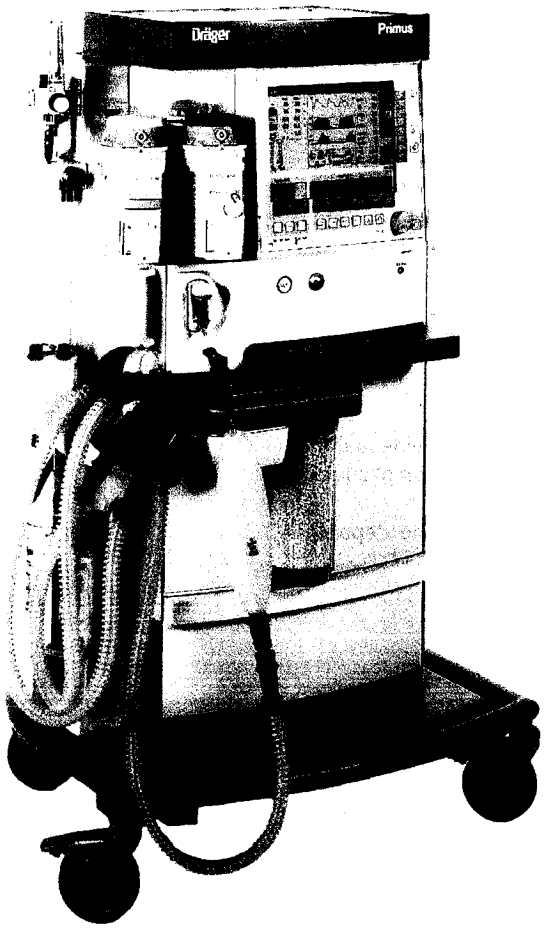
Dräger medical
A Dräger and Siemens Company

Primus



Anaesthetic Workstation
Software 2.n
Instructions for Use

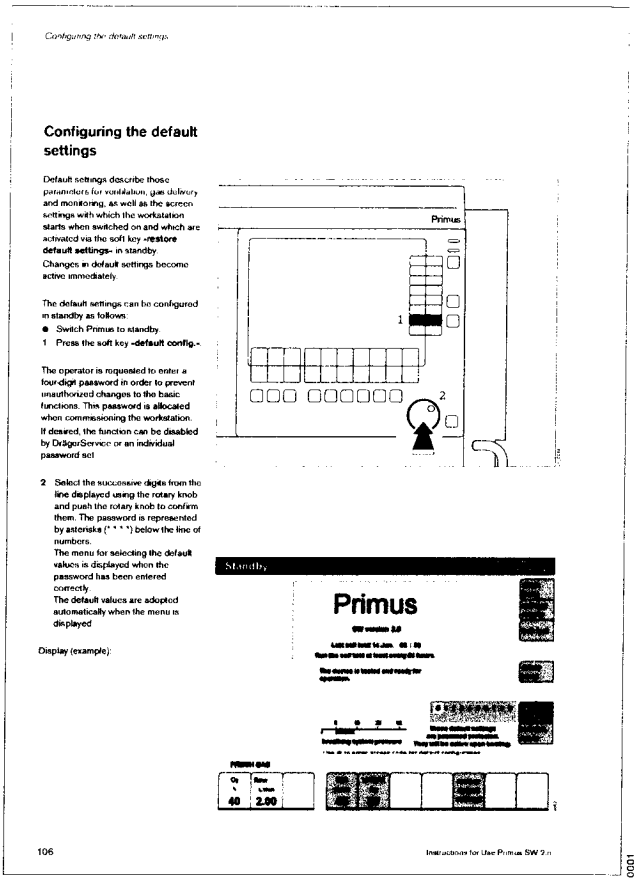
How to use these Instructions for Use

In the header is the subject...
of the main chapter.
To help you find your way around quickly.

On each page...
the instructions for use
combining text with illustrations. The information is translated directly into actions to enable the user to learn "hands-on" how to use the workstation.

Left-hand column...
the text
provides explanations and guides the user clearly and ergonomically with brief directions for using of the product. Bullets indicate the steps to be followed, and if there are several steps, numbers refer to the illustration and indicate the sequence.

Right-hand column...
the illustration
provides a link with the text and serves as a guide to the workstation. Points mentioned in the text are emphasized and non-essential information is omitted.
Screen displays guide the user and confirm the steps to be followed.



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Abbreviations and symbols

Abbreviations

Abbreviations	Meaning
Agent	*Anaesthetic gas*
AGS	Anaesthesia Gas Scavenging System
Air	Compressed air for medical use
APL	Adjustable Pressure Limitation
ATPS	Measuring conditions at ambient temperature, current atmospheric pressure and with saturated gas
BTPS	Measuring conditions at body temperature, current atmospheric pressure and with saturated gas
CAL	Calibration
Compl.	Compliance
C_{PAT}	Patient compliance
ΔO_2	Difference between inspiratory and expiratory O_2
ΔP_{PS}	Pressure difference for pressure support in pressure support mode
Des.	Desflurane
$etCO_2$	End-expiratory CO_2 concentration
Enf.	Enflurane
ex./exp.	*Expiratory*
FG	Fresh-gas
FLOW	Expiratory flow
Freq.	Frequency
$Freq._{MIN}$	Mandatory minimum frequency in pressure support mode
Hal.	Halothane
HLM	Mode with modified alarm response when using a heart lung machine
I : E	Ratio of inspiration time to expiration time
in./insp.	Inspiratory
in Des	Inspiratory desflurane concentration
in Enf	Inspiratory enflurane concentration
in Hal	Inspiratory halothane concentration
in Iso	Inspiratory isoflurane concentration
in Sev	Inspiratory sevoflurane concentration
in CO_2	*Inspiratory CO_2 concentration*
in O_2	Inspiratory O_2 concentration
INOP	Inoperable
Iso.	Isoflurane
MAC	Minimum Alveolar Concentration
Man. Spont.	Manual ventilation/ spontaneous breathing
MEAN	Mean pressure
MV	Expiratory minute volume
MV_{LEAK}	Difference between inspiratory and expiratory minute volume
MV_{MEAS}	Measured minute volume
N_2O	Nitrous oxide (laughing gas)
NiBP	Non-invasive blood pressure
NTPD	Normal temperature pressure dry (20 °C, 1013 hPa, dry)
O_2	Oxygen
Pa	Pascal (1 mbar = Pa x 100)
P_{AW}	Airway pressure
PEAK	*Peak pressure*
PEEP	Positive end-expiratory pressure
P_{INSP}	Pressure limitation in pressure mode
PLAT	Plateau pressure
Pleth	Plethysmogram
P_{MAX}	Maximum pressure
Press. Mode	Pressure mode Pressure-controlled ventilation
Press. Supp.	Pressure support mode Pressure-assisted ventilation
PS	Pressure support
Sev.	Sevoflurane
SORC	Sensitive Oxygen Ratio Controller
SpO_2	Functional O_2 saturation
sync	Synchronization
TG	*Carrier gas*

Abbreviations	**Meaning**
TIP : TINSP	Ratio of inspiratory pause time to inspiration time
TINSP	Inspiration time
TSLOPE	Rise time
UPS	Uninterruptible power supply
VAC	Vacuum (e.g. for secretion aspiration)
Vent.	Ventilation symbols
Vol.	Volumeter
Vol. Mode	Volume mode Volume-controlled ventilation
VT	Tidal volume
ZV	Piped medical gas supply for O_2, N_2O, AIR and vacuum

Symbols

Symbol	Meaning
CE 0123	Conformité Européenne Directive 93/42/EC on Medical Products
	Suppress alarm tone for 2 minutes, change priority of technical alarms and acknowledge them
	Call up standard screen
	Call up basic screens in succession
	Standby/operation switch
	Pulse rate
	Fresh-gas flowing
	Action in progress
	Upper and lower alarm limits
	Upper alarm limit only
	Lower alarm limit only
	Alarm tone suppressed for 2 minutes
	Alarm monitoring inactive
	Alarm limits disabled
	Upper alarm limit disabled
	Lower alarm limit disabled
– –	Alarm limit disabled
* * * *	4-digit password entered
	Protection class type B (body)
	Protection class type BF (body floating)
	Connection for equipotential bonding
	Note
	Close menu, return to preceding menu
	Non-rebreathing system at external gas outlet
XX %	Available operating time with uninterruptible power supply UPS
	Manual ventilation

Symbol	Meaning
	Automatic ventilation
	Connector for piped medical gas supply (ZV)
	Backup gas cylinder
	Rotary knob
c US	UL test mark
	Plug system for Vapor units

For your safety and that of your patients

For your safety and that of your patients

Strictly follow the Instructions for Use
Any use of the apparatus requires full understanding and strict observation of these instructions.
The apparatus may only be used for the purposes specified here.

Maintenance
The apparatus must be inspected and serviced every 6 months by trained service personnel.
Repair and general overhaul of the apparatus may only be carried out by trained service personnel.
We recommend that a service contract be obtained with DrägerService and that all repairs also be carried out by them.
Only authentic Dräger spare parts may be used for maintenance.
Observe chapter "Maintenance intervals".

Accessories
Only the accessories listed in the enclosed list of accessories ("Primus" equipment series 86 03 522, Rev. 09 or higher) may be used.
Note: Even accessories designed to be reused after cleaning have a limited life. Due to a number of factors connected with handling and preparation, disinfectant residues can attack the material more intensely during autoclaving; increased wear can occur and service life can be markedly shortened. Such parts should be replaced when external signs of wear become apparent, such as cracks, deformation, discoloration, peeling, etc.

Not for use in areas of explosion hazard
This apparatus is neither approved nor certified for use in areas where combustible or explosive gas mixtures are likely to occur.

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

Liability for proper function or damage
The liability for the proper function of the apparatus is irrevocably transferred to the owner or operator to the extent that the apparatus is serviced or repaired by personnel not employed or authorized by DrägerService or if the apparatus is used in a manner not conforming to its intended use.
Dräger cannot be held responsible for damage caused by *non-compliance with the recommendations given above.*
The warranty and liability provisions of the terms of sale and delivery of Dräger are likewise not modified by the recommendations given above.

Dräger Medical AG & Co. KGaA

Safety precautions*

The workstation may only be used under the permanent supervision of qualified medical personnel so that assistance can be provided immediately in the event of any *malfunctions*.

Explosive anaesthetics, such as ether or cyclopropane, must not be used due to the risk of fire.

Primus must not be used with nuclear spin tomography (MRT, NMR, NMI).
Operation of the workstation may be impaired and the patient endangered.

Drugs or other substances based on inflammable solvents, such as alcohol, must not be introduced into the patient system.
Risk of fire.
Adequate ventilation must be ensured if highly inflammable substances are used for disinfection.

Mobile radio telephones must not be used within 10 metres of the workstation.
Mobile telephones may interfere with the operation of electrical and electronic medical equipment and endanger the patient!**

The application of a wall or ceiling mounting support is designated for buildings, not for mobile facilities such as *ambulances, helicopters or ships*.

Always keep a manual ventilator at hand.
If ventilation of the patient is no longer assured due to an obvious fault in the equipment, the patient must immediately be ventilated with a separate emergency ventilator.

Do not use conductive breathing hoses or face masks.
They may cause burns during HF surgery.

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* Additional precautions can be found in the respective chapters.

** Dräger medical equipment fulfils the interference resistance requirements according to the product-specific standards or EN 60601-1-2 (IEC 60601-1-2). However, depending on the design of the mobile phone and circumstances of use, field strengths may occur in the immediate environment of a mobile phone that exceed the limits of the above standards and therefore cause interference.

Intended use

Intended use

Primus Anaesthetic Workstation for adults, children and neonates with automatic and manual ventilation, as well as spontaneous breathing with or without pressure support.

Utilizing

- Inhalation anaesthesia in rebreathing systems
- Inhalation anaesthesia in semi-closed to virtually closed systems with "low flow" and "minimal flow" techniques (for minimal gas and anaesthetic agent consumption)
- Inhalation anaesthesia in non-rebreathing systems, with a separate fresh-gas outlet for connecting of the Bain system or Magill system, for example,

with a fresh-gas flow of 0.2 to 18 L/min.

Ventilation modes

- Volume-controlled ventilation in volume mode.
  With activation of: synchronization,
  pressure support (optional)
- Pressure-controlled ventilation in pressure mode
  With activation of: synchronization,
  pressure support (optional)
- Manual ventilation (Man.)
- Spontaneous breathing (Spont.)
- Pressure-assisted spontaneous breathing in pressure support mode (optional)

The following measured values are displayed

- Peak pressure P_{PEAK}, mean pressure P_{MEAN}, plateau pressure P_{PLAT} and PEEP
- Expiratory minute volume MV,
  difference between inspiratory and expiratory minute volume MV_{LEAK},
  patient compliance C_{PAT},
  tidal volume V_T,
  breathing rate Freq.
- Inspiratory and expiratory concentrations of O_2, N_2O, anaesthetic gas and CO_2
- ΔO_2:
  difference between inspiratory and expiratory O_2 concentration

Optional:

- Functional oxygen saturation (SpO_2) and pulse rate

The following parameters are displayed as curves

- Airway pressure P_{AW}
- Inspiratory and expiratory flow
- Inspiratory and expiratory concentrations of O_2, CO_2 and anaesthetic gas

Optional:

- Plethysmogram
- p-V loops and V-flow loops

The following are displayed as bar graphs

- Inspiratory, expiratory and leakage tidal volume
- Volumeter
- Pressure
- Econometer for indicating fresh-gas utilisation (optional)

Trends showing the measured values over time and a logbook are also available.

Monitoring

by means of adjustable alarm limits which can automatically be adapted to the momentary ventilation situation.

With monitoring for

- Airway pressure P_{AW}
- Expiratory minute volume MV
- Apnoea
- Inspiratory and expiratory anaesthetic gas concentration
- Detection of anaesthetic gas mixtures (simultaneous detection of up to two anaesthetic agents)
- Inspiratory O_2 and N_2O concentrations
- Inspiratory and expiratory CO_2 concentrations
- Special alarm response in HLM mode

Optional:

- Oxygen saturation
- Pulse rate

Operating concept

Operating concept

Screen ergonomics

All the settings required for

- Gas measurement
- Fresh-gas delivery
- Ventilation
- Monitoring

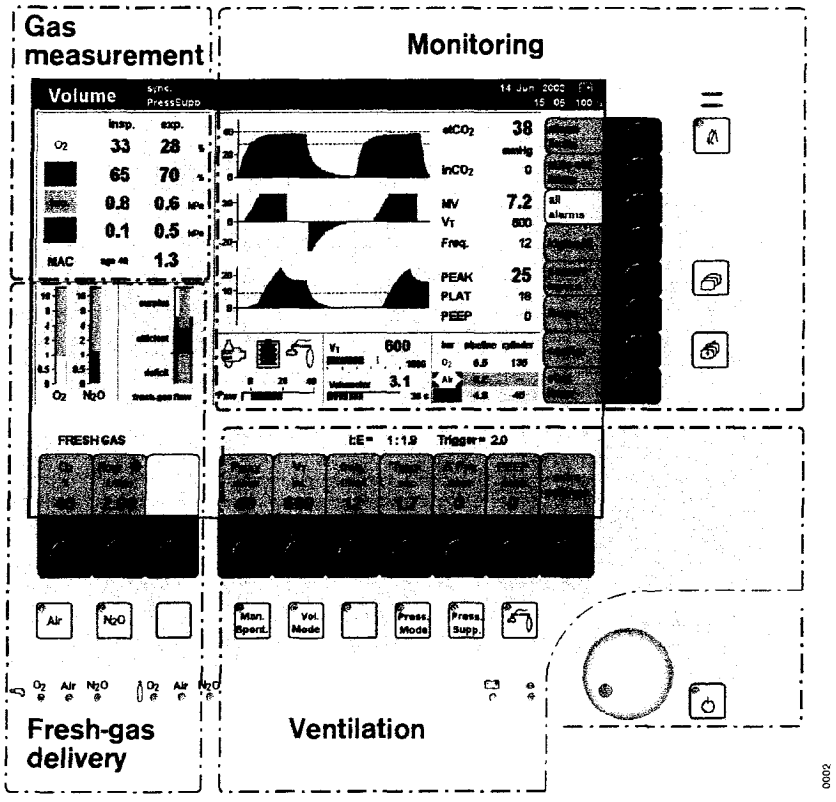
are entered on the system screen using the appropriate keys and the rotary knob.
The keys are grouped in function fields:

Top left-hand field
for gas measurement

Bottom left-hand field
for fresh-gas delivery

Top right-hand field
for monitoring

Bottom right-hand field
for ventilation

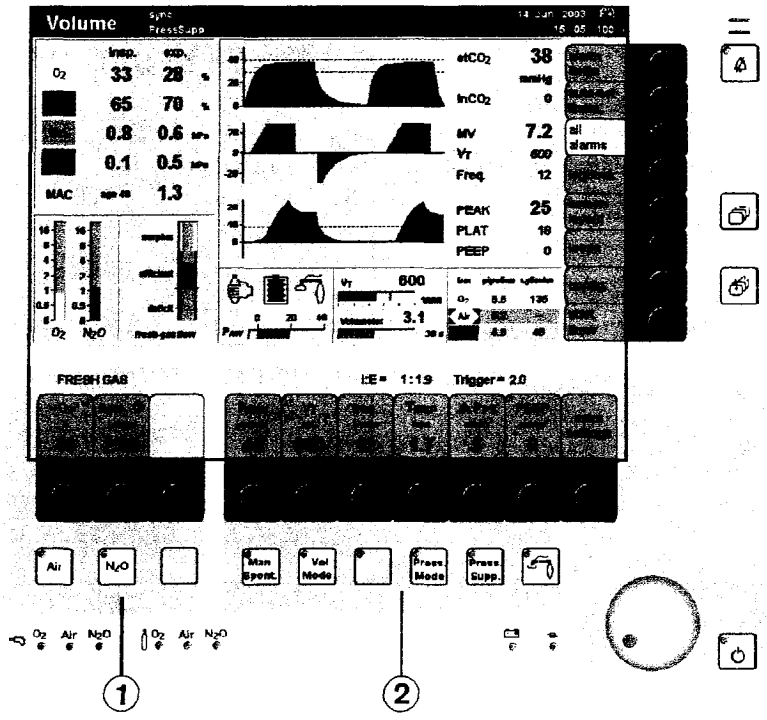


The main functions for anaesthesia, e.g. selecting of N_2O or AIR, or selecting of ventilation modes, can be selected directly by keys with permanently defined functions ("hard keys"):

1 *Left-hand block:*
The »**N_2O**« or »**Air**« keys are used to select the gas to be mixed with O_2 for the fresh-gas mix.

2 Right-hand block:
The »**Man. Spont.**«, »**Vol. Mode**«, »***Press. Mode***« *or* »***Press. Supp.***« (optional) keys are used to select the ventilation mode, or »[ ]« (optional external fresh-gas outlet).

These function keys are located in the bottom row of the control panel:
Left-hand block for setting the fresh-gas delivery.
Right-hand block for ventilation.



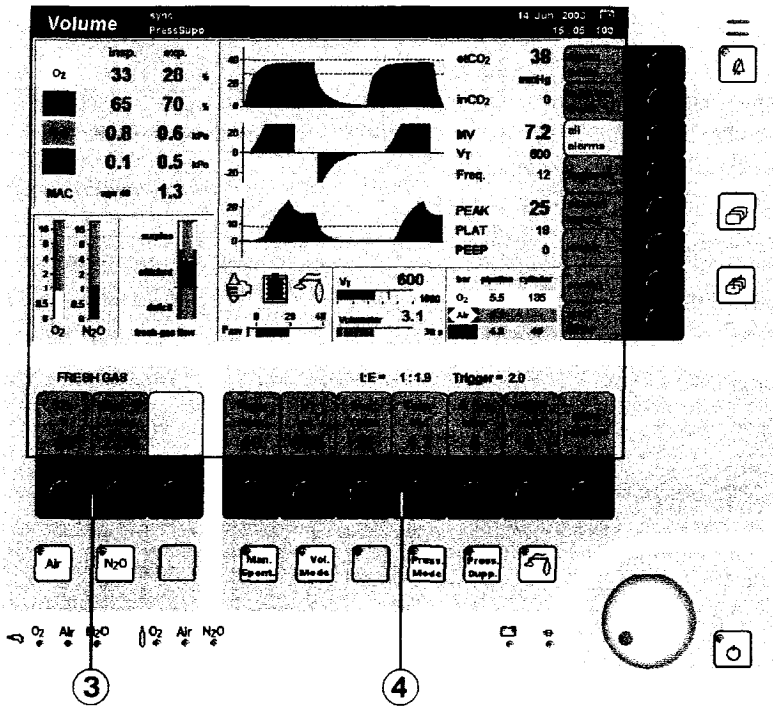
Complementary "soft keys" with variable functions are provided at the bottom edge of the screen, above each group of hard keys. These soft keys are used to set the fresh-gas delivery parameters and ventilation parameters.

