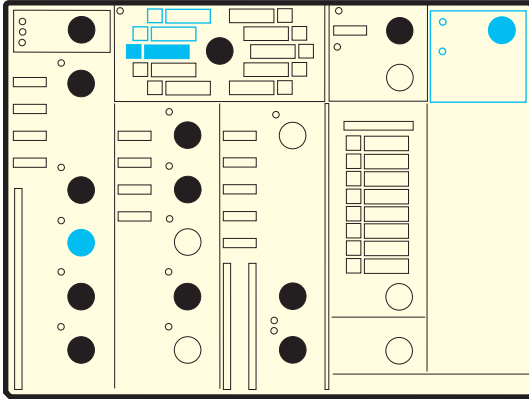
This mode can be suitable for:

- patients with no breathing capacity.
- patients who have a leakage at the endotracheal tube.
- patients who need a high initial flow rate in order to open up closed lung compartments.
- patients in whom variations in lung pressures and high peak airway pressures must be avoided.
- patients with lung injury.
- patients with asthma.
- patients with chronic obstructive bronchitis.
- patients with bronchospasm.
- pediatric patients with uncuffed tubes.
- postoperative patients.

Important considerations

- Ensure that minute volume alarms are appropriately set.
- The inspiratory time must be set, either as an exact time or as an I:E ratio, to define the length of the inspiration.
- As pause is not used, expiration will start as soon as the set inspiratory time has been achieved.
- Carefully monitor tidal volume closely as this parameter varies according to changes in the patient's lung/thorax compliance/resistance. These changes can at times be considerable.
- Maximum allowable inspiratory time is 80% of the respiratory cycle.





3000251X

Settings

The following knobs shall be used.

- Patient range selector
- “Upper press. limit”
- “Pressure Control Level above PEEP”
- “PEEP”
- “Trig. sensitivity Level below PEEP”
- “CMV freq. b/min”
- “Insp. time %”
- “Insp. rise time %”
- “Upper alarm limit” and “Lower alarm limit”
- “O₂ conc. %”

SV 300A

- “Automode”
- “Pressure Support Level above PEEP”

Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting, and for alarms and other safety issues see Patient safety.

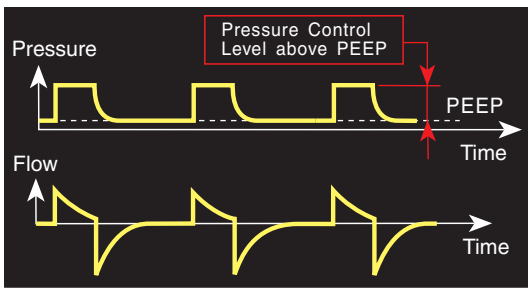
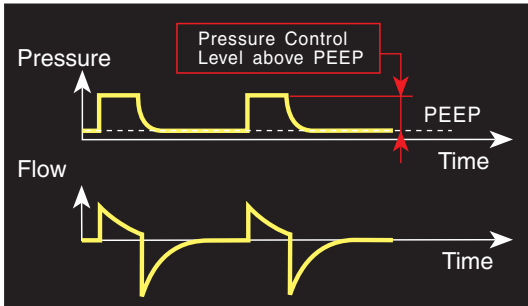
Symptom	Cause	Solution
Steep increase in inspiratory pressure.	Normal but can be adjusted.	Increase “Insp. rise time %”.
Volume too low.	Inspiratory pressure too low in present condition.	Reevaluate patient.
	Decreased compliance or increased resistance.	Increase inspiratory pressure and treat problem according to findings.
Volume too high.	Inspiratory pressure too high in present condition.	Decrease inspiratory pressure.
	Increased compliance or decreased resistance.	

Technical mode description

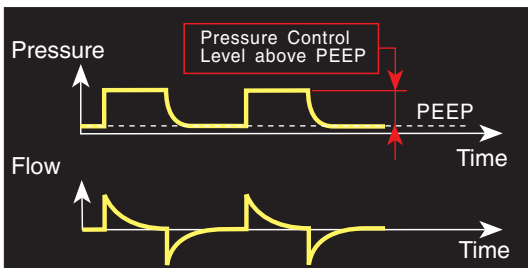
Ventilation is started by the ventilator or by a patient triggering effort and a breath is given with the preset values.

The preset “Pressure Control Level above PEEP” is maintained during the preset inspiration time.

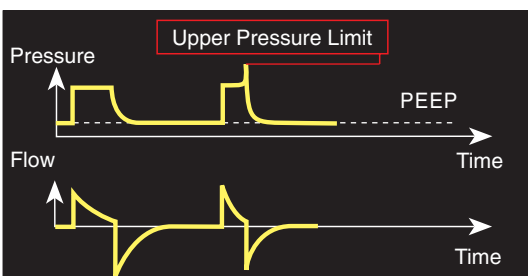
The flow is decelerating.



Inspiratory flow at the end of inspiration time may be low or even zero.



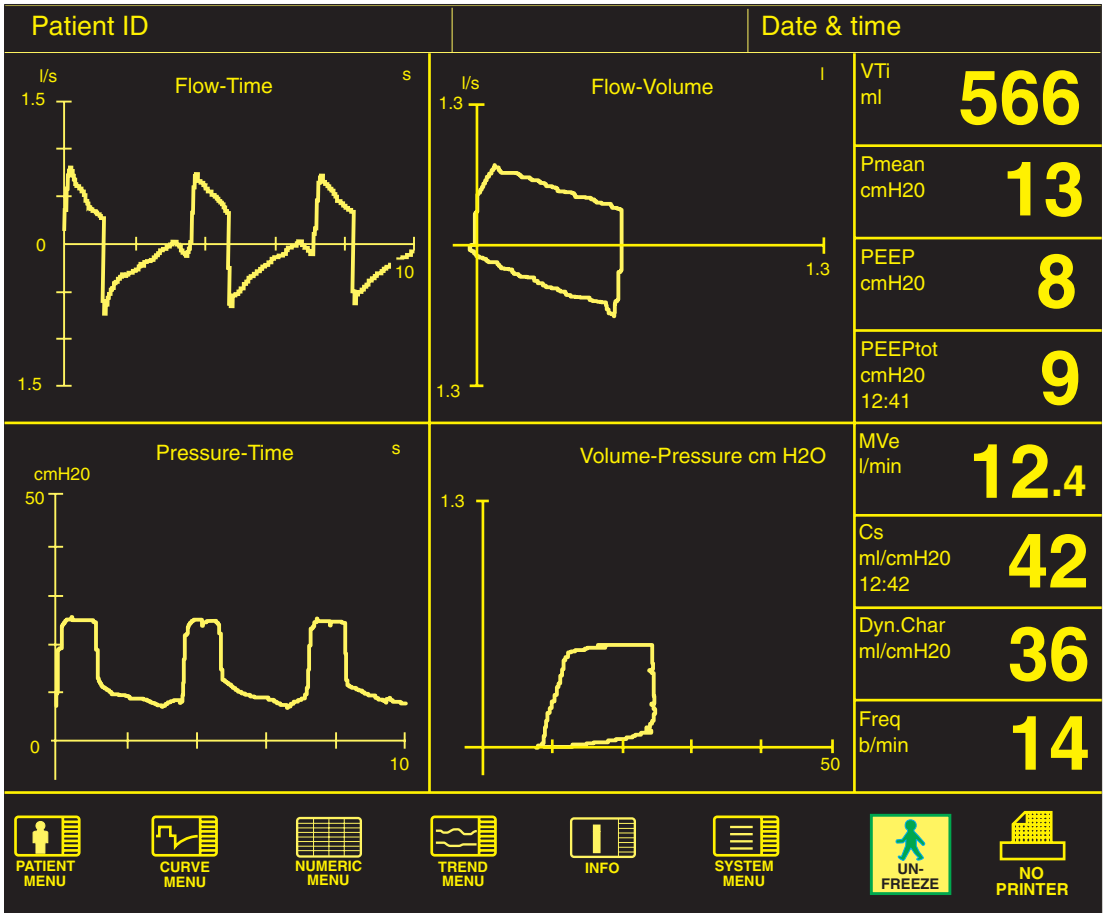
If relatively long inspiration time is used, the flow may reach zero before the end of inspiration.



If the set upper pressure limit is reached, the ventilator will immediately shift to expiration and give alarm for high airway pressure.

Ventilation modes – PC

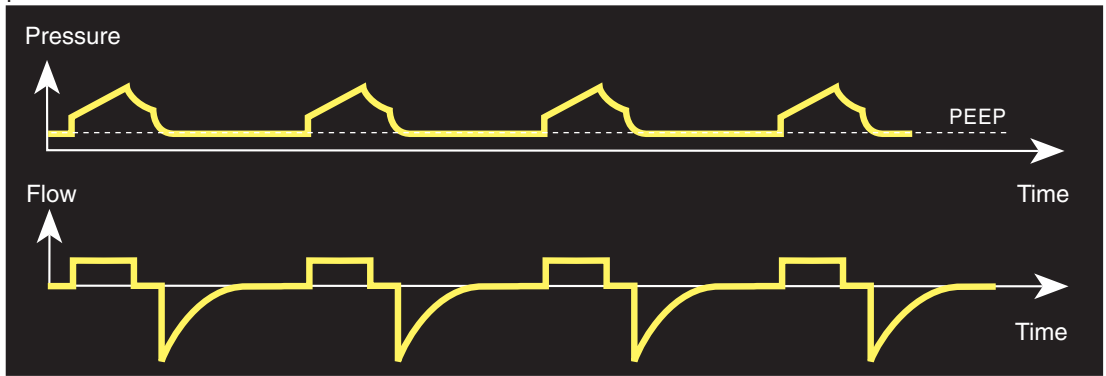
Curves obtained from Servo Screen 390



300-H43E

Curves from a postoperative patient with a bowel perforation and sepsis.

Volume Control



300-H19E

In this **control mode** the ventilator delivers the preset tidal volume with a constant flow during the preset inspiratory time, preset pause time, and at the preset frequency.

Aim of mode

The aim of this mode is to:

- provide controlled ventilation.
- deliver a preset tidal/minute volume with a preset respiratory rate independent of changes in lung/thorax resistance/compliance.
- provide a controlled inspiratory time and pause time (if set).

Ventilation modes –VC

Applicable patients

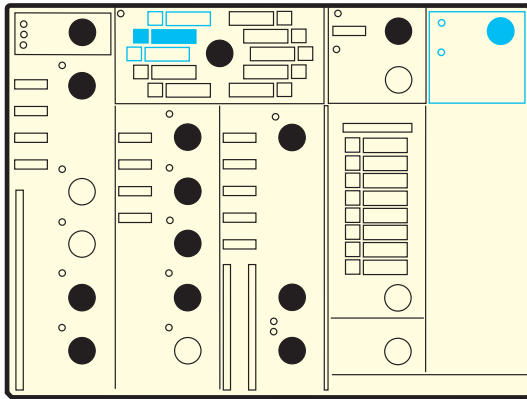
This mode can be suitable for:

- patients with “normal” lungs being ventilated for other reasons.
- general postoperative patients, again preferably with “normal” lungs.

Important considerations

- Ensure that minute volume alarms are appropriately set.
- If the patient creates a pressure below the set PEEP level during inspiration, the ventilator will provide a higher flow. The pressure is regulated to the set PEEP level to provide an “on-demand flow” corresponding to the patient’s needs. The patient should never be able to generate a pressure lower than the set sensitivity due to the fact that flow demands are matched providing for better synchronization with the ventilator.
- Carefully monitor patient airway pressures at all times, as these can change, sometimes quite dramatically, as the patient’s lung/thorax resistance/compliance changes.
- Maximum allowed inspiratory time is 80% of the respiratory cycle.
- If the upper pressure limit is reached the ventilator will immediately shift to expiration and give alarm for high airway pressure.

Ventilation modes – VC



3000252X

Settings

The following knobs shall be used.

- Patient range selector
- “Upper press.limit”
- “PEEP”
- “Trig. sensitivity Level below PEEP”
- “CMV freq. b/min.”
- “Insp. time %”
- “Pause time %”
- “Insp. rise time %”
- “Volume”
- “Upper alarm limit” and “Lower alarm limit”
- “O₂ conc. %”

SV 300A

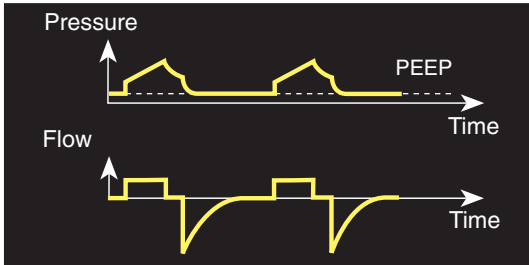
- “Automode”

Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting and for alarms and other safety issues, see Patient safety.

Symptom	Cause	Solution
Inspired tidal volume larger than expired tidal volume.	FRC increasing.	If consistent, consider air trapping.
Expired tidal volume larger than inspired tidal volume.	FRC decreasing.	If consistent, consider whether desired, otherwise increase PEEP.
	Water in the flow transducer.	Dry the flow transducer.

Technical mode description

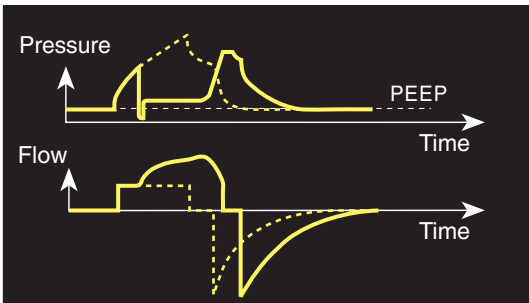


300-H20E

The preset tidal volume is delivered at the preset frequency, during preset inspiration time, with preset pause time and with constant flow.

The pressure increases the more the lungs are filled.

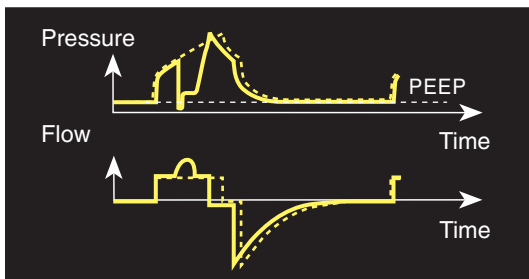
If the patient triggers to preset trigger sensitivity level, a volume controlled breath is delivered earlier according to preset values.



300-H21E

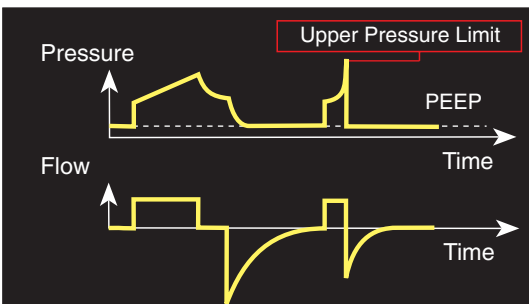
If the patient's breathing effort reaches 2 cm H₂O below preset PEEP level, the ventilator permits a higher flow.

The pressure is then regulated to 2 cm H₂O above PEEP level. The patient can thereby increase the tidal volume to meet his needs during the inspiration time.



300-H22E

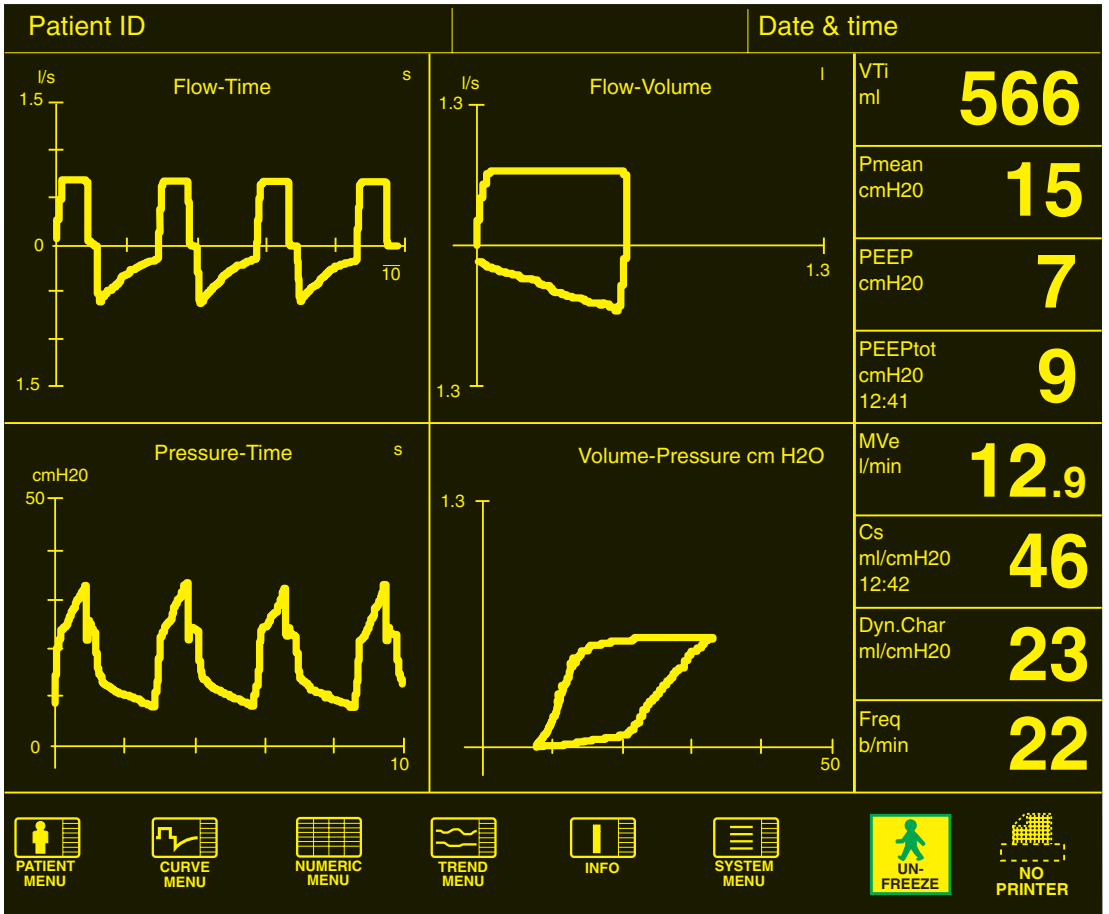
If the patient's breathing effort is enough to reach 2 cm below preset PEEP level but not enough to complete preset inspiratory tidal volume, the ventilator detects the decreasing flow and switches back to the volume controlled breath so that the preset tidal volume will be obtained.



300-H23E

If the set upper pressure limit is reached, the ventilator will immediately shift to expiration and give alarm for high airway pressure.

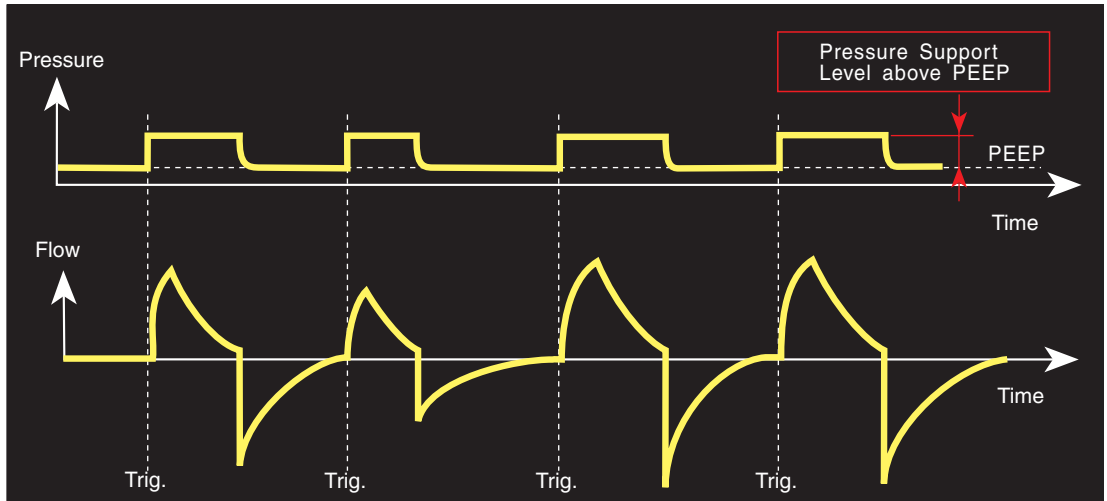
Curves and loops obtained from Servo Screen 390



300-H41E

Curves from a patient with moderate lung injury and moderate bronchospasm. The Volume-Pressure loop shows that the tidal volume is a little bit too high (beaking at top of inspiration)

Pressure Support/CPAP



300-H24E

In this **support mode** the ventilator will deliver breaths with the preset pressure kept constant during the entire inspiration and with a decelerating flow.

All breaths are triggered by the patient.

Aim of mode

The aim of this mode is:

- to provide support during the patient's inspiration according to the preset pressure support level.
- to provide a fast and flexible response to the patient's needs.
- to provide CPAP either on its own or, if required, combined with pressure support.
- to provide monitoring and alarm function for safety reasons in a spontaneous mode.
- to provide ventilation in which every breath is patient triggered.
- to provide adequate support for patients who do not have sufficient capacity to obtain adequate ventilation.
- to facilitate the weaning process.

Ventilation modes – Pressure Support/CPAP

Applicable patients

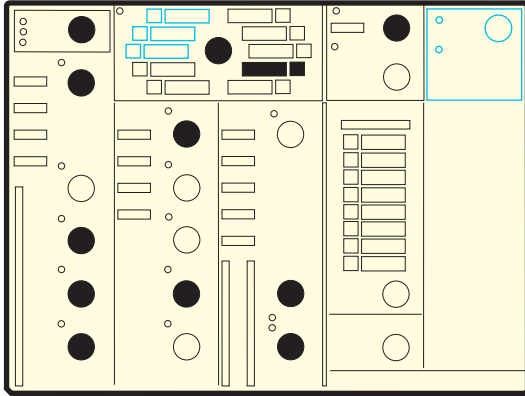
This mode can be suitable for patients :

- with intact respiratory drive.
- who can trigger breaths but cannot achieve adequate minute ventilation.
- during weaning.
- with changing ventilatory needs.
- who can breathe spontaneously but require CPAP to prevent airway closure/collapse.
- who breathe spontaneously but still require additional monitoring.
- who are sensitive to the work of breathing imposed by tracheal tube and ventilator and require support to match and overcome this resistance.
- requiring prolonged phases of weaning from ventilator dependence.
- where it is important to prevent muscular exhaustion during weaning.

Important considerations

- Ensure that the minute volume alarms are appropriately set.
- Tidal volumes should be closely monitored as they can vary as changes in lung/thorax mechanics occur.
- The PSV breath will terminate when the inspiratory flow drops to 5% of whatever the peak flow necessary to deliver the breath was.
- CMV rate and inspiratory time (time or I:E ratio) must be set to ensure the timing of the safety feature for cessation of pressure support.
- If the inspiratory time should exceed 80% of the cycle (determined by the CMV rate setting), the ventilator will shift to expiration.
- A suitable trigger sensitivity level should be set.

Ventilation modes – Pressure Support/CPAP



3000253X

Settings

The following knobs shall be used.

- Patient range selector
- “Upper press. limit”
- “Pressure Support Level above PEEP”
- “PEEP”
- “Trig. sensitivity Level below PEEP”
- “CMV freq. b/min”
- “Insp. rise time %”
- “Upper alarm limit” and “Lower alarm limit”
- “O₂ conc. %”

Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting, and for alarms and other safety issues see Patient safety.

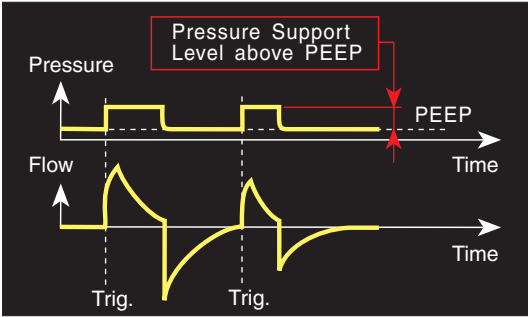
Symptom	Cause	Solution
Difficult for the patient to trigger breaths.	Trigger sensitivity set too low.	Set “Trig. Sensitivity Level below PEEP” to a more sensitive position.
Apnea or low frequency.	Too high support level.	Decrease support pressure. Consider using VS.
	No drive.	Reevalutate patient.
Increased patient frequency or ventilation too low.	Too low support level.	Increase support pressure. Consider using VS.

Ventilation modes – Pressure Support/CPAP

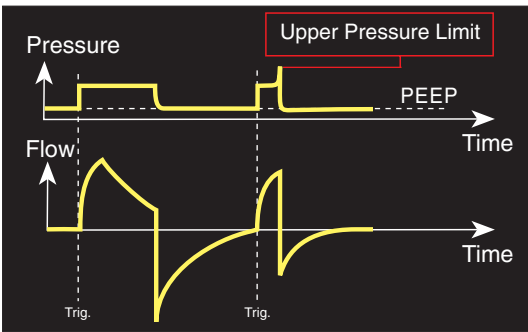
Technical mode description

When the patient triggers, the inspiration is assisted by pressure at preset pressure support level.

The patient determines respiratory rate and I:E ratio which may vary from breath to breath.

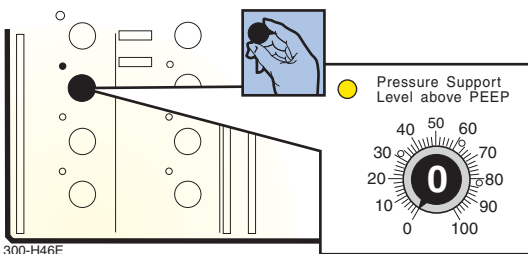


300-H26E



300-H27E

If the upper pressure limit is reached, the ventilator will immediately shift to expiration and give alarm for high airway pressure.

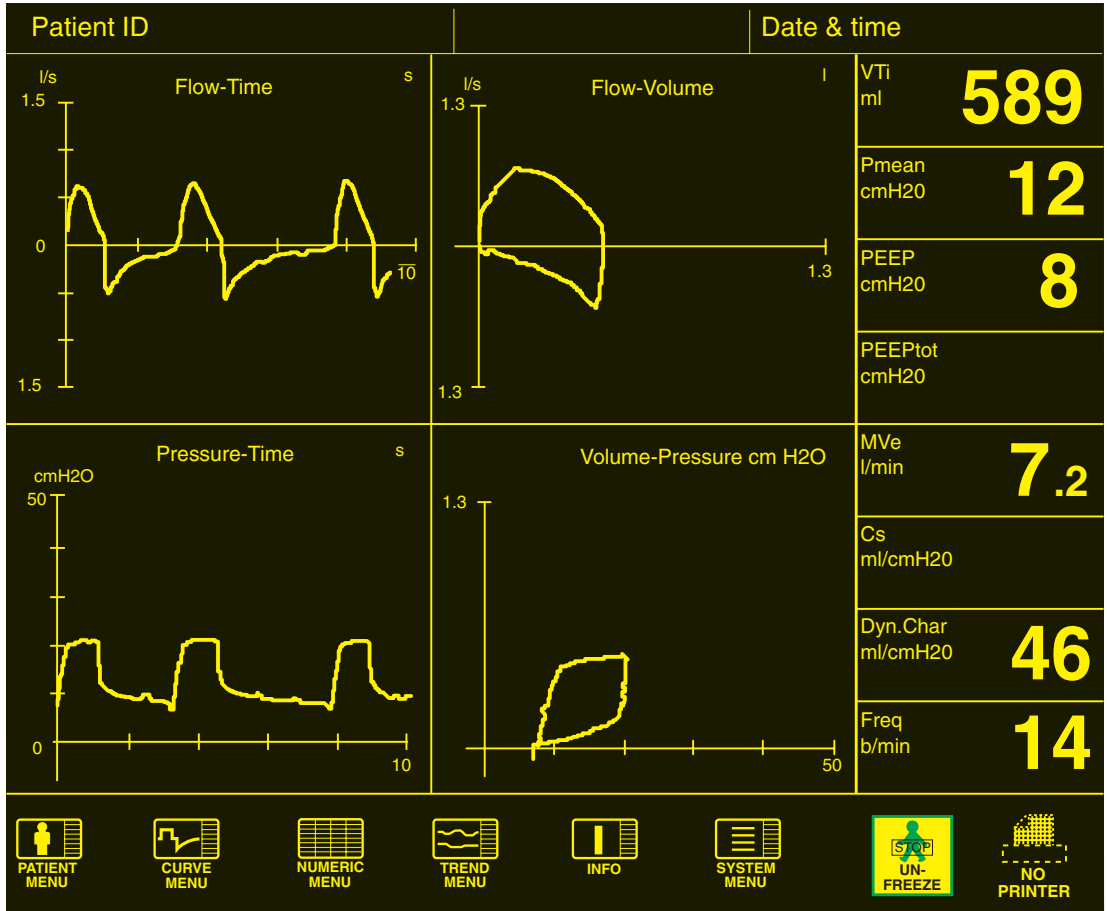


300-H46E

To get CPAP breathing, set "Pressure Support Level above PEEP" to zero.

Ventilation modes – Pressure Support/CPAP

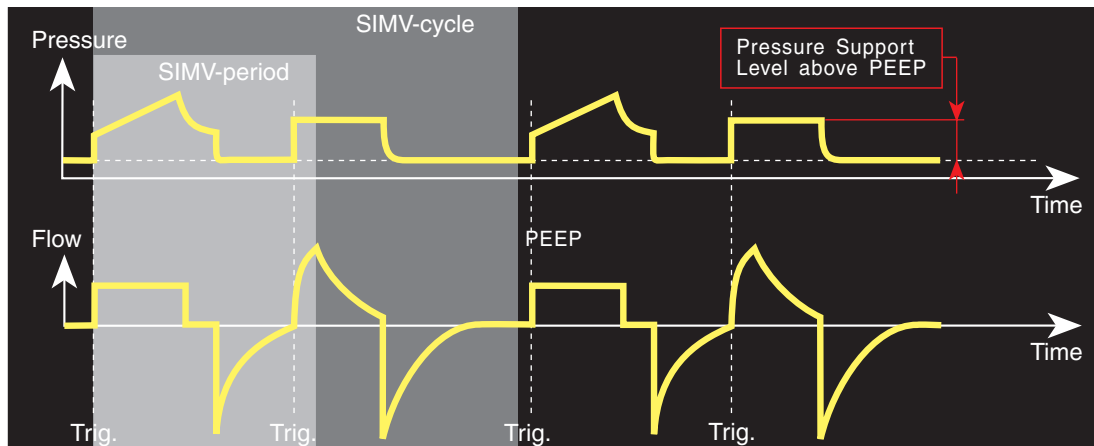
Curves and loops obtained from Servo Screen 390



300-H58E

Curves from a postoperative patient following abdominal surgery due to bowel perforation. During the operation septic. Initially ventilated on PRVC, after 24 hours shifted to PC.

SIMV (Volume Control) + Pressure Support



In this **combination mode** the ventilator will deliver mandatory breaths, as described under VC, and assisted breaths triggered by the patient, as described under PS.

Aim of mode

The aim of this mode is to:

- provide some mandatory, volume controlled breaths according to preset values.
- give the patient inspiratory pressure support during spontaneous breaths.
- deliver mandatory breaths (SIMV breaths) with a preset tidal/minute volume and a preset respiratory rate independent of changes in resistance/compliance.
- provide a constant flow for the mandatory breaths.

Ventilation modes – SIMV (VC)+PS

Applicable patients

This mode can be suitable for patients:

- with some but not sufficient breathing capacity.
- who need some breaths with controlled tidal volumes, inspiratory time and I:E ratio.
- during weaning.

Important considerations

- The time in seconds for one SIMV cycle is $\frac{60}{\text{preset SIMV-rate}}$.

Each SIMV cycle is made up of two parts:

1. The SIMV period during which the mandatory breath (or synchronized breath) will occur.
2. The spontaneous period during which the patient can breathe on his own with an inspiratory pressure support.

The SIMV period is set for each individual patient by the CMV rate setting.

Example:

SIMV rate: $10 \rightarrow \text{breath cycle time } \frac{60}{10} = 6 \text{ seconds.}$

CMV rate: $30 \rightarrow \text{SIMV period } \frac{60}{30} = 2 \text{ seconds.}$

The cycle is then based on the SIMV period. For example, if the set inspiratory time is 25%, the inspiratory time will be 25% of 2 seconds = 0.5 second. The expiratory time will then be 1.5 seconds which means an I:E ratio of 1:3. The remaining time is available for spontaneous breathing.

A breathing effort from the patient during the SIMV period will initiate the SIMV breath according to preset timing and with preset tidal volume.

A breathing effort from the patient during the spontaneous period will result in either a purely spontaneous breath or a pressure supported breath.

If the patient has insufficient spontaneous breathing capabilities, the maximum time between any two SIMV breaths is just over one cycle. To ensure adequate ventilation, the apnea alarm is activated if the time between any two consecutive breaths exceeds the apnea delay time.

- The PSV breath will terminate when the flow drops to 5% of the peak flow necessary to deliver the breath.
- If the inspiratory time should exceed 80% of the cycle (determined by the CMV rate setting), the ventilator will shift to expiration.

Ventilation modes – SIMV (VC)+PS

- If the patient creates a pressure below the set PEEP level during inspiration in SIMV breaths, the ventilator will provide a higher flow. The pressure is regulated to the set PEEP level to provide an “on-demand” flow corresponding to the patient’s needs. The patient should never be able to generate a pressure lower than the set sensitivity due to the fact that flow demands are matched providing for better synchronization with the ventilator.
- Pause can be added in this mode. During a mandatory breath the pause is counted as a part of the total inspiratory time.

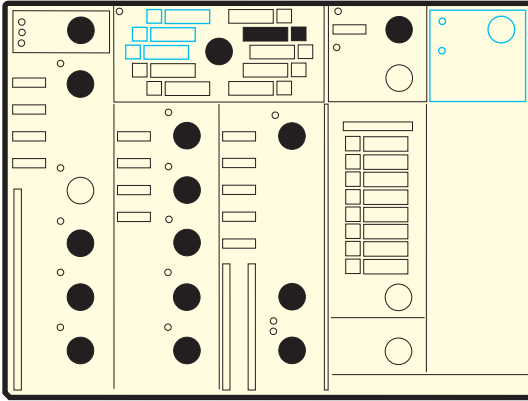
Example:

Inspiratory time 25% }
Pause time 10% } → Total inspiratory time=35%
(I:E ratio 1:1.9)

The maximum allowable inspiratory time is 80% (I:E ratio 4:1).

- Carefully monitor airway pressures for the mandatory breaths at all times as these can change, sometimes quite dramatically, as the patient’s lung/thorax resistance/compliance changes.
- If the upper pressure limit is reached the ventilator will immediately shift to expiration and give alarm for high airway pressure.

Ventilation modes – SIMV (VC)+PS



3000254X

Settings

The following knobs shall be used.

- Patient range selector
- "Upper press. limit"
- "Pressure Support Level above PEEP"
- "PEEP"
- "Trig. sensitivity Level below PEEP"
- "CMV freq. b/min"
- "Insp. time %"
- "Pause time %"
- "Insp. rise time %"
- "SIMV freq. b/min"
- "Volume"
- "Upper alarm limit" and "Lower alarm limit"
- "O₂ conc. %"

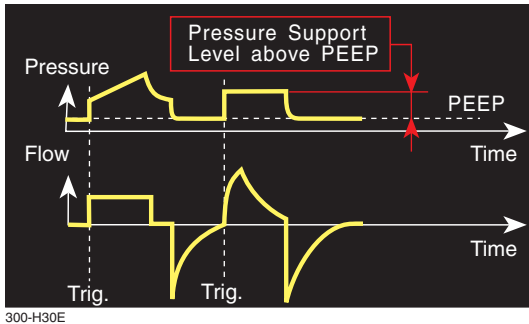
Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting, and for alarms and other safety issues see Patient safety.

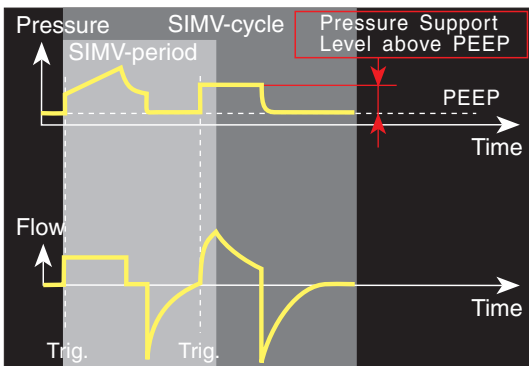
Symptom	Cause	Solution
Increased inspiratory pressure.	Increased resistance or decreased compliance.	Reevaluate the patient. Act according to findings.

Technical mode description

The ventilator is triggered by flow or pressure. A new breath (SIMV breath or assisted breath) is delivered when the trig. sensitivity level is reached.



300-H30E

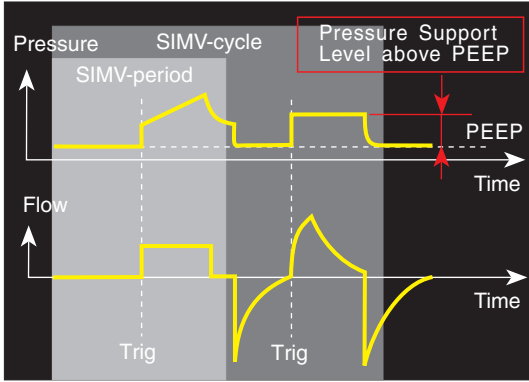


300-H32E

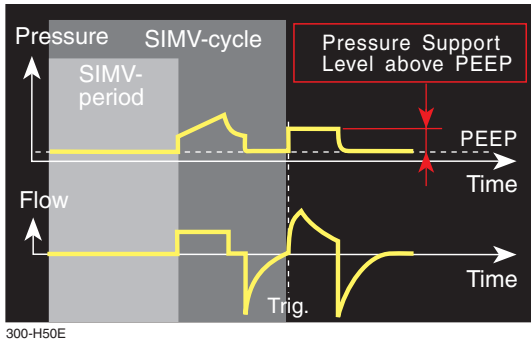
The first time the patient triggers within the SIMV period the delivered SIMV breath is a volume controlled breath. During each SIMV breath the patient can get an increased flow if needed. See VC description.

The number of supported breaths triggered within the SIMV cycle depends on the patient's breathing efforts.

Ventilation modes – SIMV (VC)+PS



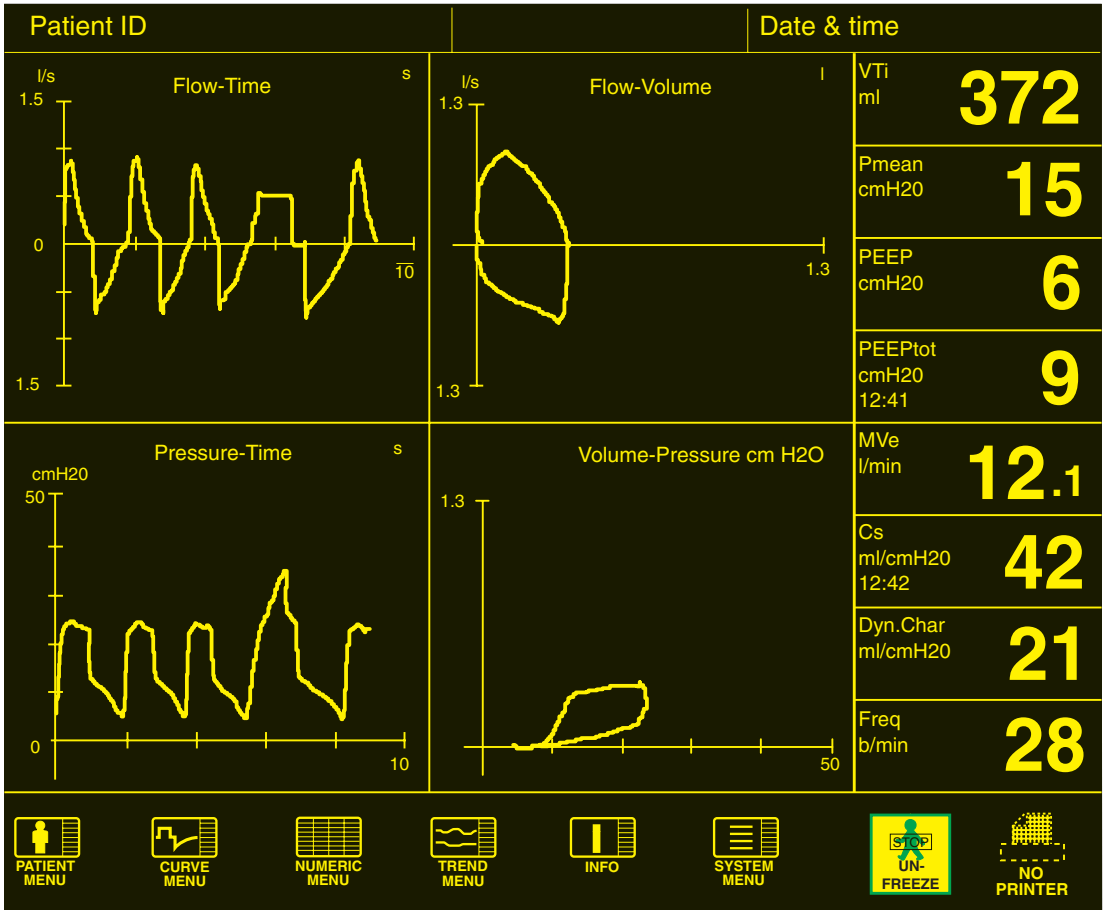
Each time the patient triggers after the SIMV breath (within the same SIMV cycle), a supported breath is given with pressure support at the preset "Pressure Support Level above PEEP". The patient determines respiratory rate, tidal volume and inspiration time. The number of assisted breaths triggered within the SIMV cycle depends on the patient's breathing efforts.



If a SIMV period passes without any breathing effort, a mandatory volume controlled breath is started by the ventilator at the end of the SIMV period. During the volume controlled breaths, the patient has the possibility to increase the flow.

Ventilation modes – SIMV (VC)+PS

Curves and loops obtained from Servo Screen 390



300-H44E

Curves from a COPD patient, Resistance high ($P_{peak} - P_{Pause}$).

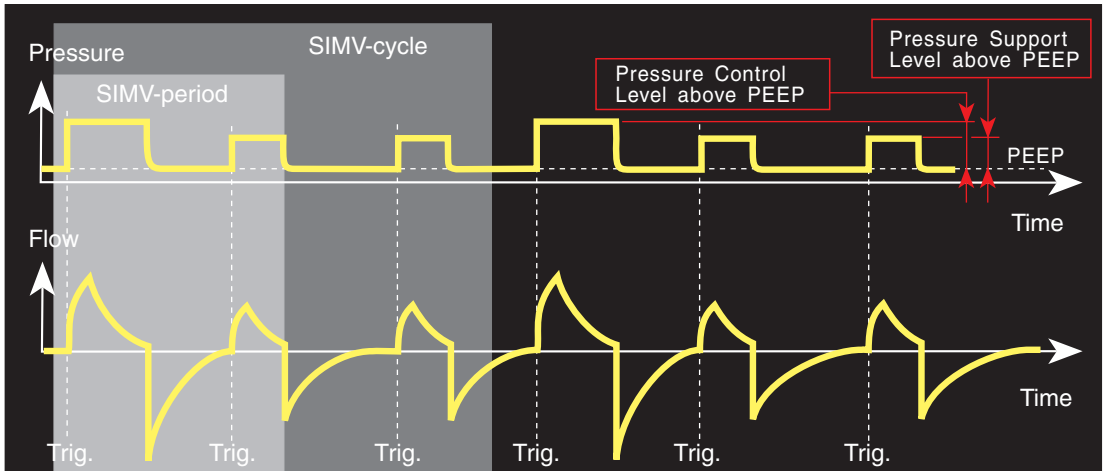
Dynamic characteristics low compared to Static compliance. Pattern recognition on the Flow-Volume and Volume-Pressure curves demonstrate the same.