3 Left-hand block:
The keys for setting the O_2 concentration and fresh-gas flow.

4 Right-hand block:
The keys for setting the parameters *for the relevant ventilation mode.*
The example shows the parameters for volume-controlled ventilation.

These soft keys have different functions, depending on the operating status or ventilation mode.

Current parameter values are displayed in the soft key field.



In a prominent position at the bottom right-hand side:

The "turn-and-push" rotary knob is the *main operating control of the device* and has the following functions in all setting operations:

1 Select/set = turn

2 Confirm = push

– to confirm the selected carrier gas or a ventilation mode

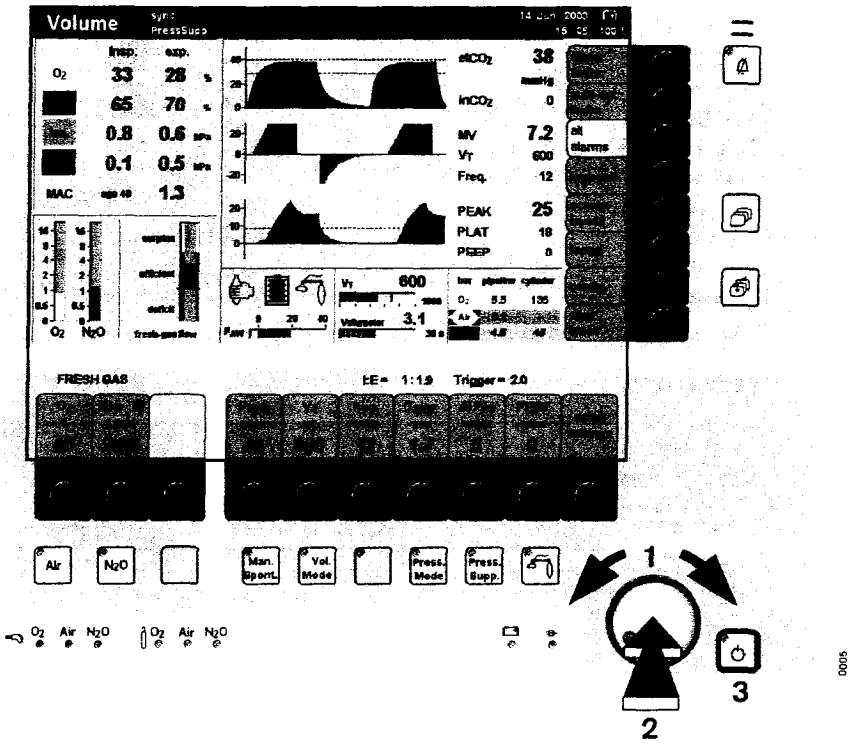
– to set and confirm the parameters for fresh-gas and ventilation modes

– to set and confirm the monitoring functions.

Beside the rotary knob:

The standby key »⏻« for switching from operation to the standby mode.

3 Press standby key »⏻« and confirm by pushing the rotary knob.



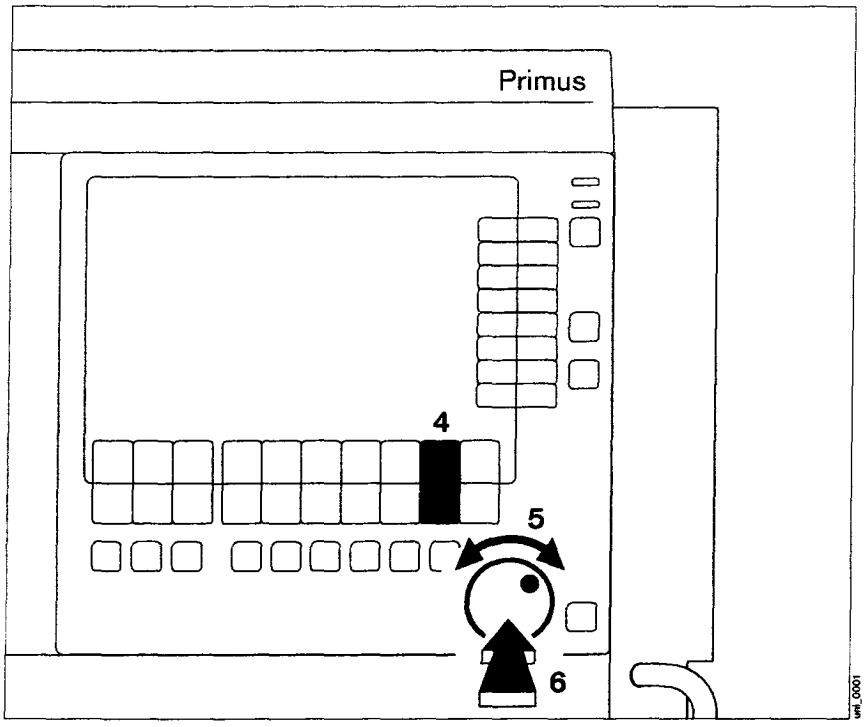
Selecting/setting ventilation parameters

Example: PEEP ventilation parameters

4 Push the soft key »PEEP«.

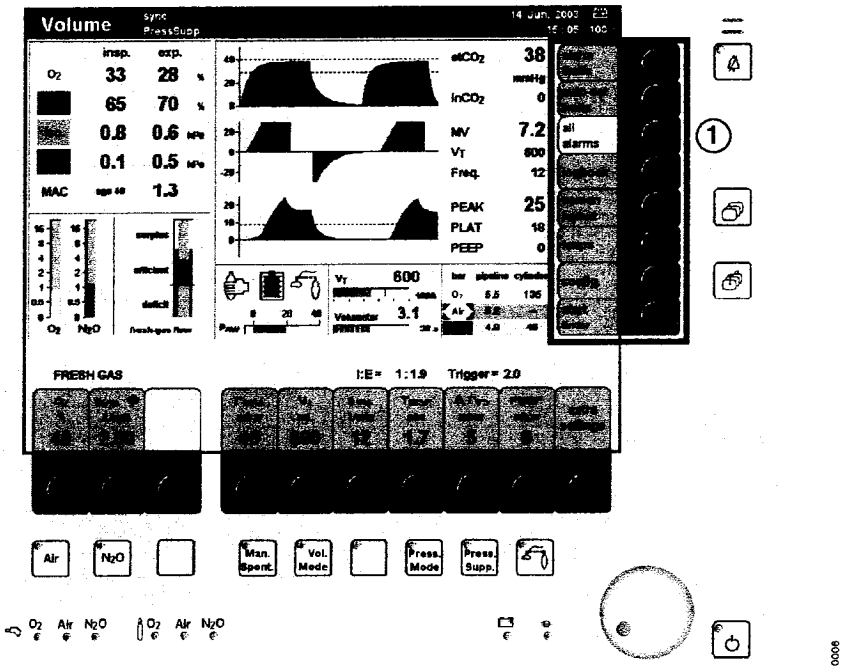
5 Select the PEEP value = turn the rotary knob.

6 Confirm the PEEP value = push the rotary knob.



1 The keys for the various monitoring functions and configurations are located on the right-hand side of the screen.

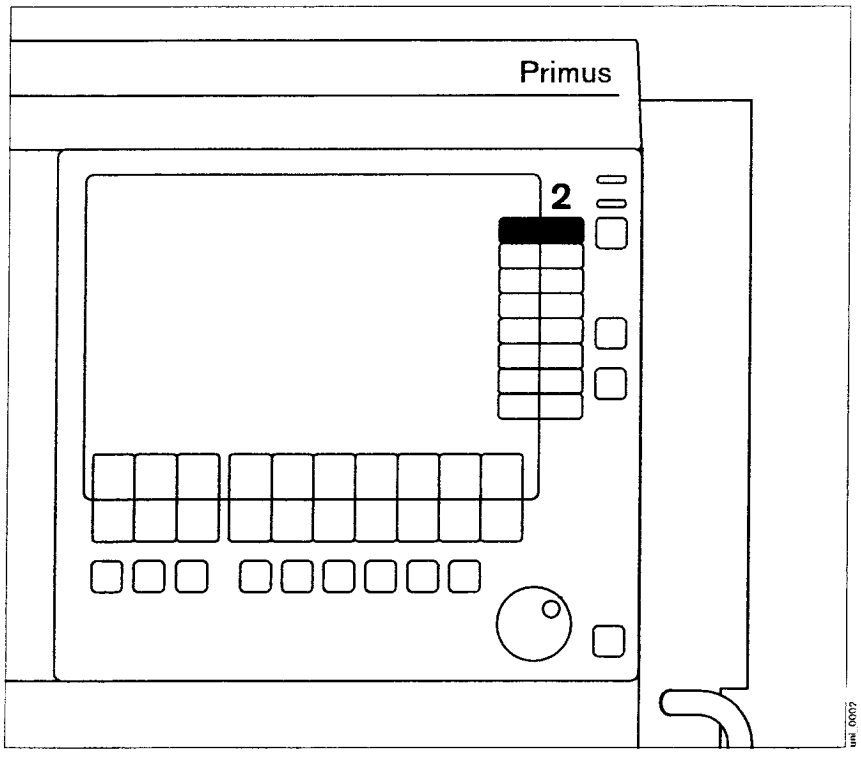
These keys also have different functions = soft keys, depending on the monitoring screen required.



Selecting/setting monitoring functions

For example, to change the lower alarm limit of the end-expiratory CO_2 concentration.

2 Press the »**alarm limits**« soft key. The »**alarm limits**« menu is displayed on the screen.

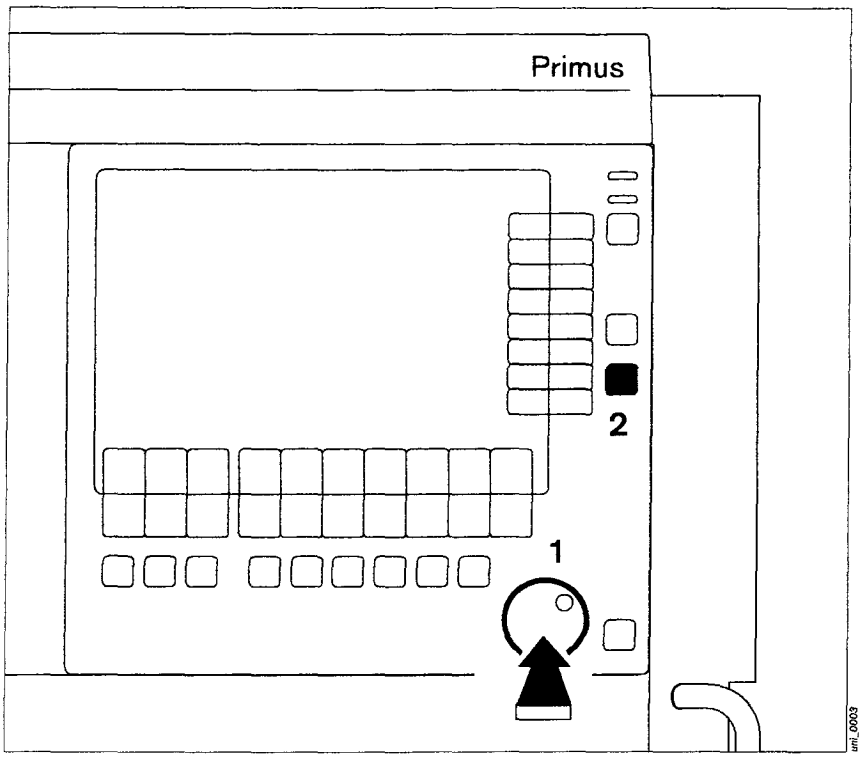


- Select the alarm limit value = turn the rotary knob.
  Confirm the selection = push the rotary knob.
  Set the alarm limit value = turn the rotary knob.
  Confirm the new alarm limit = push the rotary knob.

Exit the »**Alarm limits**« menu:

1 Confirm the » ⌐→ « symbol to exit the menu = push the rotary knob
or

2 Press the »[⏻]« key.

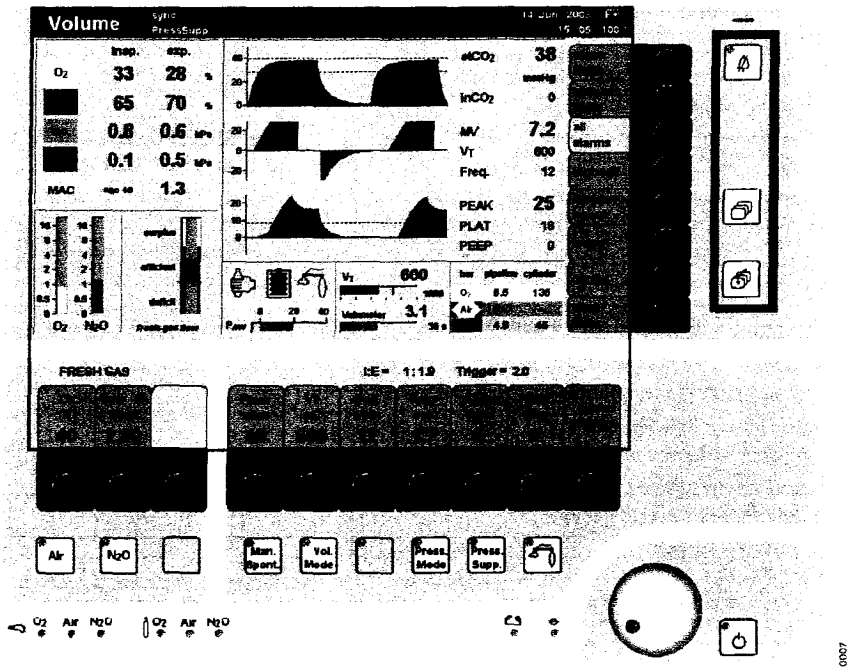


The function keys for standard functions are located on the right-hand side of the control panel.

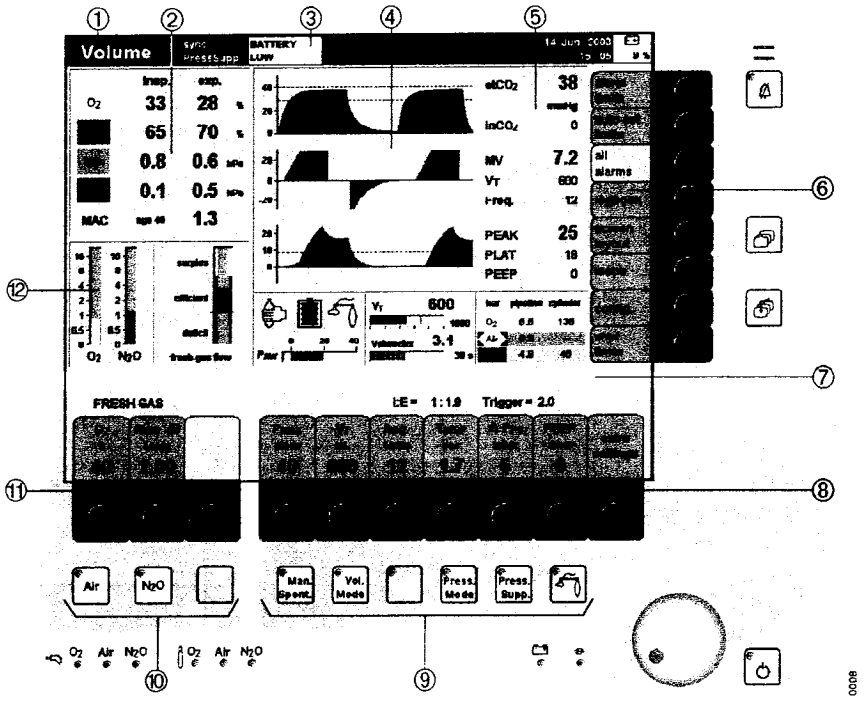
»[🔔]« Suppress the acoustic alarm for 2 minutes or change the priority of technical alarms and acknowledge them

»[⏻]« Select the screen

»[⏻]« Back to standard screen



Screen layout



① Status field:
Displays information on the current operating mode

② Numerical value field:
For gas measurement

③ Alarm field:
Displays information on alarms, warnings, etc. and their priority

④ Graphics field:
For curves and bar graphs

⑤ Numerical value field:
For numerical values

⑥ Right-hand soft keys:
For monitoring/configuration

⑦ Prompt field:
For user guidance

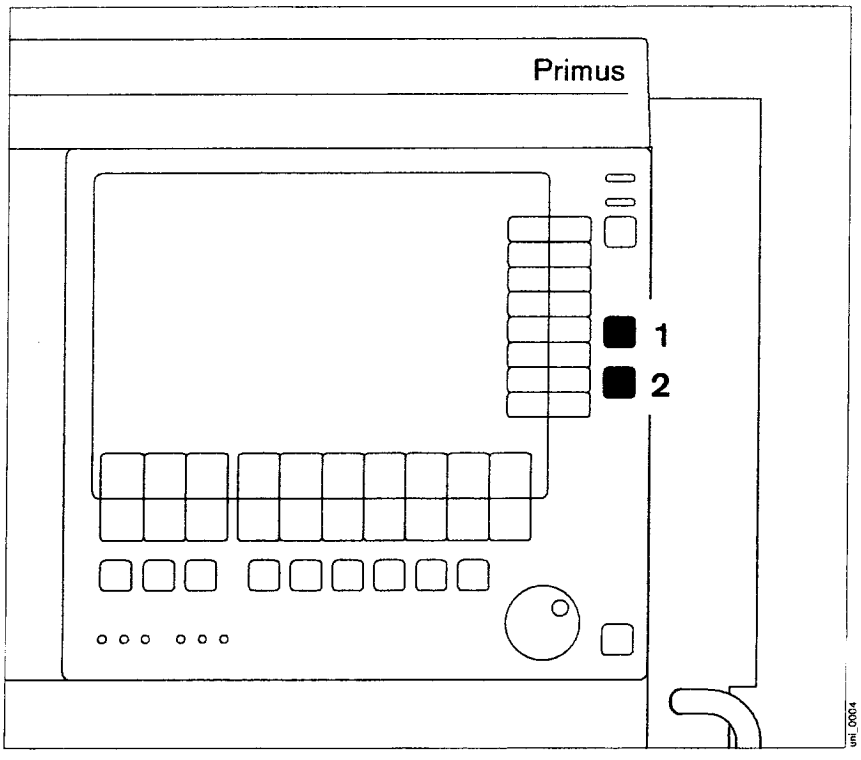
⑧ Lower soft keys:
For the ventilation mode

⑨ Keys for selecting the ventilation mode

⑩ Keys for selecting the carrier gas (N_2O or Air)

⑪ Lower soft keys:
For fresh gas delivery

⑫ Bar graphs for fresh gas (virtual flow tubes) and fresh-gas utilisation (econometer, optional)



Three basic screens for monitoring*

Standard screen, data screen and **trend screen**

To call up the screens in succession:

1 Briefly press the »[ ]« key until the required screen is displayed.

Back to the standard screen

2 Press the »[ ]« key.

* For a detailed description of the basic screens, see Monitoring, page 76.

Colour concept

Colours are used to highlight operating sequences and indicate the status of the soft keys.

Green	active, can be operated
Yellow	selected, set/confirm
Black	leads to another menu or operating function
Grey	not yet active, presettings
Orange	current selection
Grey type	cannot be operated

Horizontal soft keys

The horizontal soft keys appear green when operable.
Proceed as follows to set a ventilation parameter, e.g. PINSP:

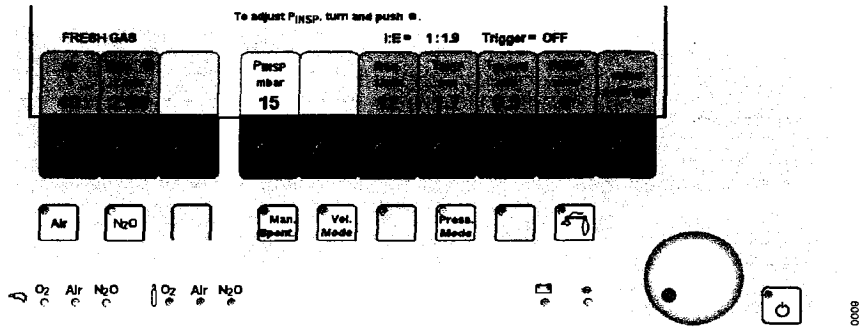
- Push the relevant soft key, the colour changes from green to yellow = setting function has been selected.
- Change, confirm the value = turn, push the rotary knob. The colour changes from yellow to green, the set value has been confirmed and is now effective.

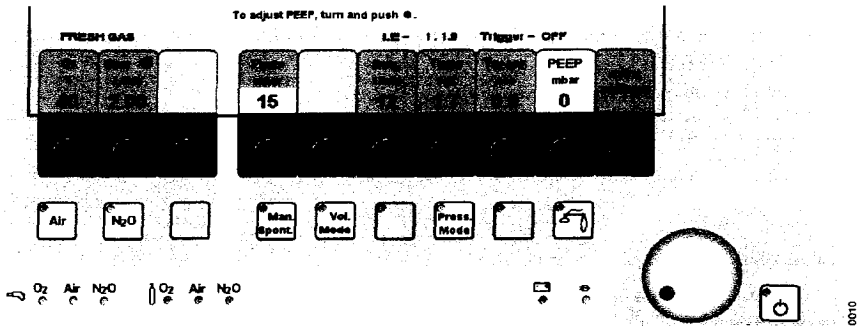
If other set values change automatically when setting a parameter, these changed settings only appear in yellow in the area around the parameter value.

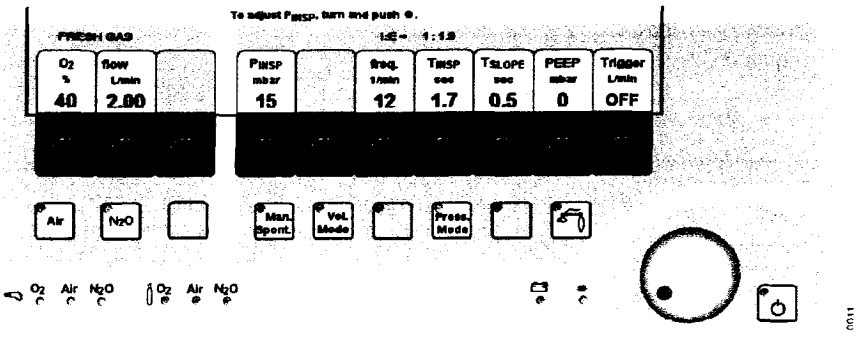
Keys with presettings which are not yet active appear in grey.
The selected parameter PINSP is yellow and can be changed.

Values shown in grey

- indicate discrepancies between the values realised by the unit and those actually set (e.g. following a failure of the O2 supply, see page 151)
- indicate that the specified accuracy is not being maintained.







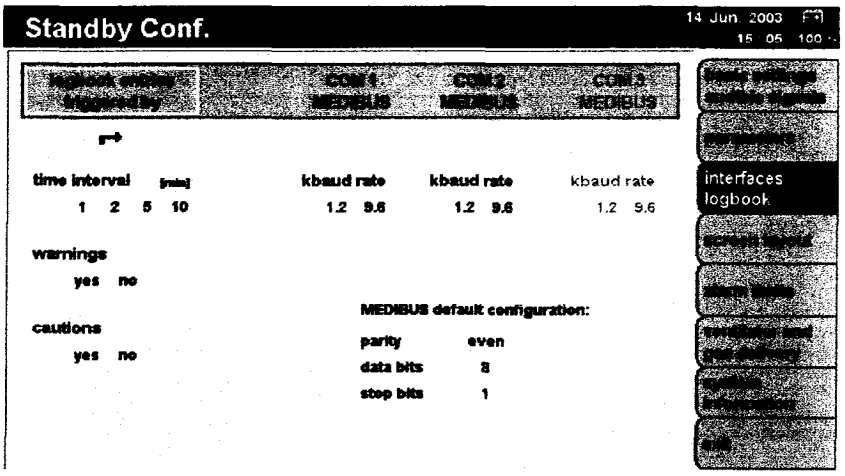
Vertical soft keys

The vertical soft keys appear in green.

- Push the soft key,
  e.g. »**interfaces**«,
  soft key appears in black.
  A menu with parameters is displayed.

Parameter bar

- Parameters with orange background: current selection.
- Yellow cursor frame around the menu title: selected submenu.
- Parameters in grey type: inactive and cannot be selected.



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Before first use

Before first use

Insert the enclosed O2 sensor, page 147. (Not applicable for consumption-free O2 measurement (optional).)
Insert the flow sensors, page 140.

Charging the battery for emergency operation

Primus has a built-in uninterruptible power supply UPS which maintains the power supply for at least 30 minutes (up to 90 minutes, depending on the ventilation parameters) in the event of a mains power failure, provided that the battery is charged.
Switching to battery power UPS takes place automatically and is indicated on the screen by the message: POWER FAIL.
The battery recharges automatically when the workstation is plugged into the mains, but only up to a maximum ambient temperature of 35 °C.

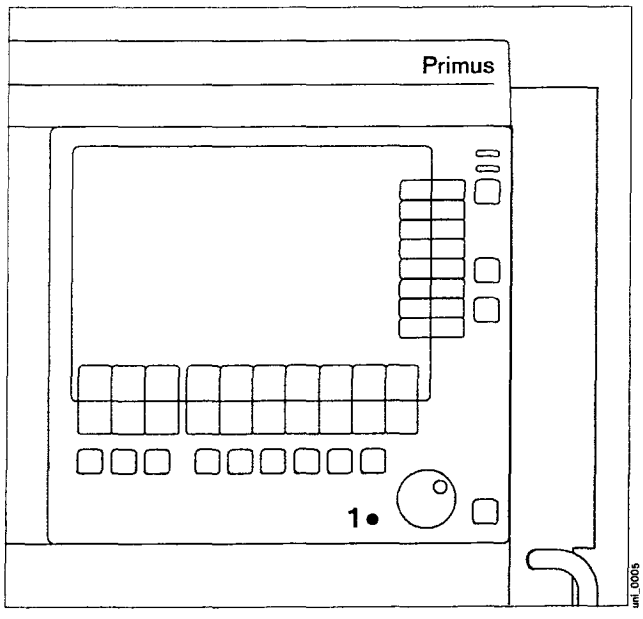
The battery must be charged for 10 hours before using the workstation for the first time:

- Plug the mains plug of the Primus workstation into the mains socket. The mains voltage must correspond to that specified on the rating plate.

1 The green LED »⏻« lights up.

- Leave Primus connected to the mains for 10 hours. The workstation does not have to be switched on.

The devices connected to auxiliary power sockets will not be powered by the UPS in the event of a power failure.



When Primus is not in use

- **The battery must be charged at least every 4 weeks. Allowing it to run low can lead to damage.**

If Primus is not used for an extended period:

- Unplug the medical gas hoses from the wall supply points of the central gas supply.
- Close the cylinder valves on the backup gas cylinders.
- Leave the workstation connected to the mains at all times.

1 The green LED »⏻« lights up.

Preparation

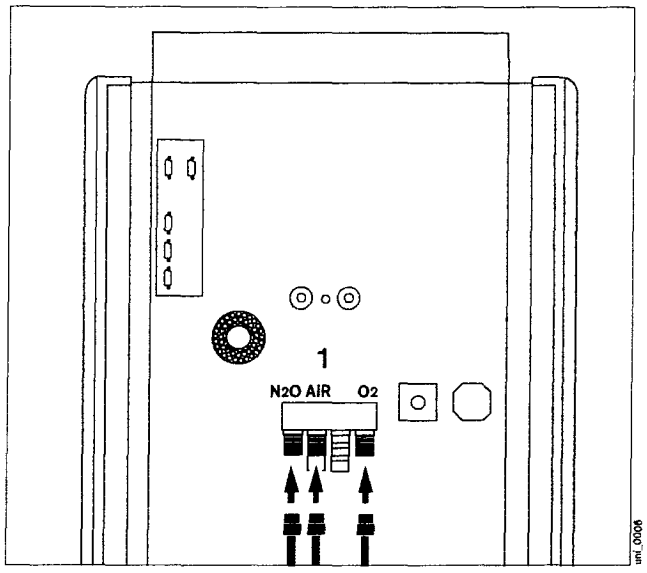
Preparation

Use only cleaned and disinfected parts!

Connecting the gas supply

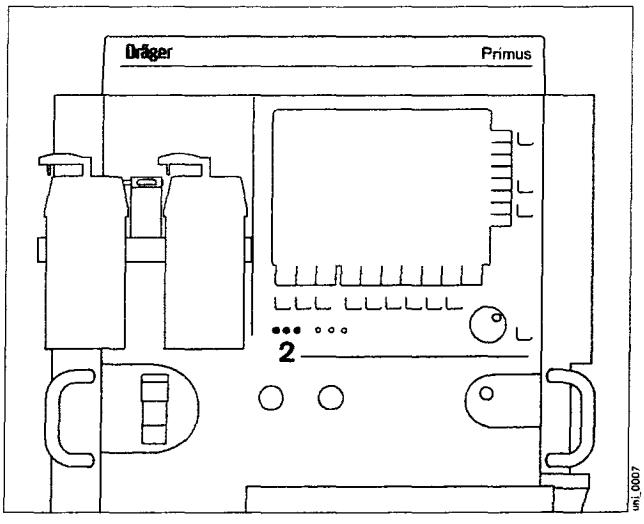
1 Screw the central gas supply pressure hoses for O_2, AIR and N_2O into the ports of the gas supply block at the back of the device. The two outer ports at the back are reserved for the backup gas cylinders.
A compressed air outlet for the optional secretion aspiration and an O_2 outlet for an external O_2 flow tube are optionally available.

- Plug the other end of the pressure hoses into the wall supply points.



- Ensure that the gas pressures at the workstation are between 2.7 and 6.9 bar:

2 All three LEDs illuminate green.
The LEDs remain dark if the gas pressure is <2.7 bar or if the gas hose is not connected.



Connecting the backup gas cylinders for O_2 and N_2O

Even if the workstation is connected to a central gas supply, cylinders must remain on the device as backup supply.

- At the back of the workstation:
  place full cylinders in the cylinder holders and secure them into position.

1 Screw the pressure reducing adapters onto the cylinder valves.

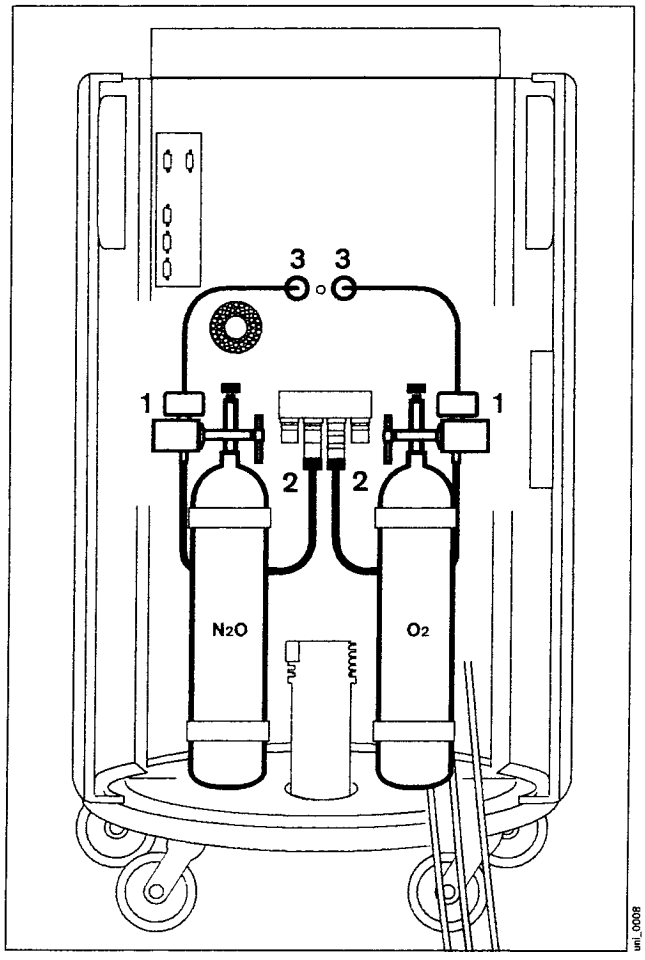
2 Screw the gas hoses into the ports at the back of the gas supply block.

3 Connect the pressure sensor leads.

- Open the cylinder valves.

The LEDs indicating the cylinder pressure status illuminate green. If the LEDs remain dark, check to make sure that the sensor plug and pressure reducer have been connected correctly and that the cylinder pressure is adequate.

- Close the cylinder valves.



If the valves remain open when connected to the central gas supply, gas may be withdrawn from the backup cylinders.

Caution when handling O_2 cylinders

- Do not oil or grease the O_2 cylinder valves or O_2 pressure reducing adapters and do not handle with greasy fingers. **Danger of explosion!**
- The cylinder valves must be opened/closed slowly by hand. Do not use tools.
- If a cylinder valve is leaky or difficult to operate, it must be repaired by an expert.
- **Only use pressure reducing adapters from Dräger.**

Connecting the anaesthetic gas scavenging system

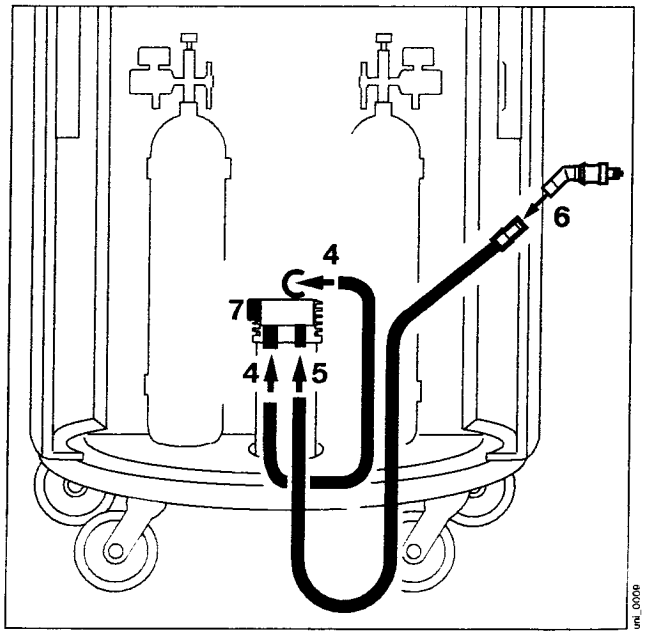
4 Connect the transfer hose to the waste gas port and to the port of the scavenging system.

5 Connect the scavenging hose to the port of the scavenging system.

6 Connect the anaesthetic waste gas probe to the aspirating hose.

7 Ensure that the second connection to the scavenging system is sealed by a screw plug.

- Follow the Instructions for Use included with the anaesthetic gas scavenging system.



Anaesthetic gas scavenging may be connected optionally* to the left-hand side of the workstation.

* not yet available

Connecting the endotracheal aspiration system (optional)

- Prepare the endotracheal aspiration system according to the Instructions for Use included with the system.

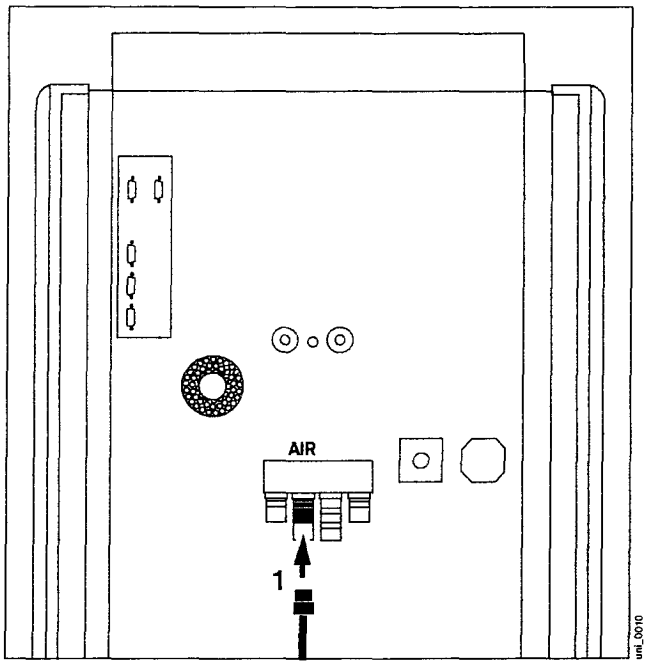
Depending on the aspiration version used:

If Air is used as driving gas:

1 Secure the Air connecting hose of the endotracheal aspiration system to the Air outlet on the back of the gas supply block (optional) or directly to the central gas supply (ZV) for Air.

For vacuum-driven aspiration:

- Connect the vacuum hose of the endotracheal aspiration system directly to the wall supply point.
- Check that the endotracheal aspiration system is ready for operation according to the Instructions for Use included with the aspiration unit.



Connecting the power supply

Connecting auxiliary systems

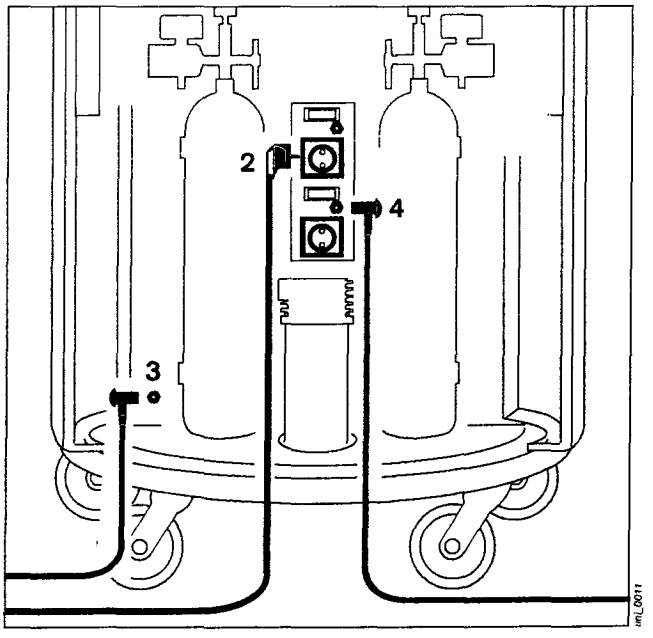
2 Connect to auxiliary sockets at the back of the workstation.

The auxiliary sockets are not powered by the uninterruptible power supply UPS in the event of a power failure!

Do not connect HF surgical devices to the auxiliary sockets!

Connecting equipment to the auxiliary power sockets may cause the patient leakage current to rise above the permitted values if a protective earth conductor should fail. The risk of electric shock cannot be excluded in such cases. Additional power adapter sockets must not be connected to the auxiliary sockets.

Note the maximum power consumption of the auxiliary systems (refer to the corresponding Instructions for Use).



Equipotential bonding

e.g. for intracardial or intracranial operations.

3 Connect one end of the earth cable to one of the connecting pins located at the back of the workstation.

- Connect the other end of the earth cable to the specified equipotential bonding point, e.g. on the operating table or ceiling lamp.

4 Connect equipotential bonding to auxiliary systems.

Connecting the power supply

The mains voltage must correspond to that specified on the rating plate at the back of the workstation.
Voltage range: 85 to 264 V.

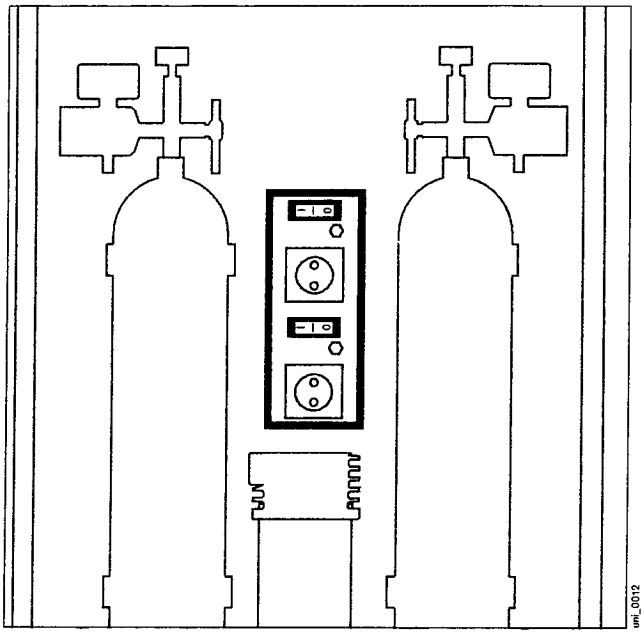
- Plug the mains plug into the wall socket.
  LED »⏻« on the front of the workstation lights up green.