Notes



SIMV (Pressure Control) + Pressure Support



300-H35E

In this **combination mode** the ventilator will deliver mandatory breaths, as described under PC, and assisted breaths triggered by the patient, as described under PS.

Aim of mode

The aim of this mode is to:

- provide some mandatory breaths at a constant pressure level during the entire inspiration.
- avoid unnecessarily high peak airway pressures.
- provide a decelerating flow pattern for both mandatory and spontaneous breaths.
- give support to the patient's spontaneous breaths.

Ventilation modes – SIMV (PC)+PS

Applicable patients

This mode can be suitable for patients:

- with some but not sufficient breathing capacity.
- who have a leakage at the endotracheal tube.
- who need some breaths with a decelerating flow, controlled according to set pressure and inspiratory time.
- who need a high initial flow rate in order to open up closed lung compartments.
- in whom variations in lung pressures and high peak airway pressures must be avoided.
- during weaning.
- who require a reduced work of breathing.

Important considerations

- Ensure that minute volume alarms are appropriately set.
- The inspiratory time must be set (either as an exact time or as an I:E ratio) to define the length of the inspiration. When the inspiratory time has been completed, expiration will follow.
- The “Pressure Control Level above PEEP” must be set to decide the inspiratory pressure level.
- As pause is not used, expiration will start as soon as the set inspiratory time has been achieved.
- Carefully monitor tidal volume closely as this parameter varies according to changes in the patient’s lung/thorax resistance/compliance. These changes can at times be considerable.
- If the patient triggers during the SIMV period, he will receive a breath according to the set parameters.

If he triggers during the spontaneous period, he will get either a purely spontaneous breath or a pressure supported breath.
- The onset of inspiration can be adjusted by altering the “Insp. rise time %” knob.
- Maximum allowable inspiratory time is 80% of the respiratory cycle.

contd.

Important considerations, continued

- The time in seconds for one SIMV cycle is $\frac{60}{\text{preset SIMV-rate}}$.

Each SIMV cycle is made up of two parts:

1. The SIMV period during which the mandatory breath (or synchronized breath) will occur.
2. The spontaneous period during which the patient can breathe on his own with an inspiratory pressure support.

The SIMV period is set for each individual patient by the CMV rate setting.

Example:

SIMV rate:
10 → breath cycle time $\frac{60}{10} = 6$ seconds.

CMV rate: $\frac{60}{30} = 2$ seconds.
30 → SIMV period

The cycle is then based on the SIMV period. For example, if the set inspiratory time is 25% the inspiratory time will be 25% of 2 seconds = 0.5 second. The expiratory time will then be 1.5 seconds which means an I:E ratio of 1:3. The remaining time is available for spontaneous breathing.

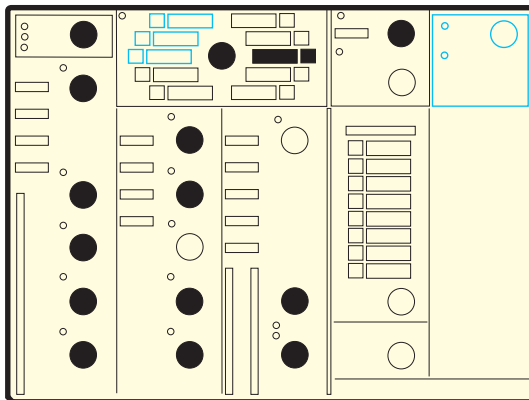
A breathing effort from the patient during the SIMV period will initiate the SIMV breath according to preset timing and with preset tidal volume.

A breathing effort from the patient during the spontaneous period will result in either a purely spontaneous breath or a pressure supported breath.

If the patient has insufficient spontaneous breathing capabilities, the maximum time between any two SIMV breaths is just over one cycle. To ensure adequate ventilation, the apnea alarm is activated if the time between any two consecutive breaths exceeds the apnea delay time.

- The PSV breath will terminate when the flow drops to 5% of the peak flow necessary to deliver the breath.
- If the inspiratory time should exceed 80% of the cycle (determined by the CMV rate setting), the ventilator will shift to expiration.

Ventilation modes – SIMV (PC)+PS



3000255X

Settings

The following knobs shall be used.

- Patient range selector
- “Upper press. limit”
- “Pressure Control Level above PEEP”
- “Pressure Support Level above PEEP”
- “PEEP”
- “Trig. sensitivity Level below PEEP”
- “CMV freq. b/min”
- “Insp. time %”
- “Insp. rise time %”
- “SIMV freq. b/min”
- “Upper alarm limit” and “Lower alarm limit”
- “O₂ conc. %”

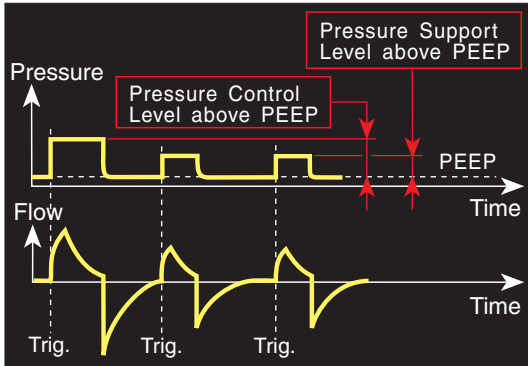
Troubleshooting

This is a short clinical troubleshooting guide for this specific mode. For general troubleshooting see chapter Troubleshooting and for alarms and other safety issues, see Patient safety.

Symptom	Cause	Solution
Irregular breathing.	Mismatch between mandatory and assisted breaths.	Increase pressure support.
The patient is fighting the ventilator.	The same as above or too low CMV frequency.	Consider more pressure support and/or less SIMV, or consider using VS.

Technical mode description

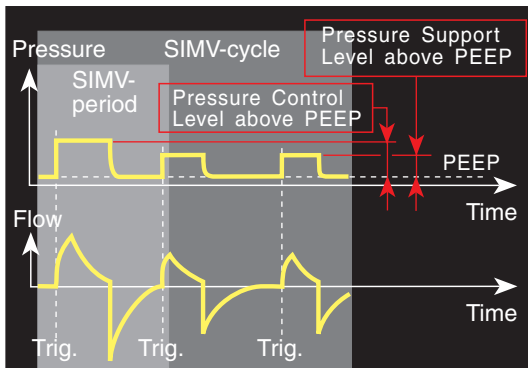
The ventilator is triggered by flow or pressure. A new breath (SIMV breath or assisted breath) is delivered when the trig. sensitivity level is reached.



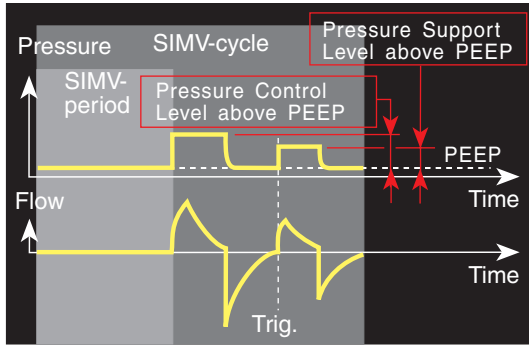
The first time the patient triggers within the SIMV period the delivered SIMV breath is a pressure controlled breath. See PC description.

The number of supported breaths triggered within the SIMV cycle depends on the patient's breathing efforts.

Each time the patient triggers after the SIMV breath (within the same SIMV cycle), a supported breath is given with pressure support at the preset "Pressure Support Level above PEEP". The patient determines respiratory rate, tidal volume and inspiration time. The number of assisted breaths triggered within the SIMV cycle depends on the patient's breathing efforts.



Ventilation modes – SIMV (PC)+PS



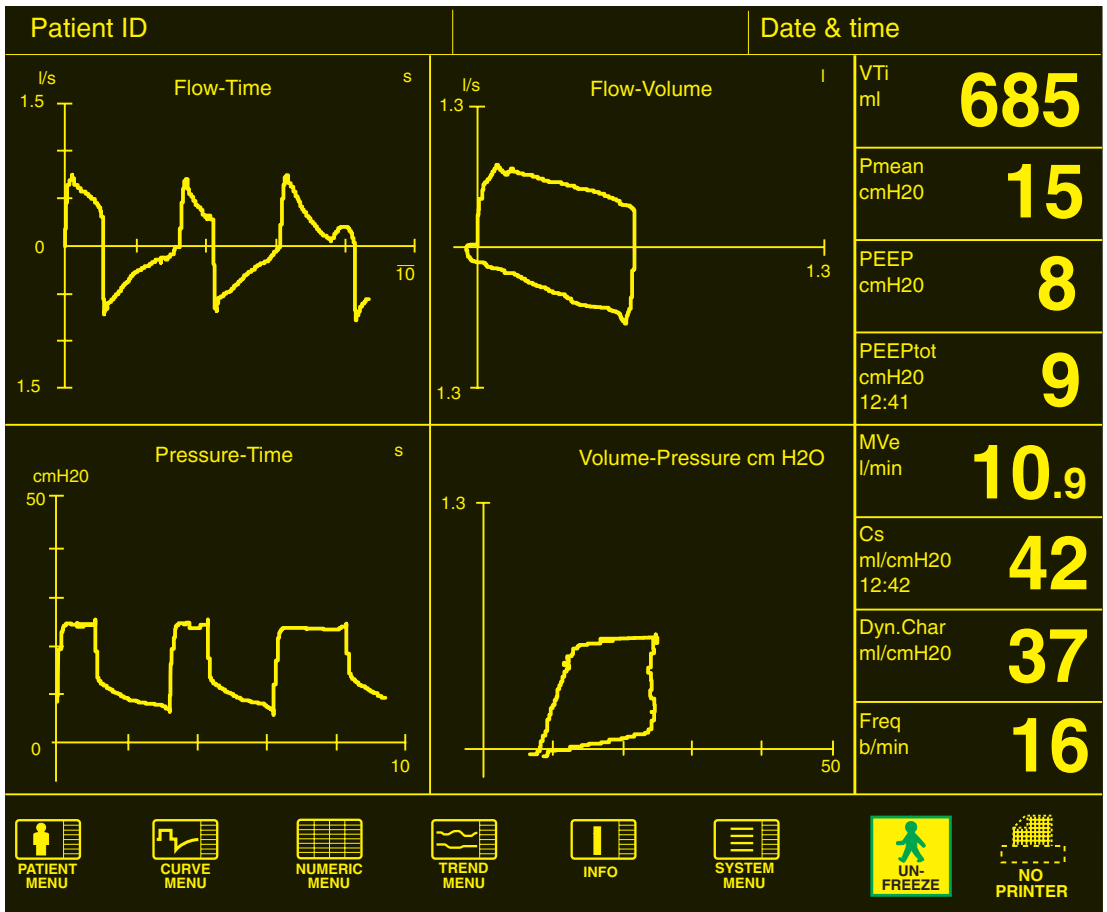
300-H49E

If a SIMV period passes without any breathing effort, a mandatory pressure controlled SIMV breath is started by the ventilator at the end of the SIMV period.



Ventilation modes – SIMV (PC)+PS

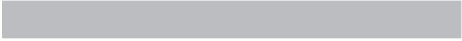
Curves and loops obtained from Servo Screen 390



300-H45E

Curves from a patient with lung injury. Resistance low. Compliance reasonably high due to PEEP.

Ventilation modes – SIMV (PC)+PS



Notes



Ventilation modes – Automode (SV 300A)

Automode

“Automode” on SV 300A is a feature where two consecutive triggering efforts from the patient will shift the ventilator status from a control mode to a support mode. The ventilator will remain in the support mode as long as the patient keeps triggering. If the patient stops breathing the ventilator will shift back to the control mode.

The “Automode” includes the following combinations of control and support modes:

Control mode		Support mode
Volume Control	↔	Volume Support
Pressure Control	↔	Pressure Support
Pressure Reg. Volume Control	↔	Volume Support

Aim of mode

- The aim of the “Automode” is to adapt the ventilator status to the patient’s breathing efforts, including respiratory drive. This means that the discontinuation of mechanical ventilation can start as soon as the patient makes his first breathing efforts. Patient comfort should also increase due to less fighting of the ventilator. Conceivably this may set a platform for a decrease in sedation level and also a shorter stay on the ventilator.

Applicable patients

- The same as for Servo Ventilator 300.
Note! The “Automode” is not applicable for patients with neuromuscular block or drugs that severely depress the respiratory drive.

Important considerations

- The mode descriptions for the SV 300 apply to SV 300A except for the description on the following pages.

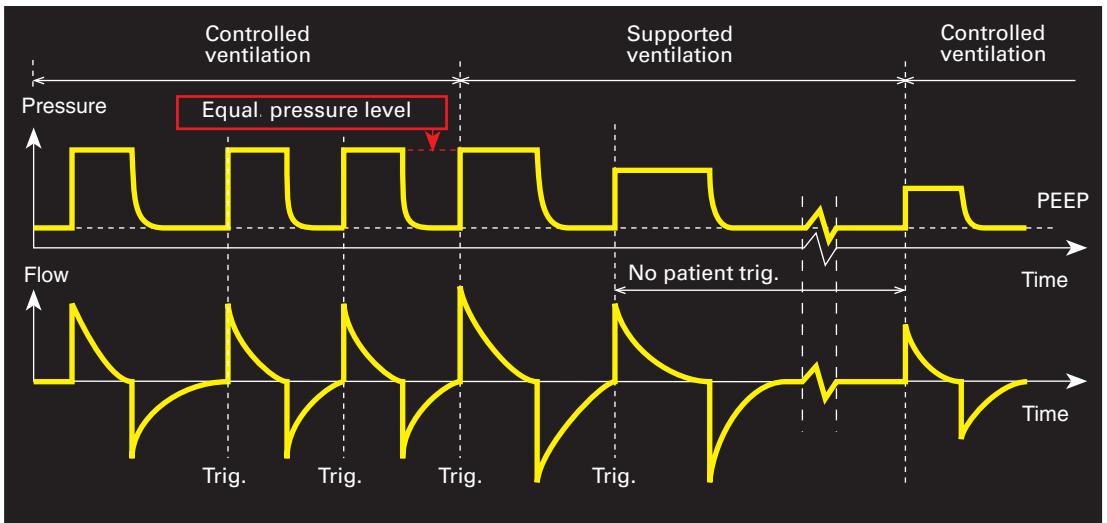
- The “Automode” can be used in “Volume Control/Support” where the support mode is “Volume Support”, “Pressure Control/Support” where the support mode is “Pressure Support” and “Pressure Reg. Volume Control/Support” where the support mode is “Volume Support”.
- If the patient can trigger the ventilator in a control mode and maintain spontaneous breathing the ventilator will switch from controlled to supported ventilation. The shift is shown by the yellow light “Support”.
- If the patient cannot maintain spontaneous breathing, the ventilator will shift back to controlled ventilation again after: Adult 12 seconds, Pediatric 8 seconds and Neonate 5 seconds.
- If a Bi-Phasic Ventilation Module for SV 300 is connected to a SV 300A the “Automode” must be turned off.
- Normally, the “Automode” operates without problems, however the following can disturb the functionality if the trigger sensitivity is set too close to the red area.
 - a short apnea period might occur after suctioning.
 - artifactual triggering can be induced:
 - by leakage or endotracheal tube suctioning
 - in patients with stiff lungs and high cardiac output.
 - by external manipulation, e.g., physiotherapy or manipulation of patient tubings.

Settings

- The same as for the SV 300 but with the addition of the controls “Automode” and, in “Pressure Control/Support”, “Pressure Support Level above PEEP”. Before activating the “Automode” in “Pressure Control”, make sure the “Pressure Support Level above PEEP” is set to a suitable level for the patient.

Ventilation modes – Automode (SV 300A)

Mode description – Pressure Reg. Volume Control/Support

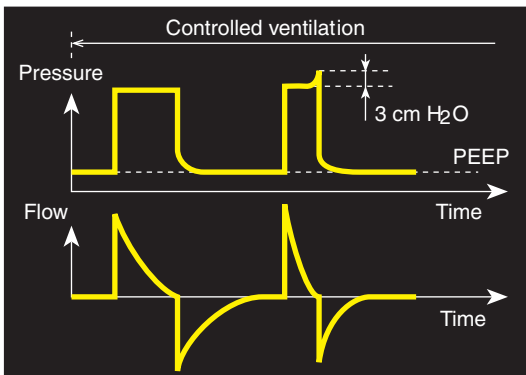


3000204E

When the “Automode” is set to “On” and the patient triggers two consecutive breaths, the ventilator shifts from Pressure Reg. Volume Control (PRVC) to Volume Support.

At the second trig the ventilator delivers one more PRVC-breath. The next breath will be a volume supported breath with a pressure level equal to the last PRVC breath.

Then each breath has to be triggered by the patient, and the pressure support will vary with each breath aiming at the same tidal volume a set in PRVC.



3000207E

If the airway pressure exceeds the calculated inspiratory pressure by more than 3 cm H₂O during the controlled breaths inspiration will immediately stop and expiration start.

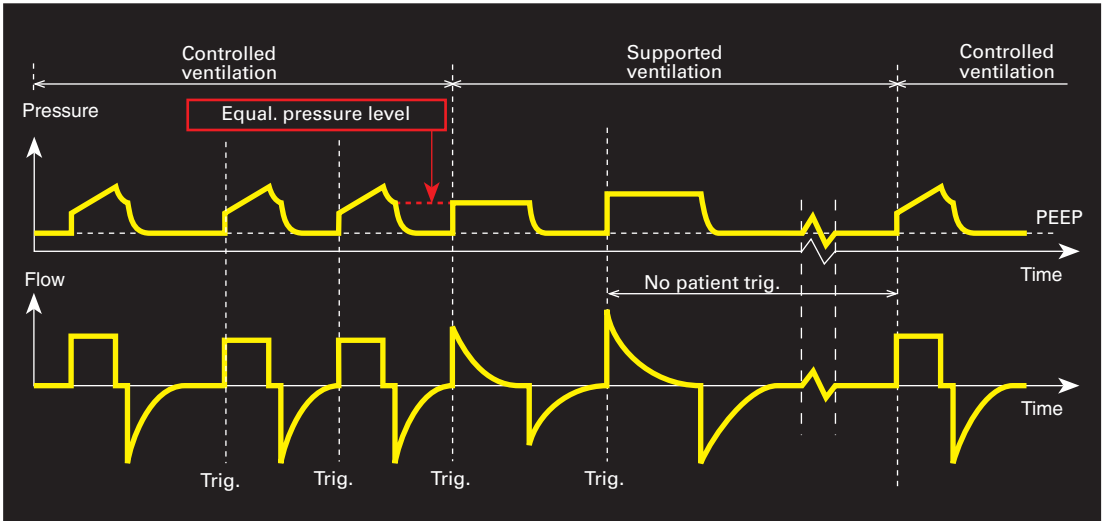
At a lower than set spontaneous frequency, the target tidal volume will increase to compensate for the loss in minute volume.

If the patient does not trigger the ventilator will switch back to the control mode after:

Adult: 12 seconds. Pediatric: 8 seconds and Neonats: 5 seconds

For detailed technical mode descriptions, see Ventilation modes: Pressure Reg. Volume Control and Volume Support.

Mode description – Volume Control/Support



3000206E

When the “Automode” is set to “On” and the patient triggers two consecutive breaths during the expiration time, the ventilator shifts from Volume Control (VC) to Volume Support.

At the second trig the ventilator delivers on more VC-breath. The next breath will be a volume supported breath with a pressure level equal to the pause pressure in VC, or, if no pause time is set, calculated with the formula: $(P_{\text{peak}} - \text{PEEP}) \times 50\% + \text{PEEP}$.

Then each breath has to be triggered by the patient, and the pressure support will vary with each breath aiming at the same tidal volume a set in VC.

At a lower than set spontaneous frequency, the target tidal volume will increase to compensate for the loss in minute volume.

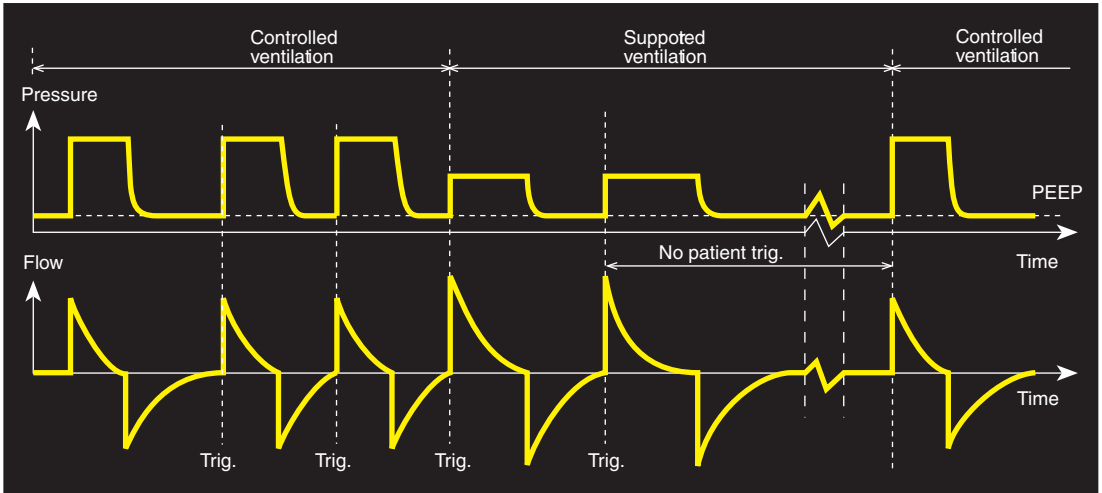
If the patient does not trigger, the ventilator will switch back to the control mode after:

Adult: 12 seconds, Pediatric: 8 seconds and Neonate: 5 seconds.

For detailed technical mode descriptions, see Ventilation modes: Volume Control and Volume Support.

Ventilation modes – Automode (SV 300A)

Mode description – Pressure Control/Support

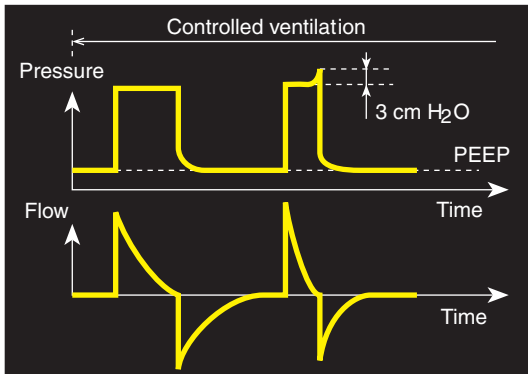


3000205E

When the “Automode” is set to “On” and the patient triggers two consecutive breaths, the ventilator shifts from Pressure Control (PC) to Pressure Support.

At the second trig the ventilator delivers on more PC-breath. The next breath will be a pressure supported breath with a pressure level equal to the set “Pressure Support Level above PEEP”.

Then each breath has to be triggered by the patient, and the pressure support will be the same for each breath.



3000207E

If the airway pressure exceeds the set inspiratory pressure by more than 3 cm H₂O during the controlled breaths, inspiration will immediately stop and expiration start.

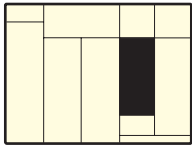
If the patient does not trigger, the ventilator will switch back to the control mode after: Adult: 12 seconds. Pediatric: 8 seconds and Neonate: 5 seconds.

For detailed technical mode descriptions, see Ventilation modes: Pressure Control and Pressure Support.

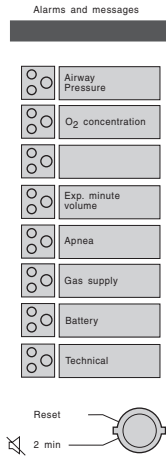
Contents

General	2
“Alarms and messages” display and alarm memory	3
Airway pressure	4
O ₂ concentration	6
Expired minute volume	7
Apnea alarm	8
Gas supply	9
Battery	10
Technical	11
Table of clinical alarms	14-15
Table of all alarms	16-17
Table explanations	18

Patient safety – General



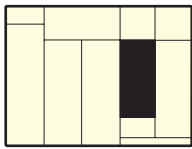
3000256E



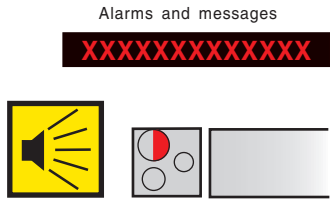
The Servo Ventilator 300/300A has a number of alarms for the protection of the patient and for alerting the staff of changes in patient conditions or possible malfunctions of the ventilator.

The primary alarm is a micro-processor system. There is also a back-up alarm system for airway pressure, expired minute volume and oxygen concentration.

The back-up alarm system is only in operation if the microprocessor system fails.



3000257E

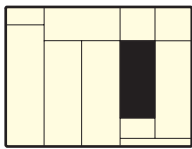


High priority alarm

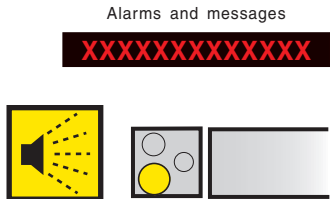
High priority alarm is given with red flashing light and an audible signal with an increasing volume except for airway pressure alarm where the alarm starts at maximum level.

A text with information about the alarm cause will automatically be displayed on the "Alarms and messages" display.

If more than one alarm is active, the alarm with the highest priority according to the table on pp 16 – 17 will be displayed. The other alarm texts will be shown when the corresponding touchpad is activated.



3000258E



Caution signal

When the caution signal, a ticking sound and a yellow light, is active the reason and the measured oxygen concentration are shown alternating on the display.

The caution signal is also active when certain alarms have been reset. For details, see table on pp 16 – 17.

300-G41E

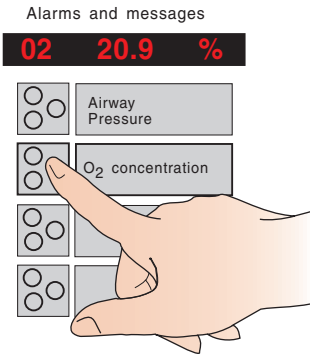


“Alarms and messages” display

Normal display function

The display normally shows the measured O₂ concentration.

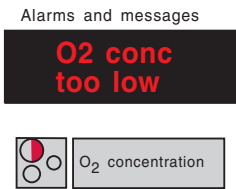
300-G42E



Touchpad activation

If a touchpad is activated when no alarm is active, the display will show different texts depending on which touchpad has been selected.

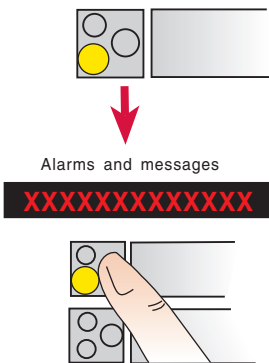
300-G43E



Alarm

When an alarm is given the reason is automatically displayed.

300-G45E



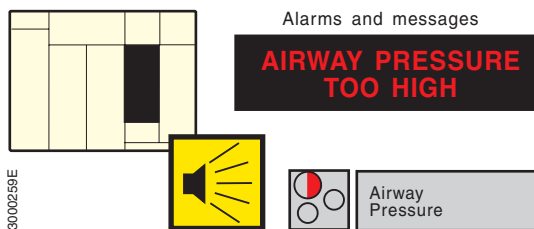
Alarm memory

When a high priority alarm is no longer active, the alarm indication is stored in memory. This is indicated by a yellow light at the touchpad for the alarm.

When the touchpad is activated the alarm text is displayed.

If an alarm is reset or if mode is changed, the stored alarm text disappears.

If the audible alarm has been muted and, within 2 minutes, the knob “Reset” is activated, the audible alarm will come back.



Airway pressure

“Upper press. limit”

If the set “Upper press. limit” is reached, a high priority alarm will be given.

At the same time inspiration will immediately stop and expiration start.

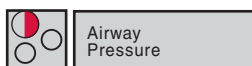
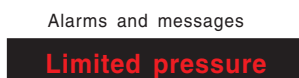
The red light at “Airway pressure” flashes and the display “Alarms and messages” shows **Airway pressure too high**.

This alarm cannot be muted.

For patient safety, always set “Upper press. limit” as low as possible in all modes of ventilation.

Note: If airway pressure rises 6 cm H₂O above set upper pressure limit the safety valve opens.

The safety valve also opens if system pressure exceeds 120 cm H₂O.



Limited pressure

If the ventilator in the modes “Pressure Reg. Volume Control” and “Volume Support” cannot obtain set tidal volume within the limited permitted pressure control level (5 cm H₂O below set upper pressure limit) and this situation goes on for 3 consecutive breaths, a high priority alarm will be given.

The red light at “Airway pressure” flashes and the display “Alarms and messages” shows the text **Limited pressure**.

This alarm can be muted.

3000448E

Patient safety – Airway pressure

Alarms and messages

High continuous pressure



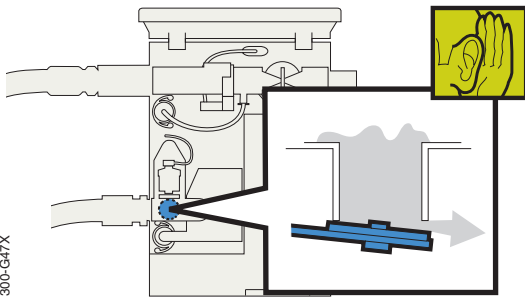
300-G49E

High continuous pressure

If the airway pressure is higher than set PEEP level +15 cm H₂O continuously for more than 15 seconds, a high priority alarm is given.

The red light at "Airway pressure" flashes and the display "Alarms and messages" shows **High continuous pressure**.

This alarm can be muted.



300-G47X

Safety valve

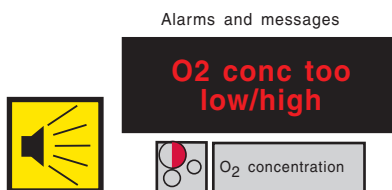
If the airway pressure continues to increase and exceeds 6 cm H₂O above the set "Upper press. limit", the safety valve will open.

The safety valve will remain open as long as the airway pressure is too high.

An alarm is given with a continuous sound, the red light at "Airway pressure" flashes and the display "Alarms and messages" shows **Airway pressure too high**.

The safety valve will open mechanically if the pressure exceeds 120 cm H₂O.

300-G50E



Lower and upper alarm limit

The alarm limits are automatically set at approx. 6% O₂ above and below the set O₂ value. High priority alarm is given if F_IO₂ is outside the set alarm limits.

The red light at "O₂ concentration" flashes and the display "Alarms and messages" shows **O2 conc too low/high**.

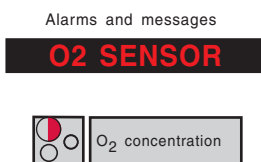
This alarm can be muted.

If the alarm limit is exceeded less than about 55 seconds the alarm memory will not be set.

If the O₂ concentration setting is changed more than 2% the alarm is automatically muted for maximum 55 seconds. This also applies at activation of "Oxygen breaths".

High priority alarm is also given, independently of settings, if the oxygen concentration drops below 18%.

300-G51E



O₂ cell disconnect

If the O₂ cell is not connected a high priority alarm is given.

The red light at "O₂ concentration" flashes and the display "Alarms and messages" shows **O2 SENSOR**.

This alarm can be muted with "2 min" or by "Reset". If the alarm is reset, it will change to a caution signal.

300-G52E



Alarms and messages

Exp minute volume too high



Exp. minute volume

300-G53E



Alarms and messages

Exp minute volume too low



Exp. minute volume

Upper alarm limit

High priority alarm is given if the exhaled minute volume exceeds the preset alarm limit.

The red light at “Exp. minute volume” flashes and the display “Alarms and messages” shows **Exp. minute volume too high**.

This alarm can be muted.

Lower alarm limit

High priority alarm is given if the exhaled minute volume drops below the preset alarm limit.

The red light at “Exp. minute volume” flashes and the display “Alarms and messages” shows **Exp. minute volume too low**.

This alarm can be muted.

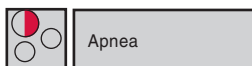
When the control is set to its leftmost position, the minimum alarm limit is:

- “Adult” 0.3 l/min
- “Pediatric” 0.3 l/min
- “Neonate” 0.06 l/min

The limits for high and low expired minute volume must always be properly set for each patient.

Alarms and messages

APNEA ALARM



900-G64E

Apnea alarm

High priority alarm is given if the time between two consecutive efforts to trigger the ventilator is longer than:

“Adult”	20 s
“Pediatric”	15 s
“Neonate”	10 s

The red light at “Apnea” flashes and the display “Alarms and messages” shows **APNEA ALARM**.

This alarm can be muted.

At apnea alarm in “Volume Support”, the ventilator will automatically switch over to “Pressure Reg. Volume Control”. The ventilator will remain in this mode until the alarm is manually reset or if another mode is selected.

Alarm

High priority alarm is given if the pressure of any of the connected gases is outside the range 2 (-5%) to 6.5 (+5%) bar. This will occur if:

- One gas is disconnected.
- One gas module is disconnected.
- Supply pressure is too high/low.

Gas supply air

If the air supply is outside the range the red light at "Gas supply" flashes and the display "Alarms and messages" shows:

**Air supply pressure too low/high,
Air: X.X bar, O2: X.X bar.**

The high priority alarm may be downgraded to a silent caution alarm if the set O₂ concentration is between 98 and 100%.

Gas supply O₂

If the O₂ supply is outside the range the red light at "Gas supply" flashes and the display "Alarms and messages" shows:

**O2 supply pressure too low/high,
Air: X.X bar, O2: X.X bar.**

The high priority alarm may be downgraded to a silent caution alarm if the set O₂ concentration is between 21 and 23%.

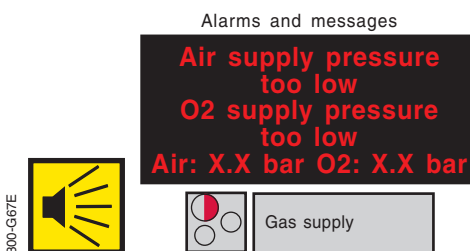
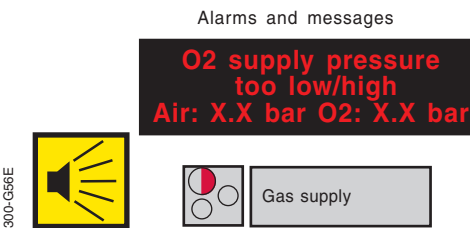
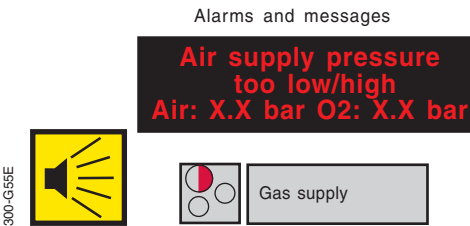
The flow from the missing gas is automatically compensated for so that the patient will get preset volumes and pressure.

Out of gas

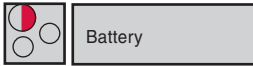
If no gas supply is available, the red light at "Gas supply" flashes and the display "Alarms and messages" shows: **Air supply pressure too low, O2 supply pressure too low Air: X.X bar, O2: X.X bar.**

The safety valve and the expiratory valve will also open.

All these alarms can be muted.



300-G58E



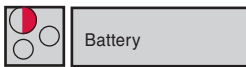
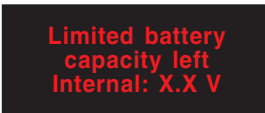
Switch to battery operation

At mains failure, the ventilator will automatically switch over to battery operation. The switch will be indicated by a high priority alarm.

When the alarm is reset, the ventilator continues to operate on battery, the caution signal is active (yellow light at "Battery" is lit) and the display "Alarms and messages" shows: **BATTERY** alternating with the **O₂ concentration**.

300-G59E

Alarms and messages



Limited battery capacity left

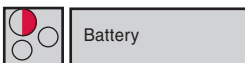
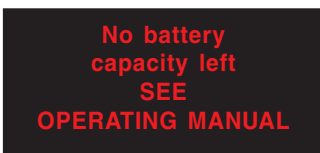
High priority alarm is given at a battery voltage below 23 V, indicating limited battery capacity.

The red light at "Battery" flashes and the display "Alarms and messages" shows: **Limited battery capacity left Internal X.X V**.

This alarm can be muted.

300-G60E

Alarms and messages



No battery capacity left

High priority alarm is given at a battery voltage below 21 V, indicating no battery capacity.

The red light at "Battery" flashes and the display "Alarms and messages" shows: **No battery capacity left**.

This alarm cannot be muted.

At 19.5 V the gas modules close, the expiratory valve and the safety valve open and an additional alarm sounds during 2 minutes.

At this point, the ventilator must be disconnected from the patient and the battery must be charged.

Irregularities

In the unlikely event of irregularities (e.g. flashing display, disturbed operation), normal function will generally be restored automatically within a few seconds.

In exceptional cases, such as high ESD levels, a manual operation of the mode selector to the “Ventilator Off” position and then back again to the original position may be necessary to restore full ventilatory support.

Alarms

Alarms and alarm messages are given for certain technical problems. Most of these have to be remedied by local technical staff trained by MAQUET or a service technician from MAQUET and are not described in this manual.

All alarms that are caused by a minor problem which can be remedied by clinical staff are described in this chapter.

At any alarm followed by the text **RESTART** on the “Alarms and messages” display, turn the ventilator off and start again. If the display still shows **RESTART**, refer to service technician.

Alarms and messages

Technical error code xx
RESTART



Technical

300-G61E

Alarms and messages

CHECK TUBINGS



Technical

Check tubings

This alarm may be activated by a disconnect of the exp. pressure transducer tubings or by a faulty exp. pressure transducer.

The pressures measured by the insp. and exp. pressure transducers are compared at the point when expiration starts for every breath.

At alarm activation the red light at “Technical” flashes and the display “Alarms and messages” shows: **Check tubings**.

The safety valve and the expiratory valve will also open for approx. 5 seconds.

This alarm can be muted.

300-G62E

Alarms and messages

**OVERRANGE:
Select
PEDIATRIC/ADULT**



Technical

Overrange

If the combination of the control panel settings or resulting insp. flow exceeds maximum flow for the selected patient range a high priority alarm is activated.

The red light at “Technical” flashes and the display “Alarms and messages” shows: **OVERRANGE: Select PEDIATRIC/ADULT**.

This alarm can be muted.

The “Insp. tidal vol. ml”, “Exp. tidal vol. ml” and “Exp. minute vol. l/min” displays will also be flashing if the maximum measurable volumes (“Neonate” 39.5 ml, “Pediatric” 395 ml) are exceeded.

Supply voltage

The internal power supply is monitored and an alarm will be activated if any of the internal supply voltages exceeds its upper or lower alarm limit. Such an alarm situation will automatically lead to opening of the SAFETY VALVE and of the EXPIRATORY VALVE and closing of the GAS MODULES. In this situation the primary alarm system *and/ or* the back-up alarm system will be activated. The back-up alarm system generates an audible alarm. "Alarms and messages" text and/or flashing LED indicators may also be shown on the front panel.

Back-up alarm

The back-up alarm system monitors:

- Airway pressure
- Expired minute volume
- Oxygen concentration
- Internal supply voltages.

The back-up alarm consists of an intermittent or in some cases continuous audible alarm. This alarm tone is generated by a beeper located next to connector N 82 on the upper right-hand side of the control unit. For checking purpose, a few short beeps of this back-up alarm will be heard each time the Mode selector is turned from or to the position "Ventilator off".

Special note concerning failure of internal supply voltage

Should the +5 V internal supply voltage fail, all front panel indications may be turned off and the intermittent back-up alarm signal may be the only alarm indication.

This alarm situation may also occur if the mains voltage is higher than specified for the power supply.

Patient safety – Table of clinical alarms

Type of alarm and priority order	Priority level	Mutable
Airway pressure	High	No
Apnea	High	Yes ⁽¹⁰⁾⁽¹¹⁾⁽¹⁵⁾
Expired minute volume	High	Yes ⁽¹⁰⁾⁽¹¹⁾⁽¹⁵⁾
O ₂ concentration	High	Yes
O ₂ cell disconnect	High/Caution ⁽⁹⁾	Yes
No battery capacity left	High	No
Limited battery capacity left	High	Yes
External power source failure	High	Yes
Pressure transducer error	High ⁽⁴⁾	Yes
Out of gas	High ⁽³⁾	Yes
Gas supply Air	High/silent caution ⁽¹⁴⁾	Yes
Gas supply O ₂	High/silent caution ⁽¹³⁾	Yes
High continuous pressure	High	Yes
Overrange	High	Yes ⁽¹⁰⁾⁽¹¹⁾⁽¹⁵⁾
Regulation pressure limited	High	Yes

For a complete table of all alarm functions, see pp 16–17.

For footnotes and other explanations, see page 18.

Patient safety —Table of clinical alarms

Resettable	Memory	“Alarms and messages” text
Aut	Yes	Airway pressure too high
Aut ⁽¹⁾	Yes	APNEA ALARM
Aut	Yes	Exp. minute volume too low/high
Aut	Yes ⁽²⁾	O2 conc too low/high
Aut/man	Yes	O2 SENSOR
Aut	Yes	No battery capacity left SEE OPERATING MANUAL
Aut	Yes	Limited battery capacity left Internal: X.X V
Aut/man	No	BATTERY
Aut	Yes	CHECK TUBINGS
Aut	Yes	Air supply pressure too low O2 supply pressure too low Air: X.X bar O2: X.X bar
Aut	Yes	Air supply pressure too low/high Air: X.X bar O2: X.X bar
Aut	Yes	O2 supply pressure too low/high Air: X.X bar O2: X.X bar
Aut	Yes	High continuous pressure
Aut	Yes	Overrange: Select pediatric/adult
Aut	Yes	Limited pressure

Patient safety – Table of all alarms

Type of alarm and priority order	Priority level	Mutable
Power failure test	High	Yes
Internal RAM test	High	Yes
Internal ROM test	High	Yes
Internal CPU test	High	Yes
Ref and timing MM error	High	Yes
Mixer MM error	High	Yes
Exp. flow MM error	High	Yes
Panel MM error	High	Yes
Range switch error	High	Yes
Mode switch error	High	Yes
Airway pressure	High	No
Apnea	High	Yes ⁽¹⁰⁾⁽¹¹⁾⁽¹⁵⁾
Expired minute volume	High	Yes ⁽¹⁰⁾⁽¹¹⁾⁽¹⁵⁾
O ₂ concentration	High	Yes
O ₂ cell disconnect	High/Caution ⁽⁹⁾	Yes
No battery capacity left	High	No
Limited battery capacity left	High	Yes
High battery voltage	High	Yes
External power source failure	High/caution ⁽⁸⁾	Yes
Pressure transducer error	High ⁽⁴⁾	Yes
Power failure	High	Yes
O ₂ potentiometer error	High	Yes
Out of gas	High ⁽³⁾	Yes
Gas supply Air	High/silent caution ⁽¹⁴⁾	Yes
Gas supply O ₂	High/silent caution ⁽¹³⁾	Yes
High continuous pressure	High	Yes
CMV potentiometer error	High	Yes
SCM μ P error	High	Yes
Overrange	High	Yes ⁽¹⁰⁾⁽¹¹⁾⁽¹⁵⁾
Barometer error	High	Yes
Regulation pressure limited	High	Yes

For footnotes and other explanations, see page 18.

Patient safety – Table of all alarms

Resettable	Memory	“Alarms and messages” text
No	No	Technical error code PFT RESTART
No	No	Technical error code RAM RESTART
No	No	Technical error code ROM RESTART
No	No	Technical error code CPU RESTART
Aut ⁽⁷⁾	Yes ⁽⁶⁾	Techn. error code μ P R&T SEE OPERATING MANUAL/RESTART
Aut ⁽⁷⁾	Yes ⁽⁶⁾	Techn. error code μ P Mix SEE OPERATING MANUAL/RESTART
Aut ⁽⁷⁾	Yes ⁽⁶⁾	Techn. error code μ P Exp SEE OPERATING MANUAL/RESTART
Aut ⁽⁷⁾	Yes ⁽⁶⁾	Techn. error code μ P Pan SEE OPERATING MANUAL/RESTART
Aut	Yes	Technical error code SwR SEE OPERATING MANUAL
Aut	Yes	Technical error code SwM SEE OPERATING MANUAL
Aut	Yes	Airway pressure too high
Aut ⁽¹⁾	Yes	APNEA ALARM
Aut	Yes	Exp. minute volume too low/high
Aut	Yes ⁽²⁾	O2 conc too low/high
Aut/man	Yes	O2 SENSOR
Aut	Yes	No battery capacity left SEE OPERATING MANUAL
Aut	Yes	Limited battery capacity left Internal: X.X V
Aut	Yes	Internal battery voltage too high Internal: X.X V
Aut/man	No	BATTERY
Aut	Yes	CHECK TUBINGS
Aut	Yes	Technical error PF SEE OPERATING MANUAL
Aut	Yes	Technical error PoO SEE OPERATING MANUAL
Aut	Yes	Air supply pressure too low O2 supply pressure too low Air: X.X bar O2: X.X bar
Aut	Yes	Air supply pressure too low/high Air: X.X bar O2: X.X bar
Aut	Yes	O2 supply pressure too low/high Air: X.X bar O2: X.X bar
Aut	Yes	High continuous pressure
Aut	Yes	Technical error code PoC SEE OPERATING MANUAL
Aut ⁽⁷⁾	Yes ⁽⁶⁾	Technical error code μ P SCM SEE OPERATING MANUAL/RESTART
Aut	Yes	Overrange: Select pediatric/adult
Aut	Yes	Technical error code Ba SEE OPERATING MANUAL
Aut	Yes	Limited pressure

Priority level

High/Caution means that the high priority alarm changes to caution signal at reset.

Resettable

Aut means that the alarm is automatically reset when the reason for alarm no longer exists.

Man means that the alarm has to be manually reset.

Table footnotes

- (1) Apnea alarm in Volume Support must be manually reset even if the reason for the alarm no longer exists.
- (2) Oxygen concentration alarm must be active more than 55 seconds to set the memory.
- (3) When out of gas alarm is activated, the safety valve and the expiratory valve are opened.
- (4) When pressure transducer error alarm is activated, the safety valve is opened for approx. 5 seconds.
- (6) No memory function if the alarm is activated during start up of the system.
- (7) No reset possibility if the alarm is activated during start up of the system. The ventilator must be turned off and on again and the micromodules must go through new tests which may fail or not fail.
- (8) The high priority alarm is downgraded to caution signal by manual reset. Exception: In "Stand by" an External power source failure is not resettable, only mutable.
- (9) The high priority alarm is downgraded to caution signal by manual reset.
- (10) By disconnect preparation the alarm will be muted for two minutes in advance.
- (11) When starting "Oxygen breaths" the alarm will be muted in advance during the oxygen breaths.
- (13) The high priority alarm is downgraded to a silent caution signal by manual reset if the preset O₂ concentration is between 21 and 23%.
- (14) The high priority alarm is downgraded to a silent caution signal by manual reset if the preset O₂ concentration is between 98 and 100%.
- (15) By changing mode from "Ventilator off Battery charging" or "Stand by" to any other mode the alarm will be muted for 20 seconds in advance.

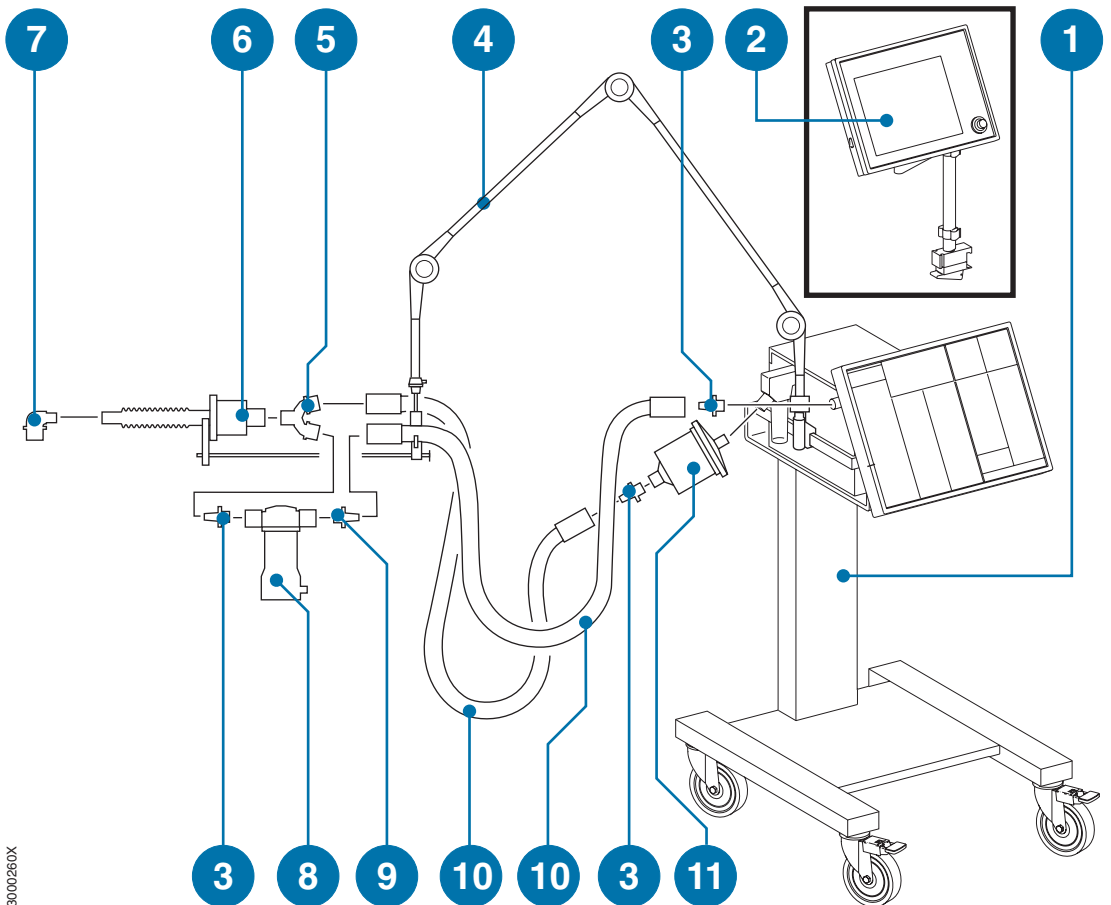
Contents

Set-ups	
Intensive care 1	2
Intensive care 2	3
Connection to patient	
Compressible volume	4-5
Calculation of compressible volume	6
Dead space	7
Compensation for compressible volume and dead space	7
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Set-ups – Intensive care 1

This is an example of a possible set-up. Some of the equipment shown is available in different variants, e.g., for children and for adults. See the catalog Products and Accessories for more information.

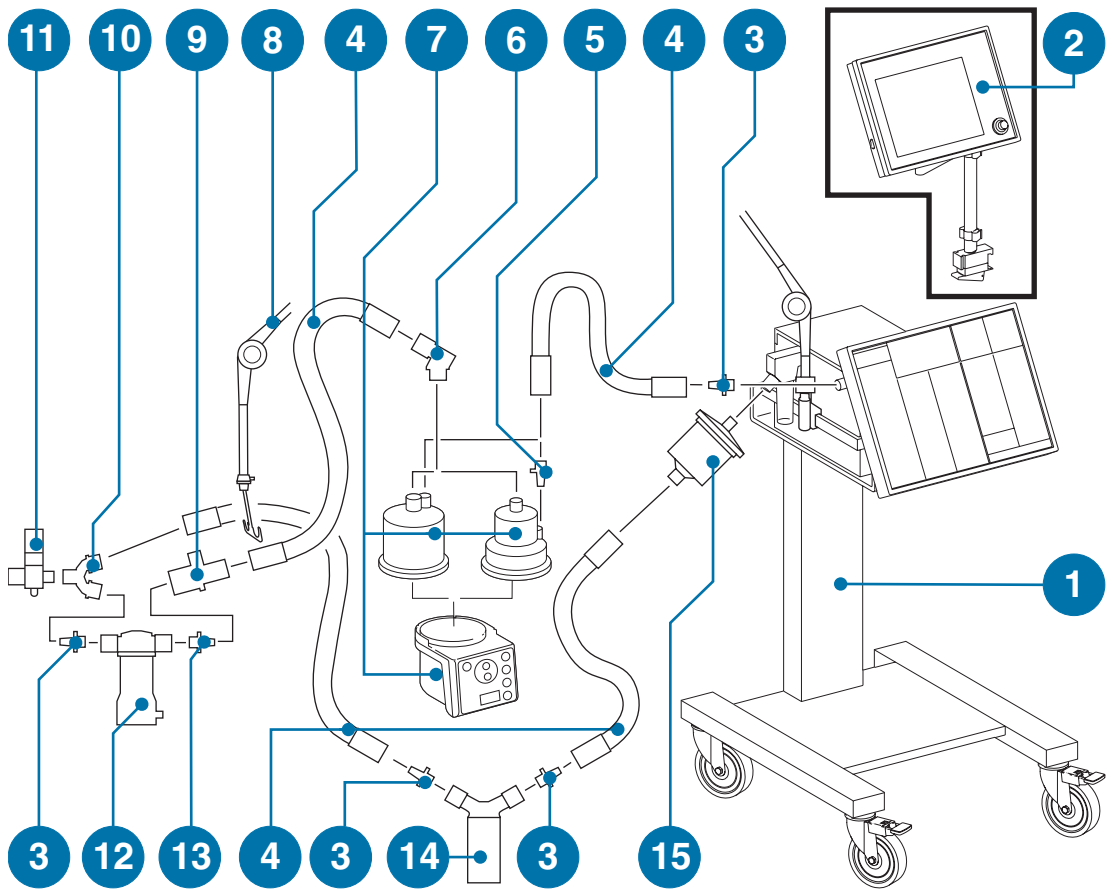


3000260X

- | | | |
|---------------------|-------------------------|-----------------------------------|
| 1. Mobile Cart 85 | 5. Y-piece | 9. Nipple connector for nebulizer |
| 2. Servo Screen 390 | 6. Servo Humidifier 153 | 10. Patient tubes |
| 3. Nipple connector | 7. Angled connector | 11. Bacteria filter |
| 4. Support arm | 8. Nebulizing chamber | |

Set-ups – Intensive care 2

This is an example of a possible set-up. Some of the equipment shown is available in different variants, e.g., for children and for adults. See the catalog Products and Accessories for more information.



3000261X

- | | | |
|--------------------------|------------------------|------------------------------------|
| 1. Mobile Cart 85 | 6. Patient tube heater | 11. CO ₂ transducer |
| 2. Servo Screen 390 | 7. Humidifier (FP) | 12. Nebulizing chamber |
| 3. Nipple connector | 8. Support arm | 13. Nipple connector for nebulizer |
| 4. Patient tube | 9. Probe housing | 14. Water trap |
| 5. Nipple connector (FP) | 10. Y-piece | 15. Bacteria filter |

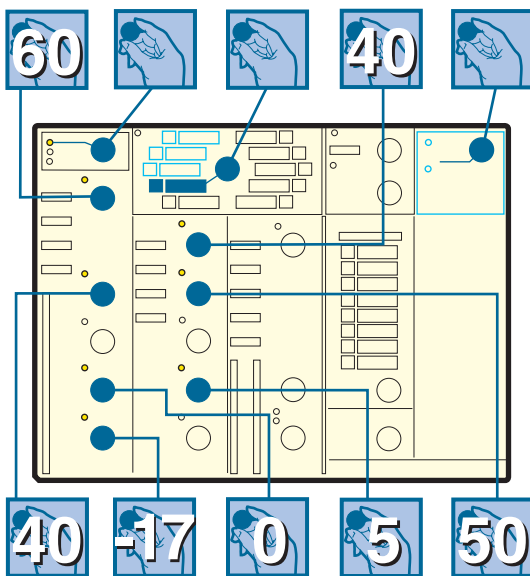
Compressible volume

Some of the inspiratory minute volume does not reach the patient because it is needed for compression of gas in the tubing system and humidifier. The compressible volume in the Servo Ventilator 300/300A itself is negligible.

When setting the minute volume, including the compensation for dead space, the compressible volume must be allowed for by adding a corresponding minute volume to the minute volume for the patient. In "Volume Control" mode and "Pressure Regulated Volume Control" the volume is set by the knob "Volume". In "Pressure Control" mode a desired volume can be reached by adjusting the pressure control level with the knob "Pressure Control Level above PEEP" and watching the measured expired minute volume.

Calculation of the breathing systems' compressible volume

- Assemble the complete breathing system which is to be used.
- Set:
 - Patient range selector: "Adult".
 - Mode selector: "Stand by".
 - "Upper press. limit": 60 cm H₂O.
 - "Pressure Control Level above PEEP": 40 cm H₂O.
 - "CMV freq. b/min": 40 breaths/min.
 - "Insp. time %": 50%.
 - "Insp. rise time %": 5%.
 - "Trig. sensitivity Level below PEEP": -17 cm H₂O.
 - "PEEP": 0 cm H₂O.
 - "Automode": Off.

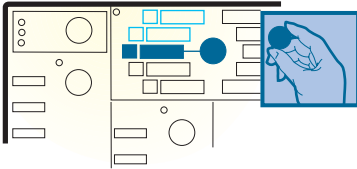


3000262X

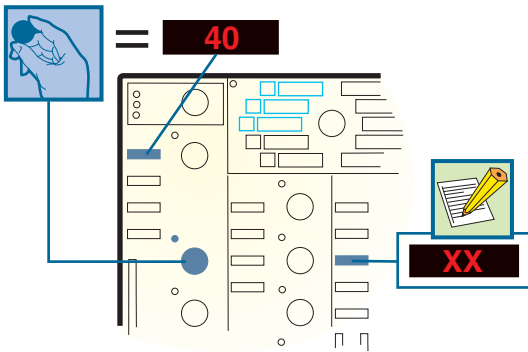
Connection to patient



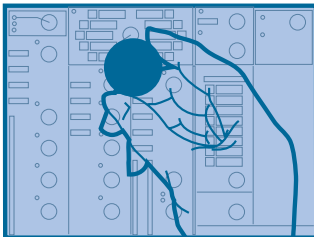
- Block the opening of the Y-piece/Servo Humidifier.



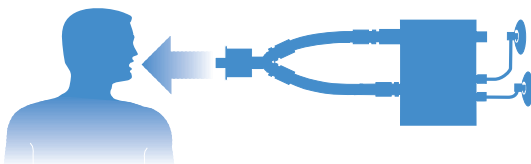
- Set to "Pressure Control" mode.



- Adjust the "Pressure Control Level above PEEP" so that the "Peak" display shows 40 cm H₂O.
- Note the "Insp. tidal vol." display reading. See example on page 8.



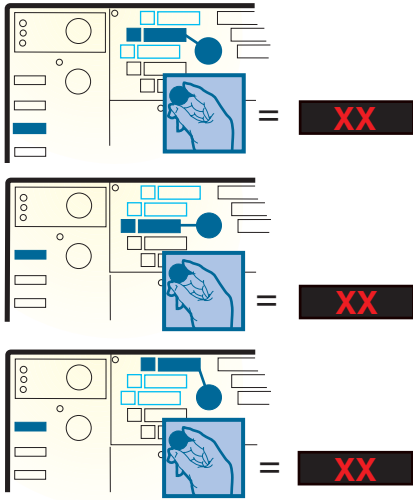
- Make all settings as appropriate for the patient.



- Connect the patient.

300-G64X

Connection to patient



- For "Volume Control": read the "Pause" pressure.
- For "Pressure Control": read the "Peak" pressure.
- For "PRVC": wait 10 breaths then read the "Peak" pressure.

- Calculate the compensation (ml) for compressible volume in each breath:

$$V_c = \frac{\text{measured "Pause" or "Peak" pressure (cm H}_2\text{O)}}{40 \text{ (cm H}_2\text{O)}} \times \text{measured insp. tidal volume (ml)}.$$

- Calculate the total minute volume compensation (ml/min) for dead space and compressible volume:

$$\text{Total minute volume compensation} = (V_d + V_c) \times \text{set CMV frequency (b/min)}$$

To get the minute volume compensation in l/min, divide the calculated value above (ml/min) by 1000.

Accessories Dead space (Vd)

Servo Humidifier 151	35 ml
Servo Humidifier 152	55 ml
Servo Humidifier 153	70 ml
Sampling adapter for Servo Gas	
Monitor 120	3 ml

Dead space

When setting minute volume, dead space in the breathing system (between the Y-piece and patient) should be compensated for. Dead space for some accessories are listed to the left.

Calculation of minute volume compensation for dead space

Minute volume compensation (ml/min) for dead space =

$V_d \times \text{CMV frequency (b/min) desired for the patient.}$

Compensation for dead space and compressible volume

In Volume Control and PRVC:

Set preset minute volume = desired minute volume (l/min) for the patient + total minute volume compensation (l/min).

See examples on next page.

Note

Always consider that the displayed measured expired minute volume is the sum of the expired minute volume from the patient and the minute volume needed for compression of gas in the breathing system.



Connection to patient

Example 1 (Adult patient)

Adult silicone rubber tubes (2 × 150 cm)

Servo Humidifier 153

Estimated dead space for the patient = 150 ml

Measured "Insp. tidal vol." = 36 ml *Measured from test set up, see p. 5*

Desired minute volume for the patient = 7.5 l/min.

Desired "CMV freq. b/min" = 15 breaths/min

Read pause or peak pressure = 22 cm H₂O

V_d = 150 ml

V_c = (22 cm H₂O/40 cm H₂O) × 36 ml = 19.8 ml

Total minute volume compensation = ($V_d + V_c$) × set CMV frequency =
(150 ml + 19.8 ml) × 15 b/min
= 2547 ml/min = 2.547 l/min.

Adjust the minute volume to 7.5 + 2.5 = 10 l/min

Example 2 (Neonate patient)

Fischer & Paykel MR 600 with infant humidifying chamber

Infant silicone rubber tube kit for F&P MR 600

Estimated dead space for the patient = 10 ml

Measured "Insp. tidal vol." = 32 ml *Measured from test set up, see p. 5*

Desired minute volume for the patient = 0.6 l/min. *Measured from test set up, see p. 5*

Desired "CMV freq. b/min" = 40 breaths/min *Measured from test set up, see p. 4*

Read pause or peak pressure = 11 cm H₂O

V_d = 10 ml

V_c = (11 cm H₂O/40 cm H₂O) × 32 ml = 8.8 ml

Total minute volume compensation = ($V_d + V_c$) × set CMV frequency
= (10 ml + 8.8 ml) × 40 b/min = 752 ml/min
= 0.752 l/min.

Adjust the minute volume to 0.6 + 0.75 = 1.35 l/min

Contents

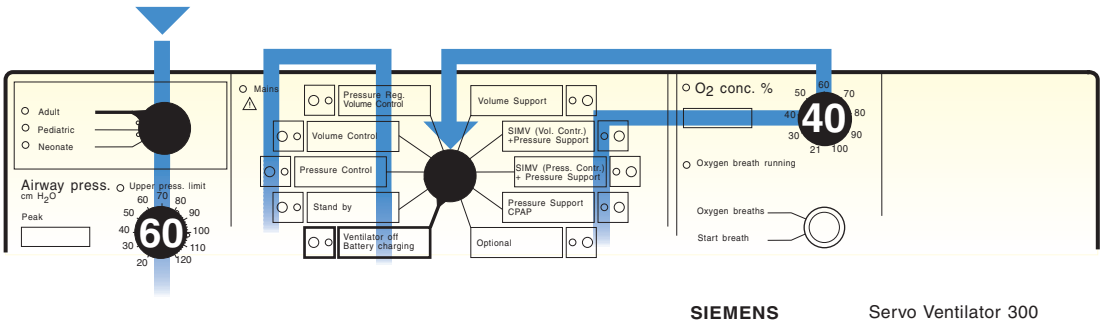
Preparations	2
1. Start up	4
2. Leakage test	5
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6. O ₂ alarm	12
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10. Log sheet	22

The pre-use check is a simplified function check which can, if allowed by hospital rules, be done instead of the function check before connecting the ventilator to a patient. This pre-use check must not substitute for the complete function check, as described in chapter Function check, which must be done after cleaning and after calibration. If a complete function check has been performed with the patient system that is to be used just before the ventilator is connected to a patient, it replaces the pre-use check. If any malfunctions are detected during the pre-use check, the ventilator must not be connected to patient. The malfunction must be remedied by local technical staff trained by MAQUET or a service technician from MAQUET.

For those who do not have access to tubings and other accessories for adults a Neonatal kit, P/N 64 06 487 E380E, is available. The kit includes an alternative Operating Manual with Pre-use check, Calibration and Function check adapted for neonatal use.

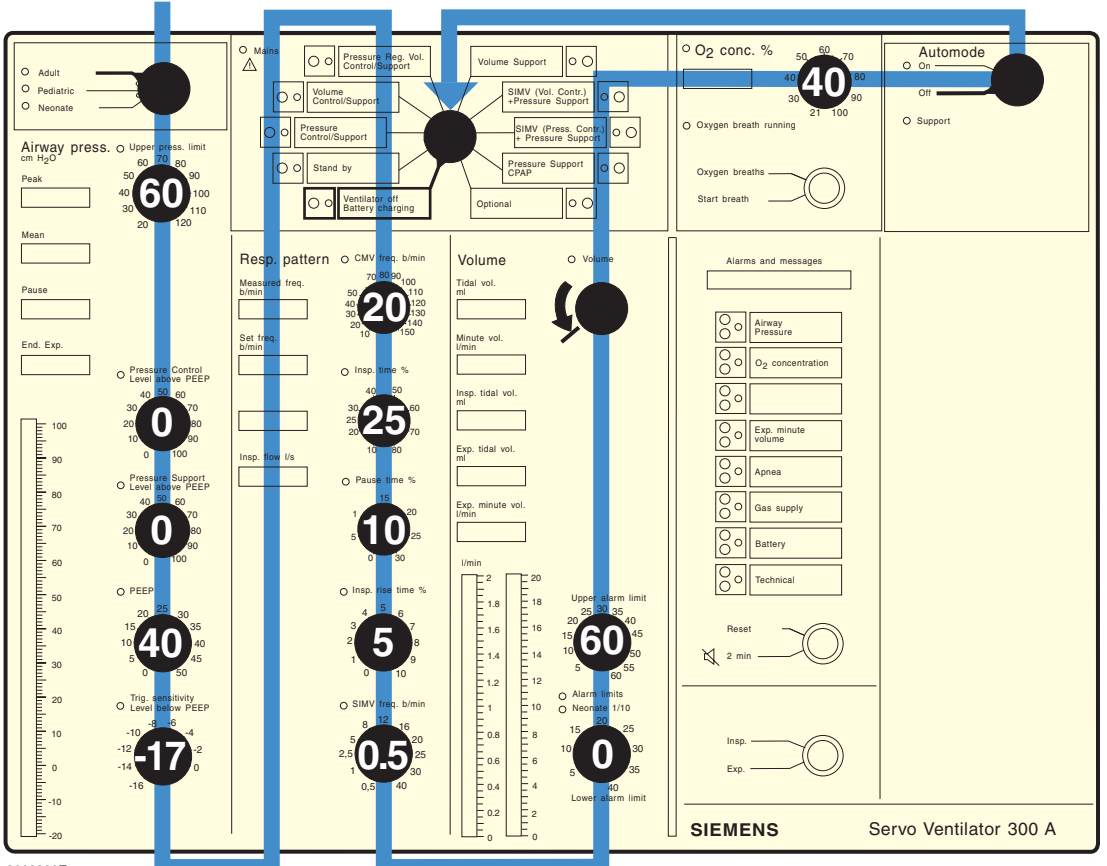
Preparations

- Set all knobs as shown.



SIEMENS

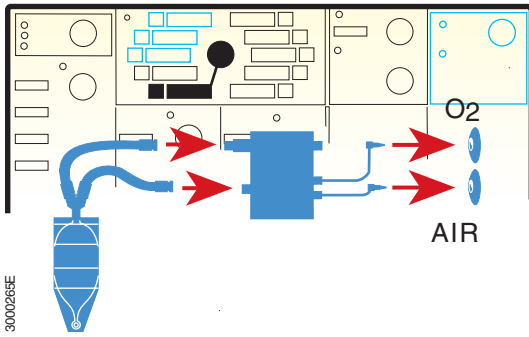
Servo Ventilator 300



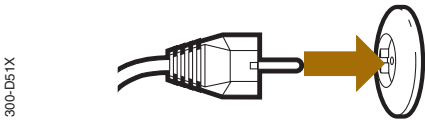
SIEMENS

Servo Ventilator 300 A

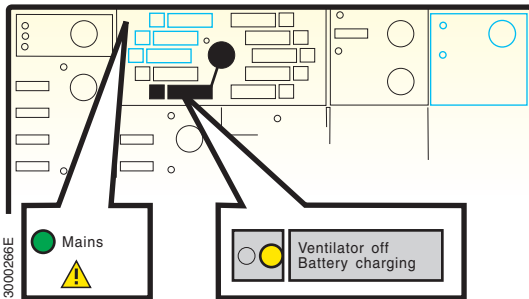
Pre-use check



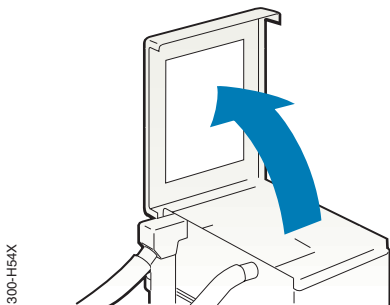
- Assemble and connect the complete patient system which is to be used.
 - Attach a test lung. Only a MAQUET test lung shall be used.
 - Connect gas supply: Air and O₂.
- Note!** If a humidifier is used it shall be inactive during the pre-use check.



- Connect the ventilator to mains.



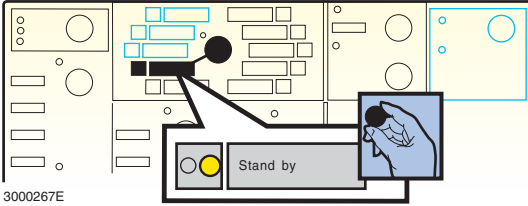
- Make sure the yellow light at “Ventilator off Battery charging” and the green light “Mains” are lit.



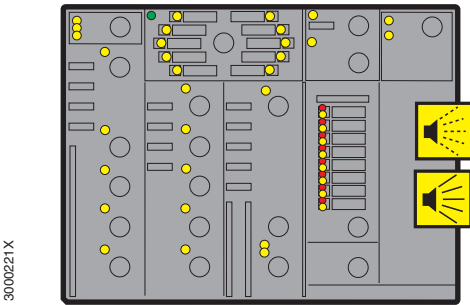
- Open the lid on the patient unit.

1. Start up

- Set the mode selector to “Stand by” and make sure:



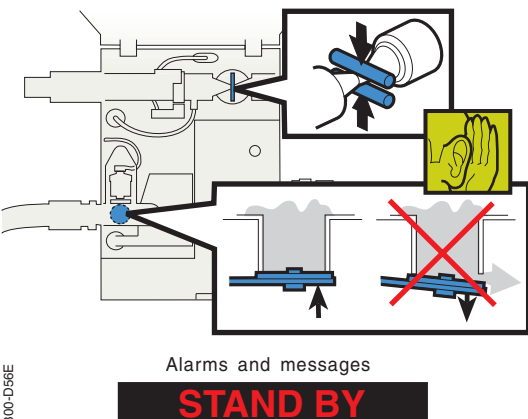
- the **back-up alarm** (intermittent signals) is heard.
- all yellow lights are lit for a few seconds.
- all yellow and red lights in the “Alarms and messages” section stay lit during an additional moment.
- the caution signal is heard.



- the expiratory valve closes.
- the safety valve closes with a distinct click.
- the “Alarms and messages” display shows STAND BY.

These checks can be done separately by repeated switching between “Ventilator off Battery charging” and “Stand by”.

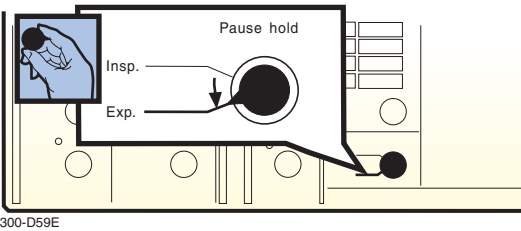
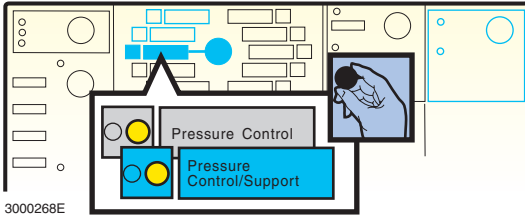
- Close the lid on the patient unit.



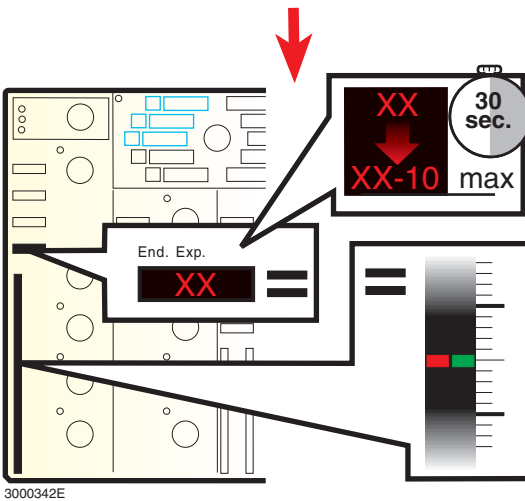
2. Leakage test

Test for leakage and pressure transducer integrity

- Set to "Pressure Control" mode.

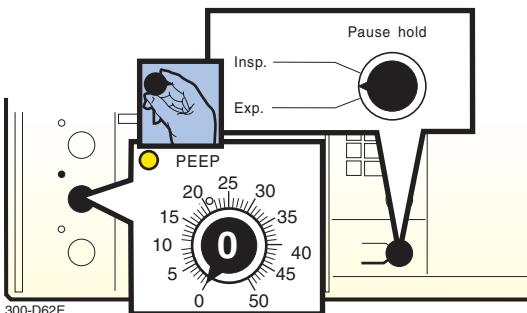


- Keep "Pause hold" at "Exp." and make sure:



- the "End exp." display reading does not drop more than 10 cm H₂O during the exp. pause hold time (30 seconds).
- the diodes showing the actual pressure on the "Airway press." bargraph show the same value ± 5 cm H₂O. If not, see chapter Calibration. **Note!** The reading may drop to zero for about 2 seconds due to apnea alarm activation.

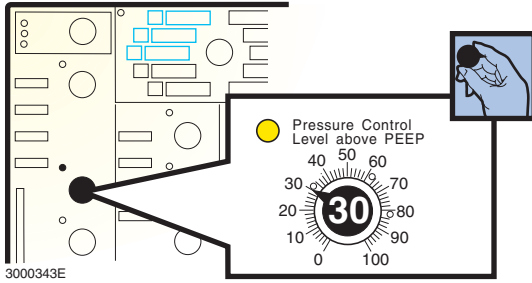
In case of leakage, check all connections in the ventilator as well as in the patient system.



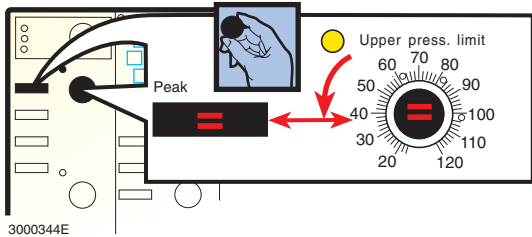
- Release "Pause hold".
- Set "PEEP" to 0 cm H₂O.

3. Upper pressure limit alarm

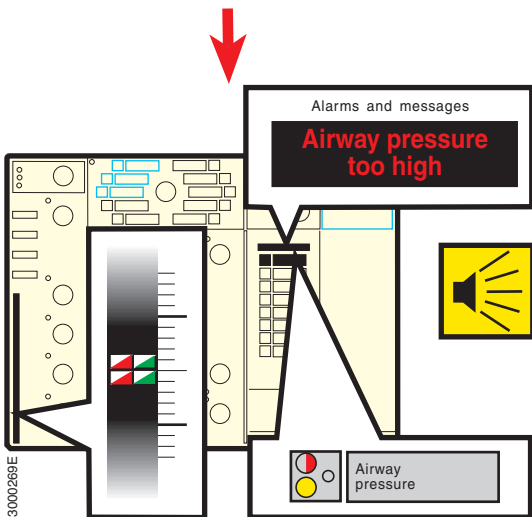
- Set "Pressure Control Level above PEEP" to 30 cm H₂O.



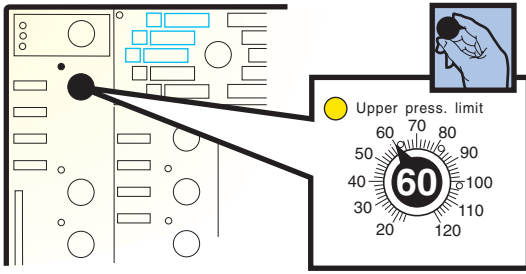
- Turn "Upper press. limit" **slowly** counter-clockwise and make sure upper pressure limit alarm is activated when "Upper press. limit" and the display "Peak" show the same value. Accuracy: ± 2 cm H₂O.



- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the inspiration stops and expiration starts.
 - the red light at "Airway pressure" in the alarm section lights up each time the alarm is activated.
 - the yellow light at "Airway pressure" is lit at the end of each alarm activation (when the red light at "Airway pressure" goes out).
 - the "Alarms and messages" display shows **Airway pressure too high**.
 - the upper pressure limit indication on the bargraph flashes.
 - the safety valve does not open. (if it opens, a distinct sound is heard and the PEEP-level drops to zero).

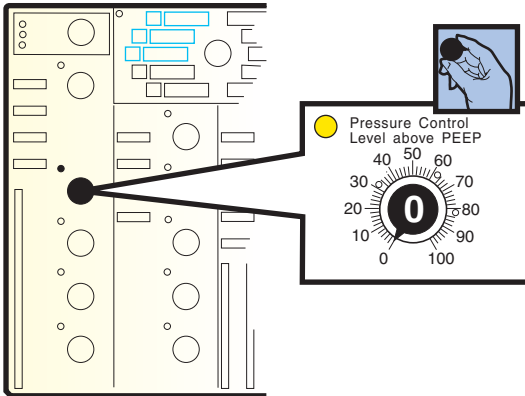


Pre-use check



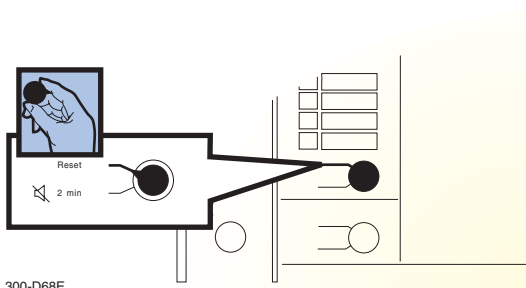
3000375E

- Set "Upper press. limit" to 60 cm H₂O.



3000345E

- Set "Pressure Control Level above PEEP" to 0 cm H₂O.



300-D68E

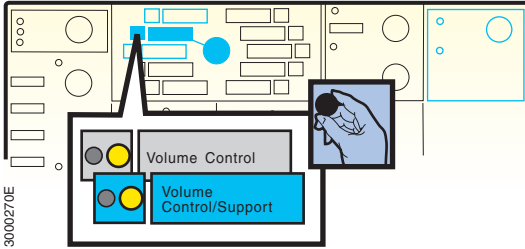
- Reset the alarm.

Important: Proceed with the instructions on the inside of the front cover before continuing the Pre-use check.

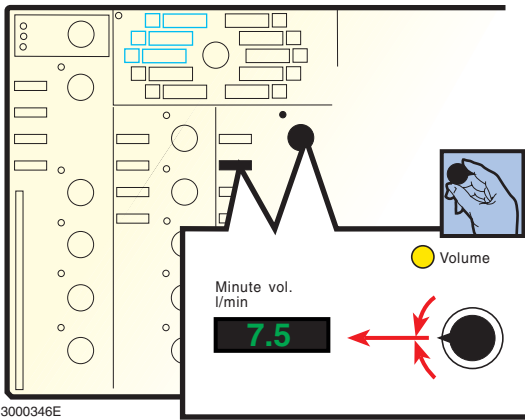
4. Minute volume alarms

Test of minute volume alarms and flow transducer integrity

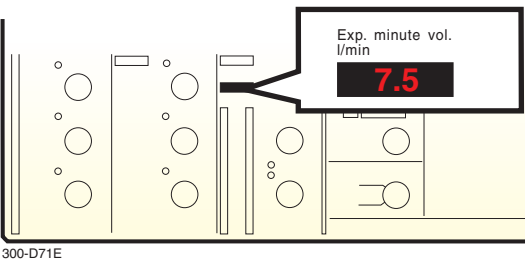
- Set to "Volume Control" mode.



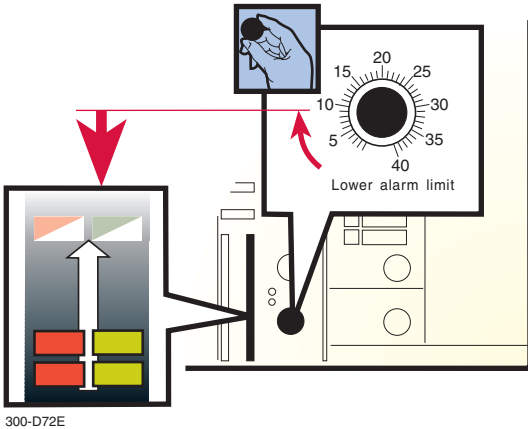
- Adjust "Volume" until the display "Minute vol. l/min" reads 7.5 l/min.



- Wait until the "Exp. minute vol. l/min" display reads 7.5 ± 0.2 l/min.

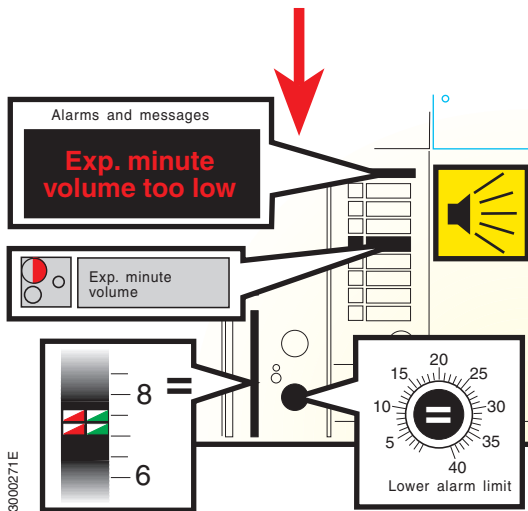


Pre-use check

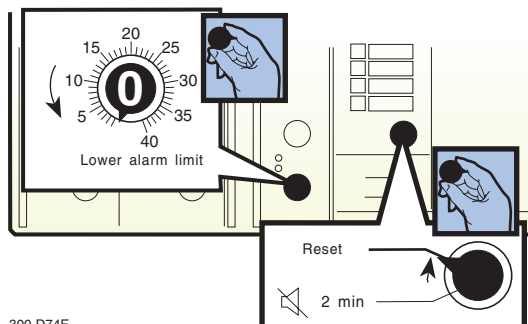


Lower alarm limit

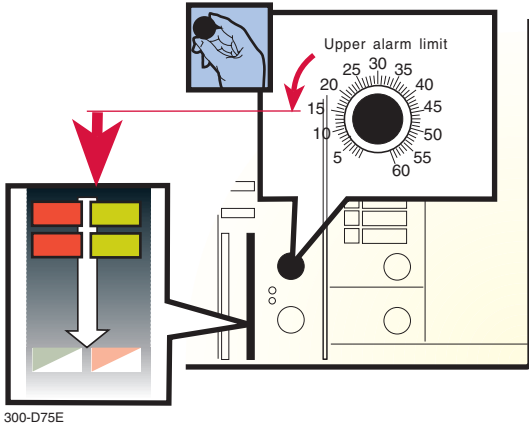
- Turn “Lower alarm limit” slowly clockwise and make sure:
 - the expired minute volume alarm is activated when the lower alarm limit indication passes the measured minute volume indication on the bargraph.



- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the “Alarms and messages” display shows **Exp. minute volume too low**.
 - the red light at “Exp. minute volume” flashes.
 - the lower alarm limit indication on the bargraph flashes.
 - the lower alarm limit indication on the bargraph corresponds to the “Lower alarm limit” setting. Accuracy: ± 0.5 l/min.



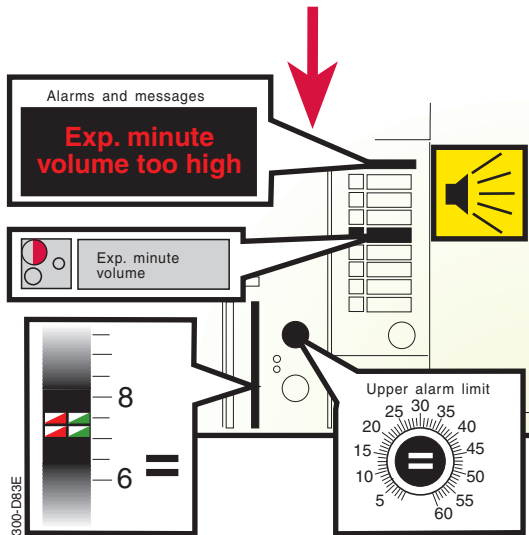
- Turn “Lower alarm limit” to 0 l/min.
- Reset the alarm.



300-D75E

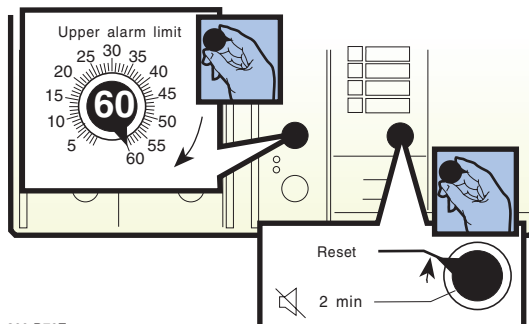
Upper alarm limit

- Turn “Upper alarm limit” **slowly** counter-clockwise and make sure:
 - the expired minute volume alarm is activated when the upper alarm limit indication passes the measured minute volume indication on the bargraph.



300-D83E

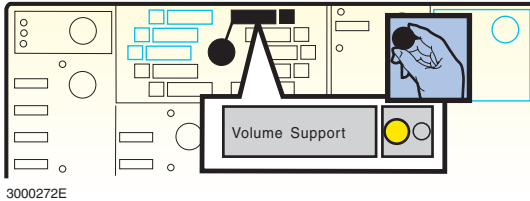
- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the “Alarms and messages” display shows **Exp. minute volume too high**.
 - the red light at “Exp. minute volume” flashes.
 - the upper alarm limit indication on the bargraph flashes.
 - the upper alarm limit indication on the bargraph corresponds to the “Upper alarm limit” setting. Accuracy: ± 0.5 l/min.



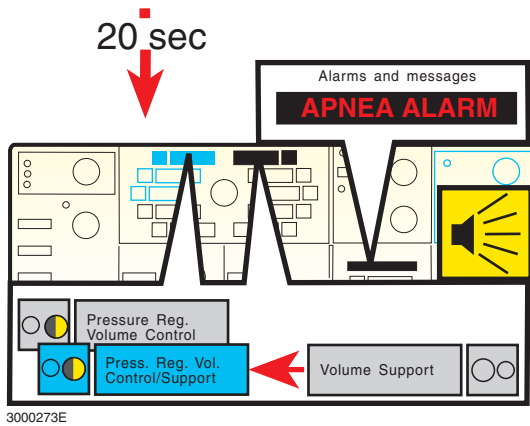
300-D76E

- Turn “Upper alarm limit” to 60 l/min.
- Reset the alarm.