Fuses for supplementary socket outlets

When using the two-fold socket strip with automatic circuit-breakers:

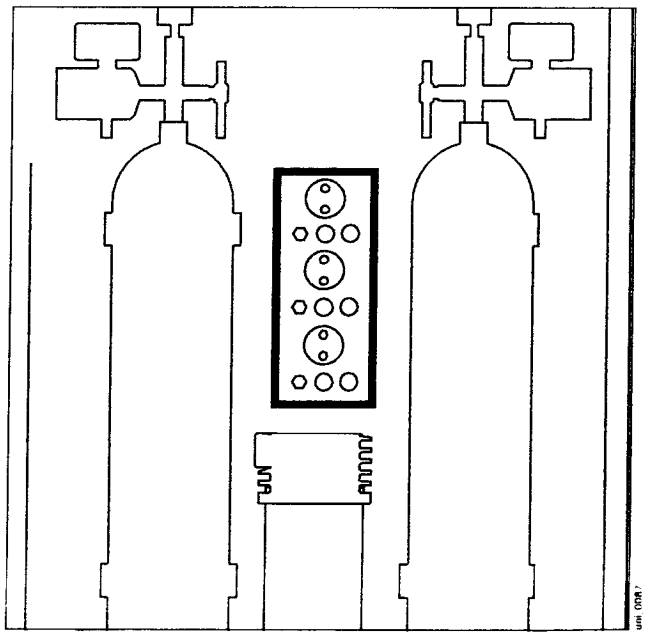
If a fuse is tripped (position 0):

- Remedy the fault, then
- Press the switch on the automatic circuit-breaker into position I. The fuse is now active again.



When using the three-fold socket strip* with safety fuses:

- Remedy the fault, then
- have the safety fuse replaced by an electrician.



* Only available in countries with socket outlets conforming to DIN 49440

Getting started

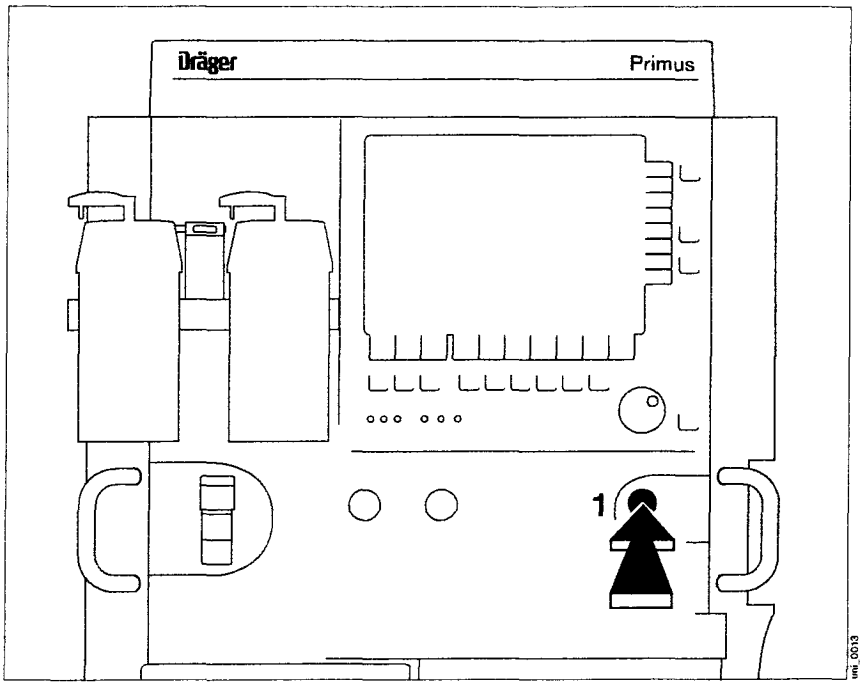
Getting started

Checking the workstation according to the check list

Preconditions:
The workstation must be prepared as described, "Hygiene and care" on page 128 to page 139 and assembled ready for operation as described from "Assembly" on page 140 to page 144. The gas supply and power supply must be connected.

Power on

1 Switch on Primus: press the power switch » ■○ ⊙▬ « an acoustic tone sounds.
After approx. 15 seconds, all LEDs and the loudspeaker are tested by Primus.



The initial screen appears after approx. 20 seconds. Primus now loads its software and tests its internal memory.

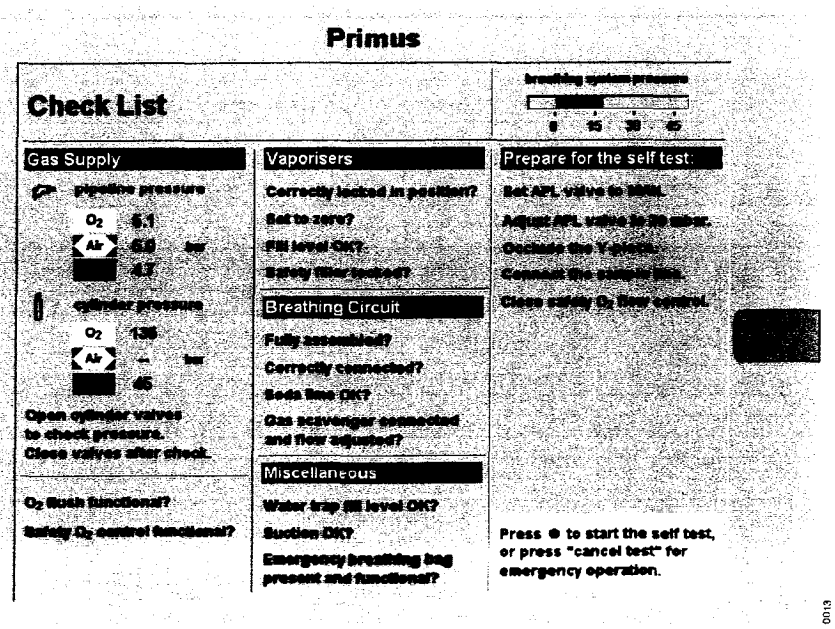
The check list is displayed after about 35 seconds.

- Check the components as instructed in the check list on the screen.

If the self test has to be interrupted, e.g. for a quick start in an emergency:

- Press the »**cancel test**« key. See "Emergency start", page 42.

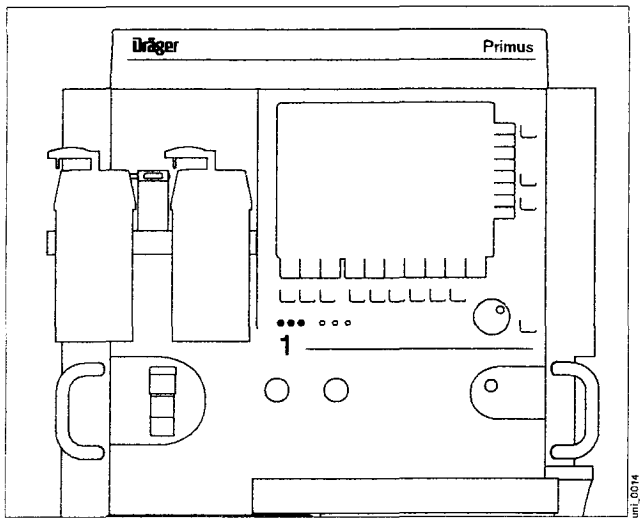
Cancelling the self test may lead to limited functionality or failure. Greater attention is required during operation if the self test has been interrupted.



Central gas supply ZV

Gas pressures:

1 All LEDs light up green if pressure values are available and are between 2.7 and 6.9 bar.
The LEDs remain dark if the gas pressure is <2.7 bar or if the gas hose is not connected.



Backup gas cylinders

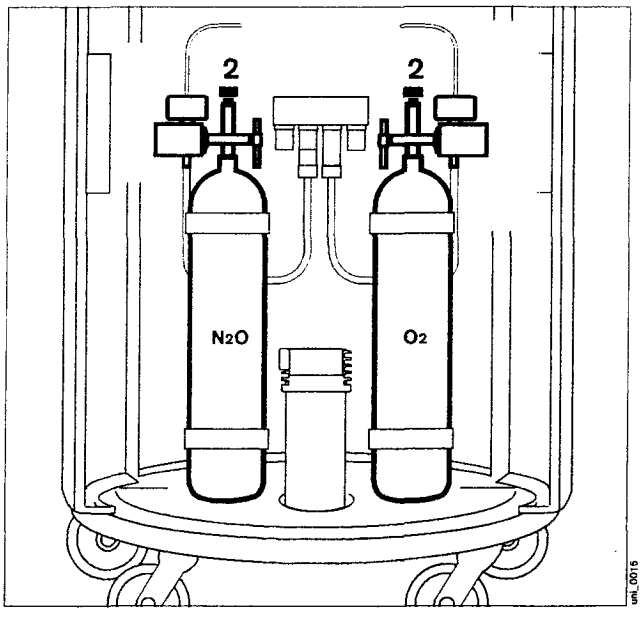
2 Slowly open the cylinder valves.

LEDs light up green when
O_2 pressure is over 20 bar
and
N_2O pressure is over 10 bar*:

The cylinder pressures are shown on the screen.

2 Close the cylinder valves again.

If the valves remain open when connected to the central gas supply, gas may be withdrawn from the backup cylinders.



The gas supplies available can be selected in the standby configuration (see page 113). Only these gas supplies will then be checked during the self test and an alarm issued in the event of a fault during normal operation. The central oxygen supply and the O_2 cylinder cannot both be configured as not present at the same time.

Open the backup gas cylinders which have been configured as present for the self test and then close them.

O_2 must be connected for the following self test.

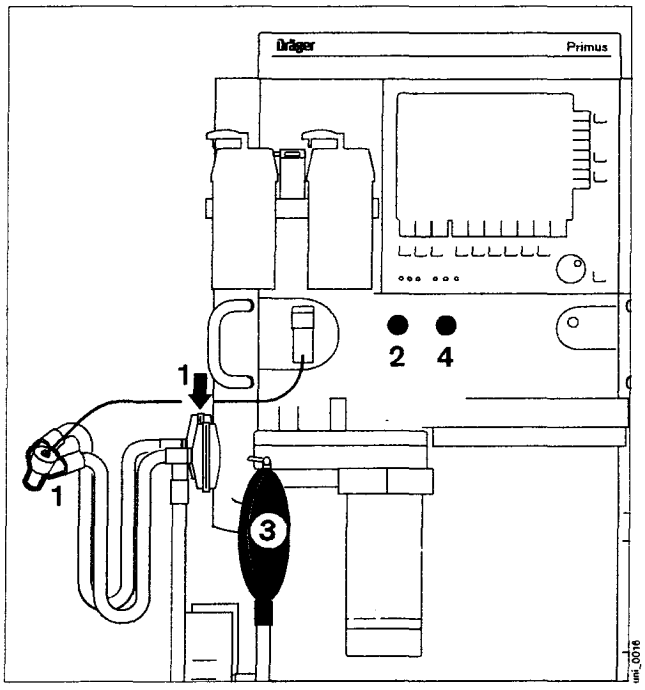
* See page 181 for precise details on cylinder pressures.

O2 flush

1 Close the Y-piece = plug firmly onto the cone.
2 Press the »**O2 +**« button.
3 Breathing bag inflates with an audible flow.

O2 emergency delivery

1 Close the Y-piece = plug firmly onto the cone.
4 Press the »**Safety O2**« knob to disengage for O2 emergency delivery and turn to adjust flow.
3 Breathing bag inflates with an audible flow.
4 Turn »**Safety O2**« knob back to its original position to discontinue emergency delivery and press it inwards.



Emergency ventilating bag

Example: Dräger Resutator 2000

- Ready for operation.

Vaporisers

Note the corresponding, individual Instructions for Use when using the Vapor 19.3, Vapor 2000 or Devapor.

The Vapor 2000 is shown and described here.

1 Locking lever points to the left = locked.
- Vapor is mounted straight and seated securly on the vaporiser connection.

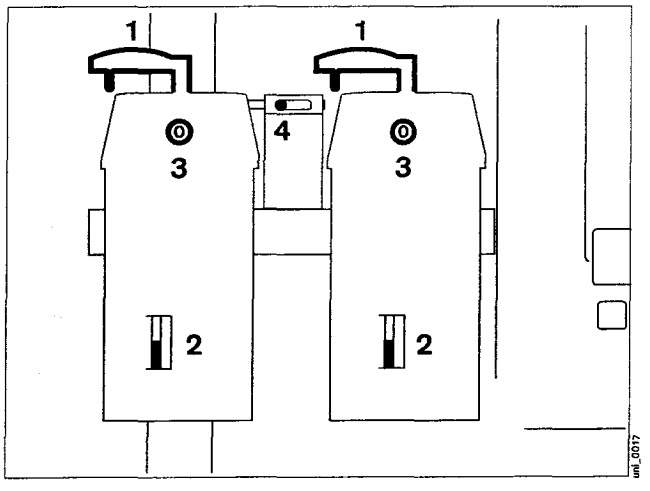
2 Filling level is adequate.
3 Handwheel set to »0« and engaged.
4 Unused vaporiser is locked by means of interlock slide (example: left-hand Vapor locked).

After filling or changing the vaporiser:

- Perform leak test, see page 73.

Note vaporiser flow limits!

Example Vapor 2000:
0.25 to15 L/min
or
0.25 to10 L/min at a concentration >5 %



Breathing system

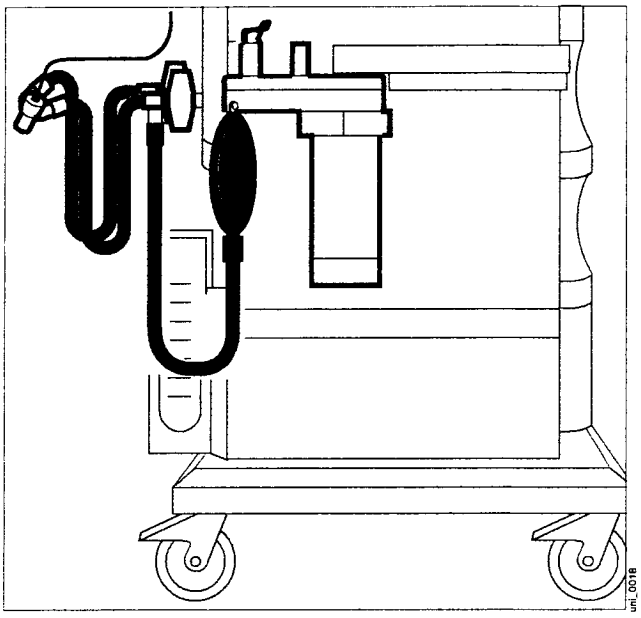
- Complete and engaged, hoses firmly plugged in.
- Insert optional filters.
- Fresh soda lime, without violet discoloration.

Drain any water which may have collected in the ventilator diaphragm.

Correct operation of the workstation will be impaired by condensation flowing back into the breathing system and ventilator diaphragm.

- Install water traps in the hoses.

Care must be taken when connecting the patient.
Risk of strangulation!

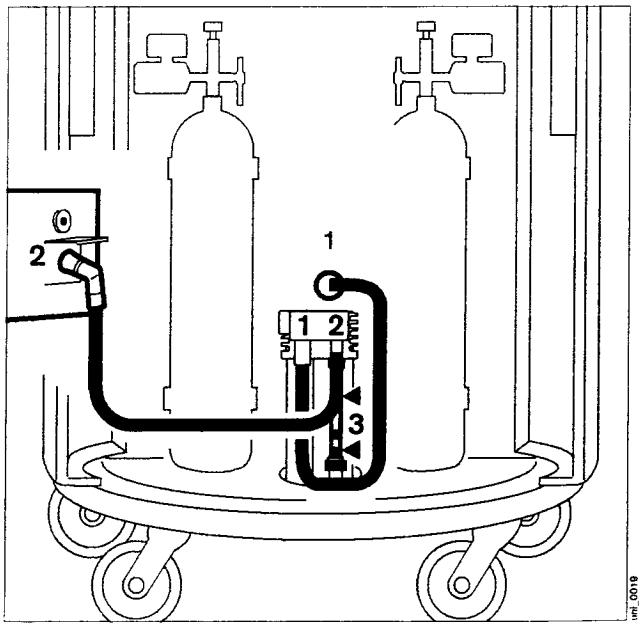


AGS anaesthetic gas scavenging system

1 The transfer hose from the waste gas port must be connected.

2 The scavenging hose must be connected, the anaesthetic waste gas probe must be plugged into the Dräger wall socket and the indicator must be green.

3 The float must be between the two marks.

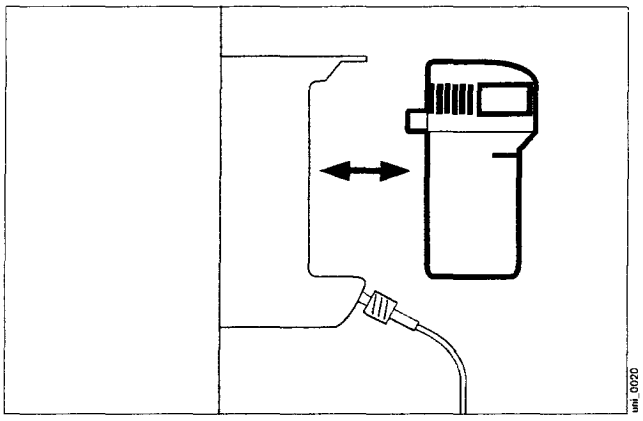


WaterLock water trap

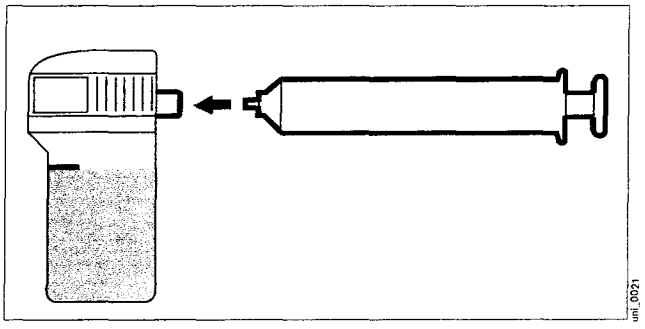
- Check filling level in water trap.

When the level reaches the mark:

- Pull the water trap out of its holder and empty it.



- Insert an empty syringe without canula, at least 20 mL, into the connector.
  Extract water, remove syringe and dispose of full syringe with ordinary domestic waste.



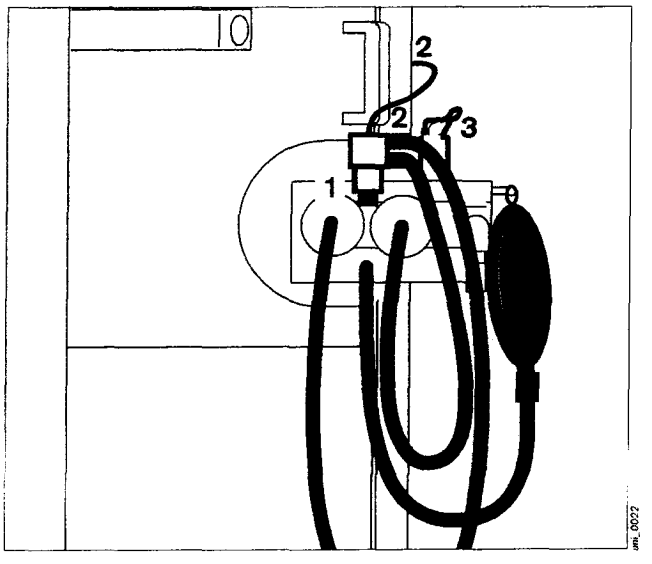
- Slide the water trap back into its holder – until it engages tangibly.

The water trap must not be used in combination with a medication nebulizer!

See page 147 for additional information on using the water trap.

Preparing Primus for the self test

1 Close the Y-piece = plug firmly onto the cone.
2 Ensure that the sample line is connected to the Y-piece and to the water trap.
3 Set APL valve to position »**MAN**« and to 30 mbar.



Self Test

If all points on the check list are OK:

- Confirm = push the rotary knob.
  The self test is started.
  It proceeds automatically and takes approx. 5 minutes.

Primus carries out the automatic tests and actions indicated on the screen.

The progress made in the self test is indicated by the bar graph.

Test results are colour-coded and displayed:

– Green: test completed successfully.
– Yellow: workstation can be used with restrictions.
– Red: test must be repeated, malfunction, operation impossible or not permitted.
  The test can no longer be cancelled.

The clock symbol »🕘« indicates which test step is momentarily being tested.

Interruption of the test is symbolized by an exclamation mark.

Errors discovered during the self test and an advisory window with information on how to remedy the problem are displayed on the screen.

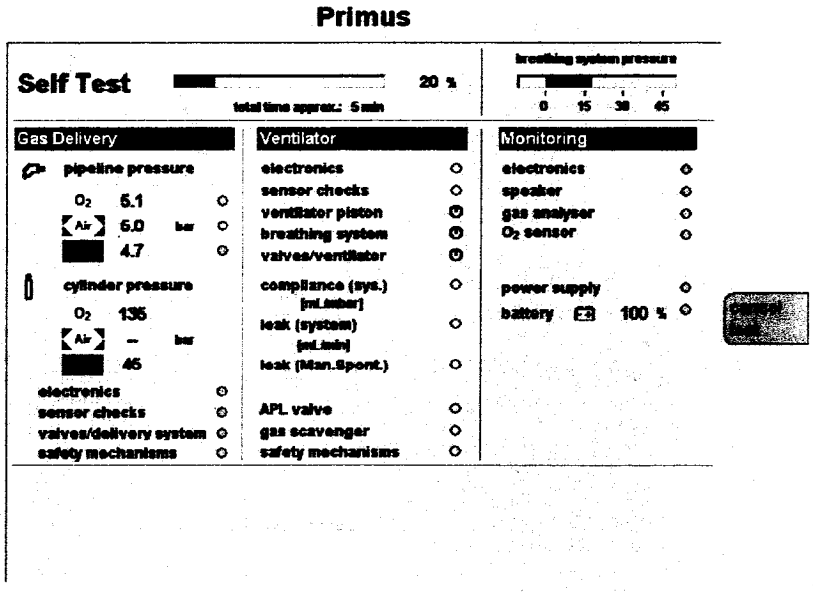
Functions highlighted in yellow can be confirmed with the »**accept.**« soft key which is then displayed, e.g. speaker failure. The workstation starts operation without this function.

Functions highlighted in yellow may not meet with the specified technical data.

Errors highlighted in red must be remedied before starting, for instance if there is no O2 supply.

The error must be remedied as quickly as possible!

If the flow sensor, oxygen sensor, or gas sensor is not operational, adequate substitute monitoring must be ensured before starting the workstation.



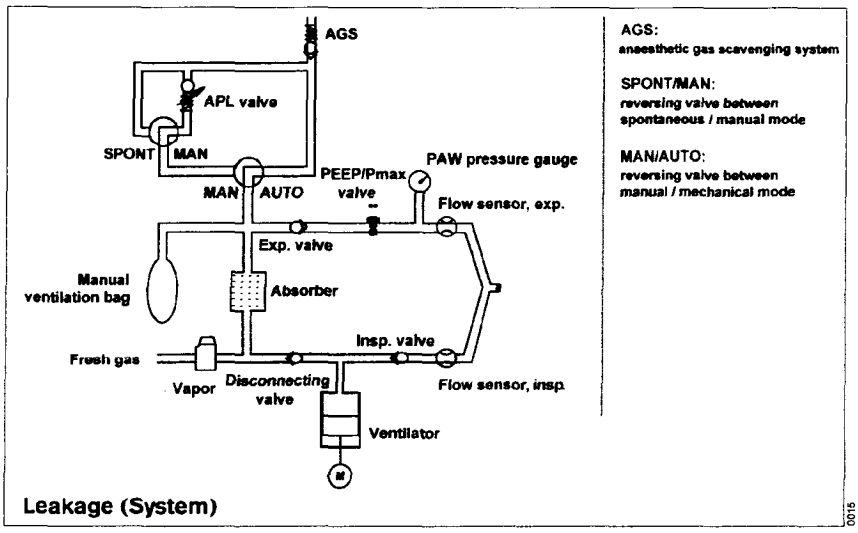
System compliance

Primus determines the current compliance of the patient system with filters, hoses and a Y-piece. Depending on the breathing hoses used, the inspiratory system compliance is approx. 1.2 mL/mbar.

Leakage

Leakages are tested in the mechanical subsystem and in the complete system (see gas diagrams).

Leakage (system):	Leak test in the mechanical ventilation branch Indication of the leakage value in mL/min and red/yellow/green test result indicator
Leakage (Man. Spont.):	Leak test in the complete system Indication of leakages >150 mL/min in mL/min and red/yellow/green test result indicator



Leakage (System)

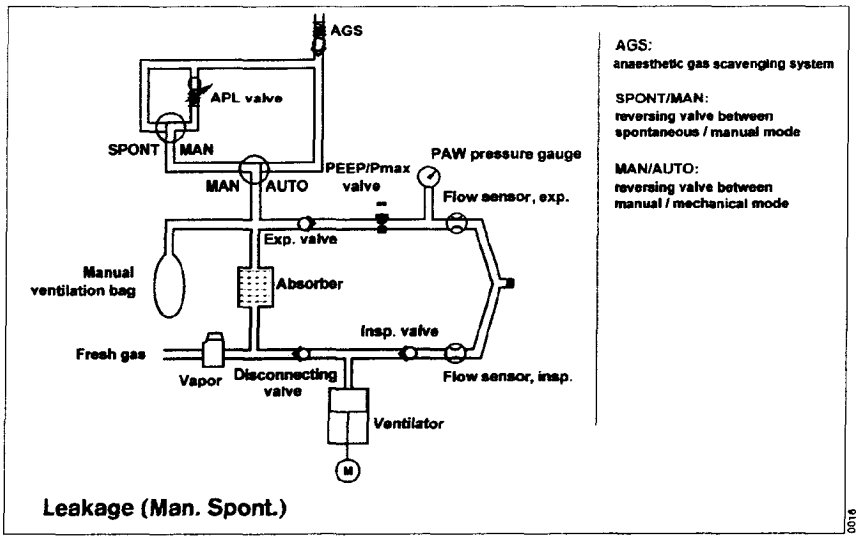
Primus determines the current leakage of the breathing system and breathing hoses. The system tolerates leakage of up to 150 mL/min.

For leaks of more than 150 mL/min:

- Check the components of the breathing system, repair any leaks and repeat the leak test.

Possible causes of leaks include:

- Damaged breathing hoses
- O2 sensor not connected or incorrectly connected
- Sample line for gas measurement not connected
- Water trap not inserted
- Breathing bag/diaphragm defective
- Vaporiser not connected correctly/ filling device open
- Absorber not firmly screwed into place
- Flow sensor not firmly screwed into place
- Breathing system not assembled and fitted correctly
- Microbial filters not connected securely



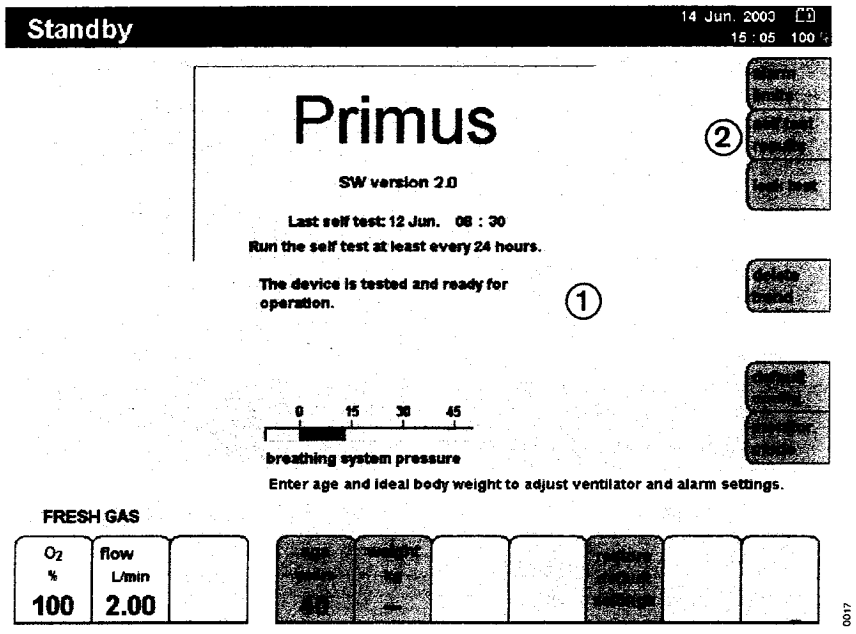
Leakage (Man. Spont.)

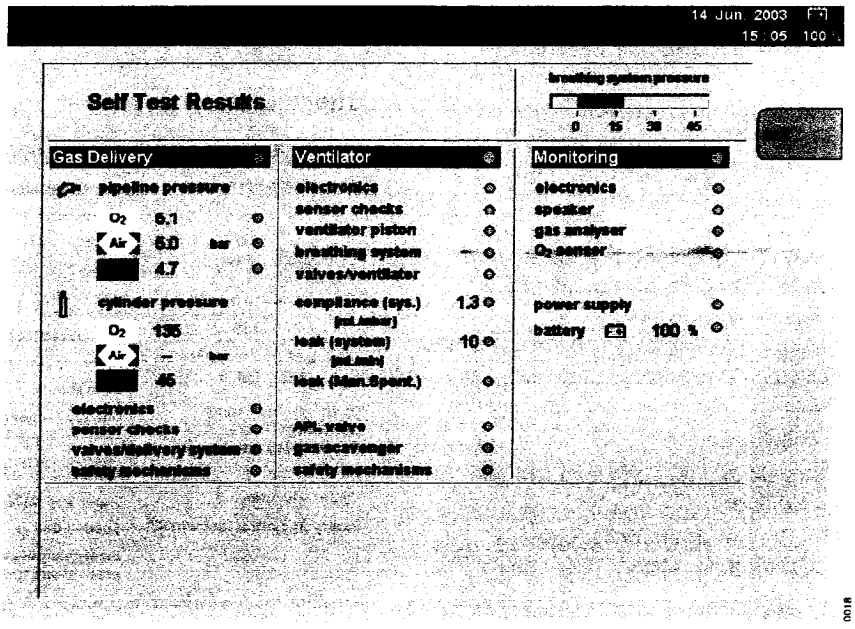
Primus switches to standby after the self test.

1 Note the information in the complete test results and the instructions for further procedure.
2 All information relating to the self test can be viewed while in standby by pressing the soft key »**self test results**«.

Display:

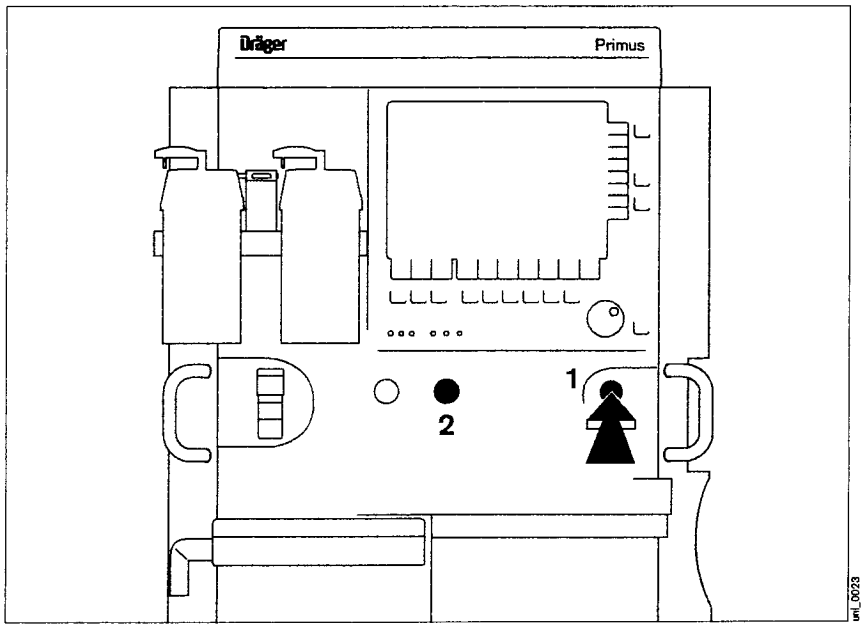
- Press the soft key »**self test results**«.





Emergency start

This procedure should only be used in emergency situations!



1 Switch on the workstation.

- Check that both vaporisers are closed.

2 Set »**Safety O2**« knob for O2 emergency flow to the required O2 flow, between 0 and 12 L/min.

- Start manual ventilation.
- Wait for the software to be internally loaded and for the electronics to be tested. The check list appears after about 35 seconds.

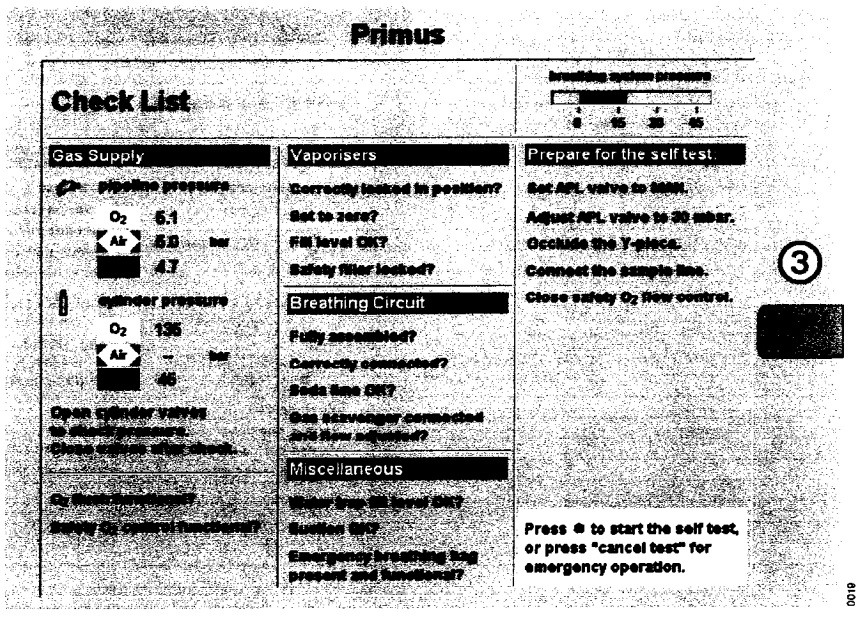
Display:

3 Press the soft key »**cancel test**«.

The device only runs through a minimal self test for about 10 seconds. Manual ventilation is interrupted for this time, but spontaneous breathing can continue.

Primus is ready for operation about 1 minute after initiating. The O2 sensor is completely calibrated after about 2 minutes.

The leakage and compliance test is not performed. The accuracy levels specified in the chapter "Technical data" cannot be guaranteed.



To prevent abuse of this feature, the self test can only be cancelled ten times in succession.

After ten cancellations, the self test cannot be cancelled the next time that Primus is started and a complete self test must be carried out.

Cancelling a test can lead to limited operation.

- **Greater attention is required during operation.**

The workstation switches to the standby mode after completing the minimal self test.

To start Primus:

- Turn the O2-safety knob for emergency metering to 0 and press it.

Select the fresh-gas setting and ventilation mode, see "Operation", page 46.

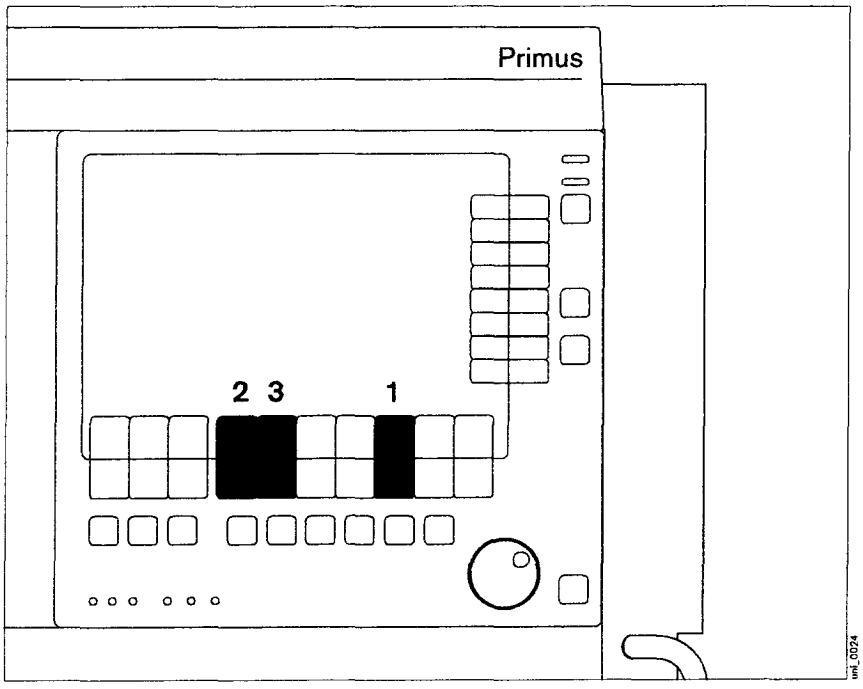
Operation

Operation

Loading default settings

The default settings for gas metering, ventilation and alarms are loaded in the standby screen and can be modified in the standard configuration if necessary.

These default settings are valid whenever Primus is switched on. They can be changed and set as required for the specific hospital concerned, see "Configuring the default settings" on page 106.



1 Press the soft key »**restore default settings**« and press the rotary knob to confirm.

Entering the patient's age

The set age influences the calculation of the MAC value, the volumeter scale, the V-axis of the loops and ventilation monitoring, as well as the alarm limits for SpO2 measurement (optional) during operation. In addition, the trigger sensitivities and software algorithms for suppressing artefacts are also modified, thus influencing the quality of ventilation in modes supporting spontaneous breathing.

2 Press the soft key »**age**«.

- Set and confirm the age using the rotary knob.

Entering the patient's ideal body weight (optional)

The patient's ideal body weight describes that proportion of body mass of relevance for setting the ventilation parameters. (The patient's body weight minus the assumed excess fat.)

The set ideal body weight influences the ventilator default settings for tidal volume VT and frequency Freq. as well as the alarm limits for the expiratory minute volume MV during operation.

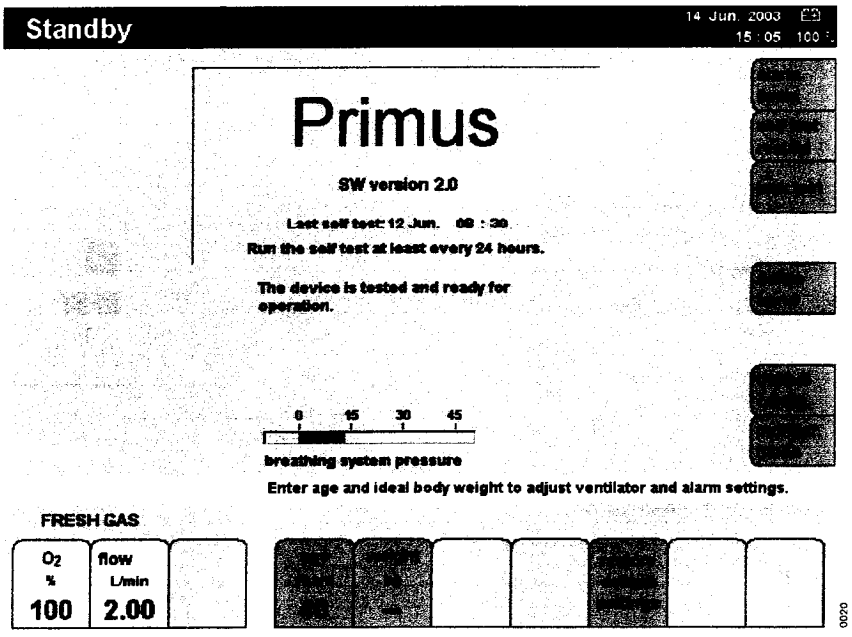
3 Press the soft key »**weight**«.

- Set and confirm the weight using the rotary knob.

Setting fresh-gas concentrations

– O_2 concentration »**O_2 %**«
– Fresh-gas flow »**flow L/min**«

The fresh-gas settings can be changed before selecting a ventilation mode. Fresh gas does not flow in the standby mode (soft keys = grey). The fresh-gas flow is not enabled until a ventilation mode has been started (soft key = green).



Adjustment ranges and default settings upon delivery

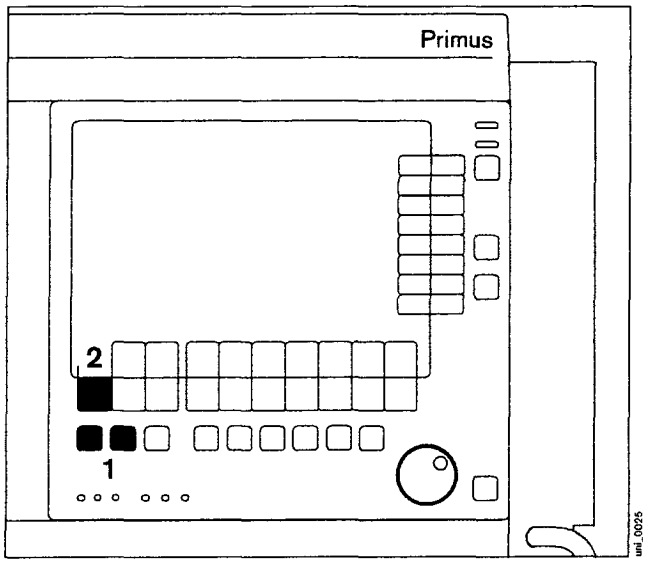
Fresh-gas parameters	Adjustment range	Default setting upon delivery
Carrier gas	Air or N_2O	Air
O_2 %	21 to 100 for carrier gas Air 25 to 100 for carrier gas N_2O	100
Fresh-gas flow L/min	0.2 to 18	2

Selecting the carrier gas

1 Press the hard key »**N2O**« or »**Air**«.
The green LED in the key flashes.

- Push the rotary knob to confirm. The green LED illuminates steadily.