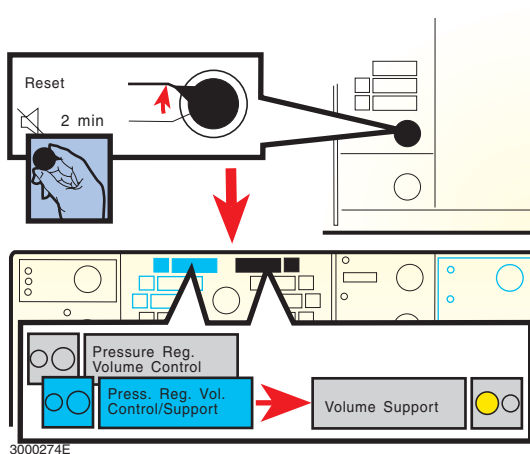
5. Apnea alarm



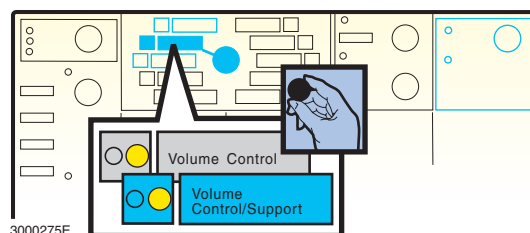
- Set to “Volume Support” mode.



- Wait for 20 seconds and make sure apnea alarm is activated.
- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the “Alarms and messages” display shows **Apnea alarm**.
 - the ventilator changes from “Volume Support” to “Pressure Reg. Volume Control” mode (indicated by flashing yellow light at “Pressure Reg. Volume Control”).



- Reset the alarm and make sure:
 - the ventilator switches back from “Pressure Reg. Volume Control” to “Volume Support.”

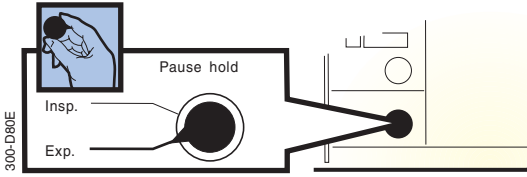


- Set to “Volume Control” mode.

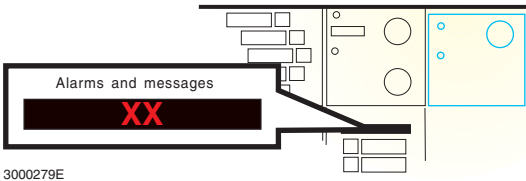
6. O₂ alarm

Lower alarm limit

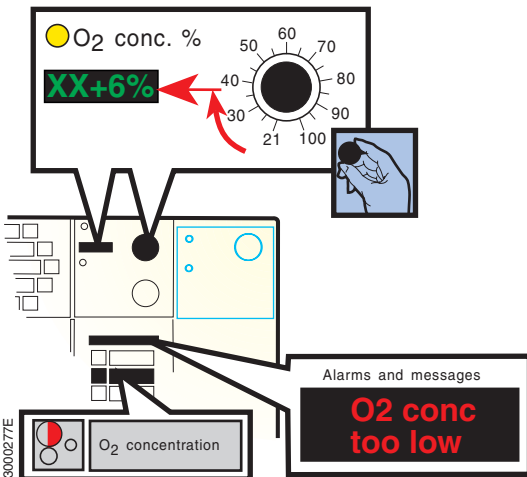
- Hold "Pause hold" at "Exp" and:



- note the O₂ concentration value on the display "Alarms and messages"

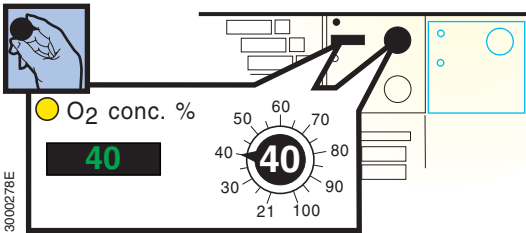


- Turn "O₂ conc. %" clockwise and make sure the O₂ concentration alarm is activated when the green display "O₂ conc. %" reading is 6 ± 1% **higher** than the noted value.

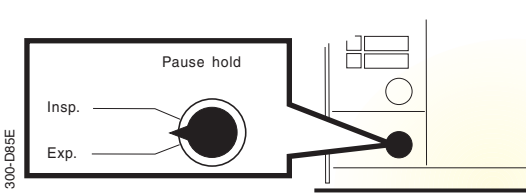


- At the alarm activation, make sure:
 - the red light at "O₂ concentration" flashes.
 - the display "Alarms and messages" shows **O2 conc too low**.

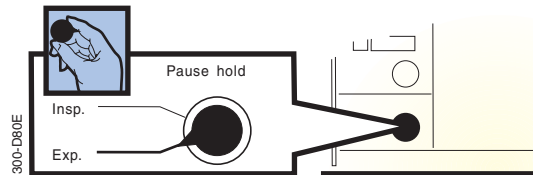
Pre-use check



- Set "O₂ conc. %" to 40%.

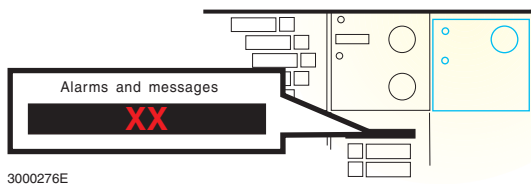


- Release "Pause hold".



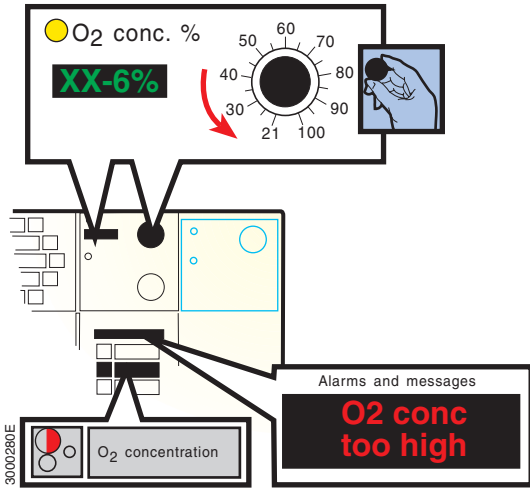
Upper alarm limit

- Hold "Pause hold" at "Exp." and:



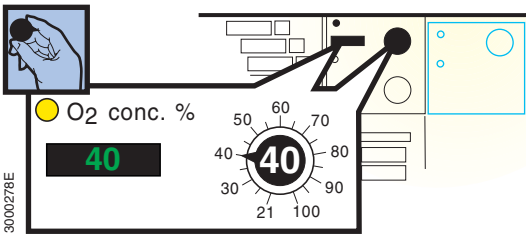
- note the O₂ concentration value on the display "Alarms and messages"

Pre-use check

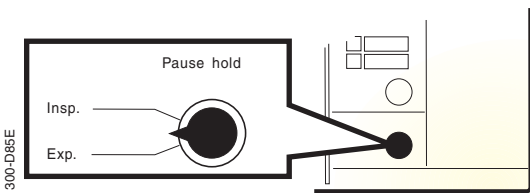


- Turn “O₂ conc. %” counter-clockwise and make sure the O₂ concentration alarm is activated when the green display “O₂ conc. %” reading is 6 ±1% **lower** than the noted value.

- At the alarm activation, make sure:
 - the red light at O₂ concentration flashes.
 - the display “Alarms and messages” shows **O2 conc too high**.



- Set “O₂ conc. %” to 40%.

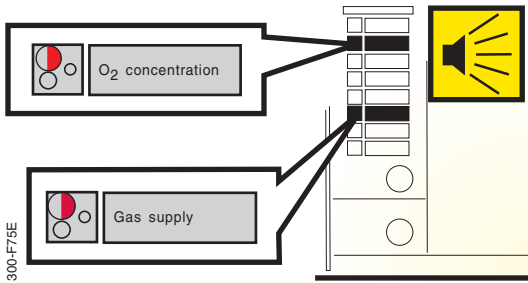


- Release “Pause hold”.

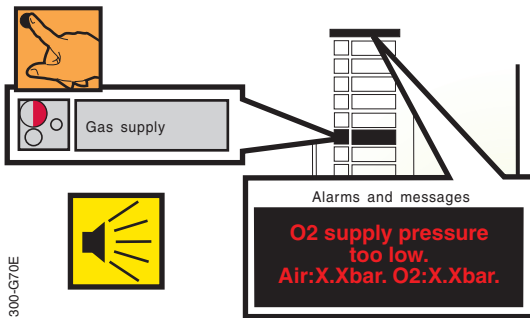
7. Gas supply system



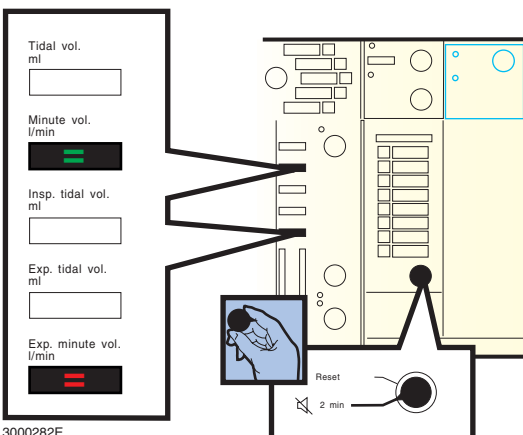
- Disconnect the O₂ supply and make sure Gas supply and O₂ concentration alarms are activated.



- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the red light at “Gas supply” flashes.
 - the red light at “O₂ concentration” flashes.

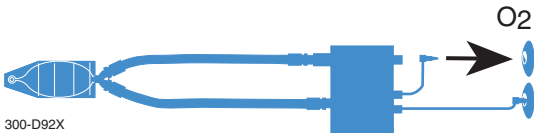


- Touch the touchpad at “Gas supply” and make sure:
 - the “Alarms and messages” display shows **O2 supply pressure too low. Air: X.Xbar. O2: X.Xbar.**

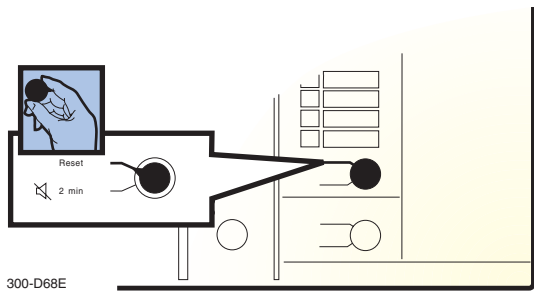


- Mute the alarm and make sure:
 - the red display “Exp. minute vol. l/min” still shows the same value as the green display “Minute vol. l/min.” Accuracy: ±0.5 l/min.

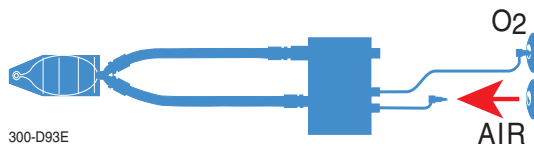
Pre-use check



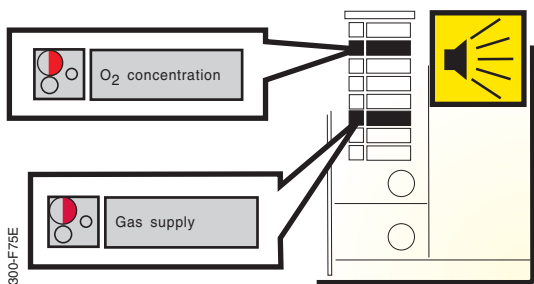
- Connect O₂ supply.



- Wait a few breaths and then reset the alarms.

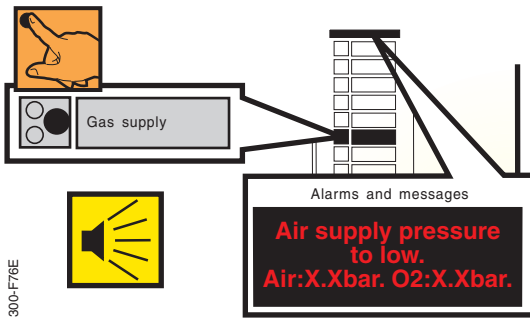


- Disconnect the air supply and make sure Gas supply and O₂ concentration alarms are activated.



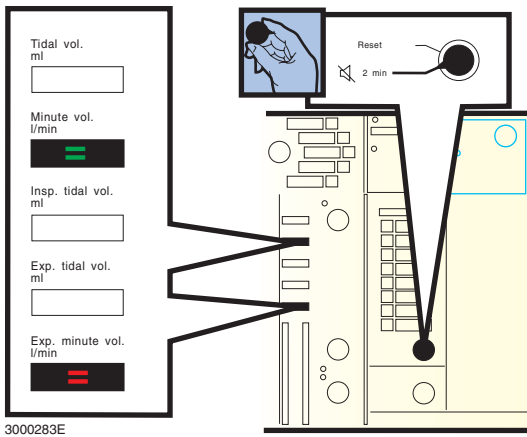
- At the alarm activations, make sure:
 - the audible alarm is heard.
 - the red light at "O₂ concentration" flashes.
 - the red light at "Gas supply" flashes.

Pre-use check



- Touch the touchpad at “Gas supply” and make sure:

–the “Alarms and messages” display shows **Air supply pressure too low.**
Air: X.X bar. O2: X.X bar.



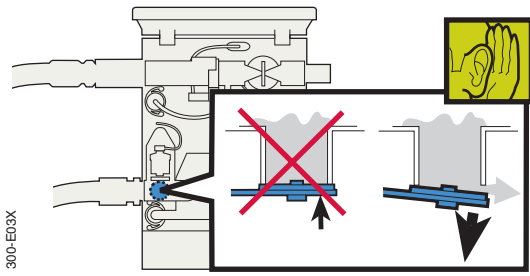
- Mute the alarm and make sure:

– the red display “Exp. minute vol. l/min” still shows the same value as the green display “Minute vol. l/min” Accuracy: ± 0.5 l/min.

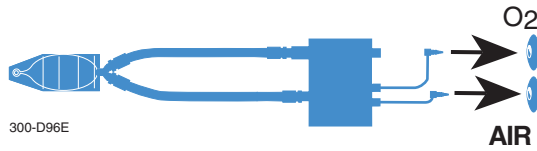


- Disconnect O_2 supply so that no gas is connected to the ventilator and make sure:

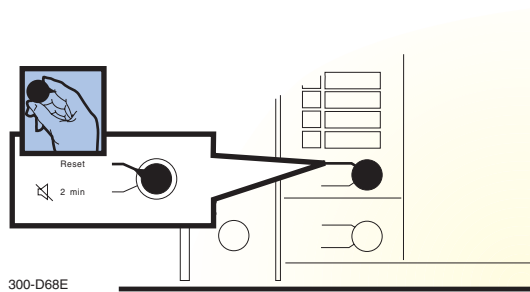
Pre-use check



- the safety valve opens with a distinct click.
- the expiratory valve opens.



- Connect the air and O₂ supplies.

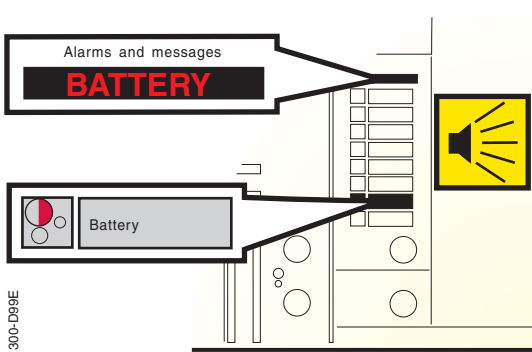
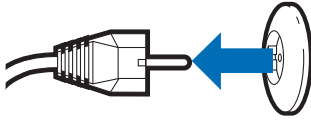


- Reset the alarms.

8. Battery operation

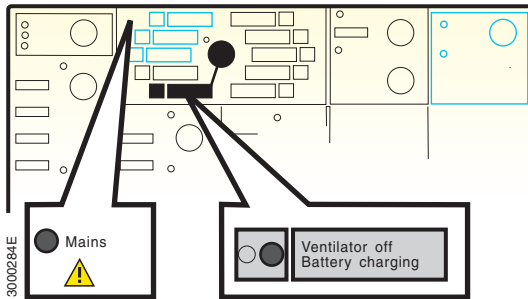
- Disconnect the ventilator from mains and make sure Battery alarm is activated.

300-D97X



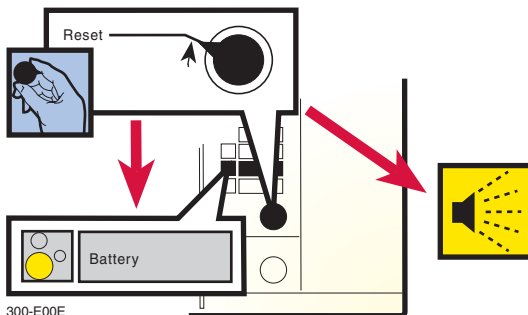
300-D99E

- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the red light at “Battery” flashes.
 - the display “Alarms and messages” flashes **BATTERY**.



300D284E

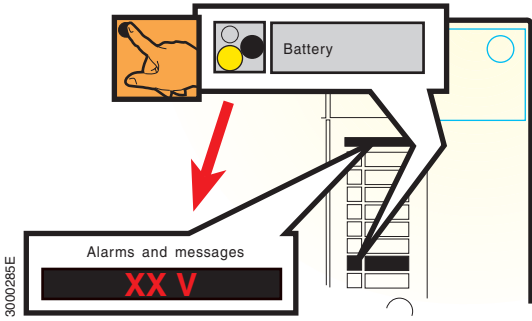
- the yellow light at “Ventilator off Battery charging” and the green light “Mains” are not lit.



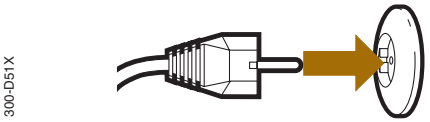
300-E00E

- Reset the alarm and make sure:
 - the caution signal starts.
 - the yellow light at “Battery” is lit.

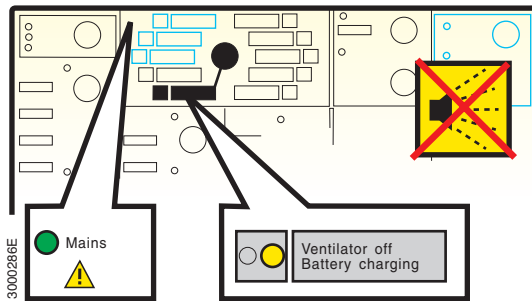
Pre-use check



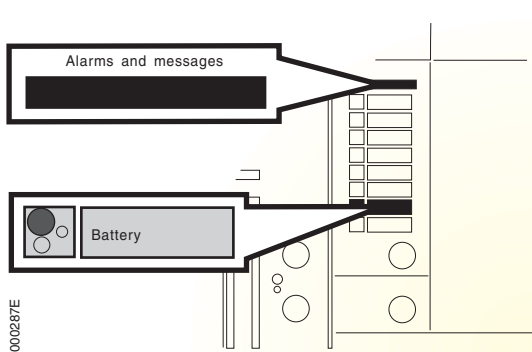
- To check the internal battery, touch the touchpad at "Battery" and read the displayed value. (Normal value approx. 24 V.)



- Connect the ventilator to mains again.



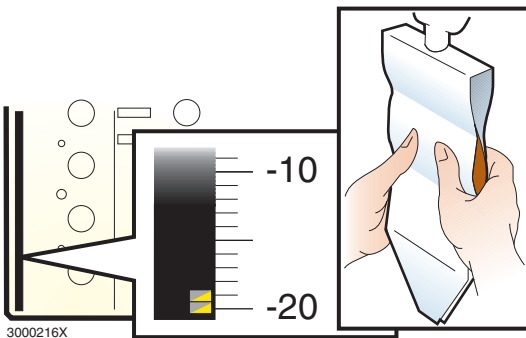
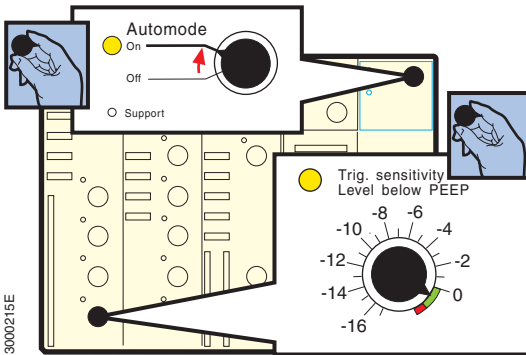
- Make sure:
 - the yellow light at "Ventilator off Battery charging" and the green light "Mains" are lit.
 - the caution signal stops.



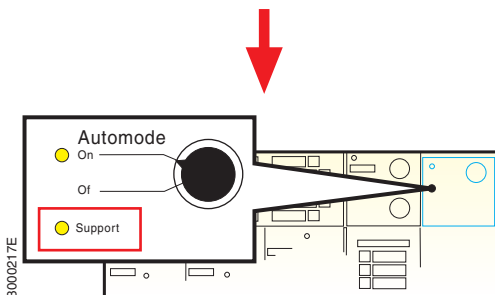
- the display "Alarms and messages" no longer flashes **BATTERY**.
- the yellow light at "Battery" is no longer lit.

9. Automode (SV 300A only)

- Set "Automode" to "On".
- Set "Trig sensitivity Level below PEEP" in the green range.

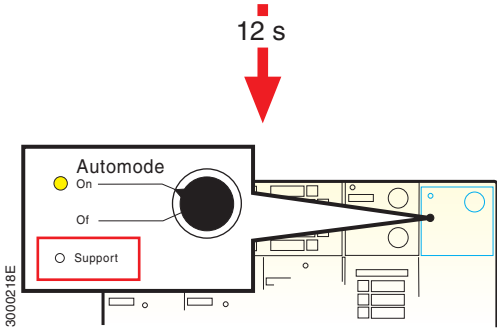


- Compress and release the test lung twice to trigger a breath. Two diodes on the bargraph for airway pressure show that a breath is triggered.

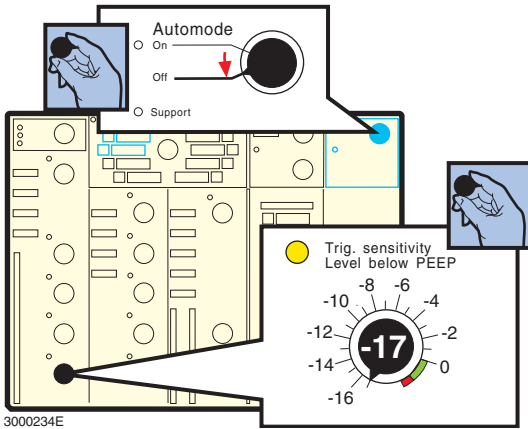


- Make sure the ventilator switches to support mode. This is shown by the yellow light "Support".

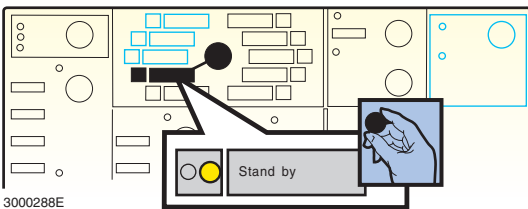
Pre-use check



- Do not trigger any more breaths and make sure the ventilator switches back to "Volume Control" after about 12 seconds. (The yellow light "Support" is no longer lit.)



- Set "Automode" to "Off".
- Set "Trig sensitivity Level below PEEP" to -17 cm H₂O.



- The Pre-use check is now complete, set the mode selector to "Stand by", or, if the ventilator is to be connected to a patient, make the appropriate settings for that patient.

10. Log sheet

- Note on a log sheet that a pre-use check has been performed.

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Problems detected before connection of patient	2
Problems detected with patient connected	6

This troubleshooting guide is divided into two sections:

- problems usually detected before you connect the patient
- problems usually detected when the patient is connected.

Note: Some of the problems may occur in both cases and are therefore included in both sections.

The suggestions made are only examples of some symptoms and solutions. The symptoms mentioned can be caused by several other reasons.

Problems detected before patient connection

Problem	Possible causes	Remedy
Mains light not lit.	Wall outlet fuse blown. Mains plug not inserted. Mains outlet switch off. Fuses blown.	Check outlet. Insert mains plug. Switch on. DO NOT change fuses yourself. Call a service technician
Self test message "Technical error code XXX".	Internal hardware problem.	Note the error code "XXX", take the unit out of operation and refer it to service.
Airway pressure falls more than 10 cm H₂O during leakage test. (Insp. pause hold).	Leakage in patient circuit. Leakage in ventilator expiratory side (internal).	Perform leakage test stepwise (from inside and out): <ol style="list-style-type: none">1. Seal inspiratory outlet.2. Connect one tube at a time directly from the inspiratory side to the expiratory side.3. Perform leakage test again.4. Check complete circuit. If above fails, refer to a service technician.

Problems detected before patient connection

Problem	Possible causes	Remedy
Expired minute volume display reads 0.	Faulty flow transducer. Tubings disconnected.	Replace flow transducer. Reconnect.
Expired minute volume value differs from that expected during pre-use check.	Leakage in test lung. Loose connections. Leakage in patient circuit. Expiratory (internal) limb of ventilator not properly inserted. Ventilator uncalibrated.	Check all external parts associated with the patient circuit and expired minute volume measurement. If necessary, calibrate the ventilator.
PEEP/CPAP and/or plateau pressure cannot be maintained.	Leakage in patient circuit or test lung.	Check patient circuit and test lung. Perform leakage test.
CPAP pressure does not reach desired value during pre-use check.	Leakage in patient circuit or test lung.	Check patient circuit and test lung.

Problems detected before patient connection

Problem	Possible causes	Remedy
Display message: "O2 SENSOR".	Oxygen sensor missing or disconnected.	Check oxygen sensor and connection.
Display message: "O2 conc too low"	Gas delivered in supply line is not oxygen. Oxygen sensor faulty or exhausted. Oxygen cell uncalibrated. Air/oxygen gas module faulty.	Check oxygen supply line. Check oxygen sensor and institute a manual calibration. If this does not help, refer unit to a service technician.
Display message: "O2 conc too high" NOTE: If oxygen breaths are activated, no audible alarm will be given during and 1 minute after the oxygen breaths.	Oxygen is delivered in air supply line. Oxygen sensor faulty. Oxygen cell uncalibrated. Air/oxygen gas module faulty.	Check air supply line. Check oxygen sensor and institute a manual calibration. If this does not help, refer unit to a service technician.

Problems detected before patient connection

Problem	Possible causes	Remedy
<p>Display message: “Air/O2 supply pressure too low/high”</p> <p>NOTE: The flow from the missing gas (air or O2) is automatically compensated for so that the patient gets the preset volumes and pressures.</p> <p>NOTE: If no gas is available, the same message is shown with the actual supply pressures.</p>	<p>Gas supply line disconnected.</p> <p>No supply from wall outlet.</p> <p>Pressure in wall outlet is too low/high while ventilator is running.</p> <p>Either the air or O₂ gas module is disconnected.</p> <p>NOTE: If no gas is available, then both expiratory and safety valves will open.</p>	<p>Check and connect gas supply lines.</p> <p>Check gas module connections.</p> <p>Call hospital technician to check supply and if necessary adjust supply pressures.</p>
<p>Display message:</p> <p>1. “BATTERY”.</p> <p>2. “Limited battery capacity left”.</p> <p>3. “No battery capacity left”.</p> <p>NOTE: At 19,5V, gas modules close and both expiratory and safety valves will open.</p>	<p>1. Unit operating on battery.</p> <p>2. Battery voltage below 23 V.</p> <p>3. Battery voltage below 21 V.</p>	<p>1. Use as normal until mains is available.</p> <p>2. 15 minutes capacity left.</p> <p>3. Recharge battery by leaving the ventilator plugged into mains.</p>
<p>Display message:</p> <p>“Internal battery voltage too high”</p>	<p>Faulty internal power supply.</p>	<p>Take the unit out of operation and refer it to service.</p>

Problems detected with patient connected

Problem	Possible causes	Remedy
Display message: “Expired minute volume too high”.	Increased patient activity. Ventilator selftriggering (autocycling). Improper alarm limit setting. Wet flow transducer.	Check patient. Check trigger sensitivity setting. Check alarm limit settings. Dry the flow transducer.
Display message: “Expired minute volume too low”.	Low spontaneous patient breathing activity. Leakage in the cuff. Leakage in the patient circuit. Improper alarm limit setting.	Check patient. Check cuff pressure. Check patient circuit (perform leakage test if necessary). Check pause time and graphics to verify. Consider more ventilatory support for the patient.
Expired minute volume display reads 0.	Flow transducer faulty. Circuit disconnected from patient.	Replace flow transducer. Connect Y-piece to patient.
Display message: “APNEA ALARM” NOTE: If in VS, ventilator will revert to PRVC. Back-up rate and time must be set.	Time between two consecutive inspiratory efforts exceeds: Adult: 20 sec. Pediatric: 15 sec. Neonate: 10 sec.	Check patient. Check ventilator settings.
PEEP/CPAP and/or plateau pressure fails to be maintained.	Leakage in cuff. Leakage in the patient circuit. Improper alarm limit setting.	Check cuff pressure. Check patient circuit (perform leakage test if necessary). Check pause time and graphics to verify. Consider more ventilatory support for the patient.

Problems detected with patient connected

Problem	Possible causes	Remedy
<p>Display message: “Overrange: Select Pediatric/Adult”.</p> <p>NOTE: Tidal volume and minute volume displays will also flash if maximum measurable volumes are exceeded.</p>	<p>Combination of settings or monitored values exceeds the allowable range for the selected patient range.</p>	<p>Check patient.</p> <p>Check ventilator settings and the monitored values and change the range accordingly.</p>
<p>Display message: “Airway pressure too high”</p> <p>NOTE: If airway pressure rises 6 cm H₂O above set upper pressure limit the safety valve opens.</p> <p>Safety valve also opens if system pressure exceeds 120 cm H₂O.</p>	<p>Kinked or blocked patient tubing.</p> <p>Mucus or secretion plug in endotracheal tube or in airways.</p> <p>Patient coughing or fighting ventilator.</p> <p>Inspiratory flow rate too high.</p> <p>Improper alarm setting.</p>	<p>Check patient.</p> <p>Check ventilator settings and alarm limits.</p>
<p>Display message: “Limited pressure”.</p> <p>NOTE: This alarm is active only in the PRVC and VS modes.</p>	<p>Kinked or blocked patient tubing.</p> <p>Mucus or secretion plug in endotracheal tube or in airways.</p> <p>Patient coughing or fighting ventilator.</p> <p>Improper alarm setting.</p> <p>Patient’s lung/thorax compliance decreasing.</p> <p>Patient’s airway resistance increasing.</p>	<p>Check patient.</p> <p>Check ventilator settings and alarm limits.</p>

Problems detected with patient connected

Problem	Possible causes	Remedy
Display message: “High continuous pressure”.	Airway pressure is higher than set PEEP plus 15 cm H ₂ O for more than 15 seconds.	Check patient. Check circuit. Check ventilator settings and alarm limits.
Display message: “Check tubings”.	Disconnected pressure transducer (expiratory). Blocked pressure transducer (expiratory). Water in expiratory limb of ventilator. Wet bacterial filter. Clogged bacterial filter.	Check ventilator internals on expiratory side. Refer to service. Replace filter. Remove water from tubing and check humidifier settings, i.e., relative humidity. Check heater wires in humidifier (if present).
Display message: “O2 SENSOR”.	Indicates oxygen sensor missing or disconnected.	Check oxygen sensor and connection and rerun self test (turn ventilator to OFF and then to ON).
Display message: “O2 conc too low”	Gas delivered in supply line is not oxygen. Oxygen sensor faulty or exhausted. Oxygen cell uncalibrated. Air/oxygen gas module faulty.	Check oxygen supply line. Check oxygen sensor and institute a manual calibration. If this does not help, refer unit to a service technician.

Problems detected with patient connected

Problem	Possible causes	Remedy
<p>Display message: "O2 conc too high"</p> <p>NOTE: If oxygen breaths are activated, no alarm will be given during and 1 minute after the oxygen breaths.</p>	<p>Oxygen is delivered in air supply line.</p> <p>Oxygen sensor faulty.</p> <p>Oxygen cell uncalibrated.</p> <p>Air/oxygen gas module faulty.</p>	<p>Check air supply line.</p> <p>Check oxygen sensor and institute a manual calibration. If this does not help, refer unit to a service technician.</p>
<p>Display message: "Air/O2 supply pressure too low/high"</p> <p>NOTE: The flow from the missing gas (air or O₂) is automatically compensated for so that the patient gets the preset volumes and pressures.</p> <p>NOTE: If no gas is available, the same message is shown with the actual supply pressures.</p>	<p>Gas supply line disconnected.</p> <p>No supply from wall outlet.</p> <p>Pressure in wall outlet is too low/high while ventilator is running.</p> <p>Either the air or O₂ gas module is disconnected.</p> <p>NOTE: If no gas is available, then both expiratory and safety valves will open.</p>	<p>Check and connect gas supply lines.</p> <p>Check gas module connections.</p> <p>Call hospital technician to check supply and if necessary adjust supply pressures.</p>
<p>Display message:</p> <ol style="list-style-type: none">1. "BATTERY".2. "Limited battery capacity left".3. "No battery capacity left". <p>NOTE: At 19,5V, gas modules close and both expiratory and safety valves will open.</p>	<ol style="list-style-type: none">1. Unit operating on battery.2. Battery voltage below 23 V.3. Battery voltage below 21 V.	<ol style="list-style-type: none">1. Use as normal until mains is available.2. 15 minutes capacity left.3. Recharge battery by leaving the ventilator plugged into mains.

Problems detected with patient connected

Problem	Possible causes	Remedy
Display message: "Internal battery voltage too high"	Faulty internal power supply.	Take the unit out of operation and refer it to service.
Self test message Technical error code XXX	Internal hardware problem.	Note the error code "XXX", take the unit out of operation and refer it to service.

Contents

Dismantling 2
Assembling 4
Log sheet 5



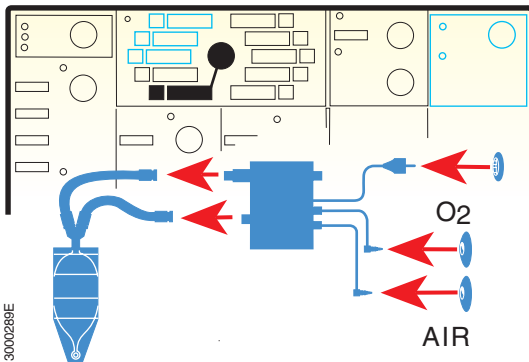
Quick exchange of expiratory channel

To be able to use the ventilator to the greatest extent MAQUET recommends that a complete, cleaned expiratory channel is always kept available. Thus the exchange and pre-use check can be made quickly between patients, and the exchanged parts can be cleaned when convenient.

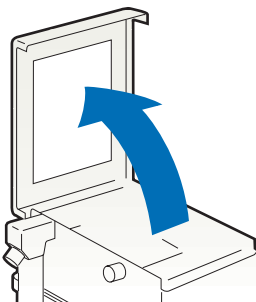
If the expiratory channel has been calibrated in another ventilator, make sure the minute volume reading is correct (see Function check pp 12-13).

Dismantling

- Set the mode selector to "Ventilator off Battery charging".
- Disconnect the ventilator from mains and gas.
- Remove all accessories.



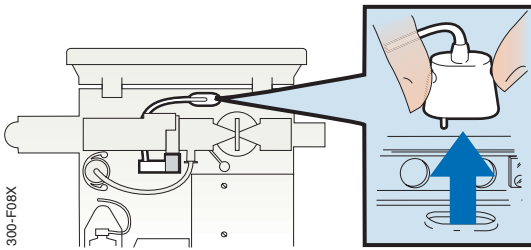
3000289E



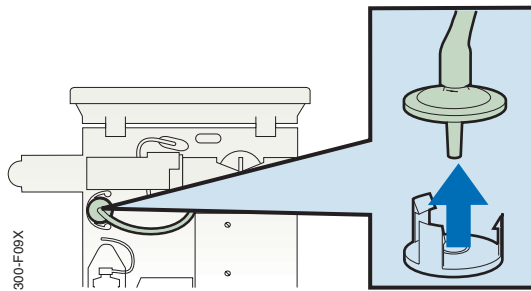
- Open the lid on the pneumatic unit.

300-E22X

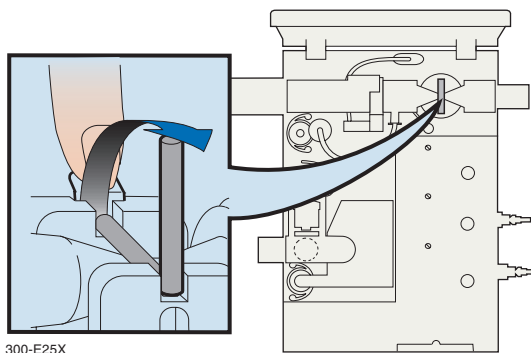
Quick exchange of expiratory channel



- Disconnect the flow transducer connector.



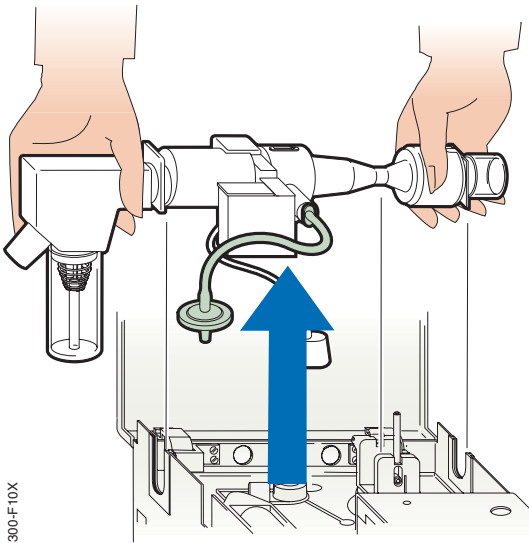
- Loosen the bacteria filter.



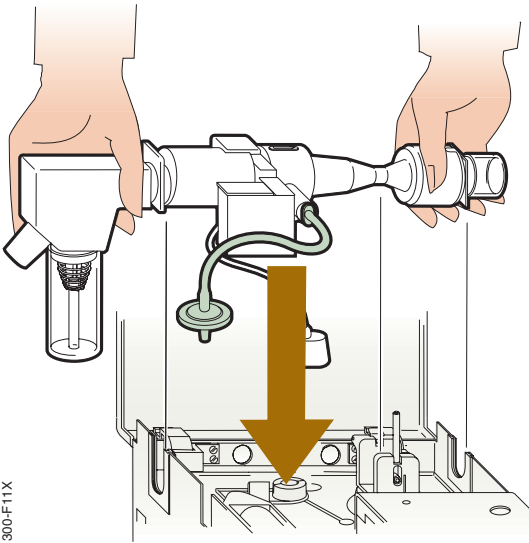
- Press the spring to open the expiratory valve.



Quick exchange of expiratory channel

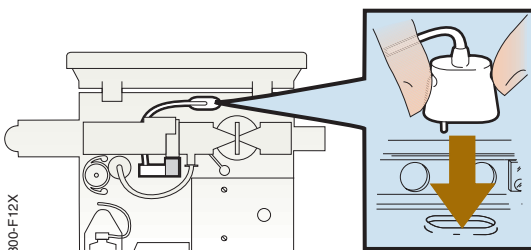


- Lift the entire expiratory channel upward. For cleaning instructions, see chapter Routine cleaning.



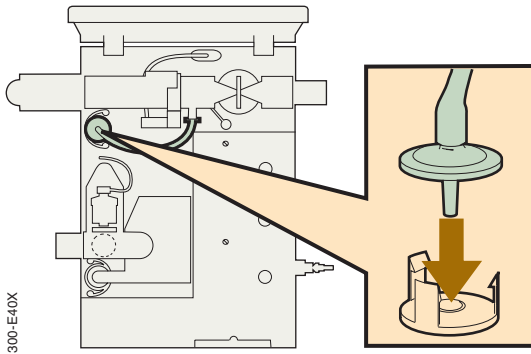
Assembling

- Make sure:
 - the new expiratory channel is correctly assembled.
 - the numbers on the flow transducer and the preamplifier correspond.
 - the number on the flow transducer label corresponds to the serial number on the ventilator.
- Put the expiratory channel in place.

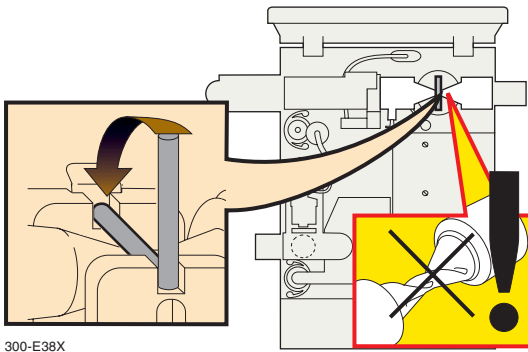


- Connect the flow transducer connector.

Quick exchange of expiratory channel



- Connect the bacteria filter.



- Make sure the expiratory valve tube is not bent or twisted.
- Close the expiratory valve.

- Carry out a pre-use check.

Log sheet

- Sign on a log sheet that the expiratory channel has been exchanged. Note also in the log sheet the number on the flow transducer.

Contents

Dismantling	2
Cleaning	5
Assembling	8
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Hygiene

The gas which passes the ventilator's inspiration system also passes a bacteria filter and is usually clean and dry.

The dry environment within the ventilator system gives unfavorable conditions for bacterial growth, and bacteria spreading against the gas flow is considered virtually impossible.

Bacteria from the patient will appear in the moist environment of the expiratory side. By attaching a disposable bacteria filter to the expiratory inlet of the ventilator, the transmission of bacteria to the expiratory channel and out into the room is reduced. This reduces the risk of infections being spread to the staff as well as cross infections between patients. The bacteria filter should be replaced according to manufacturer recommendations.

Exchange or cleaning of patient tubes, cleaning of the expiratory channel, and the exchange of expiratory pressure

transducer bacteria filter are recommended after each patient or according to the hospital routines.

The gas conveying parts of the expiration system can be decontaminated and sterilized.

The expiratory valve, the bacteria filter with tube and nipple for the expiratory pressure transducer and the mesh net in the expiratory flow transducer shall be replaced after every 1000 hours of operation.

The parts of the inspiratory system shall be sterilized, and the bacteria filters replaced after every 3000 hours of operation or within one year, whichever occurs first.

All personnel should be aware of the risk of parts being infected when disassembling and cleaning the ventilator.

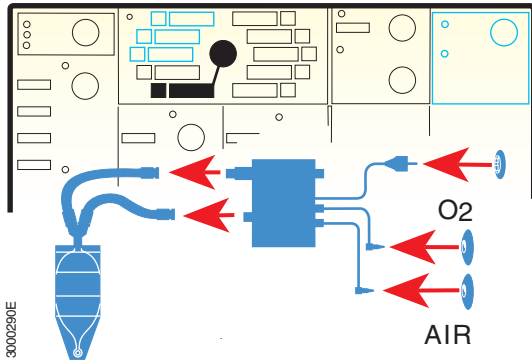
All disposable parts shall be discarded according to hospital rules and in an environmentally safe way.

Routine cleaning

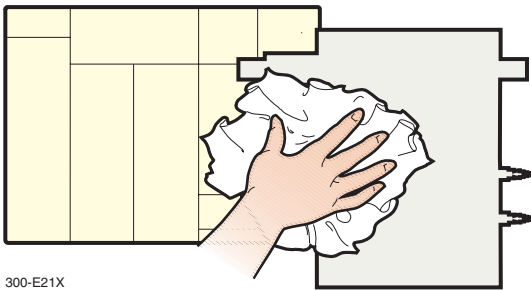
These instructions apply when the same expiratory channel is to be cleaned and then put back in the same ventilator.

Dismantling

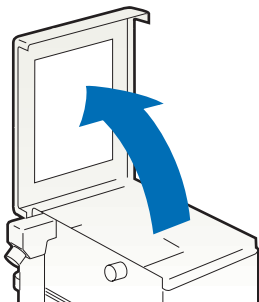
- Set the mode selector to "Ventilator off Battery charging".
- Disconnect the ventilator from mains and gas supply.
- Remove all accessories.



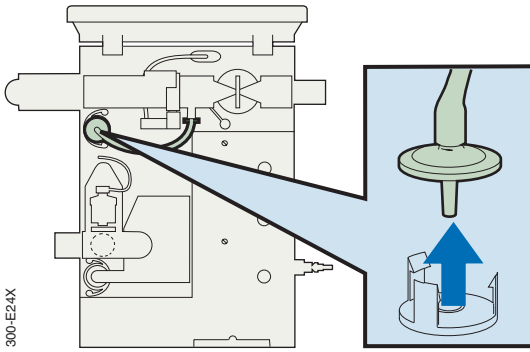
- Wipe the outside of the ventilator with a soft cloth moistened in a disinfectant.



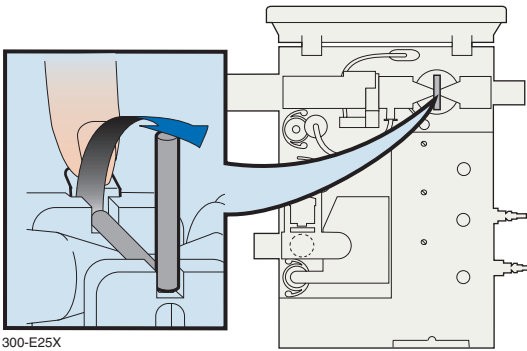
- Open the lid on the patient unit.



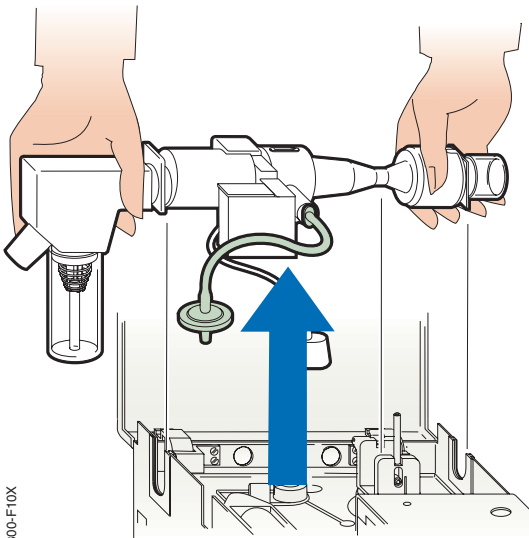
Routine cleaning



- Loosen the bacteria filter.

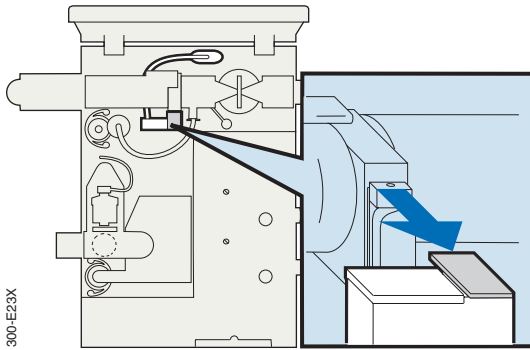


- Press the spring to open the expiratory valve.

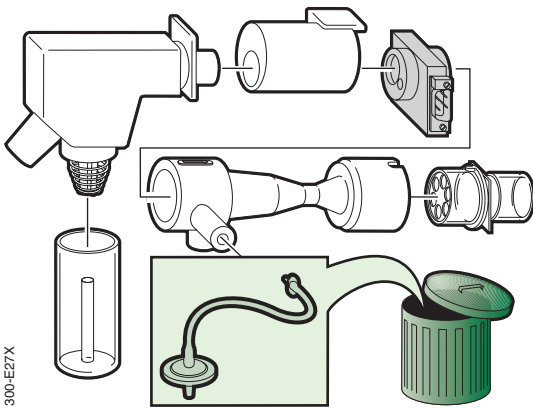


- Lift the entire expiratory channel upward.

Routine cleaning



- Disconnect the flow transducer from its amplifier.



- Dismantle the parts.
- Discard the bacteria filter with tube and nipple.

Cleaning

Flow transducer

The flow transducer is a precision instrument and must be handled carefully. The metal disc in the small channel of the transducer is very fragile and may break if it is handled carelessly.

Do not poke at the metal disc in the transducer channel.

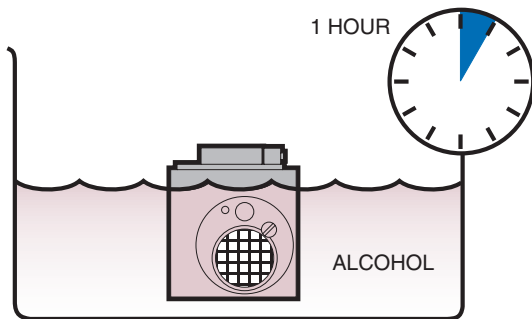
Do not flush the channel with water.

The flow transducer must not be cleaned in a dish washing machine, by ultra-sound or by using agents which contain aldehydes.

Solutions other than alcohol may cause disturbances in the function of the flow transducer.

If an agent other than alcohol is used, the cleaning routine should be carried out according to the instructions of the respective manufacturer.

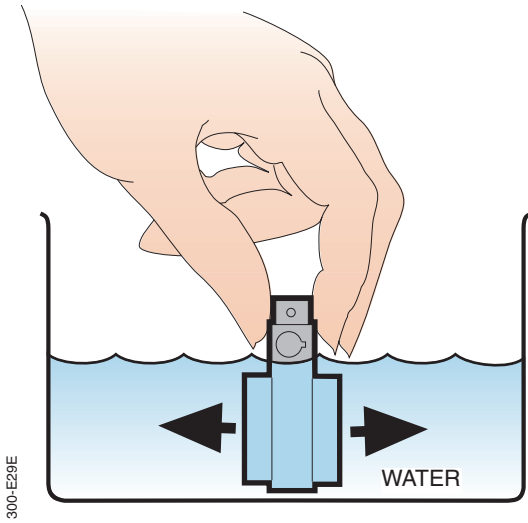
The agents used for cleaning and disinfection must have a pH between 4 and 8.5.



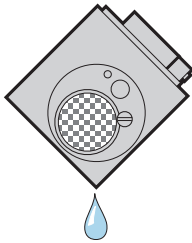
300-E28E

- Let the flow transducer lie in a 70% alcohol solution for about one hour.

Routine cleaning

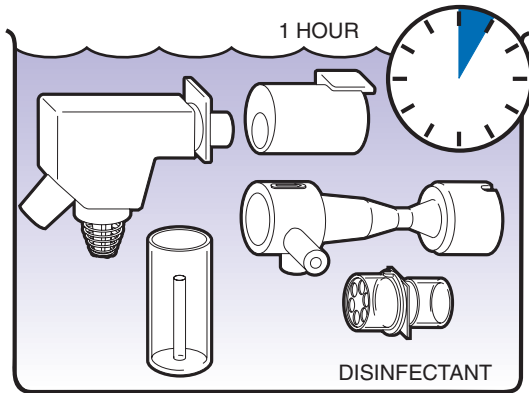


- If a solution other than alcohol is used, rinse the solution from the flow transducer by carefully moving it to and fro in a bowl of distilled water.



- Let the water run off the transducer after rinsing.

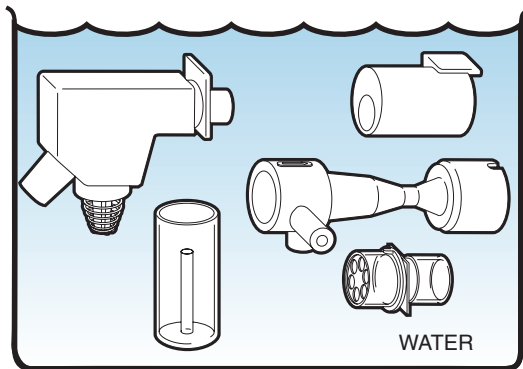
Routine cleaning



300-E31E

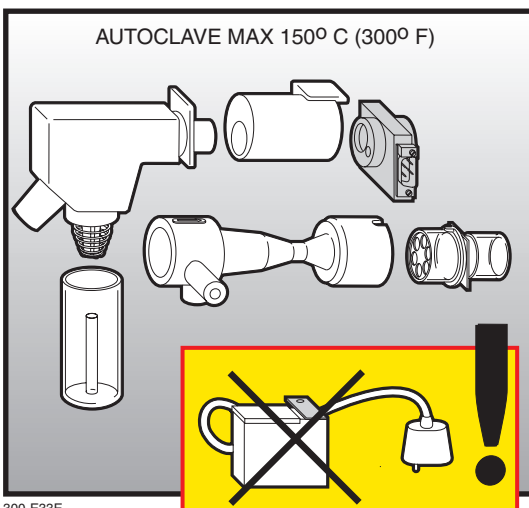
Other parts

- Soak the other parts in a disinfectant for about one hour.



300-E32E

- Rinse the parts in water.



300-E33E

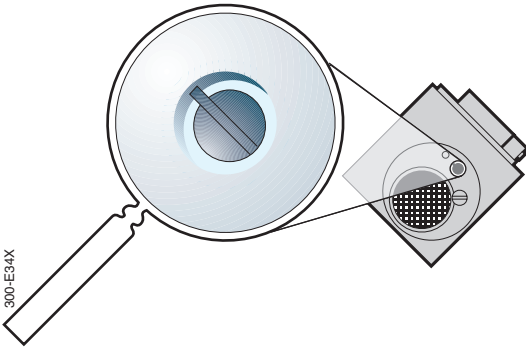
- Autoclave all parts, including the flow transducer, at a maximum temperature of 150°C (300°F).

Note! Do not autoclave the flow transducer amplifier with cable!

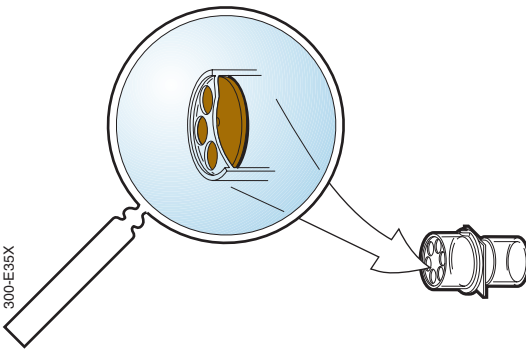
Routine cleaning

Assembling

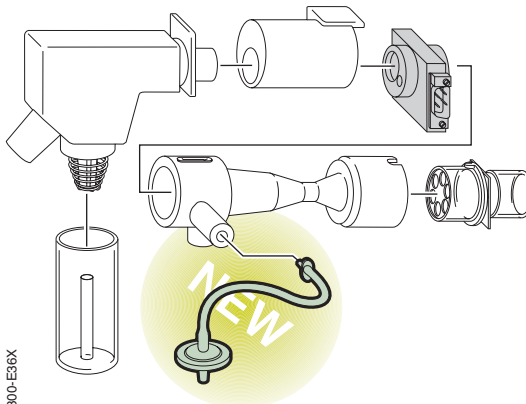
- Make sure the fine mesh net in the transducer is not blocked or damaged and the disc in the small channel is in position.



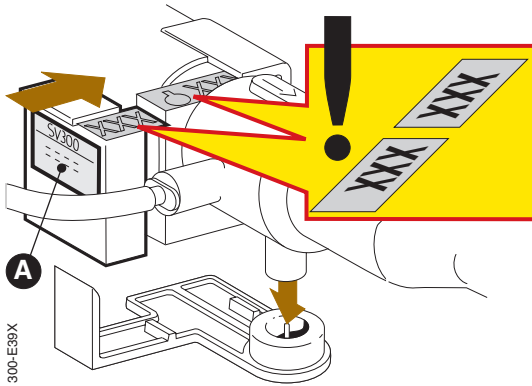
- Make sure the non-return valve is in position in the expiratory outlet.



- Assemble the expiratory channel with a new bacteria filter with tube and nipple.

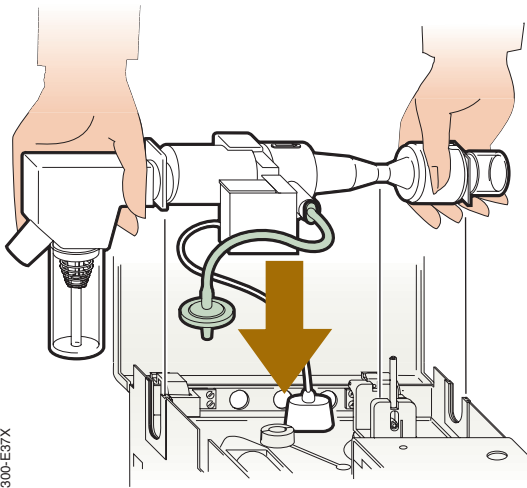


Routine cleaning



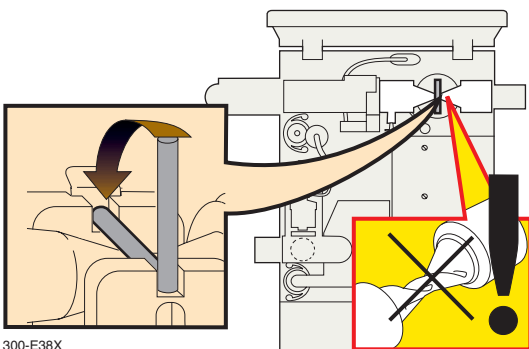
300-E39X

- Connect the flow transducer amplifier and make sure:
 - the numbers on the flow transducer and the amplifier correspond.
 - the serial number on the amplifier label (A) corresponds to the serial number on the SV 300/SV 300A.



300-E37X

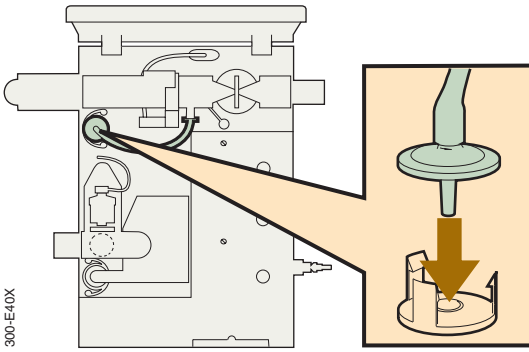
- Put the complete expiratory channel in place.



300-E38X

- Make sure the expiratory valve is not bent or twisted.
- Close the expiratory valve.

Routine cleaning



- Connect the bacteria filter.

- Attach patient tubes and necessary accessories.
- Check the ventilator as described in chapter Function check.

Log sheet

- Note on a log sheet that a routine cleaning has been performed.

Contents

Disposable parts	2
Dismantling	2
Assembling	5
Log sheet	6

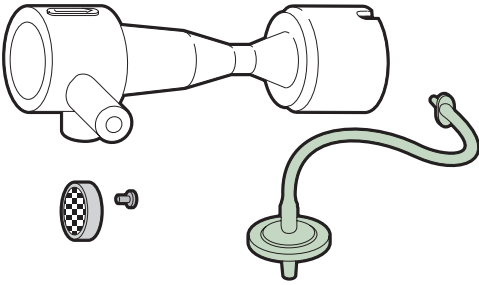
All personnel should be aware of the risk of parts being infected when disassembling and cleaning the ventilator.

Make sure the parts that have been in contact with the patient's expiratory gas are clean before any other work, e.g., repair, exchange of parts, etc, is started.

All disposable parts shall be discarded according to hospital rules and in an environmentally safe way.



300-E41X

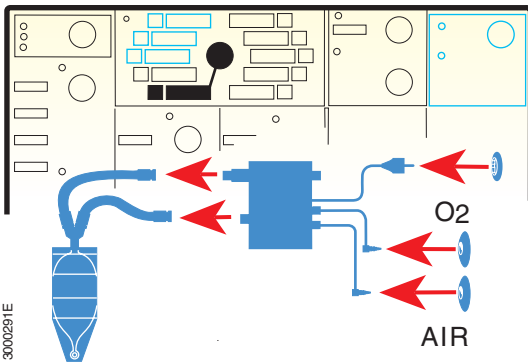


Disposable parts

Only spare parts from MAQUET shall be used.

- Bacteria filter with 13 cm tube and nipple for expiratory pressure transducer.
- Expiratory valve tube.
- Mesh net, including screw, for expiratory flow transducer.

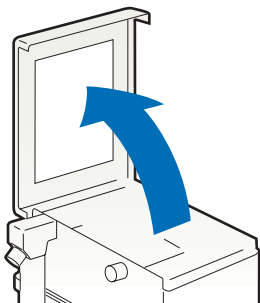
3000291E



Dismantling

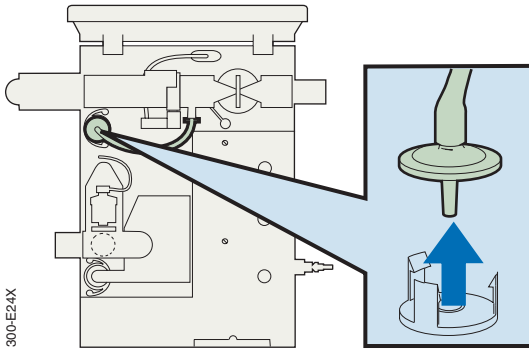
- Set the mode selector to "Ventilator off Battery charging".
- Disconnect the ventilator from mains and gas supply.
- Remove all accessories.

300-E22X

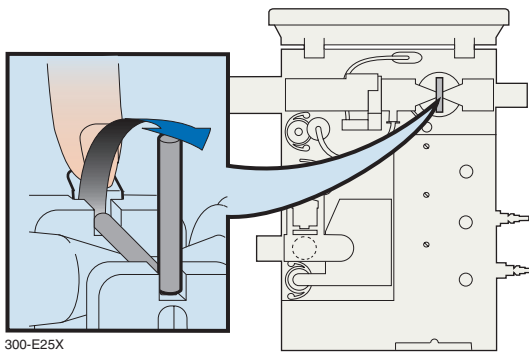


- Open the lid on the patient unit.

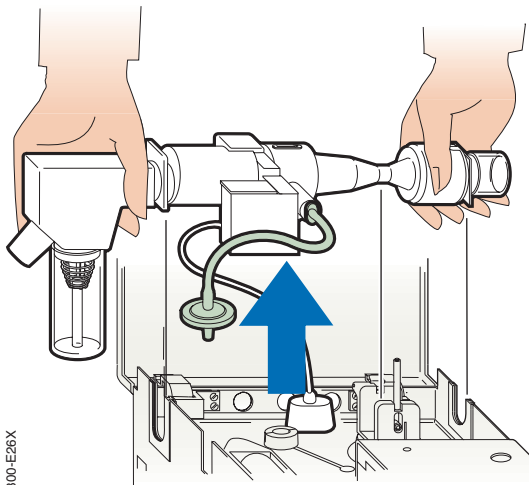
1000 hour overhaul



- Loosen the bacteria filter.



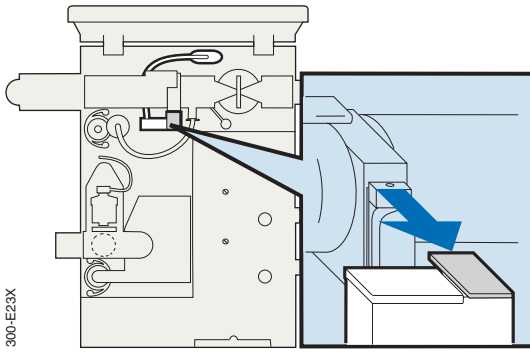
- Press the spring to open the expiratory valve.



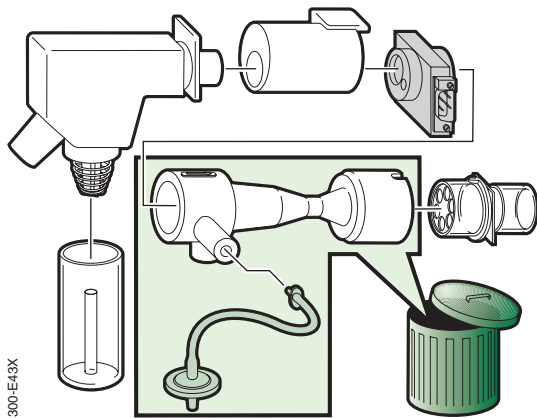
- Lift the entire expiratory channel upward.



1000 hour overhaul

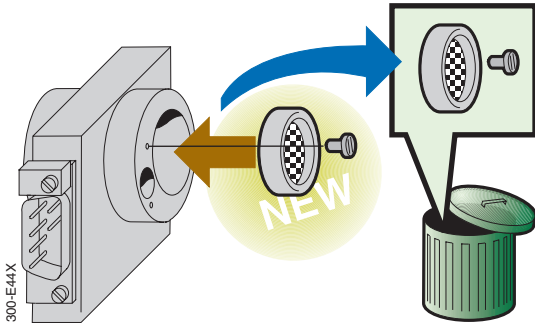


- Disconnect the flow transducer from its amplifier.

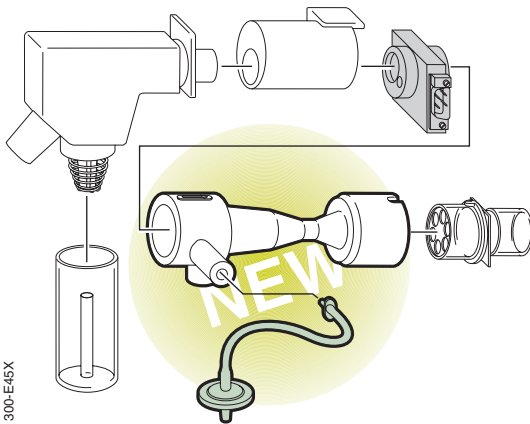


- Dismantle the expiratory channel and discard the expiratory valve tube and the bacteria filter with tube and nipple.

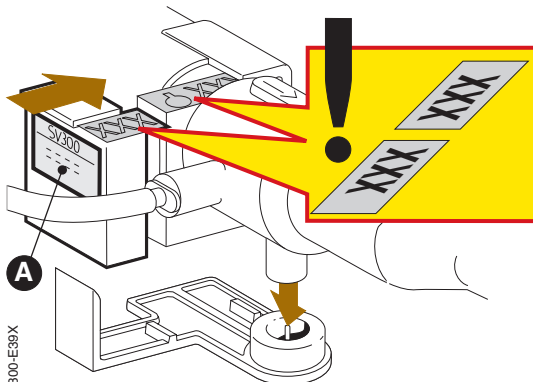
Assembling



- Replace the mesh net in the flow transducer as follows:
 - remove the screw,
 - take out the mesh net,
 - insert and secure the new mesh net.



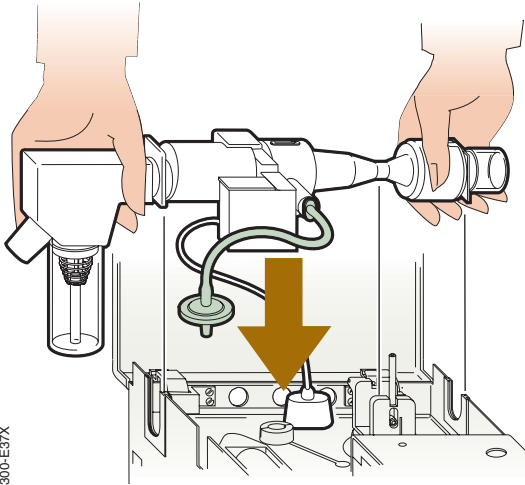
- Assemble the expiratory channel. The following items should be new:
 - expiratory valve tube.
 - bacteria filter with 13 cm tube and nipple.
 - mesh net in the expiratory flow transducer.



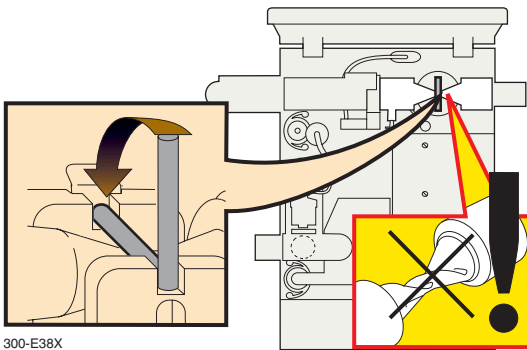
- Connect the flow transducer amplifier and make sure:
 - the numbers on the flow transducer and the amplifier correspond.
 - the serial number on the amplifier label (A) corresponds to the serial number on the SV 300/SV 300A.

If the expiratory channel has been calibrated in another ventilator, make sure the minute volume reading is correct (see Function check pp 12-13).

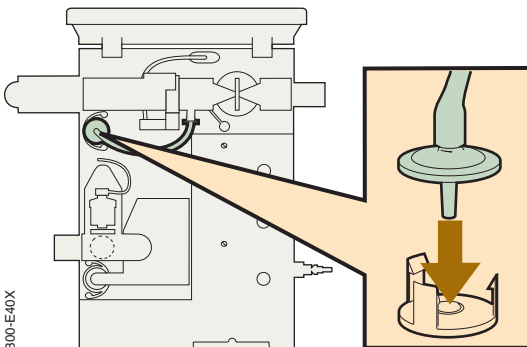
1000 hour overhaul



- Make sure the complete expiratory channel is correctly assembled, then put in place.



- Make sure the expiratory valve is not bent or twisted.
- Close the expiratory valve.



- Connect the bacteria filter.

- Carry out a pre-use check.

Log sheet

- Note on a log sheet that a 1000 hour overhaul has been performed.

Contents

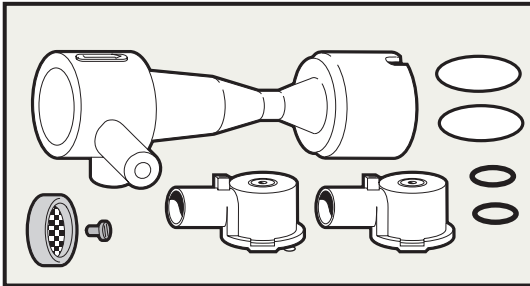
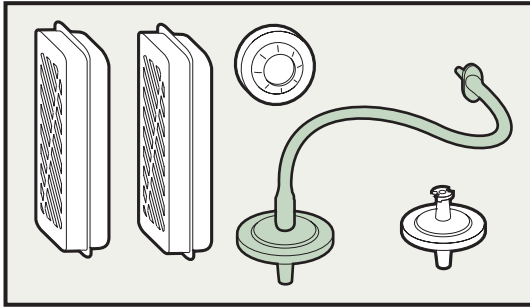
Disposable parts	2
Equipment	2
Preparations	3
Gas modules	4
Dust filter	8
Dismantling	9
Cleaning	13
Assembling	16
Log sheet	20



The internal battery shall be replaced every 3 years. See instructions in the Service Manual. An old non-functioning battery must be returned to the place of purchase or to a place where it can be disposed of properly. The battery must not be disposed of with ordinary waste. All disposable parts shall be discarded according to hospital rules and in an environmentally safe way. All personnel should be aware of the risk of parts being infected when disassembling and cleaning the ventilator.

Make sure the parts that have been in contact with the patient's expiratory gas are clean before any other work, e.g., repair, exchange of parts, etc, is started.

3000 hour overhaul with complete cleaning



300-K55X

Disposable parts

Only spare parts from MAQUET shall be used.

Bacteria filters:

- 2 for gas modules.
- 1 for inspiratory pressure transducer.
- 1 with 13 cm tube and nipple for expiratory pressure transducer.
- 1 for O₂ cell.

Other items:

- Expiratory valve tube.
- Mesh net, including screw, for expiratory flow transducer.

- 2 diaphragms for gas modules.
- 2 O-rings for gas modules.

*

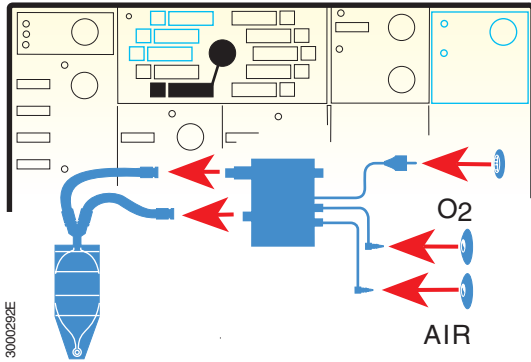
- 2 complete plastic nozzle units

* for gas modules with metal nozzle units

Equipment

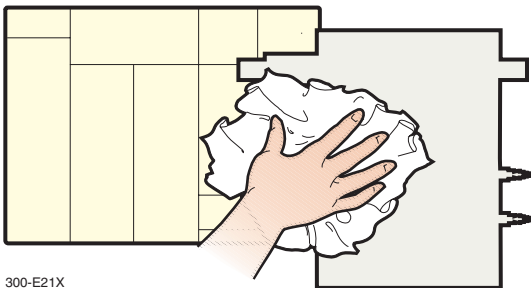
- Screwdriver.
- Hexagonal wrench 5 mm.

3000 hour overhaul with complete cleaning



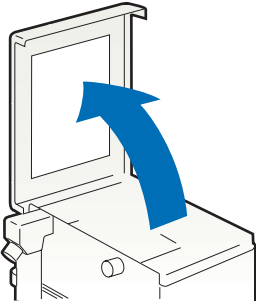
Preparations

- Set the mode selector to "Ventilator off Battery charging".
- Disconnect the ventilator from mains and gas supply.
- Remove all accessories.



- Wipe the outside of the ventilator with a soft cloth moistened in a disinfectant.

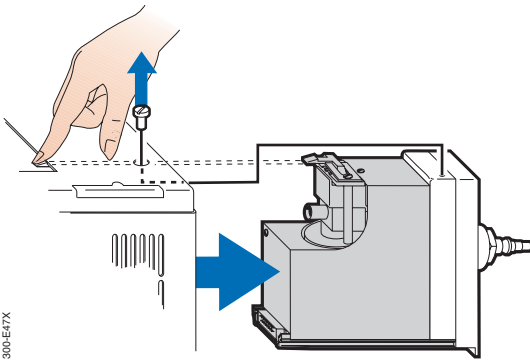
300-E22X



Gas modules

- Open the lid on the patient unit.

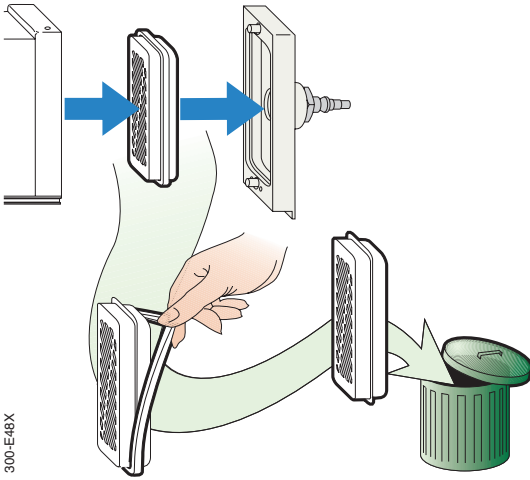
Make sure the ventilator is disconnected from mains and the mode selector is in position "**Ventilator off Battery charging**" before the gas modules are removed.



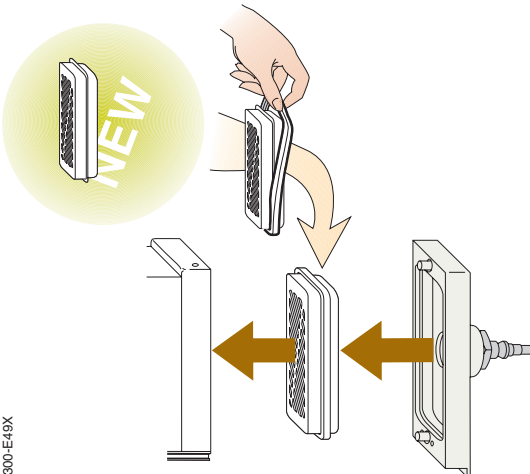
300-E47X

- Remove the plastic screw on gas module AIR.
- Press the hatch and pull the module out.

3000 hour overhaul with complete cleaning



- Unscrew the two screws on the cover with a hexagonal wrench. Open the module and take the bacteria filter out.
- Remove and save the rubber sealing for the bacteria filter.
- Discard the bacteria filter.



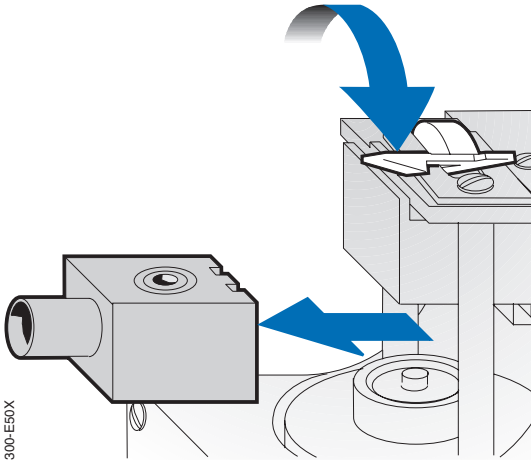
- Put the rubber sealing on the new bacteria filter.
- Put the new bacteria filter in the lid and tighten the gas module.



Gas modules

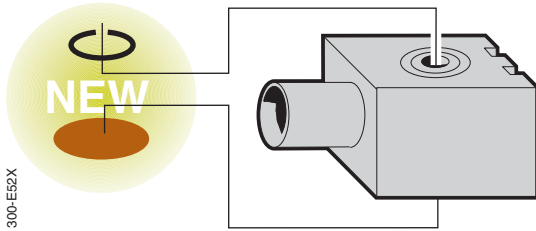
1. With metal nozzle units

- Open the hatch and remove the nozzle unit.



- Exchange the O-ring and the diaphragm.

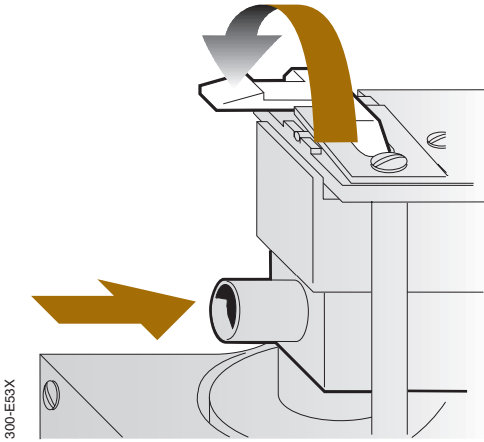
Note! Do not use any sharp tool that may damage the valve seats.



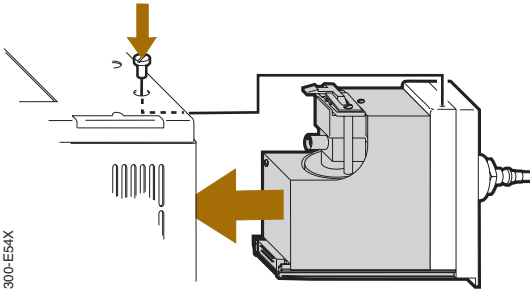
2. With plastic nozzle units

- Open the hatch and exchange the complete nozzle unit.

3000 hour overhaul with complete cleaning



- Put the nozzle unit back and close the hatch.



- Put the gas module back in the ventilator and make sure the hatch snaps into place.
- Tighten the screw.

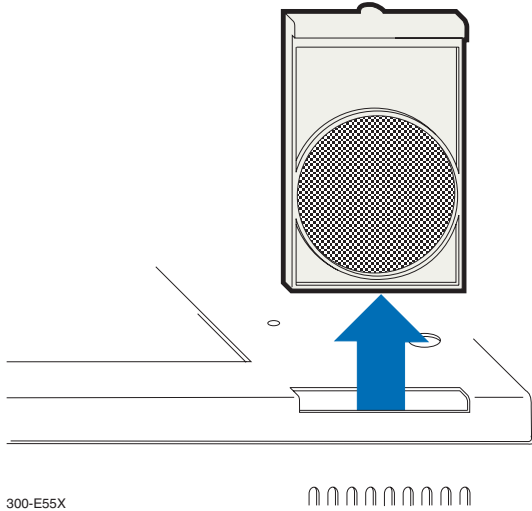
- Repeat the procedure for the gas module O₂.

Note! Wait 10 minutes before connecting pressure to the gas modules.

3000 hour overhaul with complete cleaning

Dust filter

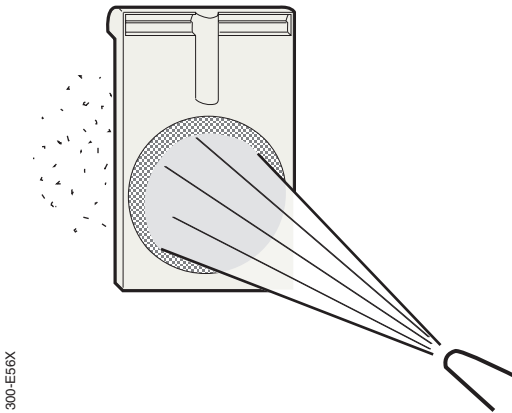
- Remove the filter.



300-E55X

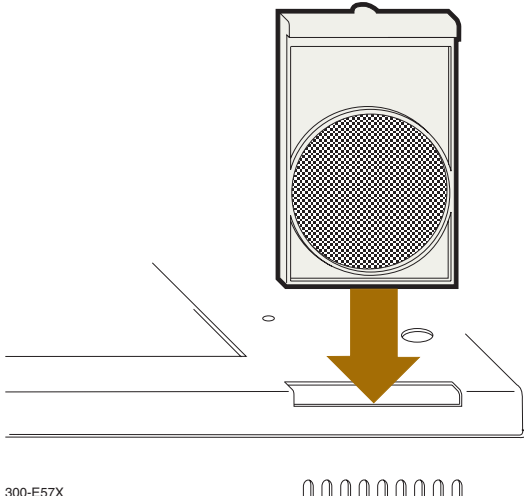
- Use compressed air to blow the filter clean. If compressed air is not available, the filter can be cleaned in water.

Do not direct the flow of compressed air toward the eyes or other unprotected parts of the body.



300-E56X

- Put the filter back.



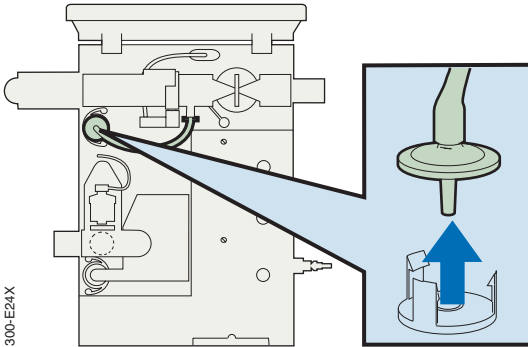
300-E57X

3000 hour overhaul with complete cleaning

Dismantling

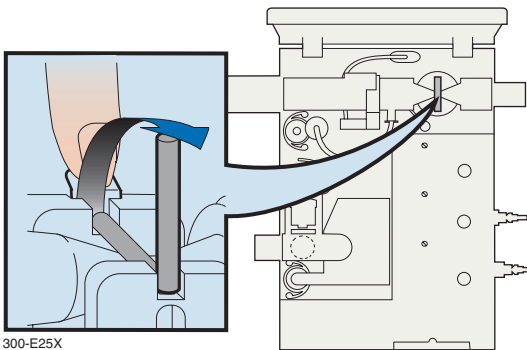
Expiratory channel

- Loosen the bacteria filter.



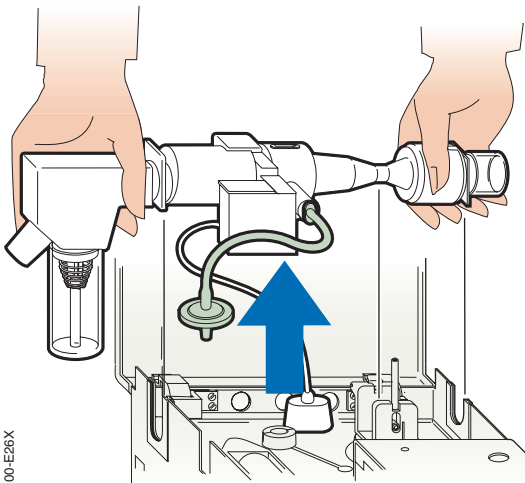
300-E24X

- Press the spring to open the expiratory valve.



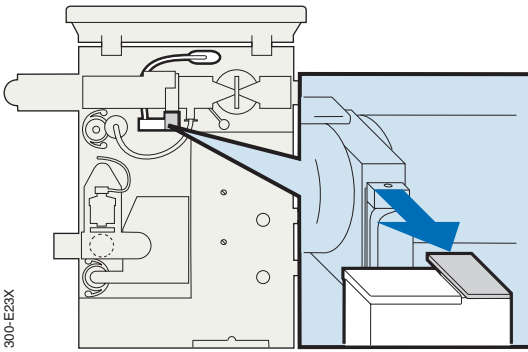
300-E25X

- Lift the entire expiratory channel upward.



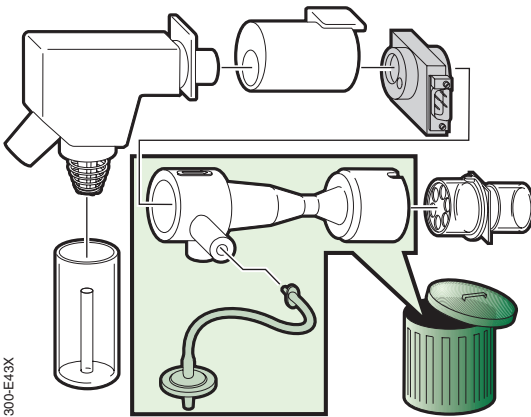
300-E26X

3000 hour overhaul with complete cleaning



300-E23X

- Disconnect the flow transducer from its amplifier.



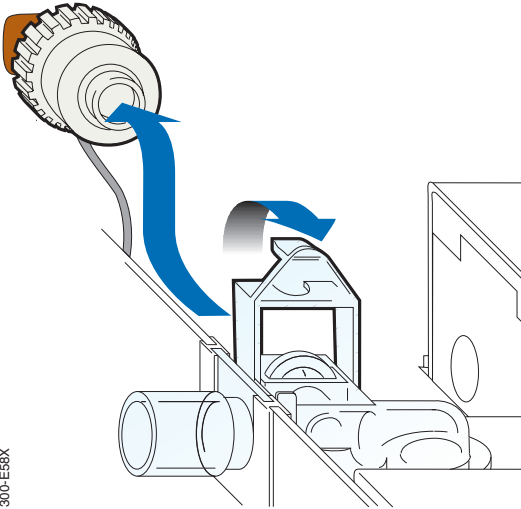
300-E43X

- Dismantle the parts.
- Discard the expiratory valve tube and the bacteria filter with tube and nipple.

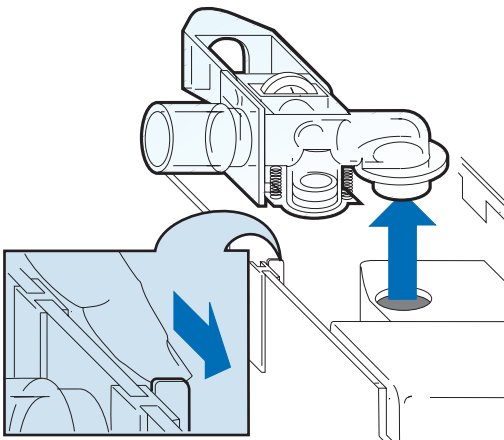
3000 hour overhaul with complete cleaning

Inspiratory channel

- Remove the O₂ cell from the inspiratory pipe.



300-E58X

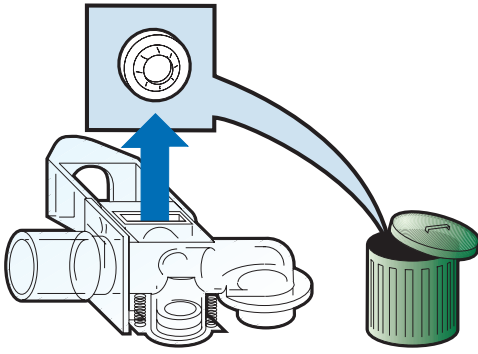


300-E59X

- Press the hatch and lift the inspiratory pipe upward.