The selected fresh-gas components are displayed on the screen.



Setting the O2 concentration

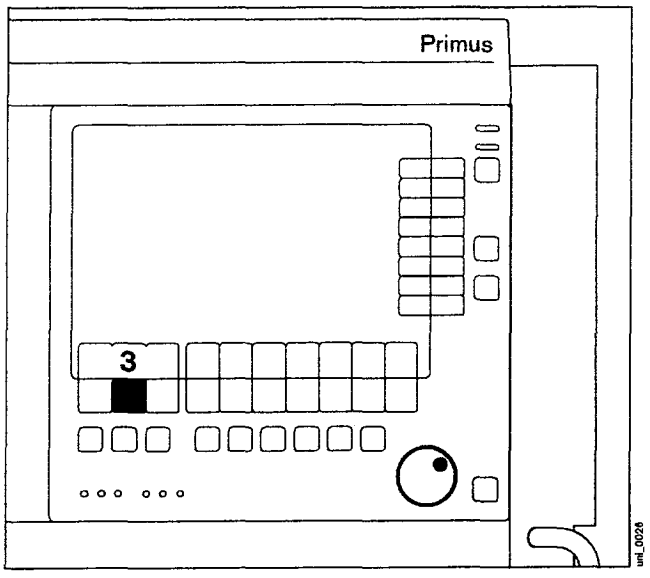
2 Press the soft key »**O2 %**«.
The key field appears yellow.

- Set and confirm the O2 concentration using the rotary knob.

Setting the fresh-gas flow

3 Press the soft key »**flow L/min**«.
The key field appears yellow.

- Set and confirm the fresh-gas flow using the rotary knob.

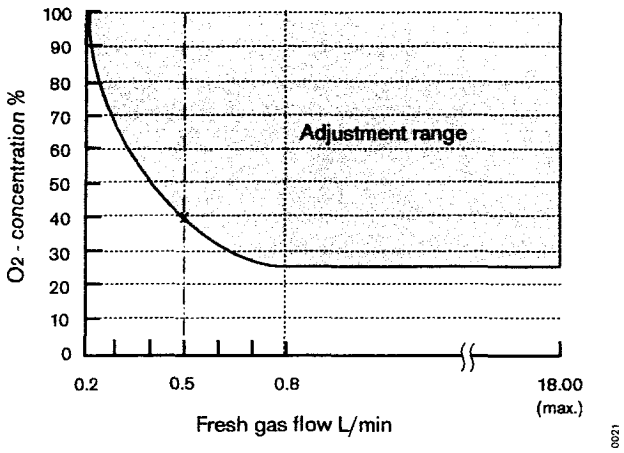


SORC (Sensitive Oxygen Ratio Controller)

Primus is fitted with an electronic O_2 minimum delivery system to avoid hypoxic gas mixtures when N_2O is selected as carrier gas. The minimum O_2 concentration is limited to 25 % for fresh-gas flows of more than 0.8 L/min.

For fresh-gas flow settings below 0.8 L/min, the O_2 concentration is automatically increased to a value corresponding to an O_2 flow of 200 mL/min. If this control system is activated, the O_2 % value is also highlighted with a yellow background in addition to the active setting. The minimum oxygen delivery consequently equals 200 mL/min when using N_2O as carrier gas.

The SORC function is not active when Air is selected as carrier gas and 100 % Air can be metered throughout the entire flow range.



Fresh-gas failure detection

– During operation, Primus checks that the piston cylinder unit has a sufficient level of fresh gas.

If the message "**FGAS LOW OR LEAK**" appears:

- Increase the fresh-gas flow.

Setting the Vapor

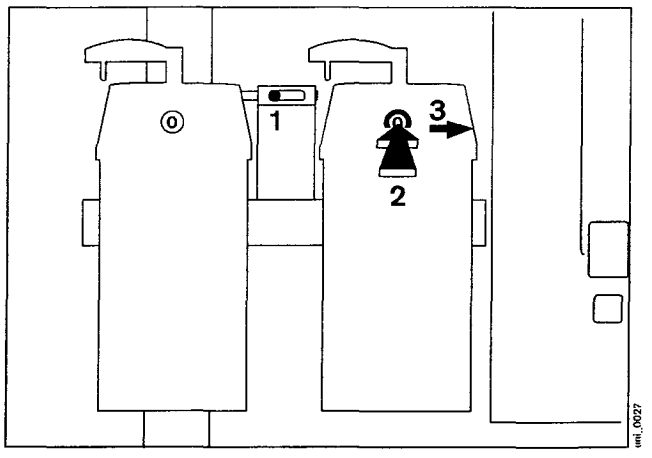
1 Lock the unused vaporiser = slide lever completely towards the unused Vapor (example: left-hand Vapor locked).

When the handwheel is set to »T«:

2 Press 0 key, engage handwheel at 0.
Wait 5 seconds for pressure to balance.

3 Press 0 key and

3 turn handwheel anticlockwise to set the required anaesthetic gas concentration.

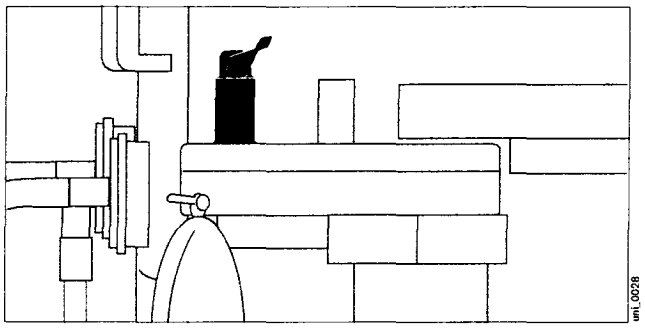


Ventilation

Ventilation

Man. Spont. ventilation mode

Choose between manual ventilation **Man.** and spontaneous breathing **Spont.** on the APL pressure limiting valve.

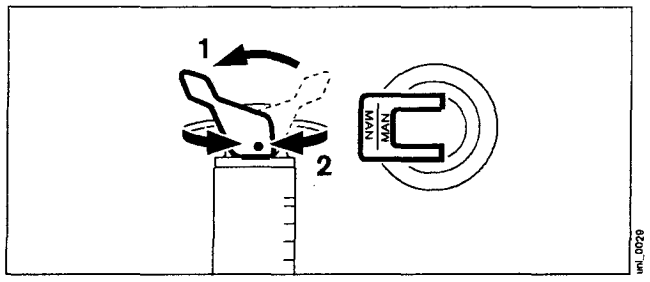


Manual ventilation

1 Set the lever of the APL pressure limiting valve to »**MAN**« and

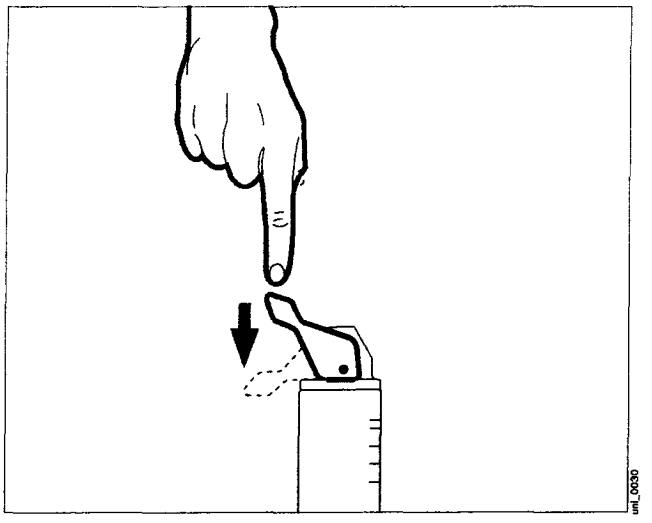
2 set the pressure limit = rotate lever.

The patient can be ventilated by hand via the manual ventilation bag. The pressure is limited to the set value.



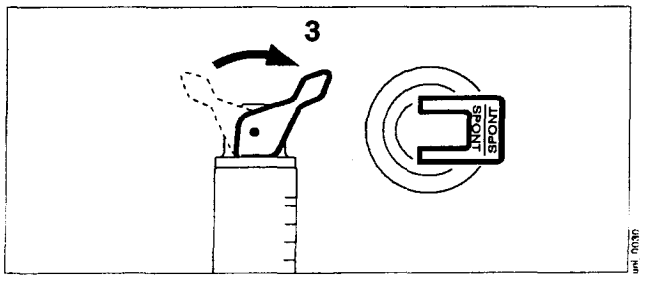
To relieve the pressure quickly:

- Press the valve lever.



Spontaneous breathing

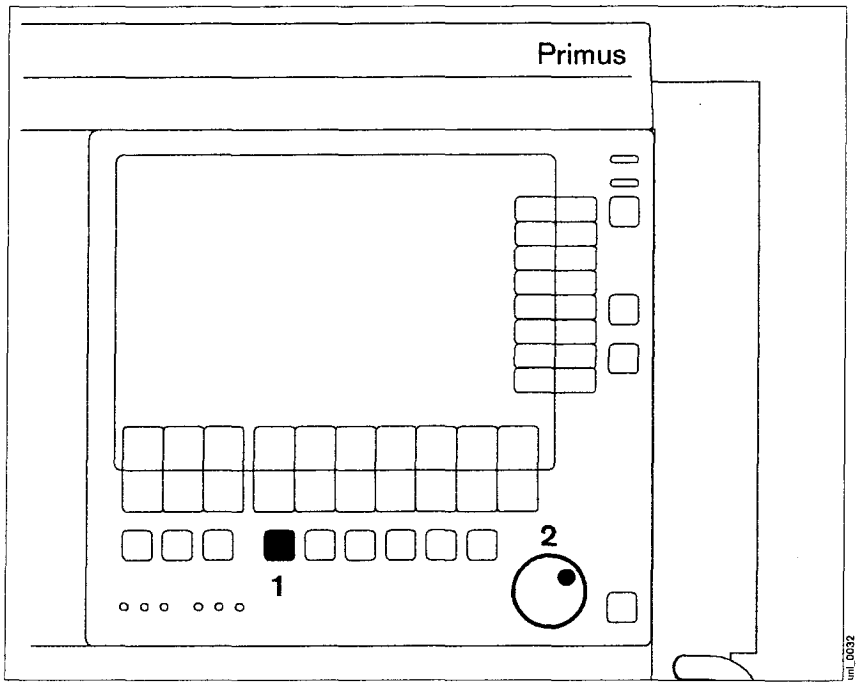
3 Set the lever of the APL pressure limiting valve to »**SPONT.**« The pressure limiting valve is now open for free spontaneous breathing, regardless of the set pressure limit.



Start manual ventilation/ spontaneous breathing

1 Press the »**Man. Spont.**« key; its LED and the status line flash.

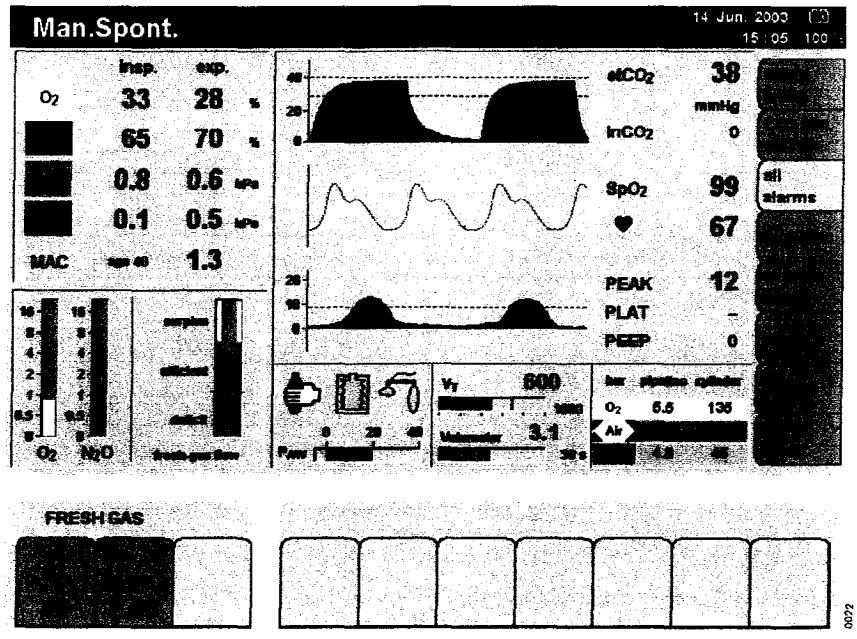
2 Confirm using the rotary knob.



Display (example):

Certain alarms are disabled automatically in the ventilation mode **Man. Spont.** in order to avoid artefacts.

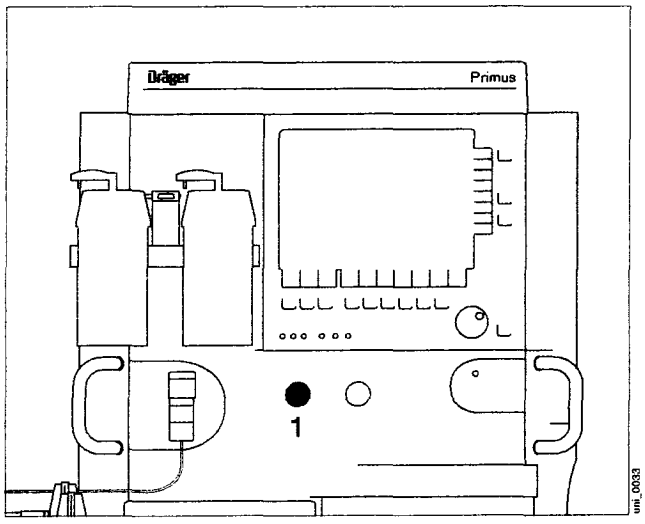
See page 97 for a list of alarms which are active in the **Man. Spont.** mode.



O2 flush

– For flushing and rapidly filling the breathing system and breathing bag with O2 while bypassing the vaporiser.

1 Push the »O2 +« button. O2 flows into the breathing system without anaesthetic gas as long as the button is pushed in.

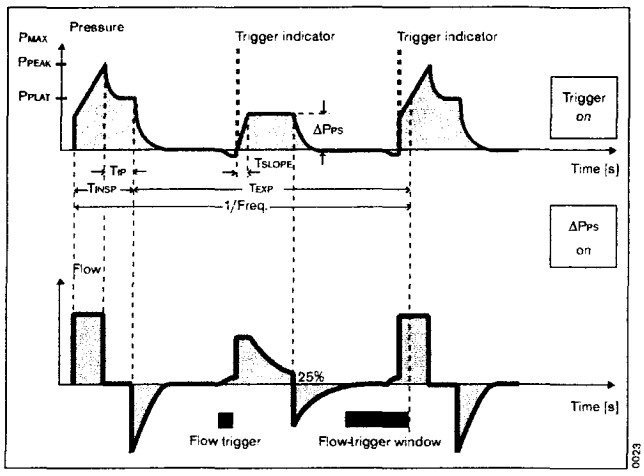


Controlled ventilation

Volume mode, volume-controlled ventilation

Volume-controlled ventilation mode with fixed mandatory tidal volume VT and frequency Freq., as well as with optional synchronization activation and variable pressure support for spontaneous breathing efforts (optional).

The respiratory cycle is defined through the frequency Freq., the inspiratory time TINSP, the magnitude of the inspiration flow, the inspiratory pause time TIP:TINSP and the tidal volume VT. Synchronization and pressure support are controlled by the sensitivity of the flow trigger and the level of ΔPPS. The maximum time interval for controlled ventilation is set via the frequency. In order to maintain a constant frequency, a time interval triggered prematurely is compensated in the next cycle.



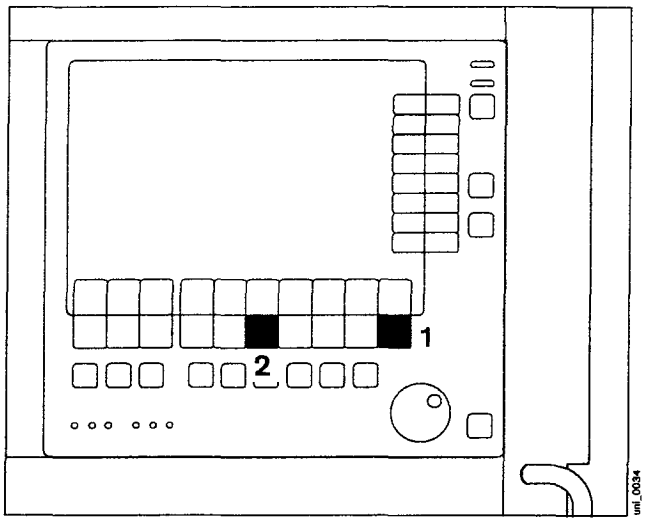
Synchronized volume-controlled ventilation

Synchronization is activated by entering a value for the trigger sensitivity. This can be defined via the soft key »**extra settings**«.

1 Press the soft key »**extra settings**«. The trigger sensitivity »**Trigger**« is displayed.

2 Press the soft key »**Trigger**«. The last value set appears as default value when the key is activated.

- Set and confirm the trigger sensitivity with the rotary knob. When finally confirmed, the indication »**sync**« in the status area of the ventilation mode lights up steadily instead of flashing.



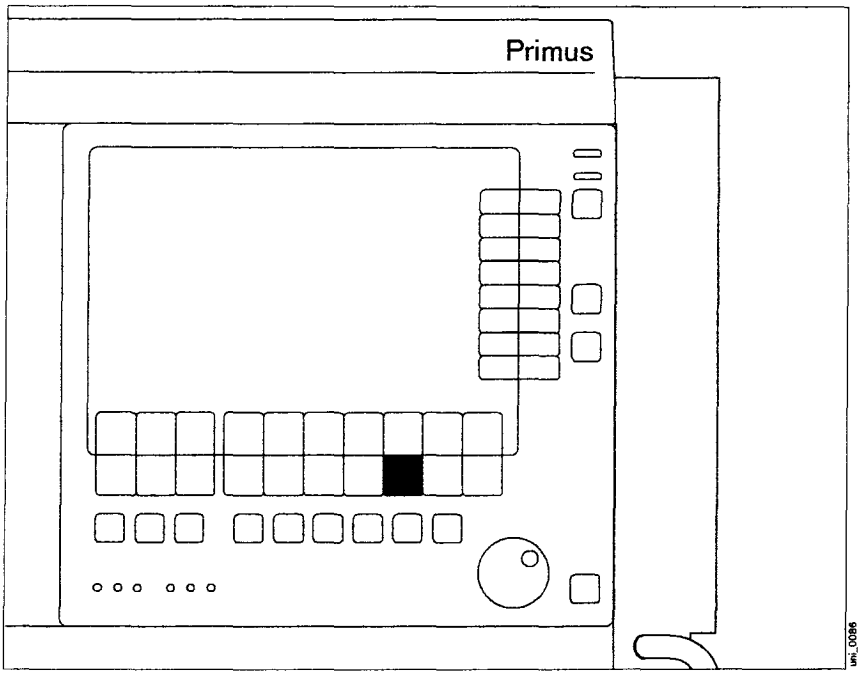
A ventilation stroke triggered by the patient is represented by a continuous vertical black line in the pressure curve and in the flow curve (trigger indicator). The active window for the stroke triggered by the patient corresponds to the last 25 % of the applicable expiratory time.

The actual trigger status is shown above the keys for the ventilation parameters.

Synchronized volume-controlled ventilation with pressure support (optional)

Pressure support is activated during volume-controlled ventilation by entering a value for the level of pressure support. This can be defined via the soft key »ΔPPS«.

- Press the soft key »ΔPPS«. When the key is activated, the last value set for pressure support appears as the default value, together with the last value set for the trigger sensitivity above it.
- Set and confirm the value for pressure support with the rotary knob. When finally confirmed, the *indication* »**PressSupp**« *in the status* area of the ventilation mode lights up steadily instead of flashing.