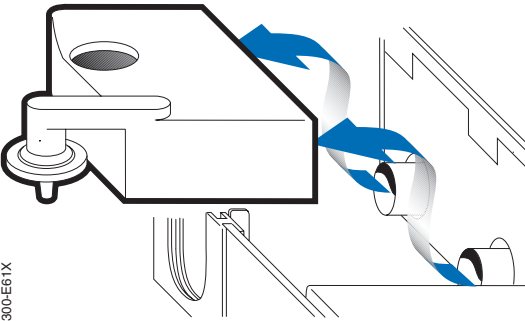
3000 hour overhaul with complete cleaning

300-E60X



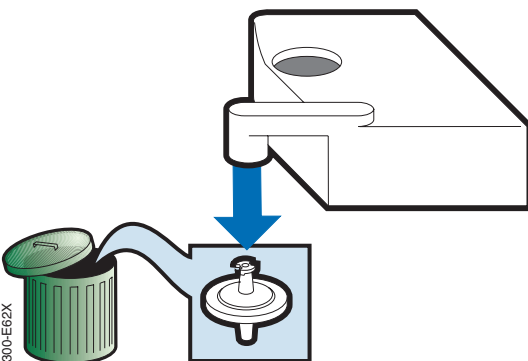
- Remove and discard the bacteria filter for the O₂ cell.

300-E61X



- Loosen the bacteria filter from its seat and remove the inspiratory mixing part.

300-E62X



- Remove and discard the bacteria filter.

Cleaning

Flow transducer

The flow transducer is a precision instrument and must be handled carefully. The metal disc in the small channel of the transducer is very fragile and may break if handled carelessly.

Do not poke at the metal disc in the transducer channel.

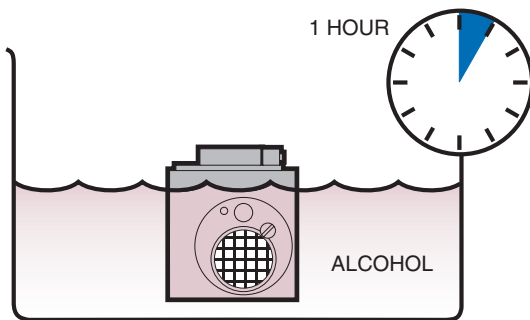
Do not flush the channel with water.

The flow transducer must not be cleaned in a dish washing machine, by ultra-sound or by using agents which contain aldehydes.

Solutions other than alcohol may cause disturbances in the function of the flow transducer.

If an agent other than alcohol is used, the cleaning routine should be carried out according to the instructions of the respective manufacturer.

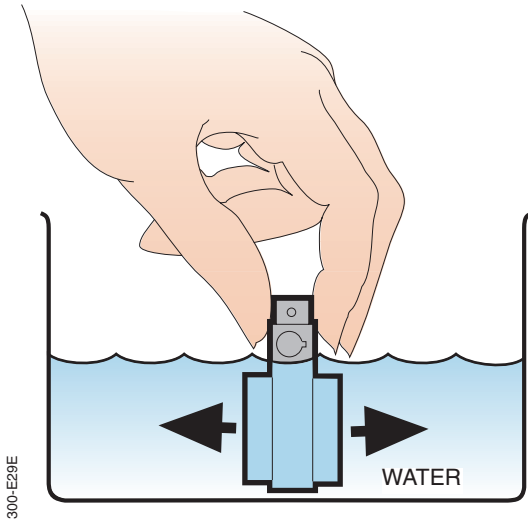
The agents used for cleaning and disinfection must have a pH between 4 and 8.5.



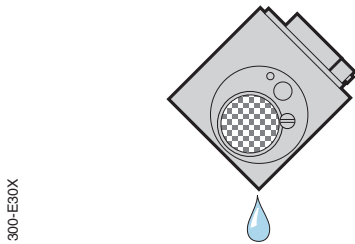
300-E28E

- Let the flow transducer lie in a 70% alcohol solution for about one hour.

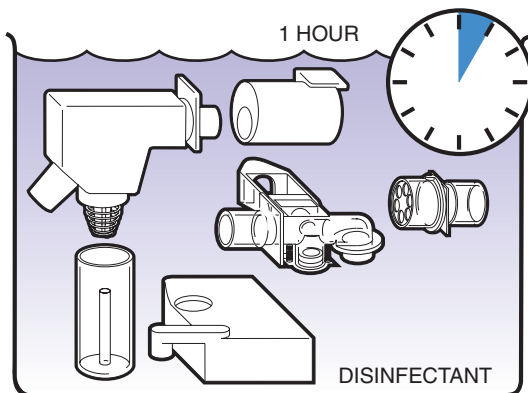
3000 hour overhaul with complete cleaning



- If a solution other than alcohol is used, rinse the solution from the flow transducer by carefully moving it to and fro in a bowl of distilled water.



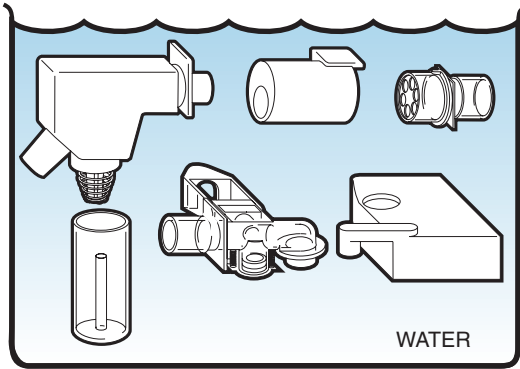
- Let the water run off the transducer after rinsing.



Other parts

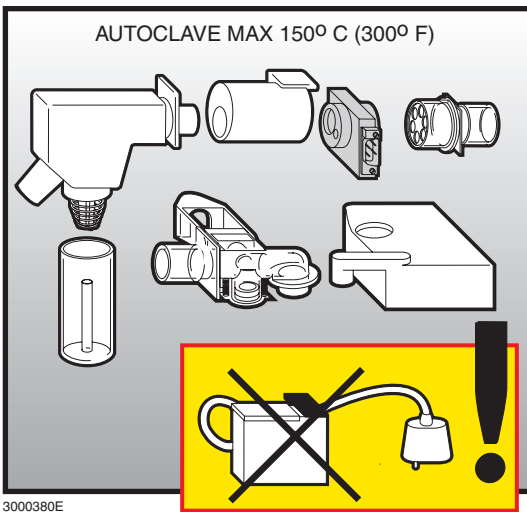
- Soak the other parts in a disinfectant for about one hour.

3000 hour overhaul with complete cleaning



3000379E

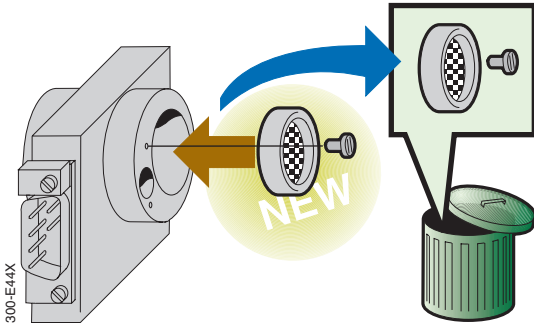
- Rinse the parts in water.



3000380E

- Autoclave all parts, including the flow transducer, at a maximum temperature of 150°C (300°F).

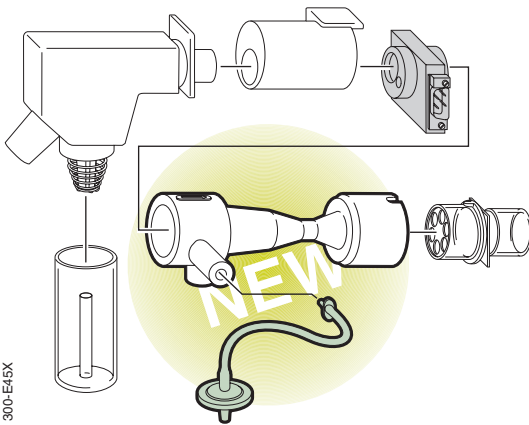
Note! Do not autoclave the flow transducer amplifier with cable!



Assembling

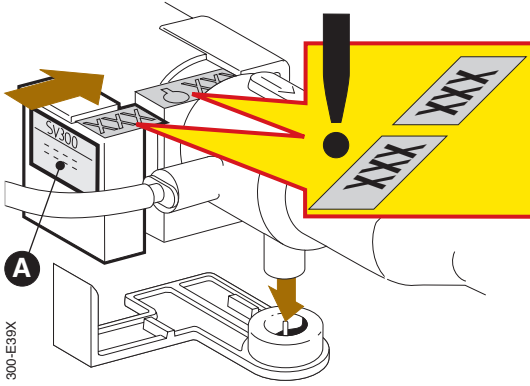
Expiratory channel

- Replace the mesh net in the flow transducer as follows:
 - remove the screw,
 - take out the mesh net.
 - insert and secure the new mesh net.



- Assemble the expiratory channel. The following items should be new:
 - expiratory valve tube.
 - bacteria filter with 13 cm tube and nipple.
 - mesh net in flow transducer.

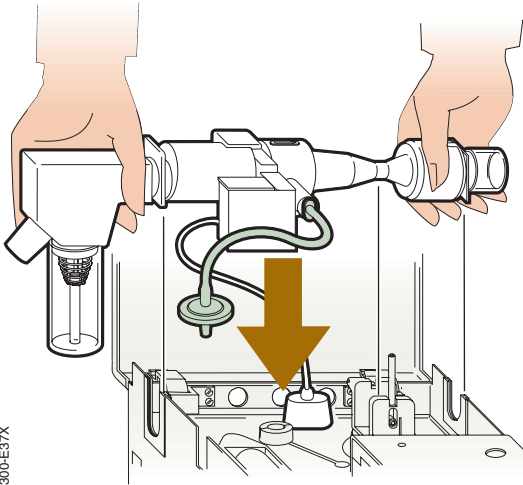
3000 hour overhaul with complete cleaning



300-E39X

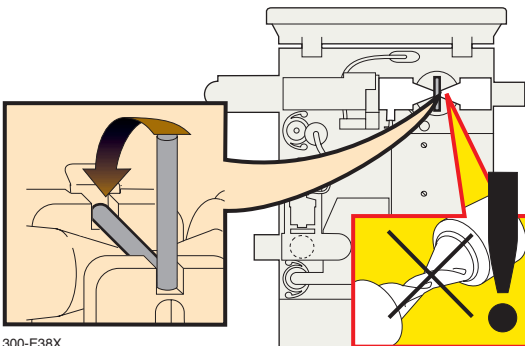
- Connect the flow transducer amplifier. Make sure:
 - the numbers on the flow transducer and the amplifier correspond.
 - the serial number on the amplifier label (A) corresponds to the serial number on the SV 300/SV 300A.

If the expiratory channel has been calibrated in another ventilator, make sure the minute volume reading is correct (see Function check pp 12-13).



300-E37X

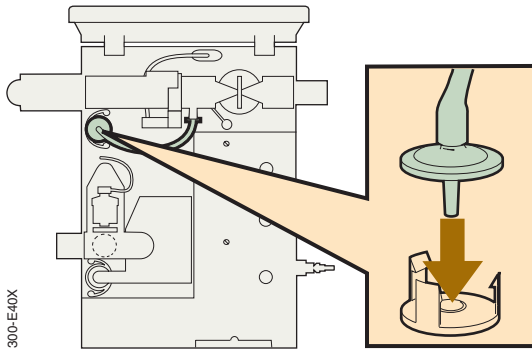
- Put the complete expiratory channel in place.



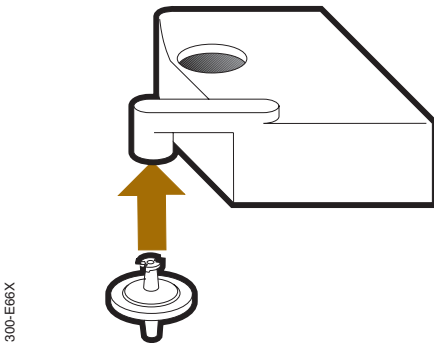
300-E38X

- Make sure the expiratory valve is not bent or twisted.
- Close the expiratory valve.

3000 hour overhaul with complete cleaning

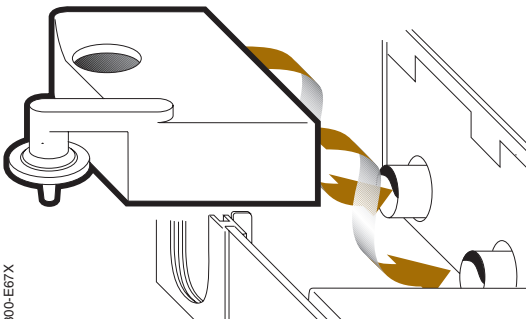


- Connect the bacteria filter.



Inspiratory channel

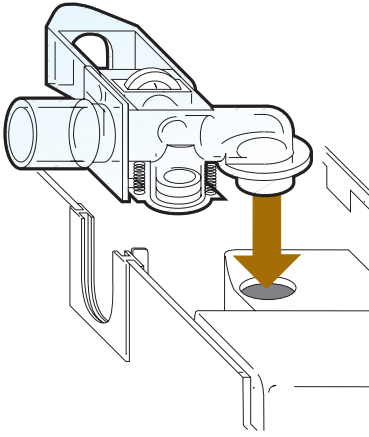
- Connect a new bacteria filter to the inspiratory mixing part. Make sure the filter is inserted correctly and well into the inspiratory mixing part. See picture.



- Put the inspiratory mixing part in position and connect the bacteria filter.

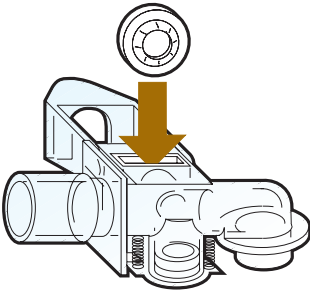
3000 hour overhaul with complete cleaning

300-E68X



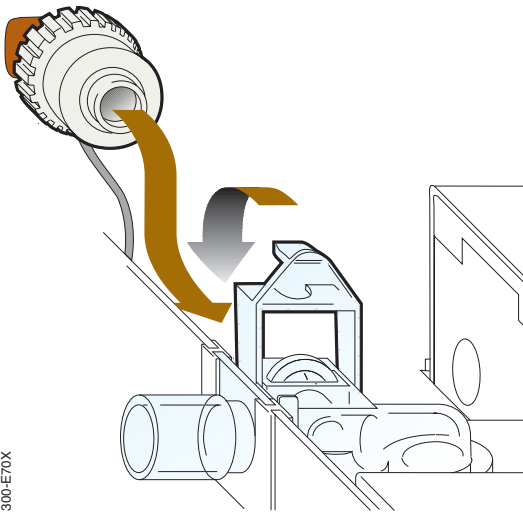
- Put the inspiratory pipe in position.
- Make sure the hatch locks.

300-E69X



- Insert a new bacteria filter for the O₂ cell.

300-E70X



- Connect and put the O₂ cell with O-ring in position.
- Close the O₂ cell holder.

Calibration and function check

- Calibrate and check the ventilator as described in chapters Calibration and Function check.

Log sheet

- Note on a log sheet that a 3000-hour overhaul has been done.

Contents

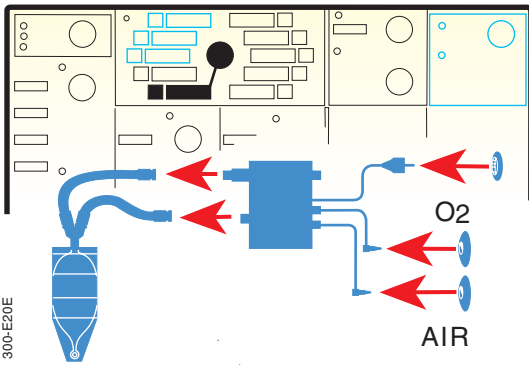
Preparations	2
Replacement	2
Calibration	4
Log sheet	6

The sealed unit contains a caustic liquid which may cause severe burns to skin and eyes. In case of contact, immediately flush with plenty of water for at least 15 minutes. For eyes, get medical attention.

Exchange of O₂ cell

Preparations

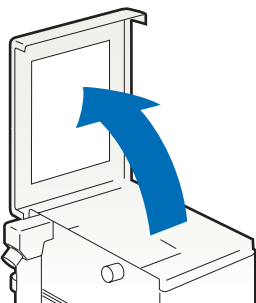
- Unpack the O₂ cell at least 30 minutes before replacement.



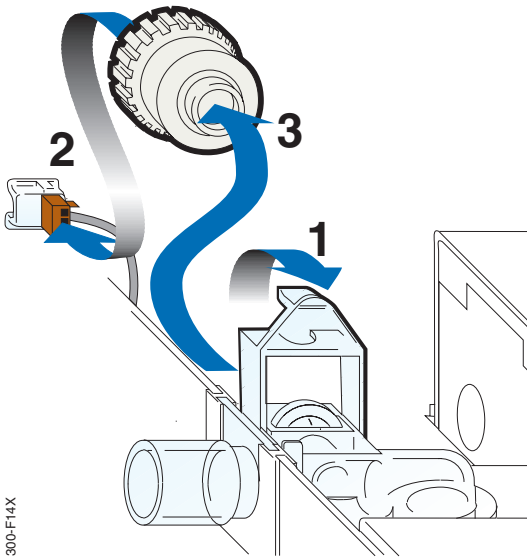
- Set the mode selector to “Ventilator off Battery charging”.
- Disconnect the ventilator from mains and gas.
- Remove all accessories.

Replacement

- Open the lid on the patient unit.



Exchange of O₂ cell



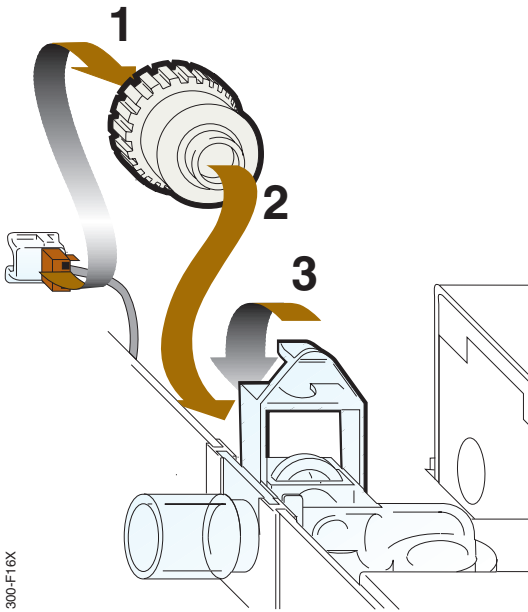
300-F14X

- Open the O₂ cell holder.
- Take the old O₂ cell out of the holder.
- Disconnect the connector from the O₂ cell.
- Discard the old O₂ cell.



An old non-functioning O₂ cell must be returned to the place of purchase or to a place where it can be disposed of properly. The O₂ cell must not be disposed of with ordinary waste.

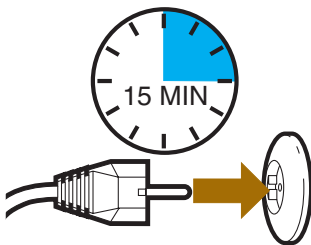
Exchange of O₂ cell



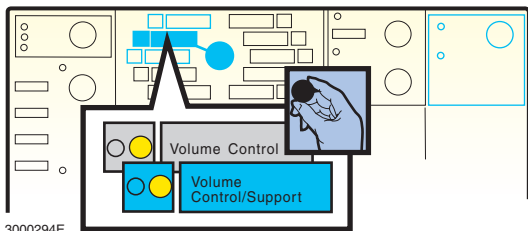
- Put a new O₂ cell with O-ring in the holder.
- Make sure the O-ring is not damaged and is in position.
- Connect the connector to the new O₂ cell.
- Close the O₂ cell holder.

Calibration

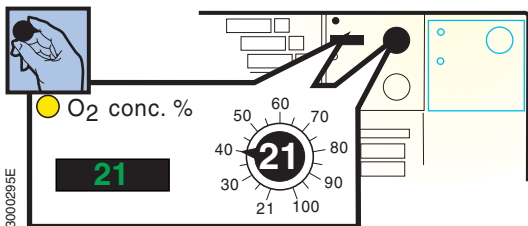
- Connect mains. Let the ventilator run for about 15 minutes.



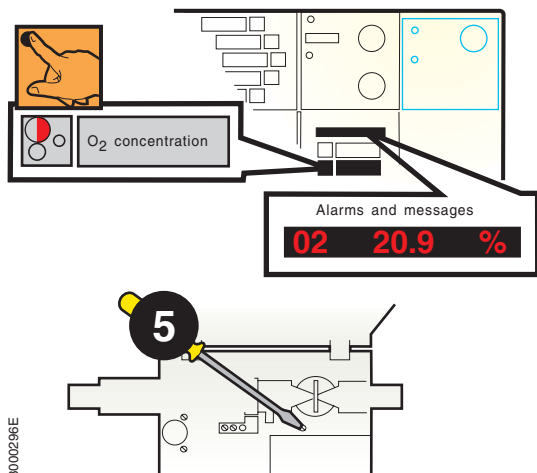
Exchange of O₂ cell



- Set the mode selector to "Volume Control".



- Set "O₂ conc.%" to 21%.



- Touch the "O₂ concentration" touchpad and make sure:
 - the display "Alarms and messages" shows 20.9%. If not, adjust with trimmer 5 (O₂% \triangleleft).

Exchange of O₂ cell

- A fine-adjustment of the calibration may be necessary after a few hours of operation when the O₂ cell has reached the same working temperature as the ventilator.

Log sheet

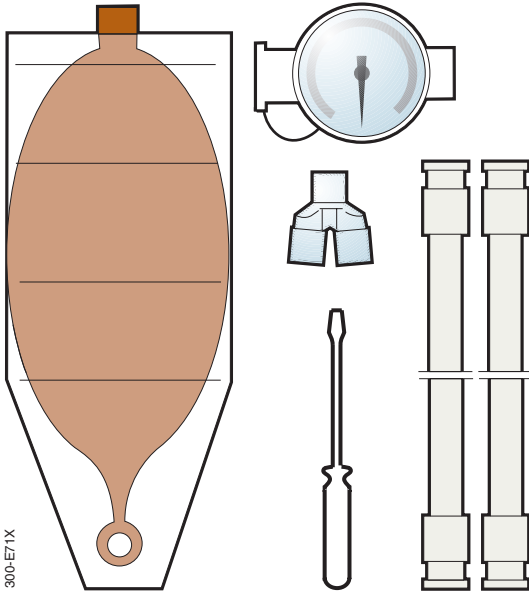
- Note on a log sheet that the O₂ cell has been exchanged.

Contents

Equipment	2
Use of touch pads	3
Trimmer location	4
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Settings for calibration	5
Balancing of pressure transducers	6
Balancing of expiratory flow transducer	7
Leakage test, patient unit	7
Pressure calibration	10
Check of inspiratory flow	14
O ₂ concentration calibration	18
Leakage test of patient tubes and test lung	19
Expiratory flow calibration	20
Log sheet	22

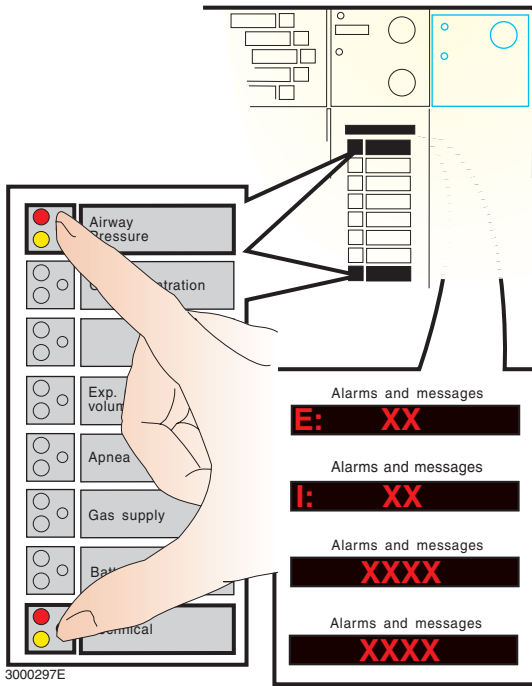
The maximum time interval between calibrations is 3000 hours of operation. If any malfunction is detected during the calibration procedure, the ventilator shall not be connected to patient before remedy of malfunction. The malfunction shall be remedied by local technical staff trained by Siemens or a service technician from Siemens. In the Servo Ventilator 300/SV 300A flow measurements and all preset and indicated volumes are referenced to standard pressure (1013 mbar, 760 mm Hg).

For those who do not have access to tubings and other accessories for adults a Neonatal kit, P/N 64 06 487 E380E, is available. The kit includes an alternative Operating Manual with Pre-use check, Calibration and Function check adapted for neonatal use.



Equipment

- Calibration manometer.
- Screwdriver.
- 2 patient tubes, adult.
- Y-piece.
- Test lung. Only a Siemens test lung shall be used.
- Gas supply: Air and oxygen.



Use of touchpads

To get information on the “Alarms and messages” display during calibration, use the touchpads as follows:

Put fingers **simultaneously** on the “Airway pressure” and “Technical” touchpads.

E: display mode

First touch gives the E: display mode where the pressure at the expiratory pressure transducer is shown.

I: display mode

Second touch gives the I: display mode where the pressure at the inspiratory pressure transducer is shown.

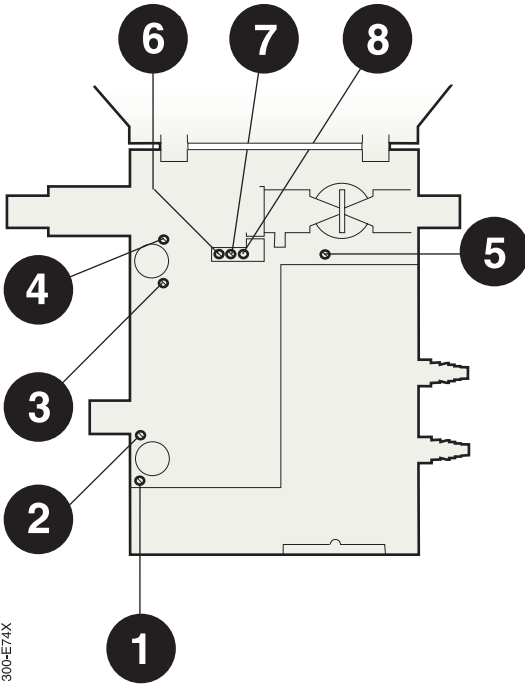
Barometer display mode

Third touch gives the Barometer display mode where the internally measured barometric pressure in mbar or mm Hg is shown.

Selection of the displayed unit (mbar or mm Hg) is described in the Service Manual, chapter Adjustments.

Normal display mode

Fourth touch brings back normal display mode. Normal display mode will also automatically be back after one minute.



300-E74X

Trimmer location

1. Inspiratory pressure transducer, zero ($P_{insp} \rightarrow \text{O}$).
2. Inspiratory pressure transducer, gain ($P_{insp} \nearrow$).
3. Expiratory pressure transducer, gain ($P_{exp} \nearrow$).
4. Expiratory pressure transducer, zero ($P_{exp} \rightarrow \text{O}$).
5. O_2 % gain, ($O_2 \% \nearrow$).
6. Expiratory flow transducer, gain ($V_{exp} \nearrow$).
7. Expiratory flow transducer balance, ($V_{exp} \odot$).
8. Light emitting diode.

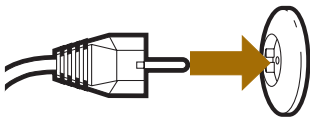
Each trimmer is protected by a plastic cover. Lift the cover to get access to the trimmer.

Preparations

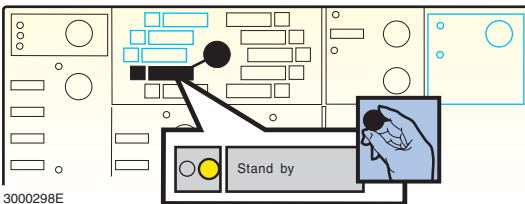
- Connect the ventilator to mains.

Note! Do not connect patient tubes or gas supply to the ventilator.

- Set the mode selector to “Stand by” and allow at least 15 minutes for warming up.
- Open the lid on the patient unit.




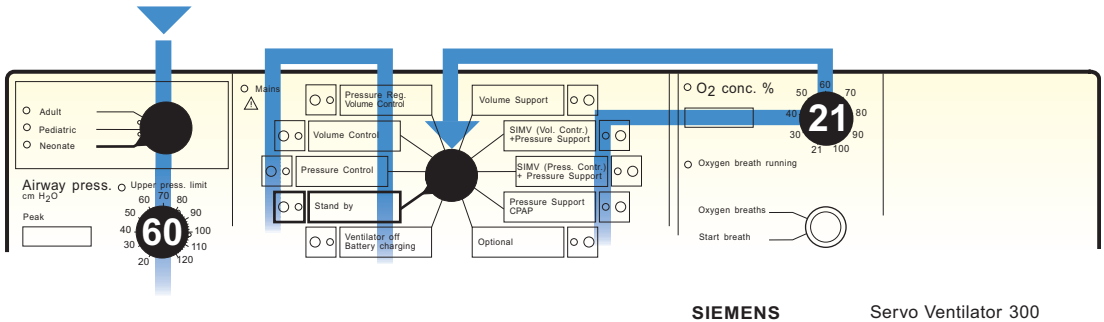
300-D51X



3000298E

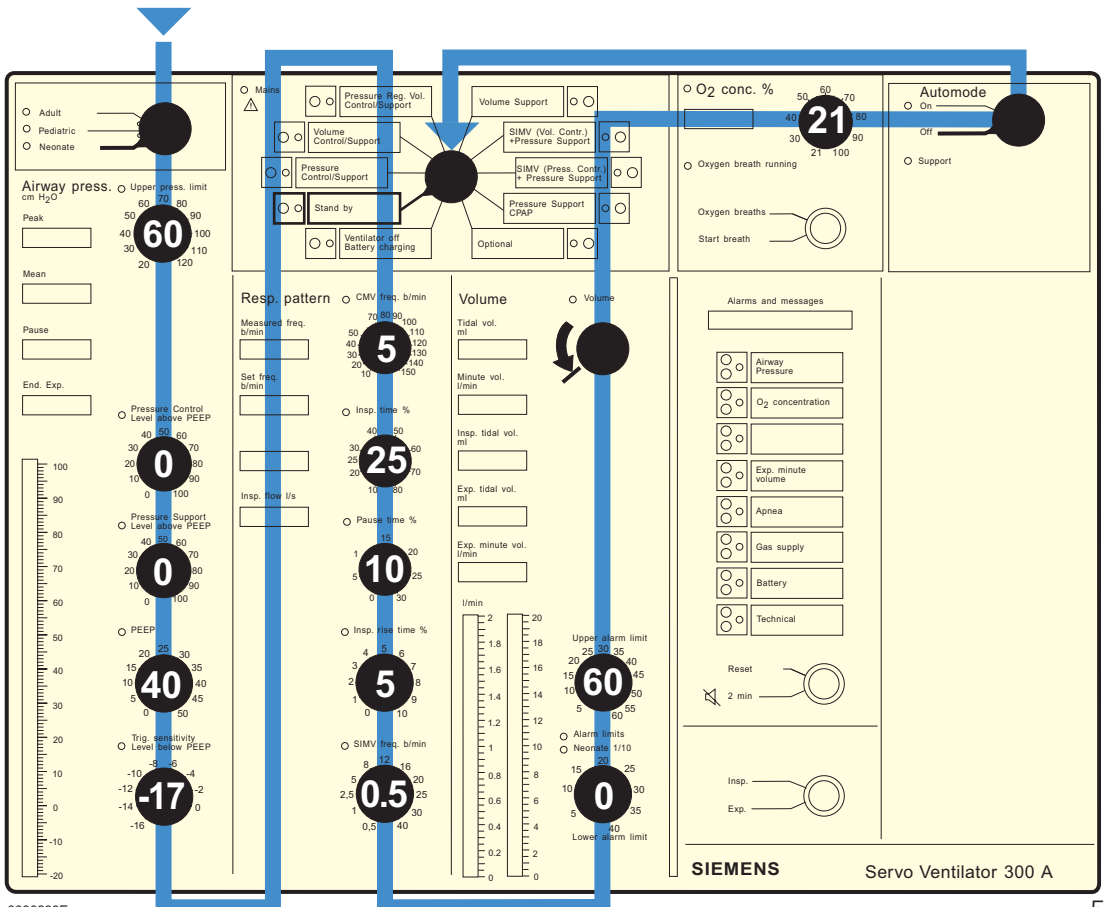
Settings for calibration

- Set the front panel controls as shown.
- Alarms activated during calibration can be muted with the “ 2 min” control.



SIEMENS

Servo Ventilator 300

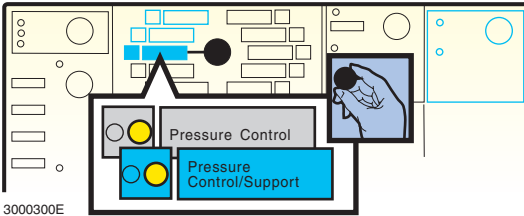


SIEMENS

Servo Ventilator 300 A

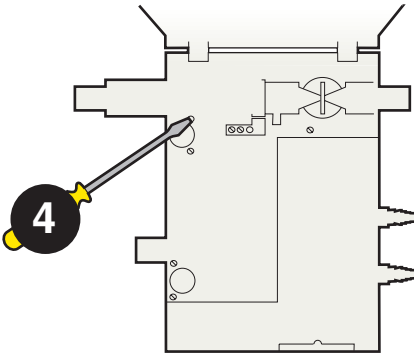
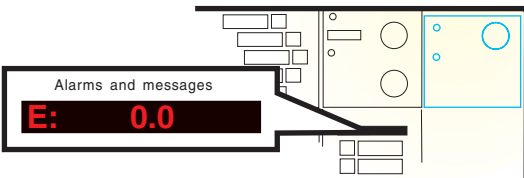
Balancing of pressure transducers

- Set to "Pressure Control" mode.



Expiratory pressure

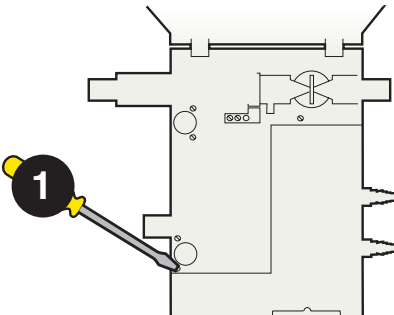
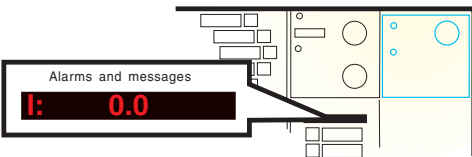
- Use the touchpads to get into E: display mode.
- Check that the display "Alarms and messages" shows E: 0.0 ±0.1 cm H₂O
- If not, adjust trimmer 4 (P_{exp} → ⊕ ←) to correct reading.



3000301E

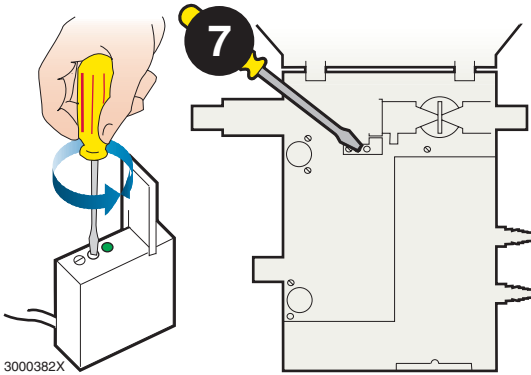
Inspiratory pressure


- Use the touchpads to get into I: display mode.
- Check that the display "Alarms and messages" shows I: 0.0 ±0.1 cm H₂O.
- If not, adjust trimmer 1 (P_{insp} → ⊕ ←) to correct reading.



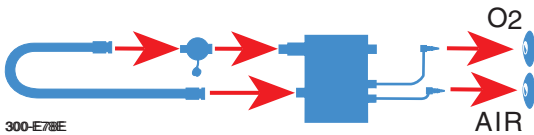
3000302E

Balancing of expiratory flow transducer

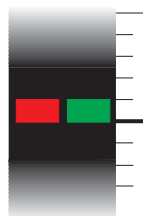


- Open the lid on the expiratory flow amplifier.
- Check that the green diode is lit.
- If not, adjust trimmer 7 (V_{exp} ) until the diode is lit.

Leakage test, patient unit

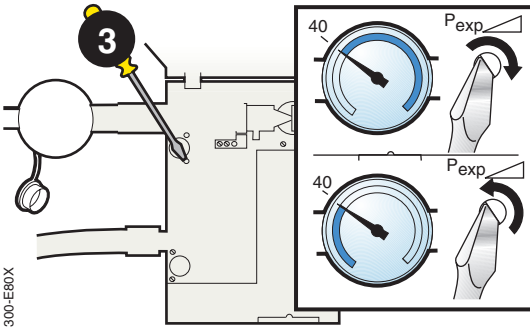


- Connect gas supply (air and O_2). The safety valve will close when gas supply is connected.
- Connect the calibration manometer to the expiratory inlet and connect the inspiratory outlet and the calibration manometer with a patient tube.





- If the left and right diode, showing the actual pressure on the "Airway press." bargraph, differ less than 5 cm H_2O from each other, go directly to page 9.

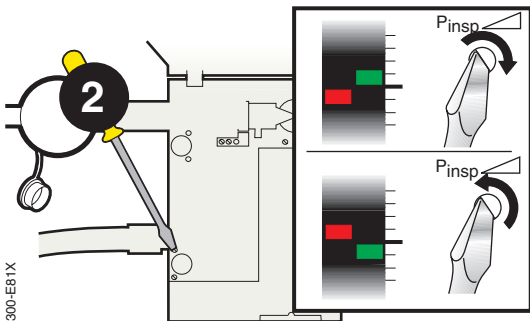
Calibration





300-E80X

If not, the following preliminary calibrations must be made (normally, this will not be necessary):

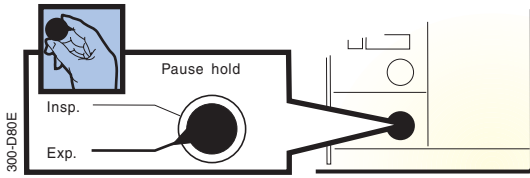
- Check the calibration manometer reading.
- If the **calibration manometer** continuously shows:
 - a value **higher** than 40, adjust trimmer 3 (P_{exp} ) clockwise
 - a value **lower** than 40, adjust trimmer 3 (P_{exp} ) counter-clockwise.



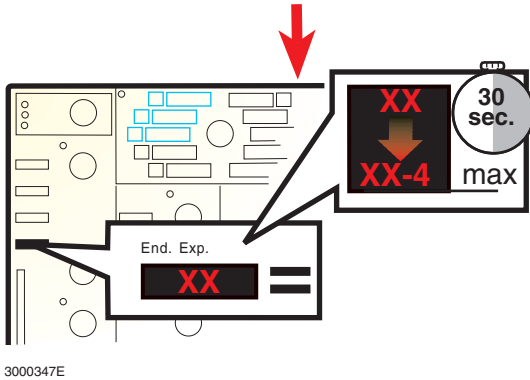
300-E81X

- If the **left diode** on the “Airway press.” bargraph (actual insp. pressure) shows:
 - a **lower** value than the right (actual exp. pressure), adjust trimmer 2 (P_{insp} ) clockwise
 - a **higher** value than the right (actual exp. pressure), adjust trimmer 2 (P_{insp} ) counter-clockwise.

Calibration

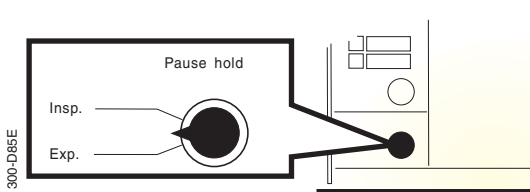


- Keep "Pause hold" at "Exp." and make sure:



- the reading on the display "End exp." does not fall more than 4 cm H₂O during the expiratory pause hold time (30 seconds).

Note! The reading may drop to zero for about 2 seconds due to apnea alarm activation.



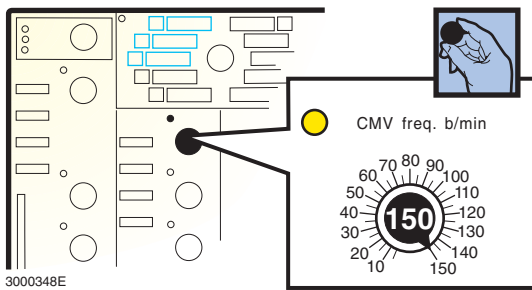
- Release "Pause hold".

Pressure calibration

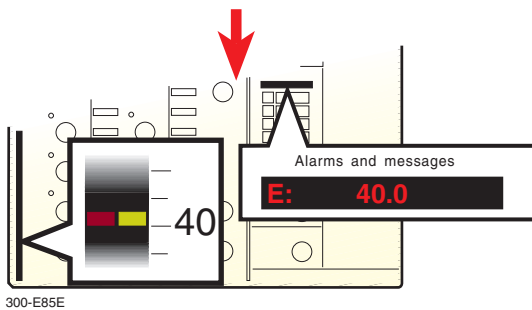
Expiratory pressure



- Connect patient tubes, Y-piece and test lung.

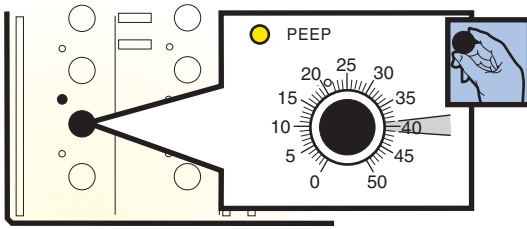


- Set "CMV freq. b/min" to 150 b/min.



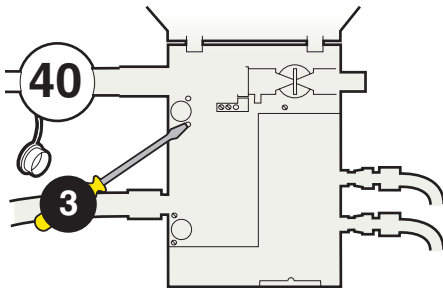
- Make sure:
 - the display "Alarms and messages" shows 40.0 ± 0.5 cm H₂O in E: display mode.
 - the right diode (actual exp. pressure) on the "Airway press." bargraph shows 40 cm H₂O.

Calibration



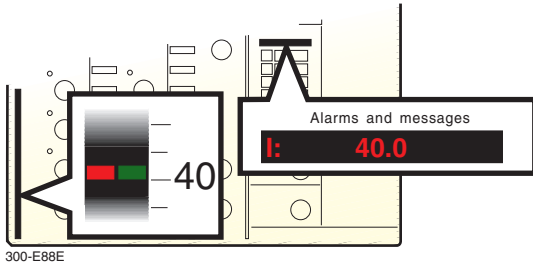
300-E86E

- If not, adjust to correct reading with "PEEP".



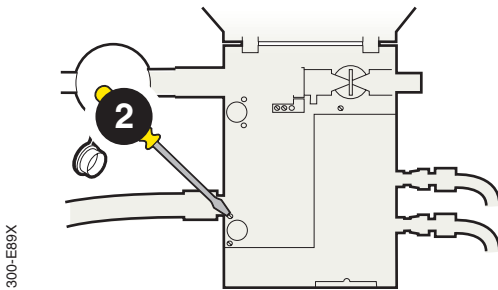
300-E87X

- Make sure the calibration manometer shows 40 cm H₂O.
- If not, adjust trimmer 3 (P_{exp}) to correct reading.



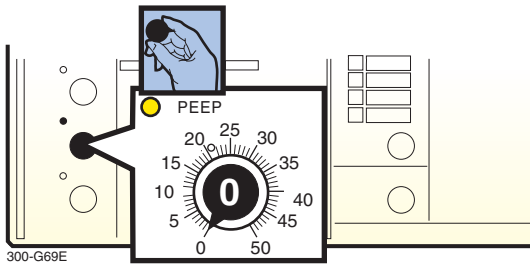
Inspiratory pressure

- Make sure:
 - the display “Alarms and messages” shows 40.0 ± 0.5 cm H₂O in I: display mode.
 - the left diode (actual insp. pressure) on the “Airway press.” bargraph shows 40 cm H₂O.

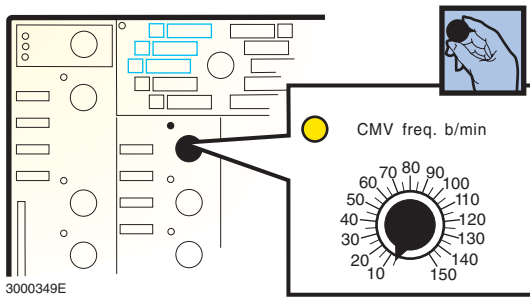


- If not, adjust trimmer 2 (P_{insp}) to correct reading.

Calibration



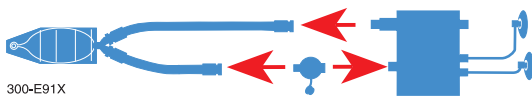
- Set "PEEP" to 0 cm H₂O.



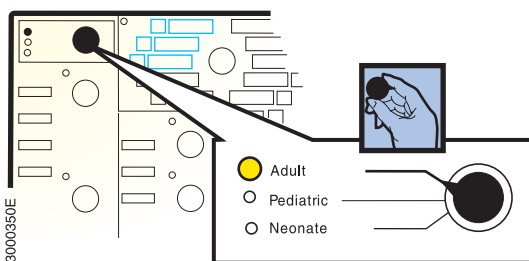
- Set "CMV freq. b/min" to minimum.

Check of inspiratory flow

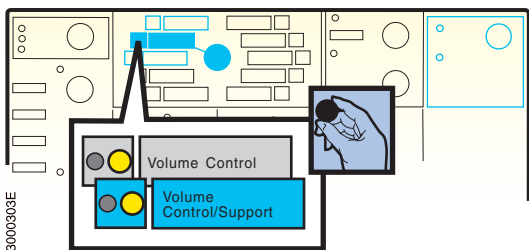
Air flow



- Remove the patient tubes and test lung and move the calibration manometer to the inspiratory outlet.

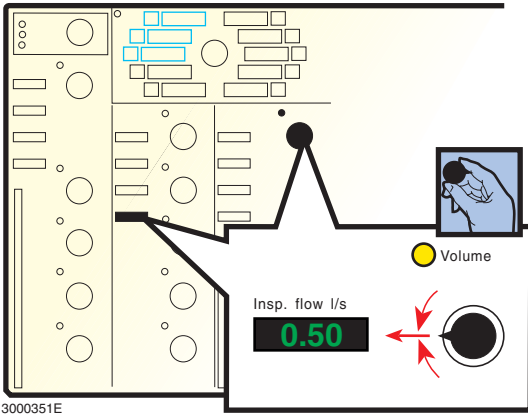


- Set the patient range selector to "Adult".



- Set to "Volume Control" mode.

Calibration

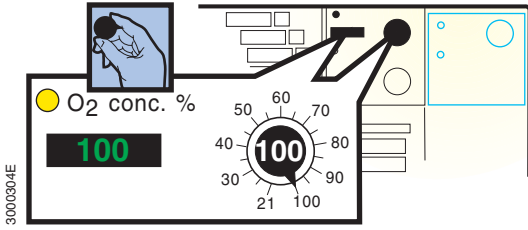


- Adjust “Volume” until the display “Insp. flow l/s” shows 0.50 l/s.

Barometric pressure		Calibration manometer reading
mbar	mm Hg	cm H ₂ O
700	525	65
720	540	64
740	555	62
760	570	60
780	585	59
800	600	57
820	615	56
840	630	54
860	645	53
880	660	52
900	675	51
920	690	50
940	705	49
960	720	48
980	735	47
1000	750	46
1013	760	45
1020	765	45
1040	780	44
1060	795	43
1080	810	42
1100	825	42

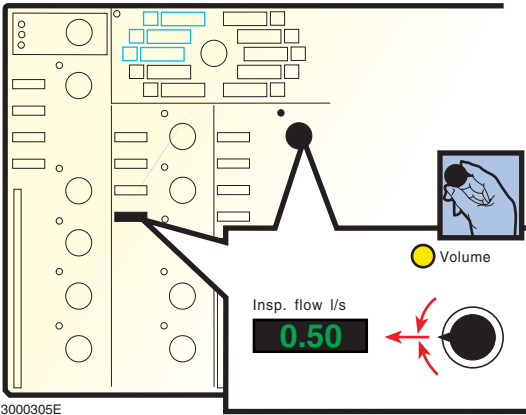
- Use the touchpads to get into Barometer mode.
- Read the barometric pressure on the “Alarms and messages” display.
- In the table find the **Barometric pressure** value closest to the displayed value.
- Wait 6 - 8 breaths.
- During inspiration, check that the calibration manometer reading is equal to the **Calibration manometer reading** value in the table ± 5 cm H₂O.

Calibration



O₂ flow

- Set "O₂ conc. %" to 100%.

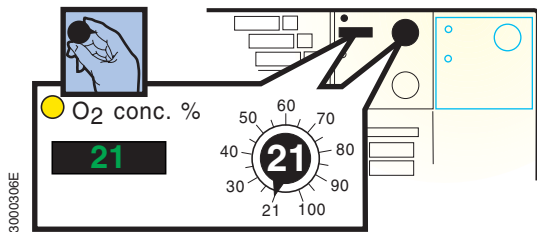


- Make sure the display "Insp. flow l/s" still shows 0.50 l/s. If not, adjust "Volume" to correct reading.

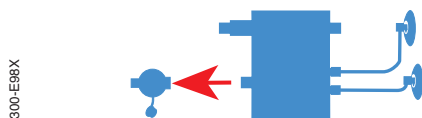
Barometric pressure		Calibration manometer reading
mbar	mm Hg	cm H ₂ O
700	525	73
720	540	71
740	555	69
760	570	67
780	585	66
800	600	64
820	615	62
840	630	61
860	645	60
880	660	58
900	675	57
920	690	56
940	705	55
960	720	53
980	735	52
1000	750	51
1013	760	51
1020	765	50
1040	780	49
1060	795	48
1080	810	47
1100	825	47

- Use the touchpads to get into Barometer mode.
- Read the barometric pressure on the "Alarms and messages" display.
- In the table find the **Barometric pressure** value closest to the displayed value.
- Wait 6 - 8 breaths.
- During inspiration, check that the calibration manometer reading is equal to the **Calibration manometer reading** value in the table ± 5 cm H₂O.

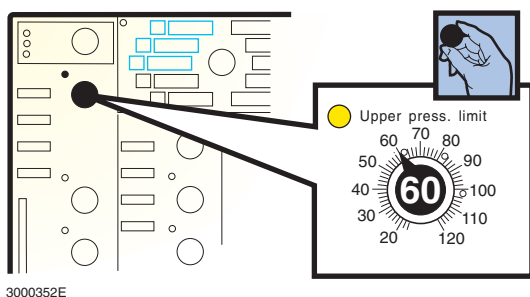
Calibration



- Set "O₂ conc.%" to 21%.




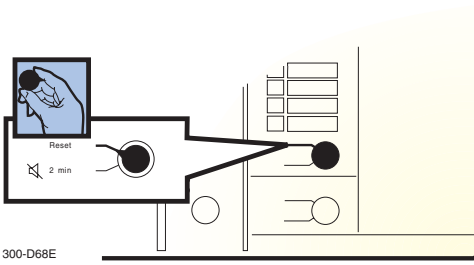
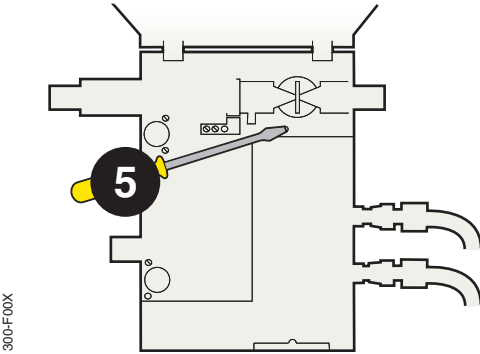
- Remove the calibration manometer.



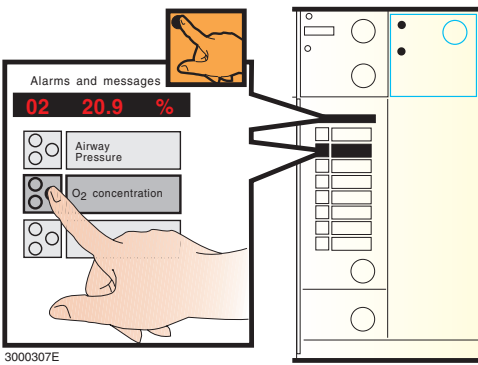
- Make sure "Upper press. limit" is set to 60 cm H₂O.

O₂ concentration calibration

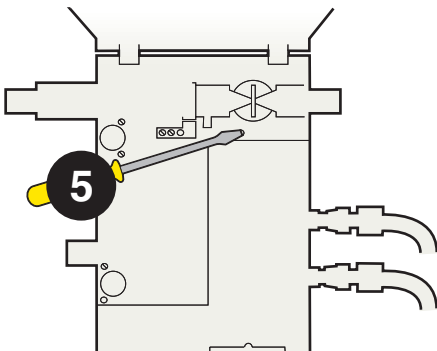
- If O₂ concentration alarm is active, turn trimmer 5 (O₂ % ) until the alarm stops.



- Reset the alarm.



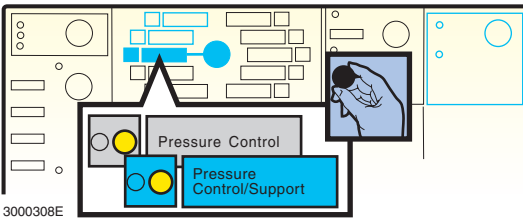
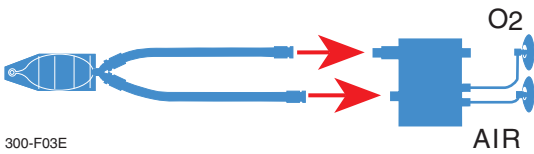
- Touch the "O₂ concentration" touchpad and check that the display "Alarms and messages" shows 20.9 ±0.1%.



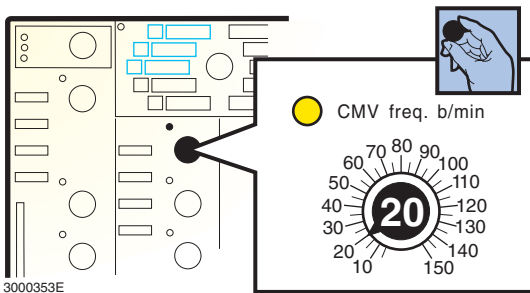
- If not, adjust with trimmer 5 (O₂ % )

Leakage test of patient tubes and test lung

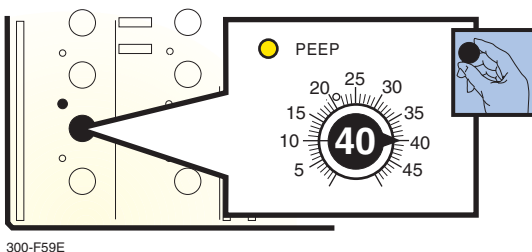
- Connect patient tubes, Y-piece and test lung.



- Set to "Pressure Control" mode.

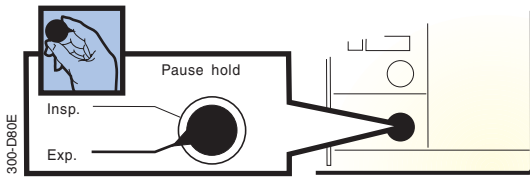


- Set "CMV freq. b/min" to 20 b/min.



- Set "PEEP" to 40 cm H₂O.

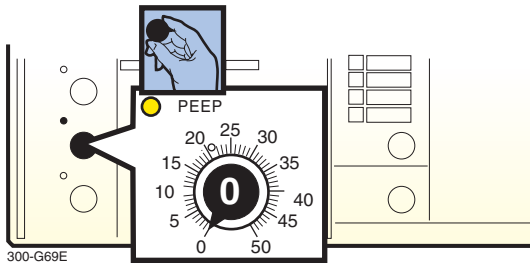
Calibration



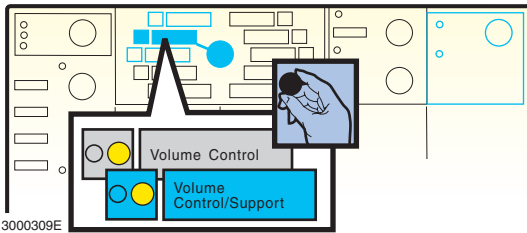
- Keep "Pause hold" at "Exp." and make sure:
 - the reading on the display "End exp." does not fall more than 10 cm H₂O during the expiratory pause hold time (30 sec).

In case of leakage, exchange the patient tubes/test lung before continuing the calibration.

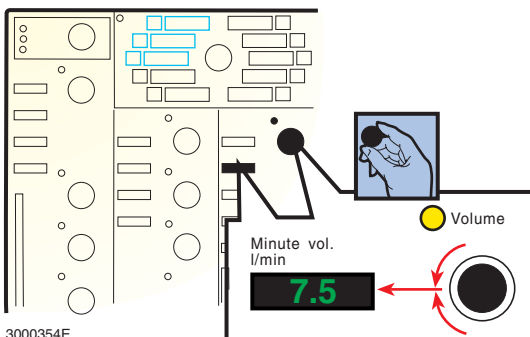
Expiratory flow calibration



- Set "PEEP" to 0 cm H₂O.

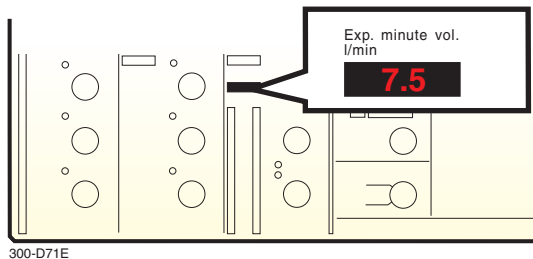


- Set to "Volume Control" mode.

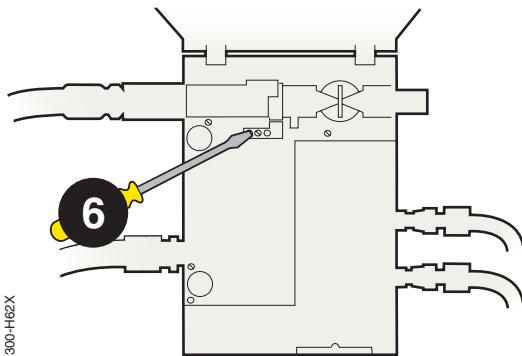


- Adjust "Volume" until the green display "Minute vol. l/min" shows 7.5 l/min.

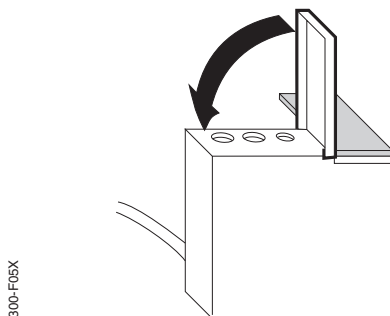
Calibration



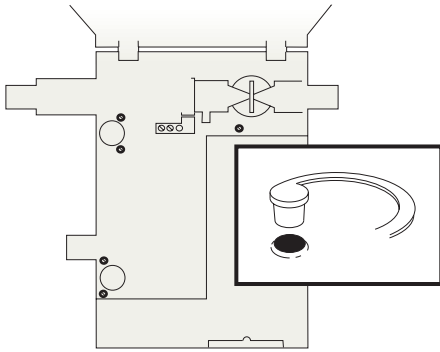
- Wait a few breaths, then check that the red display “Exp. minute vol. l/min” shows 7.5 ± 0.1 l/min.



- If not, adjust trimmer 6 (V_{exp}) to correct reading.



- Close the lid on the flow amplifier.



- Make sure all plastic covers over trimmers are closed.
- Check the ventilator as described in chapter Function check.

Log sheet

- Note on a log sheet that a calibration has been performed.

Contents

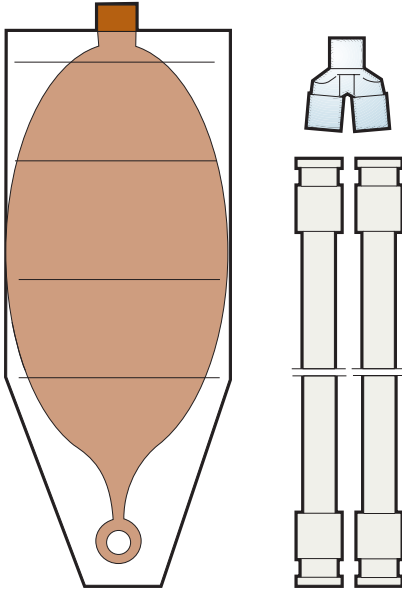
Equipment	2
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A complete function check must be done after cleaning and after calibration (before the ventilator is connected to a patient). If any malfunctions are detected during the function check, the ventilator must not be connected to patient before remedy of malfunction. The malfunction must be remedied by local technical staff trained by MAQUET or a service technician from MAQUET.

For those who do not have access to tubings and other accessories for adults a Neonatal kit, P/N 64 06 487 E380E, is available. The kit includes an alternative Operating Manual with Pre-use check, Calibration and Function check adapted for neonatal use.

Equipment

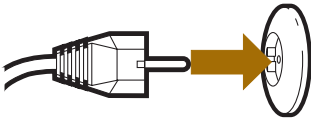
- 2 patient tubes.
- Y-piece.
- Test lung. Only a MAQUET test lung shall be used.
- Gas supply: Air and O₂.



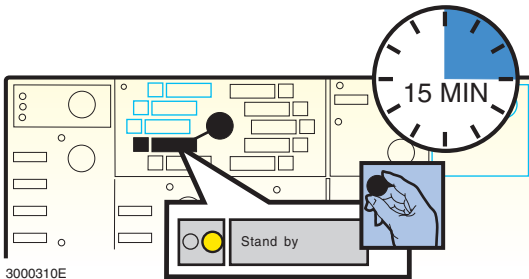
Preparations

- Connect the ventilator to mains.

300-D51X

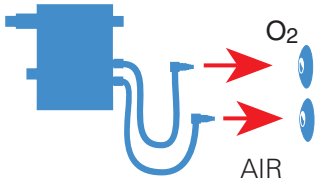


- Set the mode selector to "Stand by". Allow a warm-up period of at least 15 minutes.



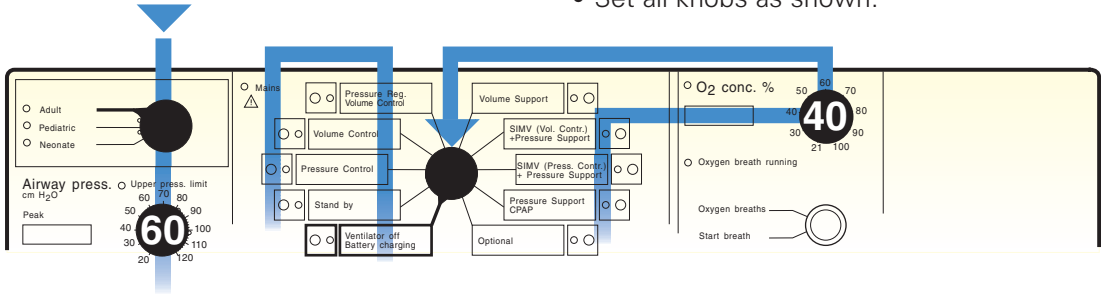
Function check

300-F22E



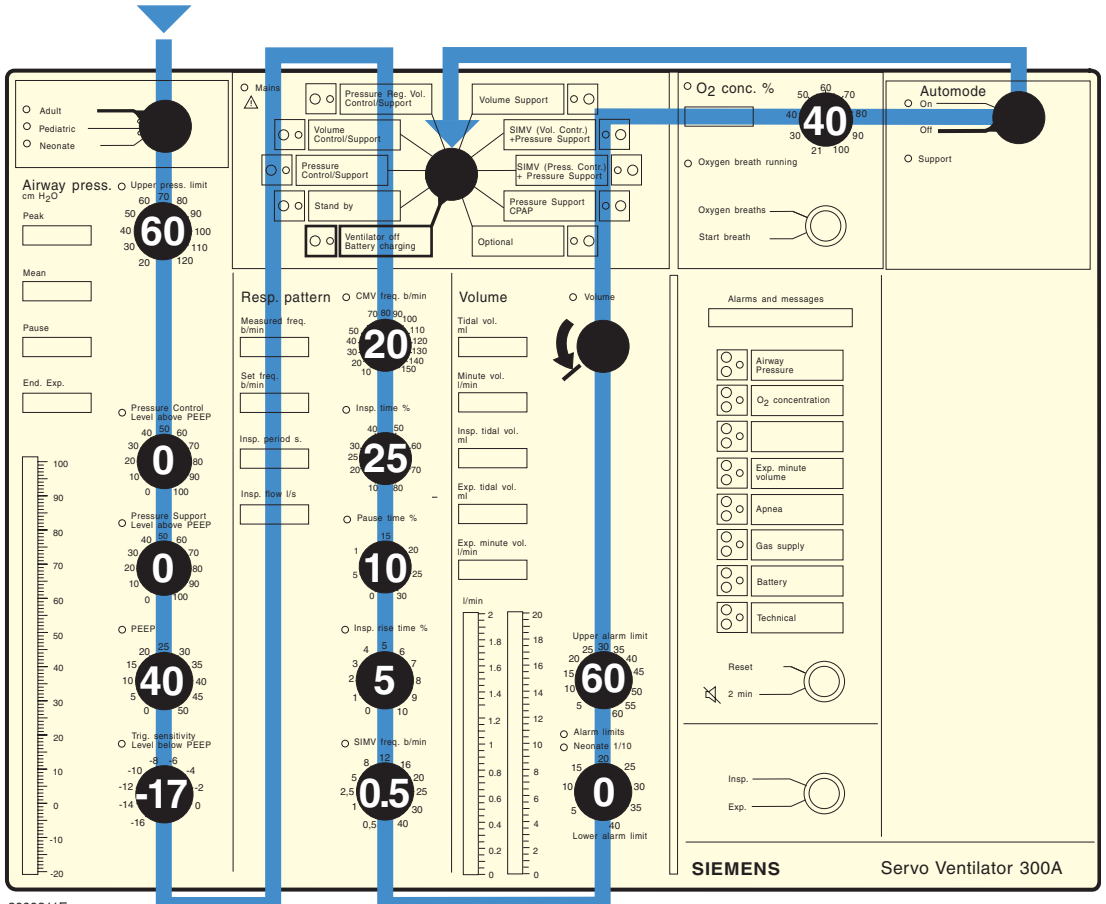
- Connect gases.

- Open the lid on the patient unit.
- Set all knobs as shown.



SIEMENS

Servo Ventilator 300



SIEMENS

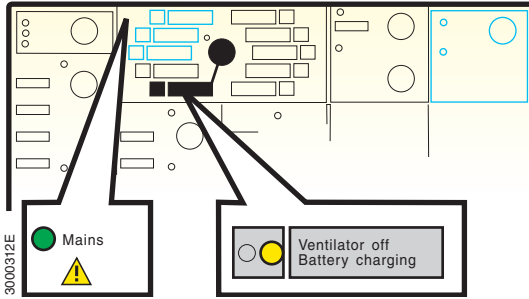
Servo Ventilator 300A

3000311E

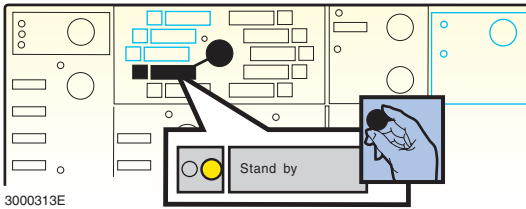
Function check

1. Start up

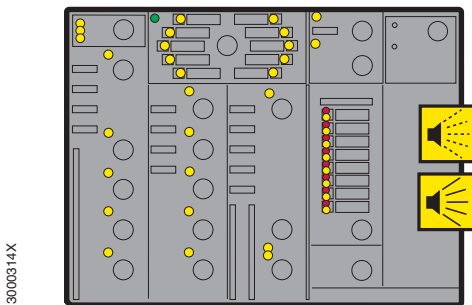
- Make sure the yellow light at “Ventilator off Battery charging” and the green light “Mains” are lit.



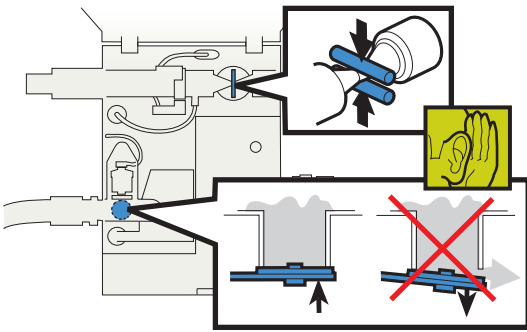
- Set the mode selector to “Stand by” and make sure:



- the **back-up alarm** (intermittent signals) is heard.
- all yellow lights are lit for a few seconds.
- all yellow and red lights in the “Alarms and messages” section stay lit during an additional moment.
- the caution signal is heard.



Function check



Alarms and messages

STAND BY

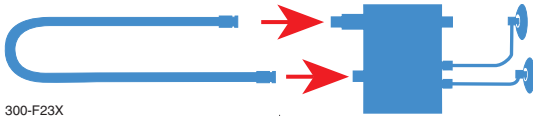
300-D56E

- the expiratory valve closes.
- the safety valve closes with a distinct click.
- the "Alarms and messages" display shows STAND BY.

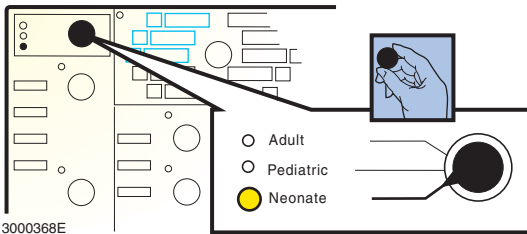
These checks can be done separately by repeated switching between "Ventilator off Battery charging" and "Stand by".

2. Leakage test

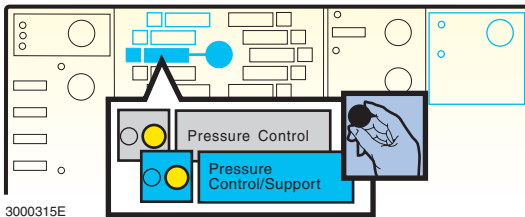
Test for leakage and pressure transducer integrity



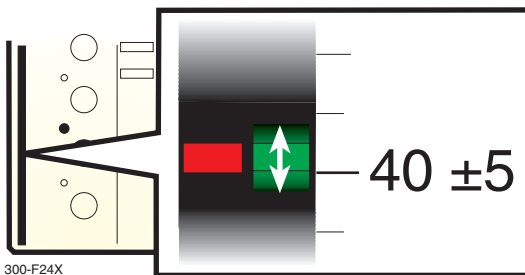
- Connect a patient tube between the inspiratory outlet and the expiratory inlet.



- Set the patient range selector to "Neonate".

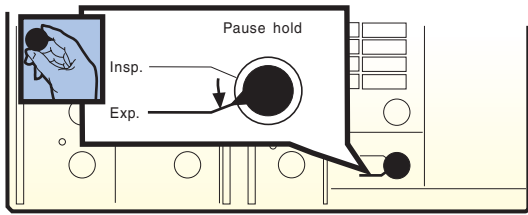


- Set to "Pressure Control" mode.



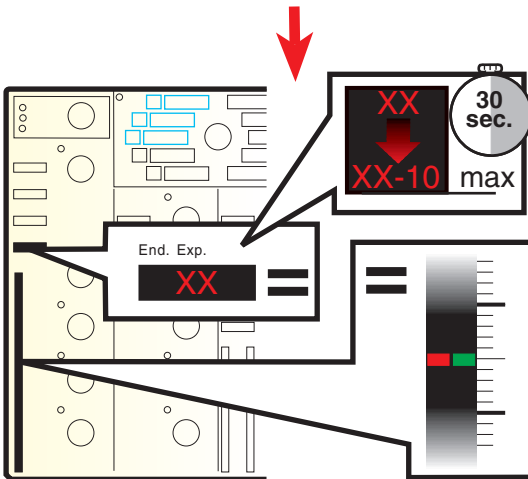
- Make sure:
 - the diodes showing the actual pressure on the "Airway press." bargraph show the same value ± 5 cm H₂O. If not, see chapter Calibration. **Note:** The diodes can be hidden behind the diodes showing the set PEEP level.

Function check



300-D59E

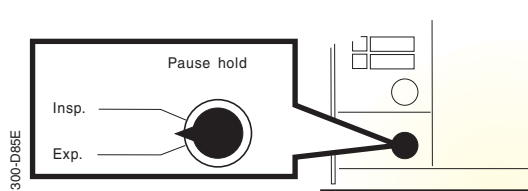
- Keep "Pause hold" at "Exp." and make sure:



3000356E

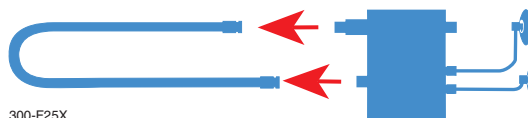
- the "End exp." display reading does not drop more than 10 cm H₂O during the exp. pause hold time (30 seconds).
- the diodes showing the actual pressure on the "Airway press." bargraph show the same value ±5 cm H₂O. If not, see chapter calibration. **Note:** The diodes can be hidden behind the diodes showing the set PEEP level.

In case of leakage, check all connections in the ventilator.



300-D88E

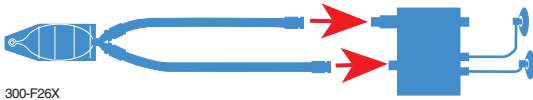
- Release "Pause hold".



300-F25X

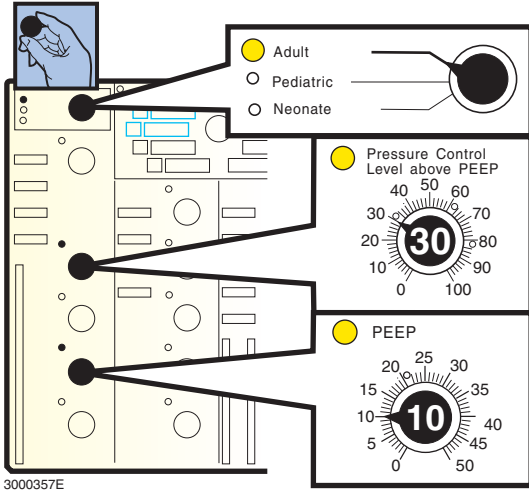
- Remove the patient tube.

3. Pressure levels



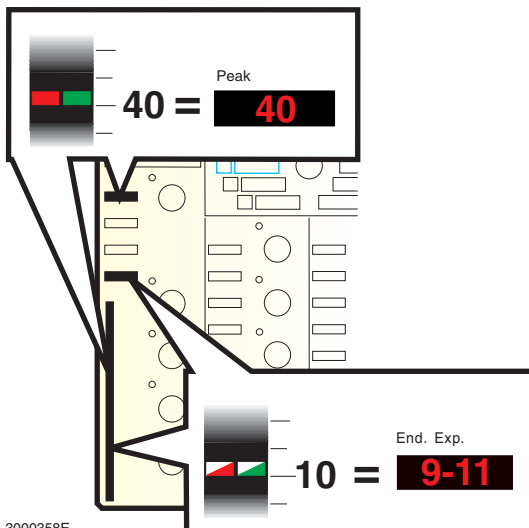
300-F26X

- Connect patient tubes, Y-piece and test lung.



3000357E

- Set the patient range selector to "Adult".
- Set "Pressure Control Level above PEEP" to 30 cm H₂O.
- Set "PEEP" to 10 cm H₂O.

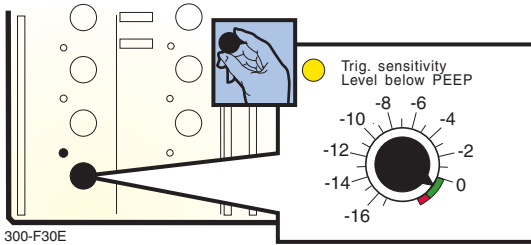


3000358E

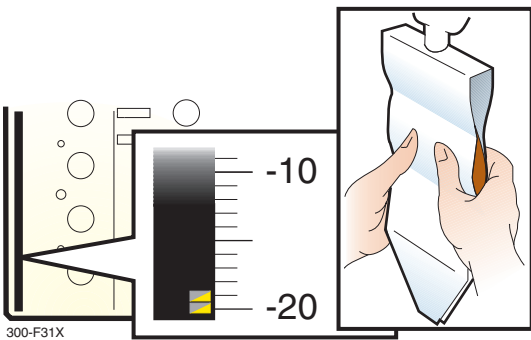
- Make sure the pressure indication on the "Airway press." bargraph equals the display "Peak" reading at the end of inspiration. The value must be in the range 38 – 42 cm H₂O.
- Make sure the pressure indication on the "Airway press." bargraph equals the display "End exp." reading at the end of expiration. The value must be in the range 9 – 11 cm H₂O.

4. Trigger function

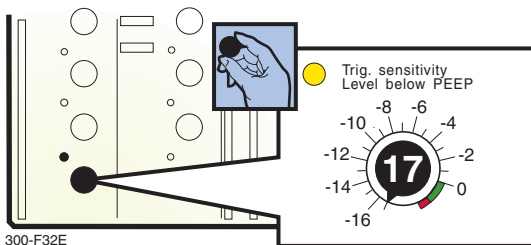
- Set "Trig. sensitivity Level below PEEP" in the green range.



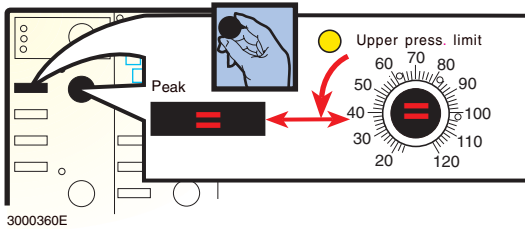
- Toward the end of expiration, quickly compress and release the test lung and make sure:
 - two yellow diodes at the lower right end of the "Airway press." bargraph flash once.
 - a breath is initiated.



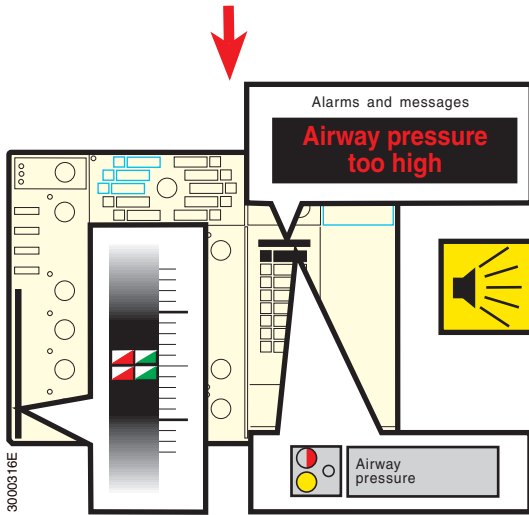
- Set "Trig. sensitivity Level below PEEP" to -17 cm H₂O.



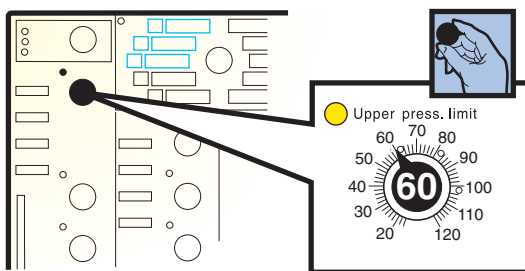
5. Upper pressure limit alarm



- Turn “Upper press. limit” **slowly** counter-clockwise and make sure upper pressure limit alarm is activated when “Upper press. limit” and the display “Peak” show the same value ± 2 cm H₂O.

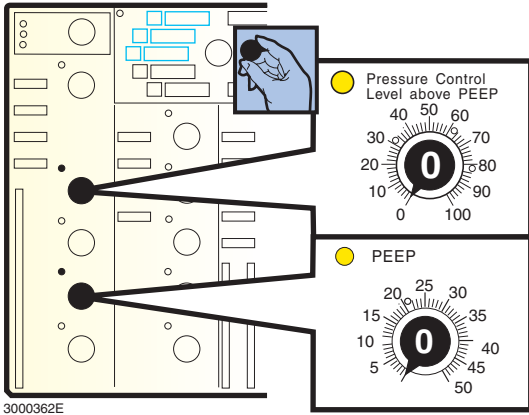


- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the inspiration stops and expiration starts.
 - the red light at “Airway pressure” in the alarm section lights up each time the alarm is activated.
 - the yellow light at “Airway pressure” is lit at the end of each alarm activation (when the red light at “Airway pressure” goes out).
 - the “Alarms and messages” display shows **Airway pressure too high**.
 - the upper pressure limit indication on the bargraph flashes.
 - the safety valve does not open. (If it opens, a distinct sound is heard and the PEEP-level drops to zero.)

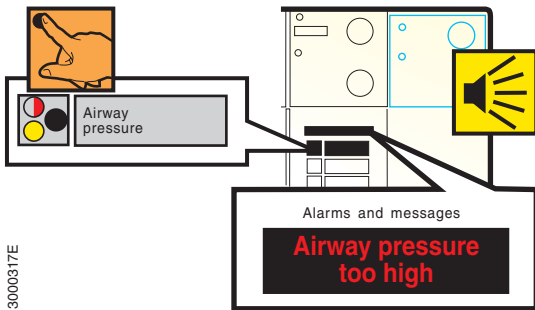


- Set “Upper press. limit” to 60 cm H₂O.

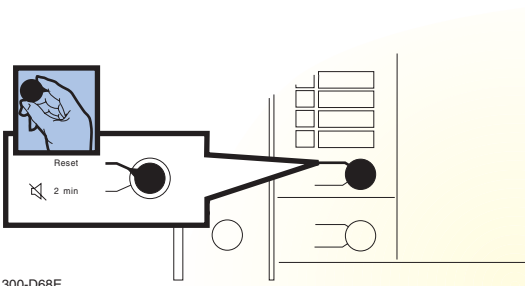
Function check



- Set "Pressure Control Level above PEEP" to 0 cm H₂O.
- Set "PEEP" to 0 cm H₂O.



- Touch the touchpad at "Airway pressure" in the alarm section and make sure the display shows **Airway pressure too high**.



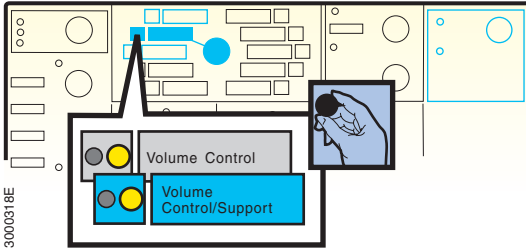
- Reset the alarm.

Important: Proceed with the instructions on the inside of the front cover before continuing the Function check.

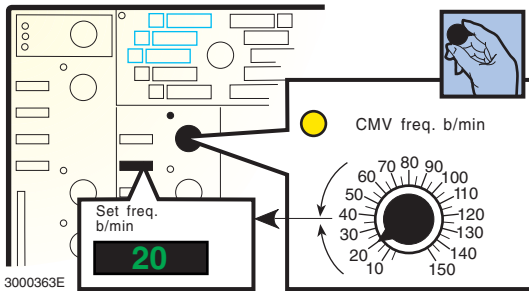
6. Tidal and minute volumes

Test of tidal and minute volumes and flow transducer integrity.

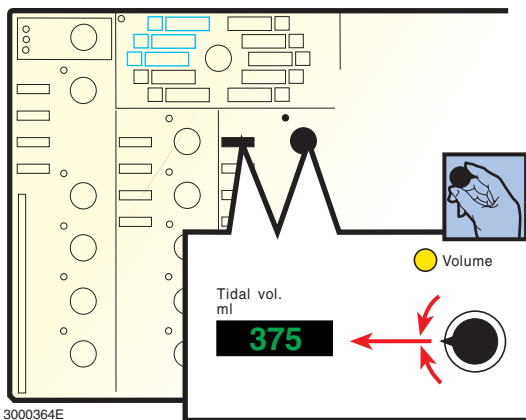
- Set to "Volume Control" mode.



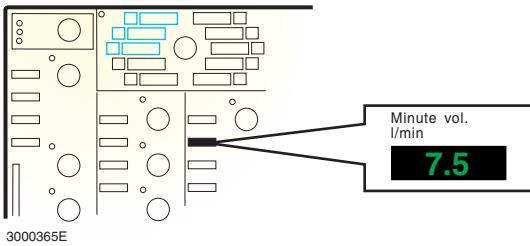
- Adjust "CMV freq. b/min" so that the green display "Set freq. b/min" shows 20 b/min.



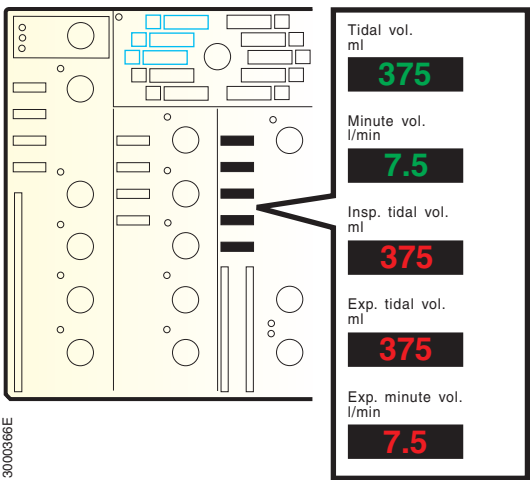
- Adjust "Volume" so that the green display "Tidal vol. ml" shows 375 ml.



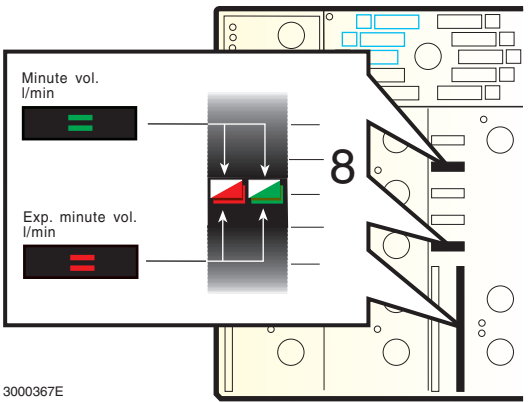
Function check



- Make sure the green display "Minute vol. l/min" shows 7.5 ± 0.2 l/min.



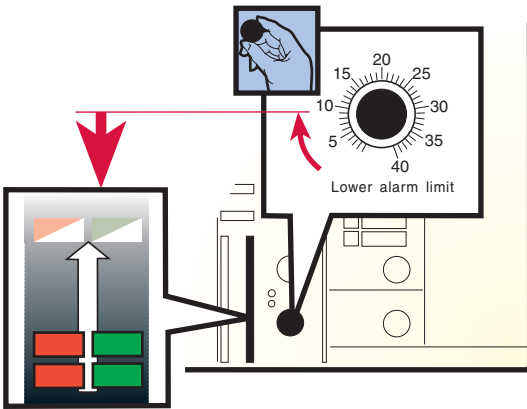
- Wait a few breaths, then make sure:
 - the readings on the red display "Insp. tidal vol. ml" and the green display "Tidal vol. ml" correspond. Accuracy: ± 10 ml.
 - the readings on the red display "Exp. tidal vol. ml" and the green display "Tidal vol. ml" correspond. Accuracy: ± 10 ml.
 - the readings on the red display "Exp. minute vol. l/min" and the green display "Minute vol. l/min" correspond. Accuracy: ± 0.2 l/min.



- Also make sure the minute volume bargraph shows:
 - preset minute volume at the same value as the green display "Minute vol. l/min." Accuracy: ± 0.5 l/min
 - measured minute volume at the same value as the red display "Exp. minute vol. l/min." Accuracy: ± 0.5 l/min.