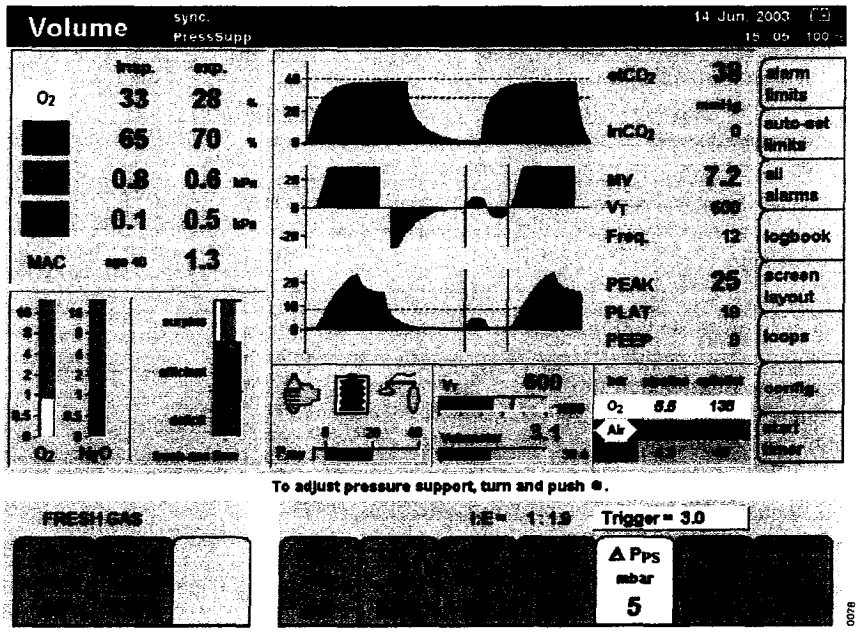


If the patient was being ventilated without synchronization when pressure support was activated, synchronization will now be activated automatically with the last trigger setting used.

Synchronization is maintained with the set value when pressure support is deactivated and set to »OFF«.

Pressure support is automatically deactivated when the trigger is deactivated and set to »OFF«.

The actual trigger status is shown above the keys for the ventilation parameters.



Adjustment ranges and default values upon delivery

Ventilation parameters	Adjustment range	Default value upon delivery[1)]
Pressure limitation PMAX [mbar]	10 to 70 min. PEEP +10	40
Tidal volume VT [mL]	20 to 1400[2)]	600
Frequency Freq.[3),4)] [1/min]	3 to 80	12
TINSP[4)] [sec.]	0.2 to 6.7	1.7
Insp. pause time : insp. time TIP : TINSP [%]	0 to 60	10
PEEP [mbar]	0 to 20 max. PMAX – 10	0
Trigger sensitivity »Trigger« [L/min]	OFF, 0.3 to 15	3.0 (Press. Supp. Mode) OFF (Vol./ Press. Mode)
Pressure support »ΔPPS«[5)] [mbar]	OFF, 3 to 50 max. PMAX–PEEP	5 (Press Supp. Mode) OFF (Vol./ Press. Mode)
Rise time «TSLOPE« [sec.]	0.0 to 2.0	0.0

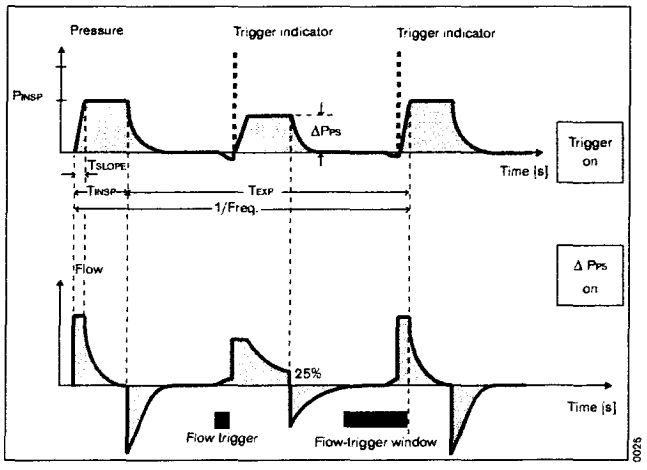
1) The default values can be set specifically for the hospital concerned, see page 106.
2) Optionally 10 to 1400 mL.
3) Depending on the configuration, the inspiratory time TINSP can be automatically changed together with adjustment of the frequency so that the resultant ratio of inspiration to expiration I:E remains constant. Only applies if trigger = OFF, see "Ventilator and gas delivery" on page 113.
4) The resultant ratio of inspiration to expiration I : E is also displayed in parallel.
5) Optional.

Pressure mode, pressure-controlled ventilation

Pressure-controlled ventilation mode with fixed pressure limitation PINSP and frequency Freq., as well as with optional synchronization activation and variable pressure support for spontaneous breathing efforts (optional).

A continuous pressure is applied to the patient during the inspiratory time TINSP. The rate at which the pressure curve rises is pre-set via the rise time TSLOPE. Synchronization and pressure support are controlled by the sensitivity of the flow trigger and level of ΔPPS. The maximum time interval for controlled ventilation is set via the frequency. In order to maintain a constant frequency, a time interval triggered prematurely is compensated in the next cycle.

Changes in lung compliance and ventilation parameters influence the tidal volume.



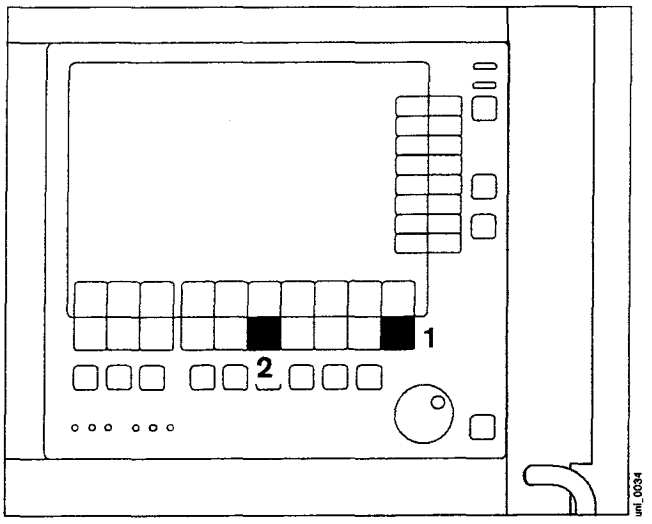
Synchronized pressure-controlled ventilation

Synchronization is activated by entering a value for the trigger sensitivity. This can be defined via the soft key »**extra settings**«.

1 Press the soft key »**extra settings**«. The trigger sensitivity »**Trigger**« is displayed.

2 Press the soft key »**Trigger**«. The last value set appears as default value when the key is activated.

- Set and confirm the trigger sensitivity with the rotary knob. When finally confirmed, the indication »**sync**« in the status area of the ventilation mode lights up steadily instead of flashing.



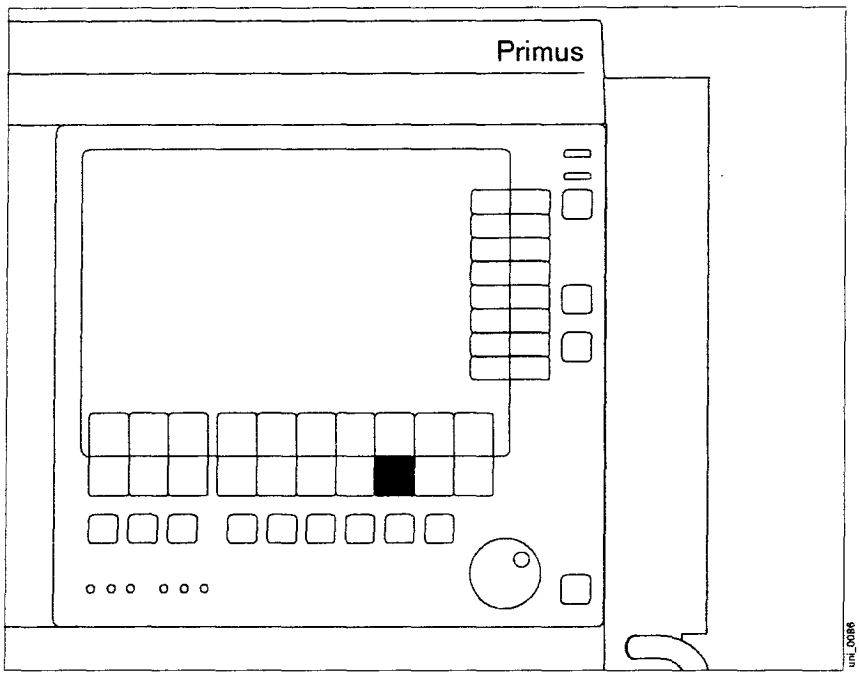
A ventilation stroke triggered by the patient is represented by a continuous vertical black line in the pressure curve and in the flow curve (trigger indicator). The active window for the stroke triggered by the patient corresponds to the last 25 % of the applicable expiratory time.

The actual trigger status is shown above the keys for the ventilation parameters.

Synchronized pressure-controlled ventilation with pressure support (optional)

Pressure support is activated during pressure-controlled ventilation by entering a value for the level of pressure support. This can be defined via the soft key »ΔPPS«.

- Press the soft key »ΔPPS«. When the key is activated, the last value set for pressure support appears as the default value, together with the last value set for the trigger sensitivity above it.
- Set and confirm the value for pressure support with the rotary knob. When finally confirmed, the indication »**PressSupp**« in the status area of the ventilation mode lights up steadily instead of flashing.

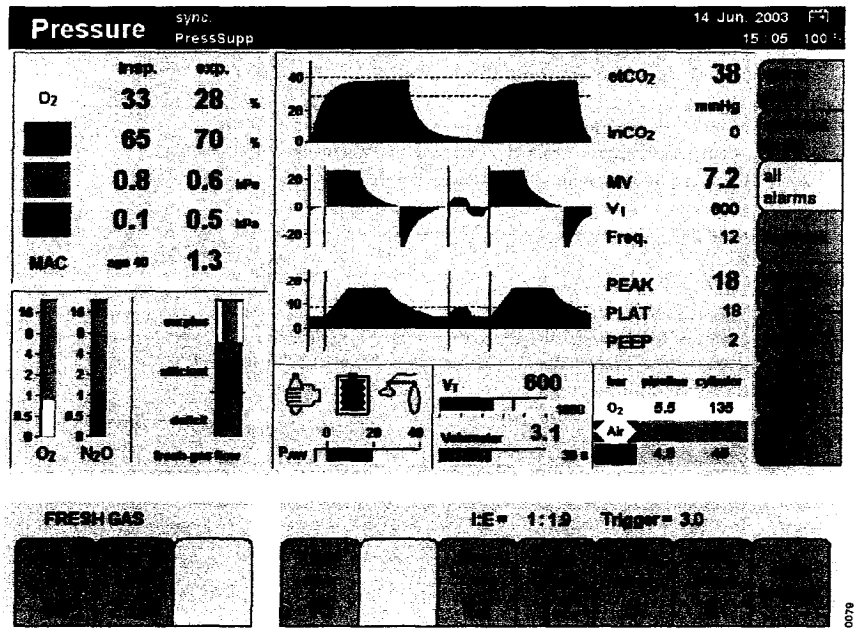


If the patient was being ventilated without synchronization when pressure support was activated, synchronization will now be activated automatically with the last trigger setting used.

Synchronization is maintained with the set value when pressure support is deactivated and set to »OFF«.

Pressure support is automatically deactivated when the trigger is deactivated and set to »OFF«.

The actual trigger status is shown above the keys for the ventilation parameters.



Adjustment ranges and default values upon delivery

Ventilation parameters	Adjustment range	Default value upon delivery[1]
Pressure limitation PINSP [mbar]	5 to 70 min. PEEP +5	15
Frequency Freq.[2),3)] [1/min]	3 to 80	12
Inspiratory time TINSP[3)]	0.2 to 6.7	1.7
PEEP[4)] [mbar]	0 to 20 max. PINSP –5	0
Trigger sensitivity Trigger [L/min]	OFF, 0.3 to 15	3,0 (Press. Supp. Mode) OFF (Vol./ Press. Mode)
Pressure support ΔPPS[5)] [mbar]	OFF, 3 to 50 max. PMAX–PEEP	5 (Press. Supp. Mode) OFF (Vol./ Press. Mode)
Rise time TSLOPE [sec.]	0.0 to 2.0	0.0

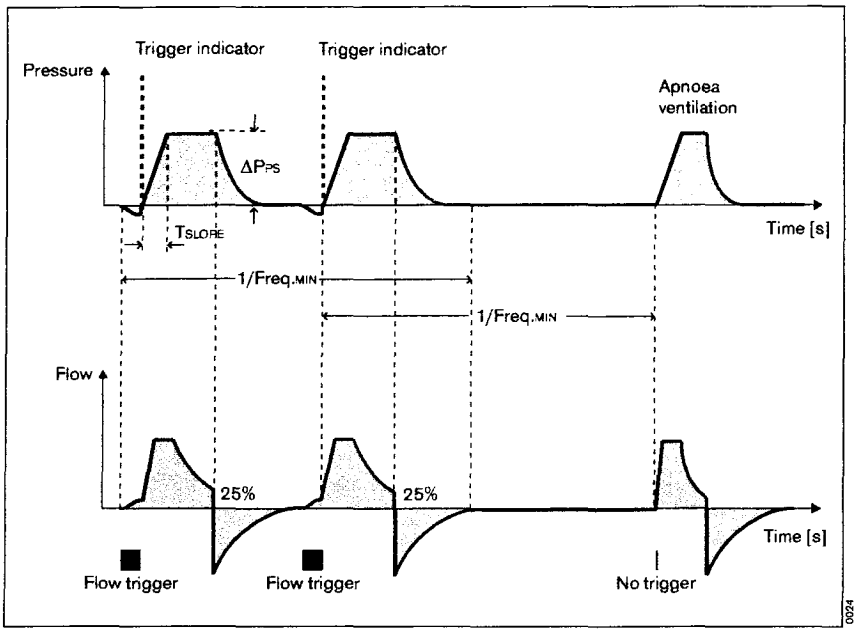
1) The default values can be set specifically for the hospital concerned, see page 106.
2) Depending on the configuration, the inspiratory time TINSP can be automatically changed together with adjustment of the frequency so that the resultant ratio of inspiration to expiration I : E remains constant.
Only applies if trigger = OFF, see "Ventilator and gas delivery" on page 113.
3) The resultant ratio of inspiration to expiration I : E is also displayed in parallel.
4) Depending on the configuration, the pressure limit PINSP can be changed automatically together with adjustment of the PEEP value. See "Starting ventilation mode" on page 64 and "Ventilator and gas delivery" on page 113.
5) Optional.

Pressure support mode (optional)

Pressure-assisted ventilation mode for patients with spontaneous breathing. Synchronization and pressure support for the spontaneous breathing efforts are controlled via the sensitivity of the flow trigger and the level of ΔPPS. The rate at which the pressure curve rises is pre-set via the rise time TSLOPE.

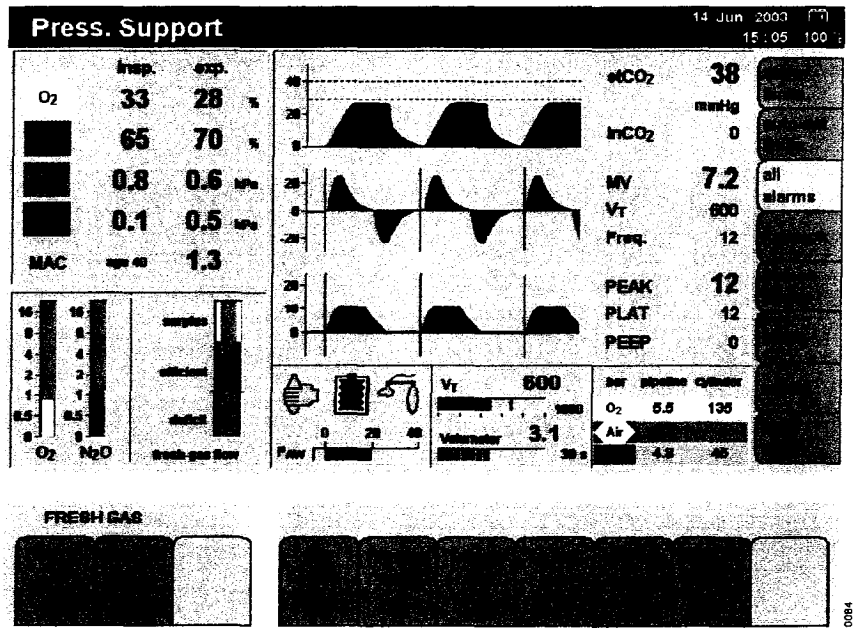
The maximum inspiratory time for a spontaneous breathing stroke varies with age. It is equal to not more than 1.5 seconds in patients under the age of 4 and not more than 4 seconds in patients with a set age of more than 4 years.

Inspiration is ended as soon as the actual inspiration flow drops below 25 % of the inspiratory peak flow. Any leakage is compensated at the actual airway pressure at the same time.



Apnoea ventilation can additionally be set via the minimum frequency FreqMIN. The ventilator is automatically triggered via FreqMIN if there is no spontaneous breathing activity by the patient. This is not a mandatory ventilation stroke by the ventilator; the patient can end the stroke triggered by the ventilator at any time by breathing spontaneously. This stroke is *not identified by a trigger indicator.*

Apnoea ventilation can also be deactivated again via FreqMIN (OFF position).



Adjustment ranges and default values upon delivery

Ventilation parameters	Adjustment range	Default value upon delivery[1)]
Minimum frequency[2)] FreqMIN [1/min]	OFF, 3 to 20	3
PEEP [mbar]	0 to 20	0
Trigger sensivity Trigger [L/min]	0.3 to 15	3.0
Pressure support ΔPPS [mbar]	3 to 50	5
Rise time TSLOPE [sec.]	0.0 to 2.0	0.0

1) The default values can be set specifically for the hospital concerned, see page 106.
2) The inspiratory time is limited by adjustment of Freq.MIN to yield a maximum ratio of 1:1 for I : E, thus ensuring an adequate expiratory time.

Presetting the ventilation mode

e.g. pressure-controlled ventilation

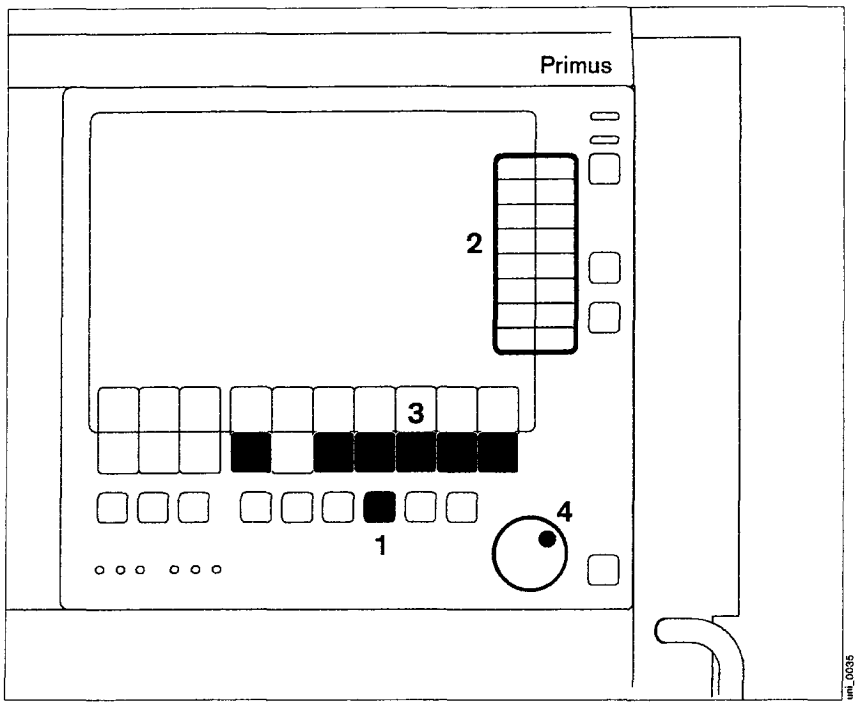
1 Press the soft key »**Press. Mode**«, its LED and the status line flash.

- The ventilation parameters valid for this mode are displayed on the screen against a grey background.