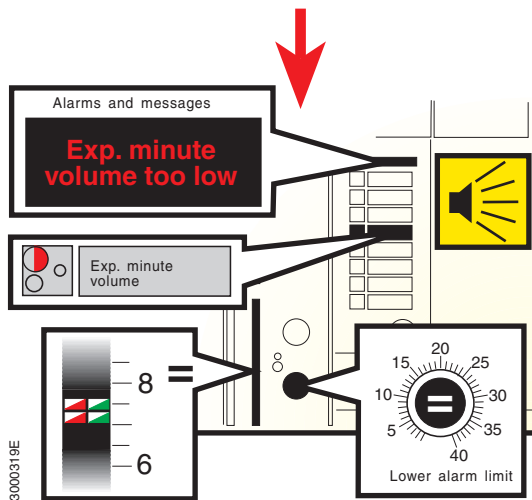
7. Minute volume alarms

Lower alarm limit



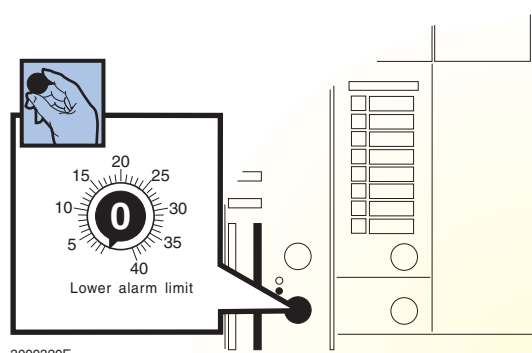
300-D72E

- Turn “Lower alarm limit” slowly clockwise and make sure:
 - the expired minute volume alarm is activated when the lower alarm limit indication passes the measured minute volume indication on the bargraph.



3000319E

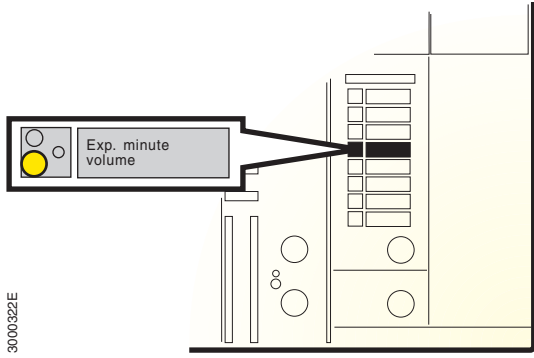
- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the “Alarms and messages” display shows **Exp. minute volume too low**.
 - the red light at “Exp. minute volume” flashes.
 - the lower alarm indication on the bargraph flashes.
 - the lower alarm limit indication on the bargraph corresponds to the “Lower alarm limit” setting. Accuracy: ± 0.5 l/min.



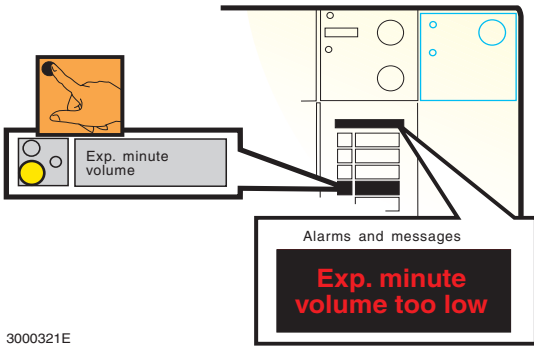
3000320E

- Turn “Lower alarm limit” to 0 l/min.

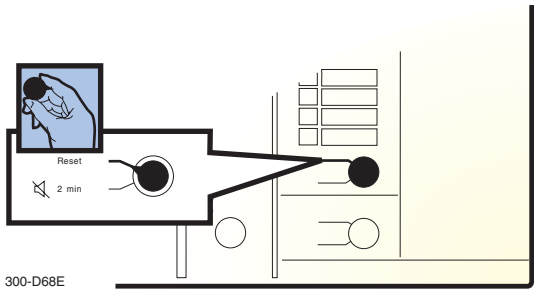
Function check



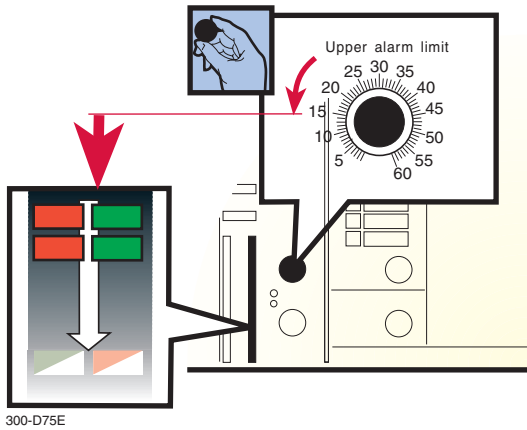
- Make sure the yellow light at "Exp. minute volume" is lit.



- Touch the "Exp. minute volume" touchpad and make sure the display "Alarms and messages" shows **Exp. minute volume too low**.

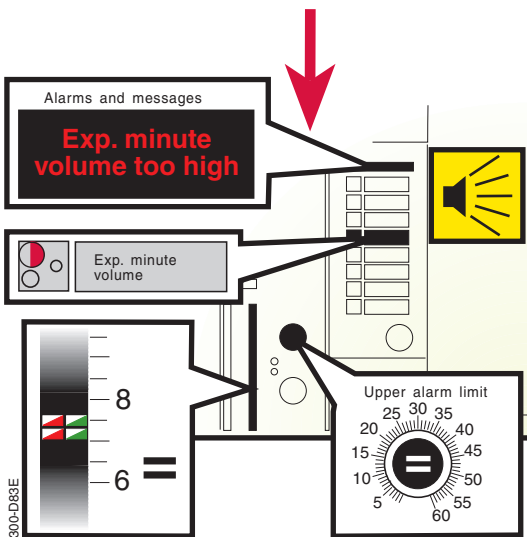


- Reset the alarm.

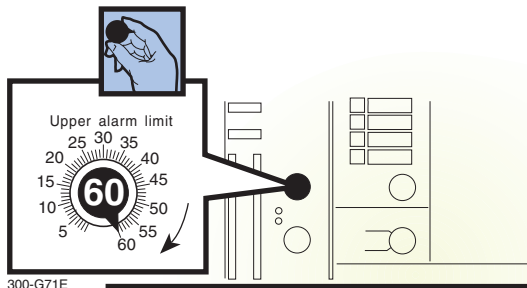


Upper alarm limit

- Turn “Upper alarm limit” slowly counter-clockwise and make sure:
 - the expired minute volume alarm is activated when the upper alarm limit indication passes the measured minute volume indication on the bargraph.

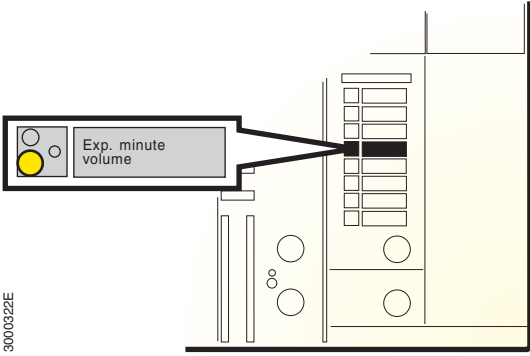


- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the “Alarms and messages” display shows **Exp. minute volume too high**.
 - the red light at “Exp. minute volume” flashes.
 - the upper alarm limit indication on the bargraph flashes.
 - the upper alarm limit indication on the bargraph corresponds to the “Upper alarm limit” setting. Accuracy: ± 0.5 l/min.



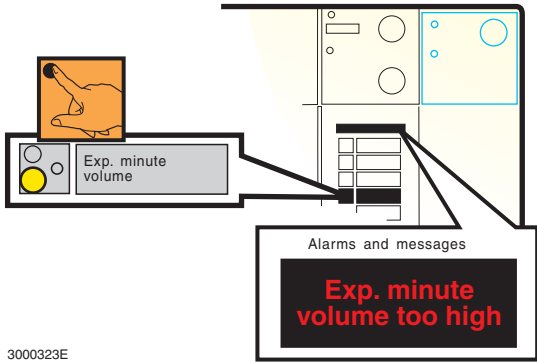
- Turn “Upper alarm limit” to 60 l/min.

Function check



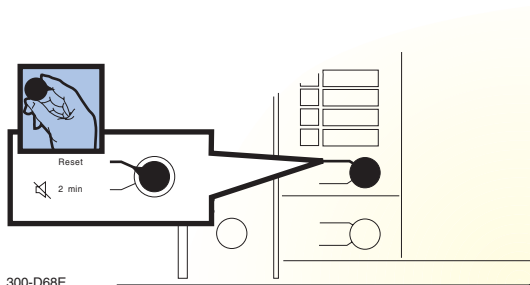
3000322E

- Make sure the yellow light at "Exp. minute volume" is lit.



3000323E

- Touch the "Exp. minute volume" touchpad and make sure the display "Alarms and messages" shows **Exp minute volume too high**.

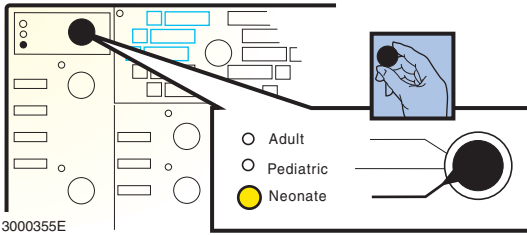


300-D68E

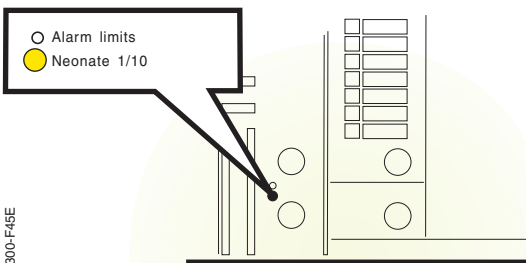
- Reset the alarm.

8. Check of "Neonate" range

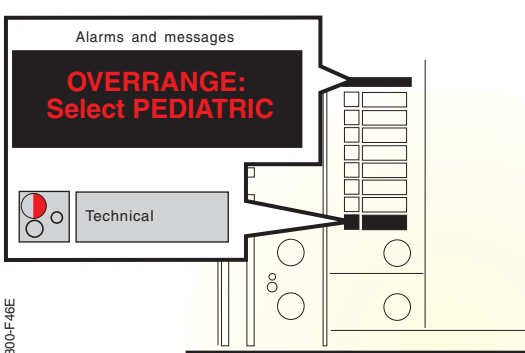
- Set the patient range selector to "Neonate."



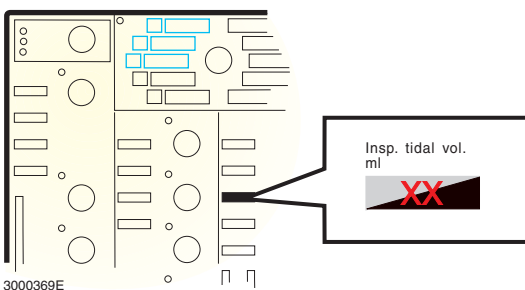
- Make sure:
 - the yellow light "Neonate 1/10" is lit.



- the red light at "Technical" flashes.
- the display "Alarms and messages" shows **Overrange: Select pediatric.**

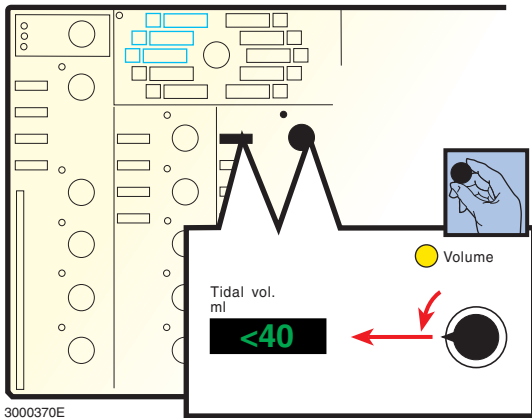


- the red "Insp. tidal vol. ml" display flashes.

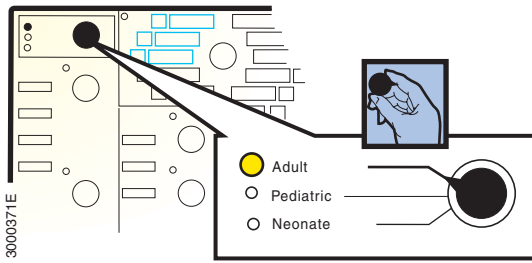


- Check the "Upper alarm limit" and "Lower alarm limit" for expired minute volume as described in section 7.

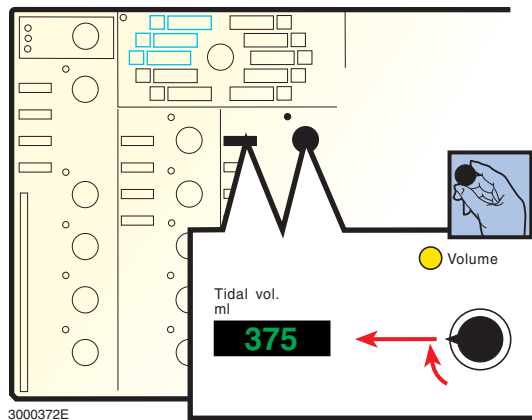
Function check



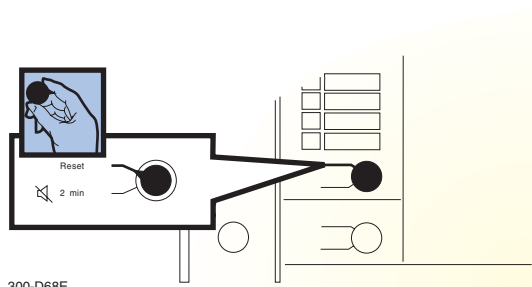
- Turn "Volume" counter-clockwise until the display "Insp. tidal vol. ml" stops flashing. The green display "Tidal vol. ml" reading shall be below 40 ml.



- Set the patient range selector to "Adult."



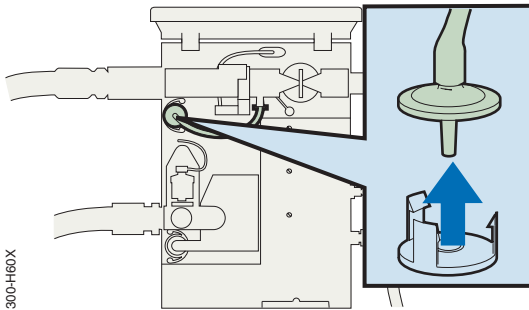
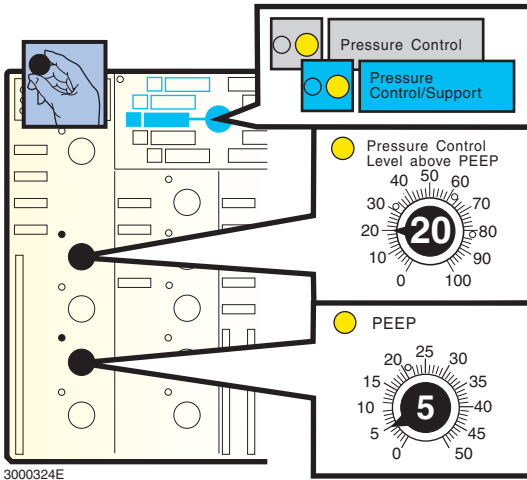
- Set "Volume" so that the display "Tidal vol. ml" shows 375 ml.



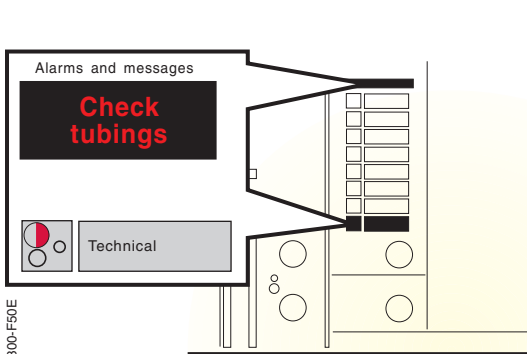
- Reset all alarms.

9. "Check tubings" alarm

- Set to "Pressure Control" mode.
- Set "Pressure Control Level above PEEP" to 20 cm H₂O.
- Set "PEEP" to 5 cm H₂O.

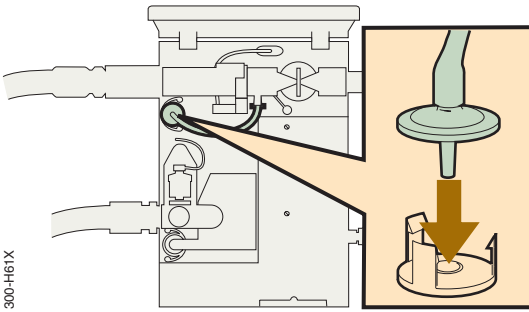


- Loosen the bacteria filter.



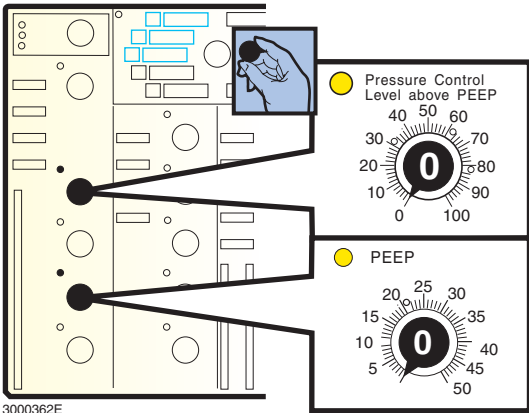
- Make sure:
 - the red light at "Technical" flashes
 - the display "Alarms and messages" shows **Check tubings**.
 - the safety valve opens for approx 5 seconds.

Function check



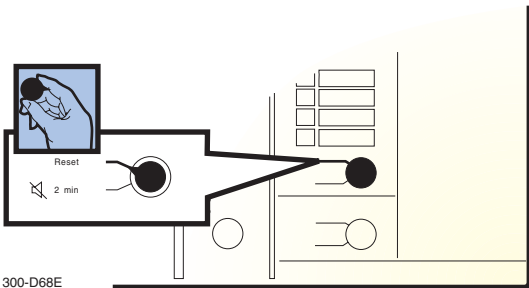
300-H61X

- Reconnect the bacteria filter.



3000362E

- Set "Press. Control Level above PEEP" to 0 cm H₂O.
- Set "PEEP" to 0 cm H₂O.

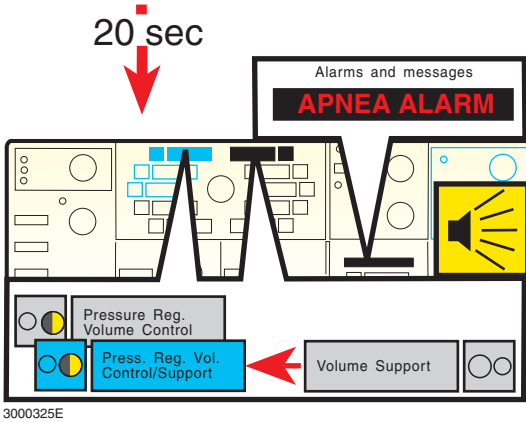
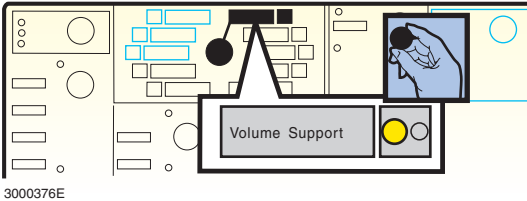


300-D68E

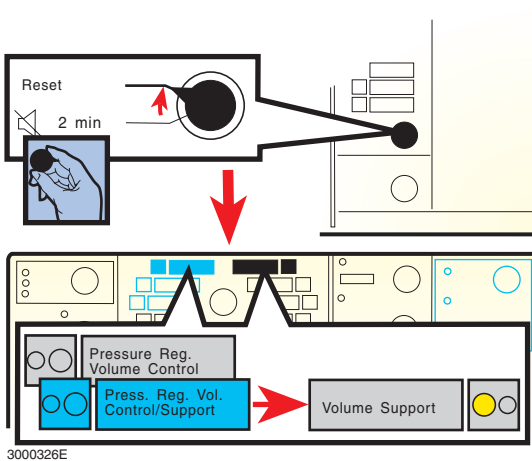
- Reset the alarm.

10. Apnea alarm

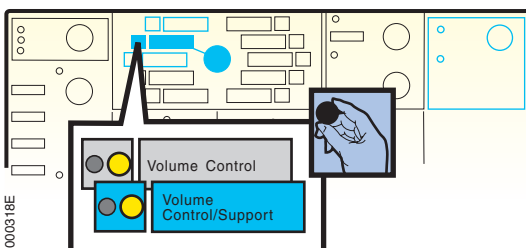
- Set to "Volume Support" mode.



- Wait for 20 seconds and make sure apnea alarm is activated.
- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the "Alarms and messages" display shows **Apnea alarm**.
 - the ventilator changes from "Volume Support" to "Pressure Reg. Volume Control" mode (indicated by flashing yellow light at "Pressure Reg. Volume Control").



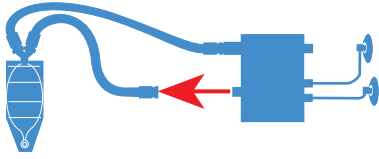
- Reset the alarm and make sure:
 - the ventilator switches back from "Pressure Reg. Volume Control" to "Volume Support."



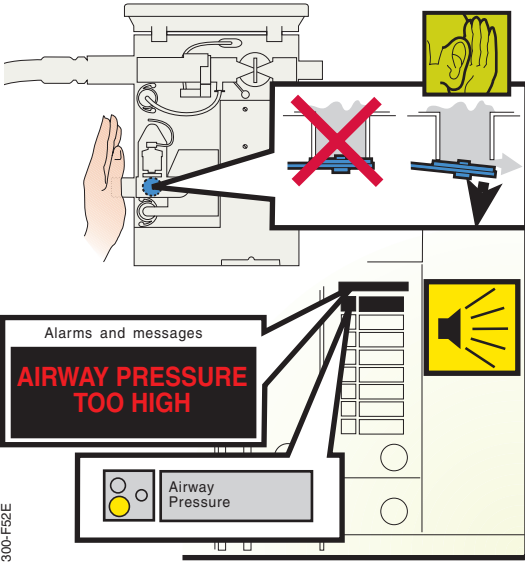
- Set to "Volume Control" mode.

11. Safety valve

300-K57X



- Disconnect the patient tube from the inspiratory outlet.



- Cover the opening of the inspiratory outlet and make sure:
 - the audible alarm is heard.
 - the safety valve opens with a distinct click.
 - the display “Alarms and messages” shows **Airway pressure too high**.
 - the yellow light at “Airway pressure” is lit.

Do not activate the safety valve repeatedly since this may cause an overload of the electromagnet that controls the valve.

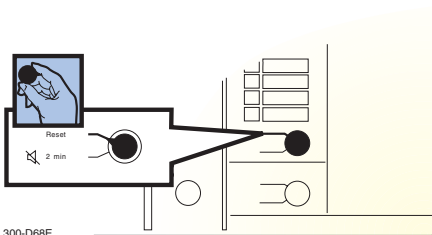
300-F52E



- Connect the patient tube to the inspiratory outlet.

300-K58X

- Reset the alarm.

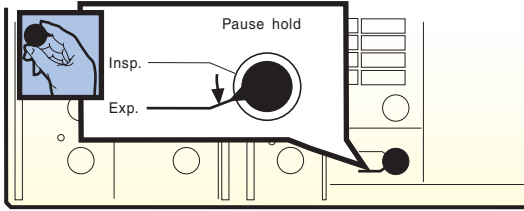


300-D68E

12. O₂ alarm

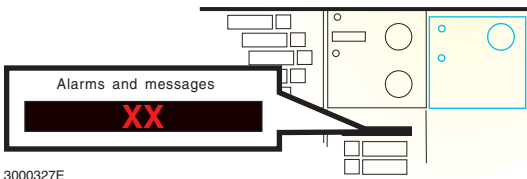
Lower alarm limit

- Hold "Pause hold" at "Exp" and:



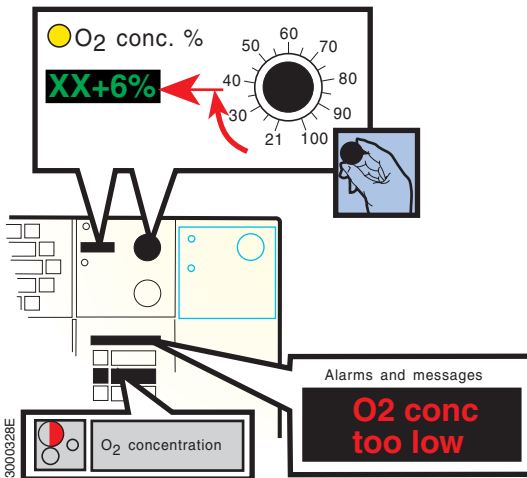
300-D59E

- note the O₂ concentration value on the display "Alarms and messages." The reading shall be 40 ± 3% O₂.



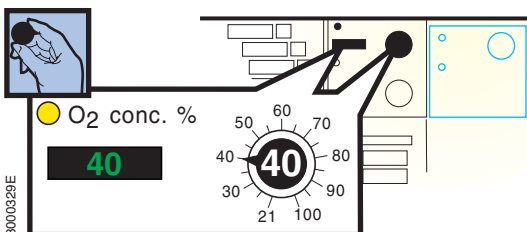
3000327E

- Turn "O₂ conc. %" clockwise and make sure the "O₂ concentration" alarm is activated when the green display "O₂ conc. %" reading is 6 ± 1% **higher** than the noted value.



3000328E

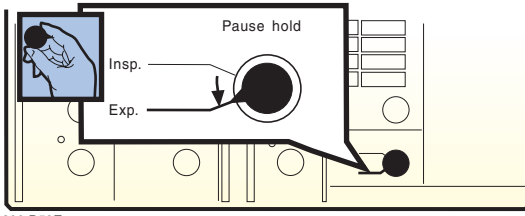
- At the alarm activation, make sure:
 - the red light at "O₂ concentration" flashes.
 - the display "Alarms and messages" shows **O₂ conc too low**.



3000329E

- Set "O₂ conc.%" to 40%.

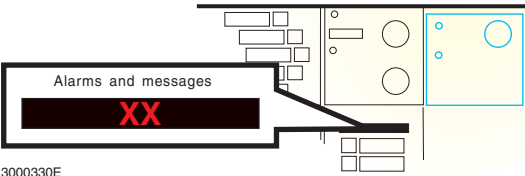
Function check



300-D59E

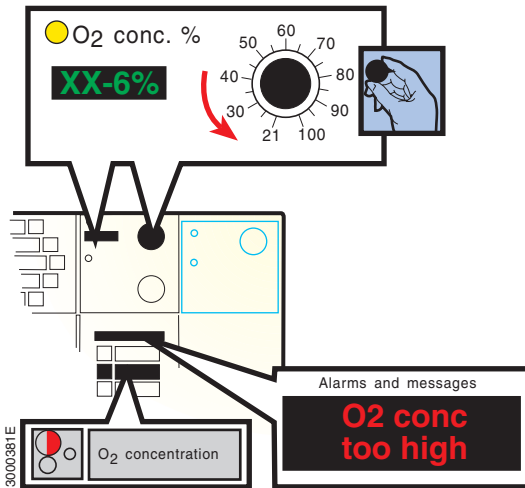
Upper alarm limit

- Hold "Pause hold" at "Exp." and:



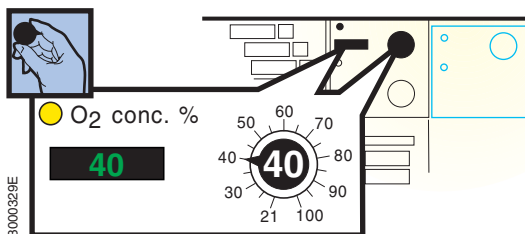
3000330E

- note the O₂ concentration value on the display "Alarms and messages." The reading shall be 40 ± 3% O₂.



3000381E

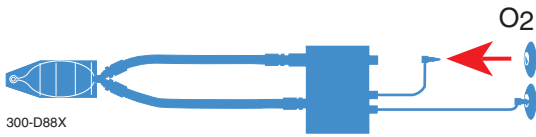
- Turn "O₂ conc. %" counter-clockwise and make sure the O₂ concentration alarm is activated when the green display "O₂ conc. %" reading is 6 ± 1% **lower** than the noted value.
- At the alarm activation, make sure:
 - the red light at "O₂ concentration" flashes.
 - the display "Alarms and messages" shows **O₂ conc too high**.



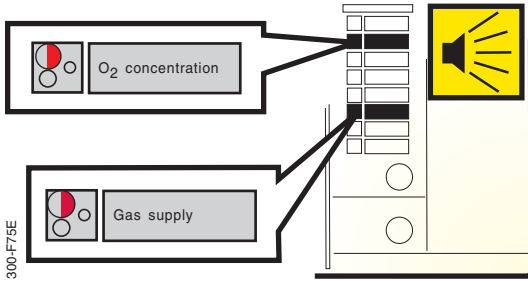
3000329E

- Set "O₂ conc. %" to 40%.

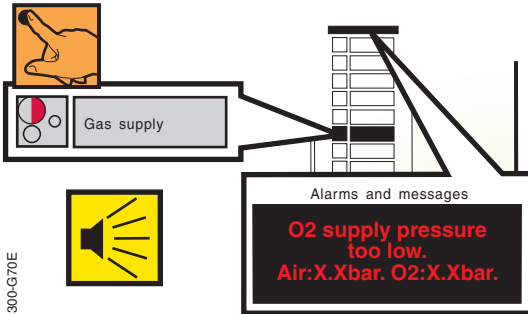
13. Gas supply system



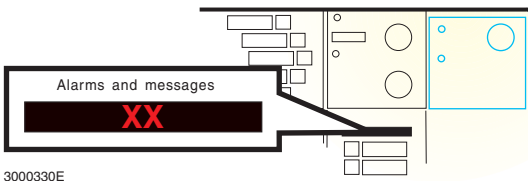
- Disconnect the O₂ supply and make sure Gas supply and O₂ concentration alarms are activated.



- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the red light at “Gas supply” flashes.
 - the red light at “O₂ concentration” flashes.

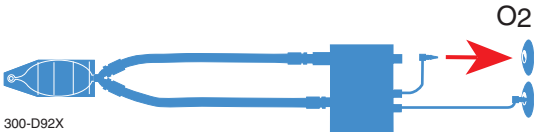


- Touch the touchpad at “Gas supply” and make sure:
 - the “Alarms and messages” display shows **O2 supply pressure too low. Air: X.X bar. O2: X.X bar.**

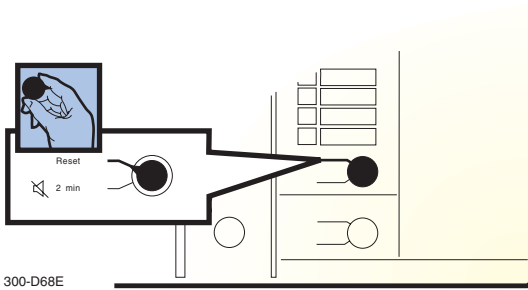


- Mute the alarm and make sure:
 - the red display “Exp. minute vol. l/min” still shows the same value as the green display “Minute vol. l/min.” Accuracy: ±0.5 l/min.

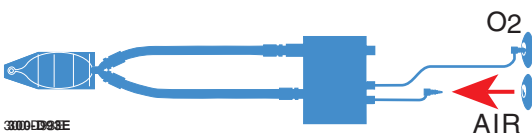
Function check



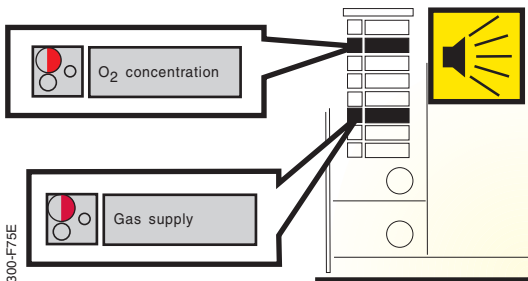
- Connect O₂ supply.



- Wait a few breaths and then reset the alarms.

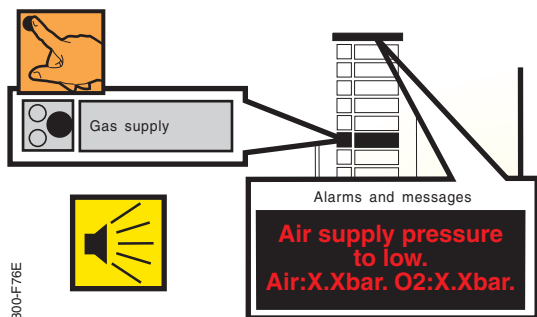


- Disconnect the air supply and make sure Gas supply and O₂ concentration alarms are activated.

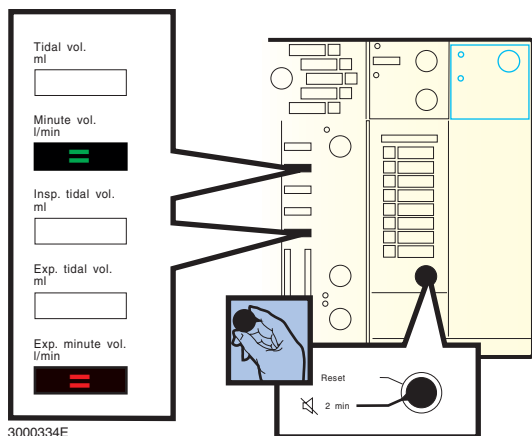


- At the alarm activations, make sure:
 - the audible alarm is heard.
 - the red light at “O₂ concentration” flashes.
 - the red light at “Gas supply” flashes.

Function check



- Touch the touchpad at “Gas supply” and make sure:
 - the “Alarms and messages” display shows **Air supply pressure too low.**
Air: X.X bar. O2: X.X bar.

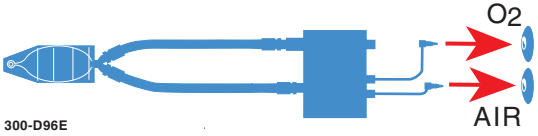


- Mute the alarm and make sure:
 - the red display “Exp. minute vol. l/min” still shows the same value as the green display “Minute vol. l/min”. Accuracy: ± 0.5 l/min.

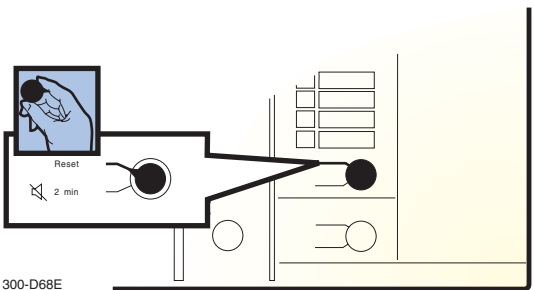
Function check



- Disconnect O₂ supply so that no gas is connected to the ventilator.
Make sure:
 - the safety valve opens with a distinct click.
 - the expiratory valve opens.



- Connect the air and O₂ supplies.

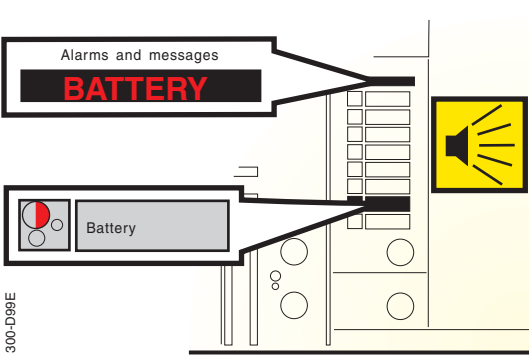
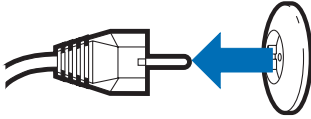


- Reset the alarms.

14. Battery operation

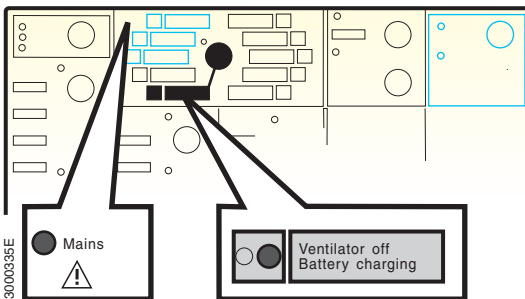
- Disconnect the ventilator from mains and make sure Battery alarm is activated.

300-D97X



300-D99E

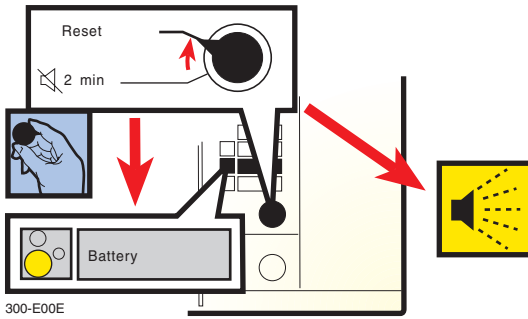
- At the alarm activation, make sure:
 - the audible alarm is heard.
 - the red light at “Battery” flashes.
 - the display “Alarms and messages” flashes **BATTERY**.



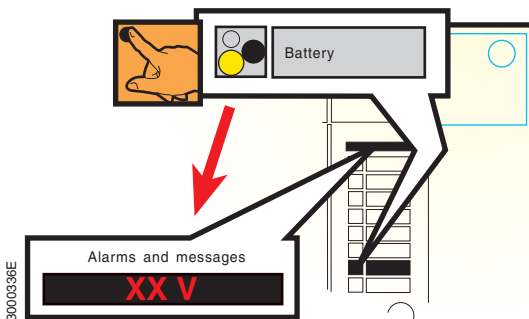
3000335E

- the yellow light at “Ventilator off Battery charging” and the green light “Mains” are not lit.

Function check



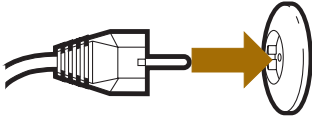
- Reset the alarm and make sure:
 - the caution signal starts.
 - the yellow light at “Battery” is lit.



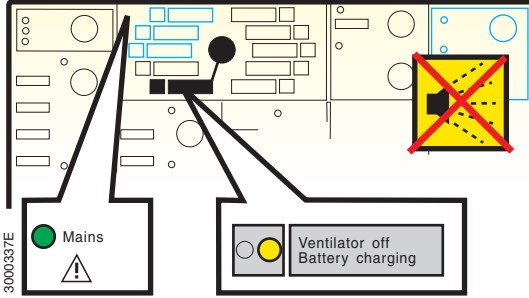
- To check the internal battery, touch the touchpad at “Battery” and read the displayed text. (Normal value approx. 24 V.)

Function check

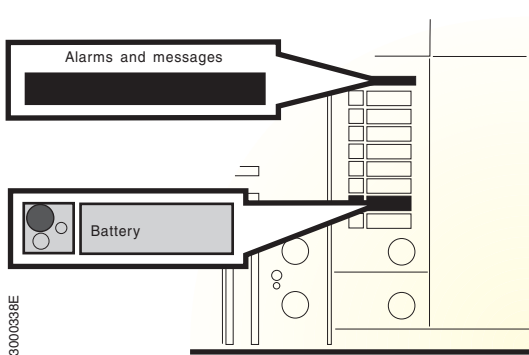
300-D51X



- Connect the ventilator to mains again.



- Make sure :
 - the yellow light at “Ventilator off Battery charging” and the green light “Mains” are lit.
 - the caution signal stops.

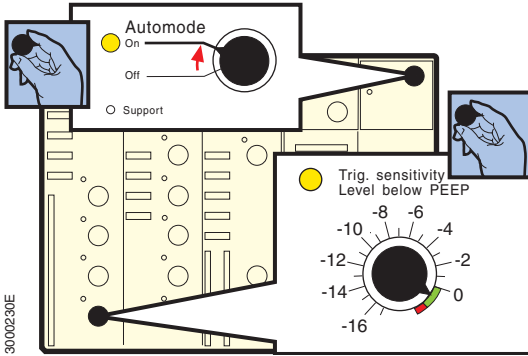


- the display “Alarms and messages” no longer flashes **BATTERY**.
- the yellow light at “Battery” is no longer lit.

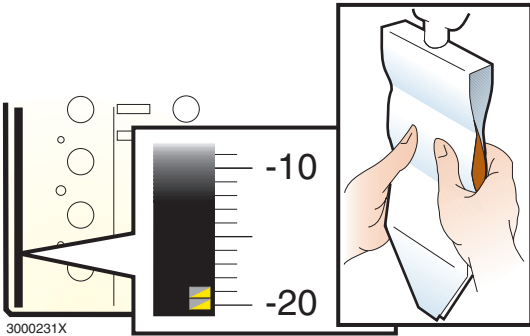
300038E

15. Automode (SV 300A only)

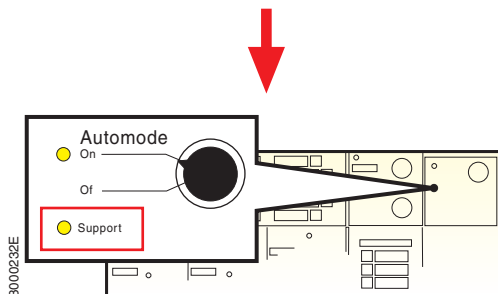
- Set "Automode" to "On".
- Set "Trig sensitivity Level below PEEP" in the green range.



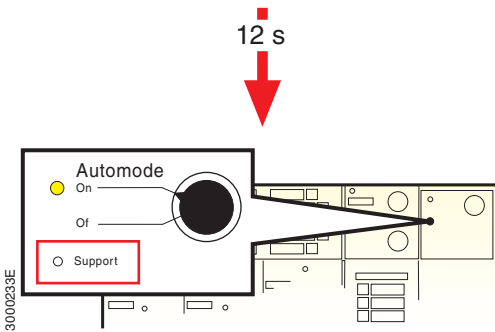
- Compress and release the test lung twice to trigger a breath. Two diodes on the bargraph for airway pressure show that a breath is triggered.



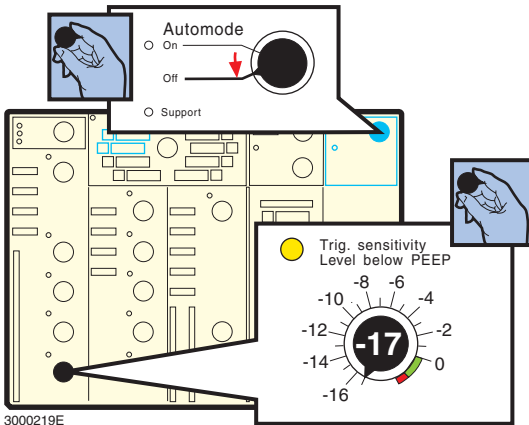
- Make sure the ventilator switches to support mode. This is shown by the yellow light "Support".



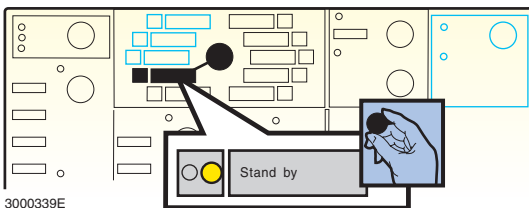
Function check



- Do not trigger any more breaths and make sure the ventilator switches back to "Volume Control" after about 12 seconds. (The yellow light "Support" is no longer lit.)



- Set "Trig sensitivity Level below PEEP" to -17 cm H₂O.
- Set "Automode" to "Off"



- The Function check is now complete, set the mode selector to "Stand by", or, if the ventilator is to be connected to a patient, make the appropriate settings for that patient.

16. Log sheet

- Note on a log sheet that a function check has been performed.

Notes



Lined writing area consisting of 20 horizontal lines.

Servo Ventilator 300/300A – Operating Manual 8.1/9.1
Art.-Nr. 64 08 004 E313E

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