2 Soft keys grey = parameters are not yet active

3 Press the soft key for the individual ventilation parameters and their colour changes to yellow.

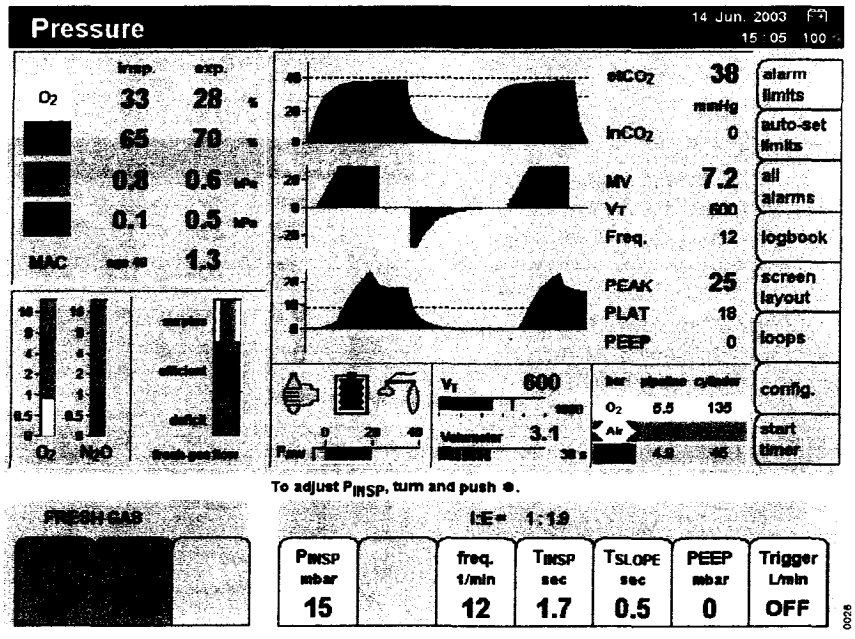
4 Set and confirm the ventilation parameters via the rotary knob.



Display (example):

The system reverts to the last active mode if there is no interaction by the user within 15 seconds when pre-setting the ventilation mode.

In this example, the system returns to volume-controlled ventilation.

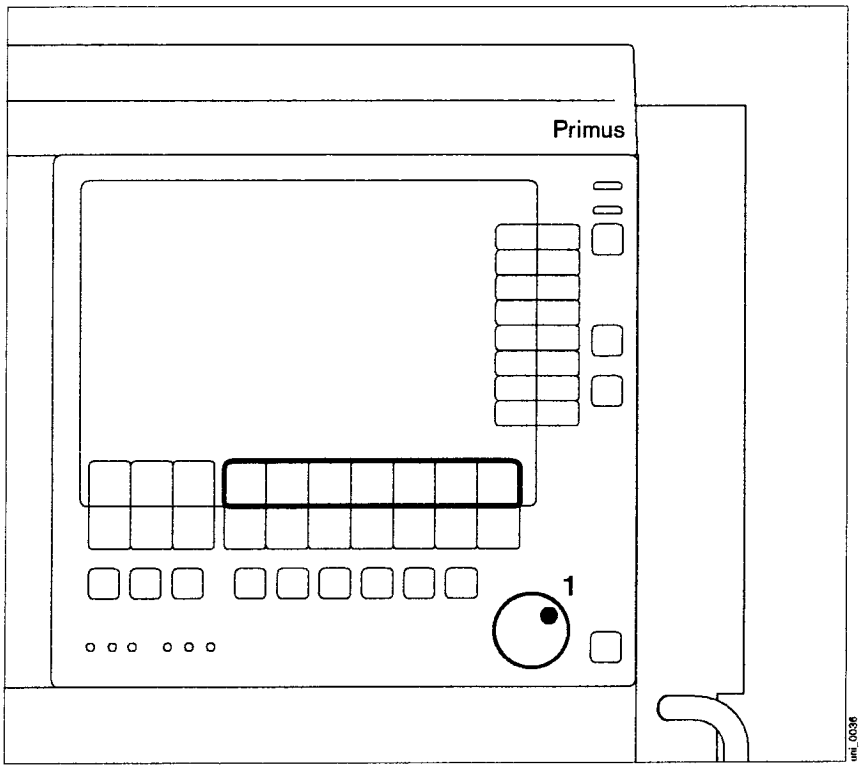


Starting ventilation mode

e.g. pressure-controlled ventilation

1 Confirm via rotary knob.

- Soft keys turn green.



The preset ventilation parameters are displayed on the screen.

Fresh-gas flows, as indicated by the rotating symbol » ◔ « in the soft key »**flow L/min**«.

If a ventilation parameter has to be changed:

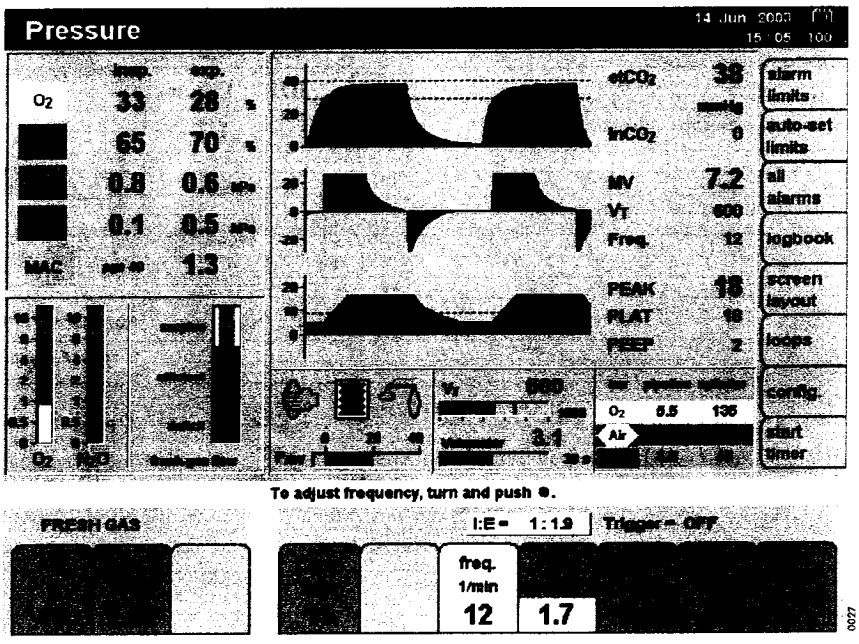
- Press the soft key for the ventilation parameter concerned, then set and confirm the ventilation parameter via the rotary knob.

Frequency changes

Depending on the configuration, the inspiratory time TINSP can be automatically changed together with adjustment of the frequency in volume or pressure-controlled ventilation without synchronization, so that the resultant ratio of inspiration to expiration I : E remains constant, see page 113.

For dependent setting of the change in TINSP:

- Press Frequency key, key lights up yellow.
- Adjust the ventilation parameter Frequency via the rotary knob and press the rotary knob to confirm. The value for the ventilation parameter TINSP automatically turns yellow and is adjusted at the same time. The ratio of inspiration to expiration I : E remains constant.



Changes in PEEP

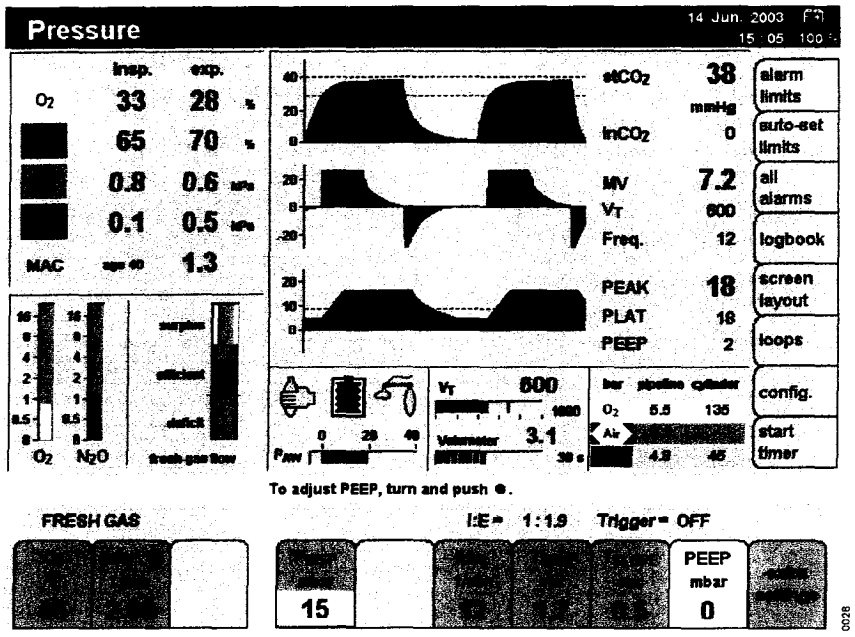
Depending on the configuration, the pressure limit PINSP can also be changed automatically when changing the PEEP value, see "Ventilator and gas delivery" on page 113.

For automatic PINSP adjustment:

- Press »**PEEP**« soft key; it is highlighted in yellow.
- Set and confirm the ventilation parameter PEEP via the rotary knob. The value for the ventilation parameter PINSP automatically turns yellow and is adjusted at the same time.

Changes in TINSP

TSLOPE may be reduced simultaneously if TINSP is reduced.



Changing between ventilation modes

When changing to a different ventilation mode, the pre-settings are adopted or appropriately derived from the parameters of the preceding mode.

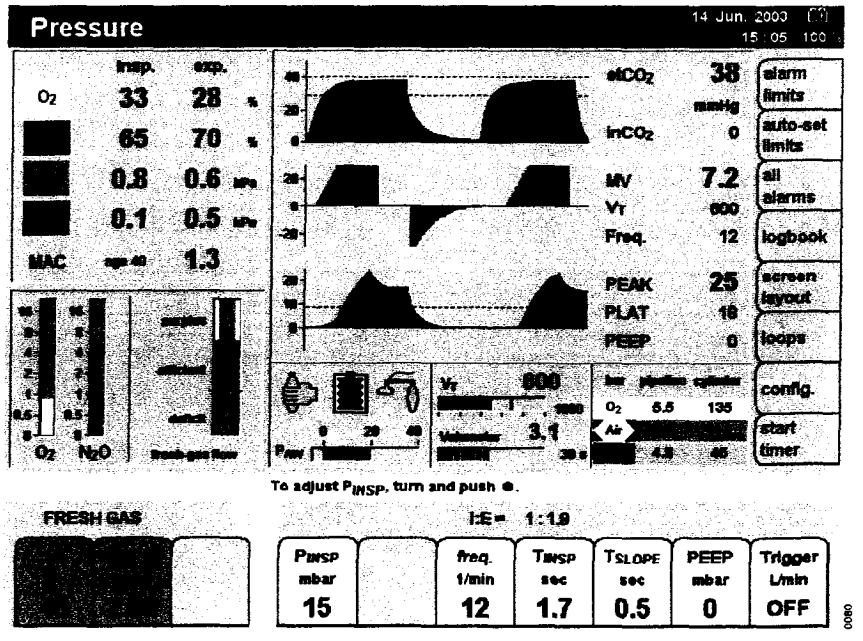
Parameters which are identical in both ventilation modes are adopted directly (Freq., TINSP, PEEP, ΔPPS, Trigger).

When changing from volume-controlled *to pressure-controlled ventilation:*

The measured parameter PPLAT is adopted as the new value for PINSP.

When changing from pressure-controlled to volume-controlled ventilation:

The new tidal volume VT is adopted from the measured minute volume MV and set frequency Freq. Only the minute volume applied by the ventilator is taken into account. Pressure-supported breathing strokes by the patient are disregarded.



When changing from automatic ventilation modes to pressure support mode (optional):

The set PEEP, ΔPPS and trigger are adopted.

If ΔPPS and/or trigger were "OFF", the last values used are adopted in pressure support mode. The configured default settings are used in all other cases.

Changing from pressure support mode (optional) to automatic ventilation modes:

The set PEEP, ΔPPS and trigger are adopted. The last values set are used for the other parameters and the configured default settings in all other cases.

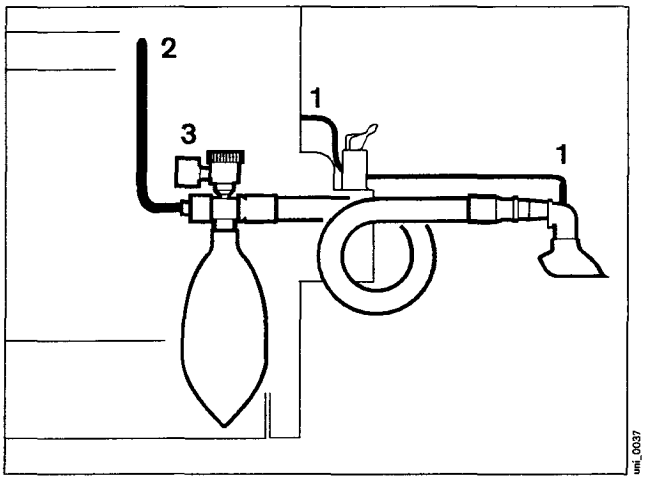
Using non-rebreathing systems (only with optional external fresh-gas outlet)

Example: Bain system

- Prepare the Bain system according to the corresponding Instructions for Use.

For prescribed monitoring of O_2, CO_2 and anaesthetic gases:

1 Screw the sample line onto the Luer lock connection of the mask manifold and to the water trap at the front of the device.



For mask manifolds without sample line connector:

- Place a T-piece with filter between the mask pipe and fresh gas connection port.

or:

- Where applicable, use a Luer lock filter connection.

2 Connect the fresh-gas hose of the Bain system to the fresh-gas outlet.

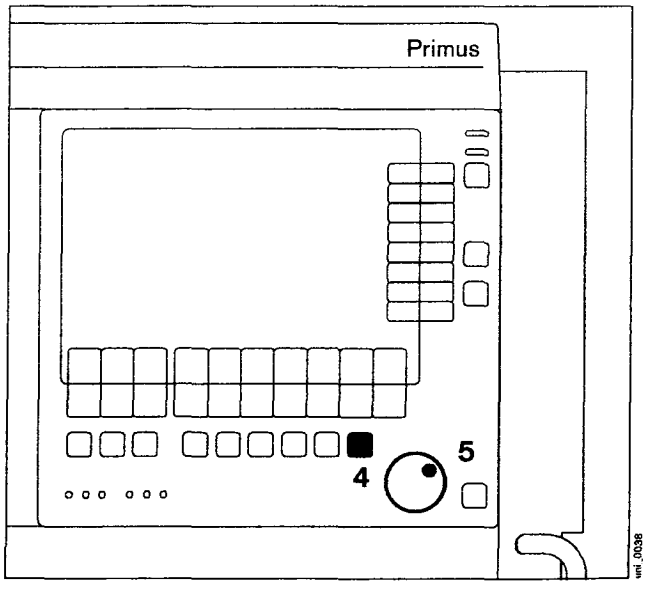
3 The anaesthetic gas scavenging hose of the non-rebreathing system can be connected to the Y-piece of the breathing system in Primus.

- Follow the Instructions for Use included with the Bain system.

Divert fresh gas to the external outlet:

4 Press »[ ]« key,

5 confirm with rotary knob.



Display (example):

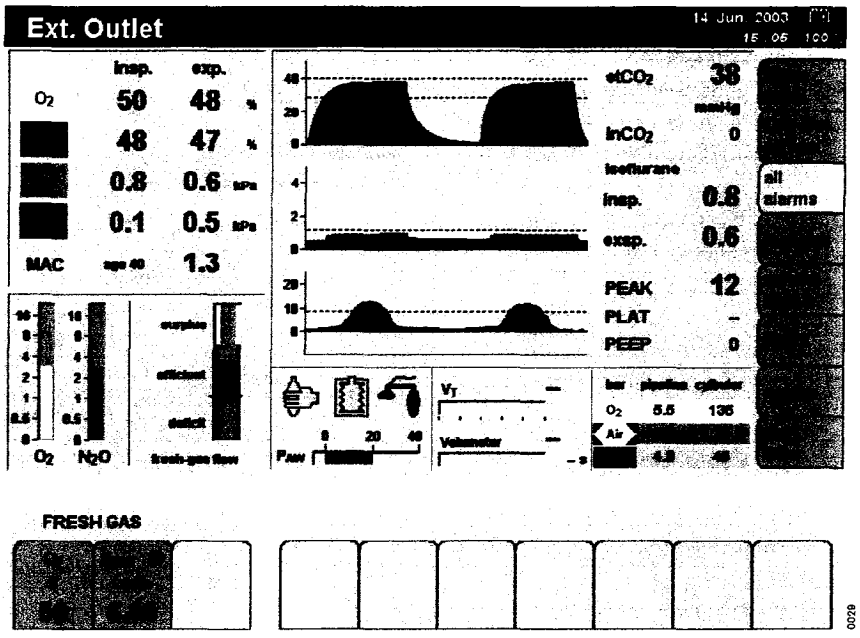
The airway pressure PAW and the mandatory frequency Freq., PPEAK and PMEAN are measured at the external fresh-gas outlet.

Pressure measurement may be impaired by activating the O2 flush or O2 emergency delivery.

The minute volume MV and tidal volume VT are not measured.

- Set the fresh-gas flow. The fresh-gas supply must be equal to at least twice the minute volume in order to exclude rebreathing.

Certain alarms are disabled automatically in order to avoid artefacts, see table on page 97.



Caution! Ambient air may become contaminated with anaesthetic agent when using non-rebreathing systems.

Excess fresh gas can be discharged into the anaesthetic gas scavenging line via the breathing system of Primus. For this purpose, the non-rebreathing system must be connected to the Y-piece of the breathing hoses connected to the breathing system.

Ending the external fresh-gas mode

- Press any ventilation mode key.
- The LED of the selected ventilation mode and the display in the status line flash.
- Confirm via rotary knob.

Ventilation via the internal rebreathing system in Primus is restored directly in this way.

When changing from the external non-rebreathing system to the rebreathing system in Primus:

- Reconnect the sample line to the Y-piece.

Ventilating children

For tidal volumes VT of less than 200 mL:

- Use paediatric hoses.

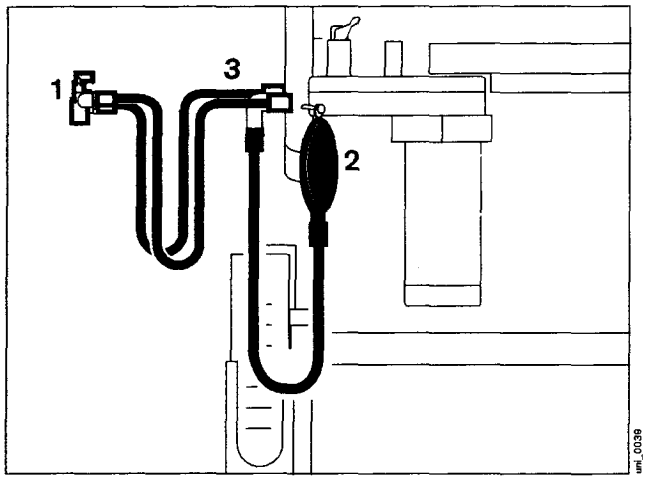
Connecting the breathing hoses

1 Use a Y-piece with connection for sample line.

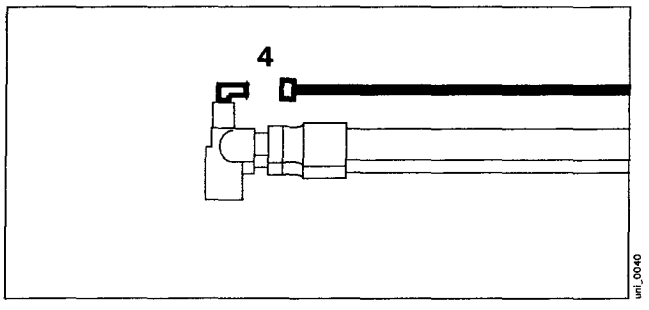
- The inspiratory and expiratory microbial filter 654 St should not be used – this reduces system compliance.

2 Connect a 0.5 L breathing bag with socket to the breathing hose with the large connection sleeves. Slip the breathing hose over the angled socket. Hang the 0.5 L breathing bag onto the hook.

3 Slip the breathing hoses with the large sleeves onto the inspiratory and expiratory sockets and connect the small sleeves to the Y-piece.



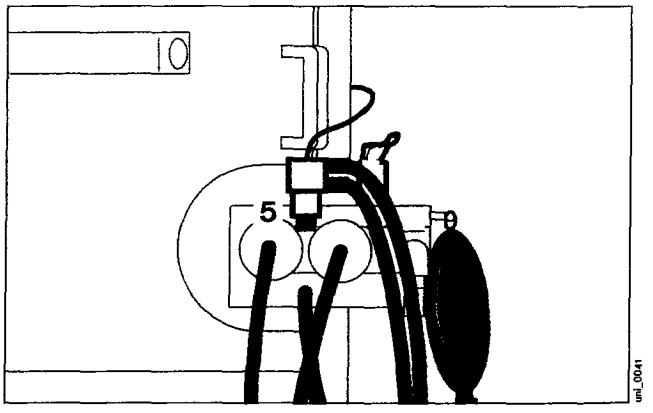
4 *Connect the sample line to the Y-piece and water trap.*



To determine system compliance and leakage:

5 Firmly connect the Y-piece to the cone.

- To determine system compliance and leakage, see "Leak test" on page 73.



Changing patients

Changing patients

To switch Primus to standby:

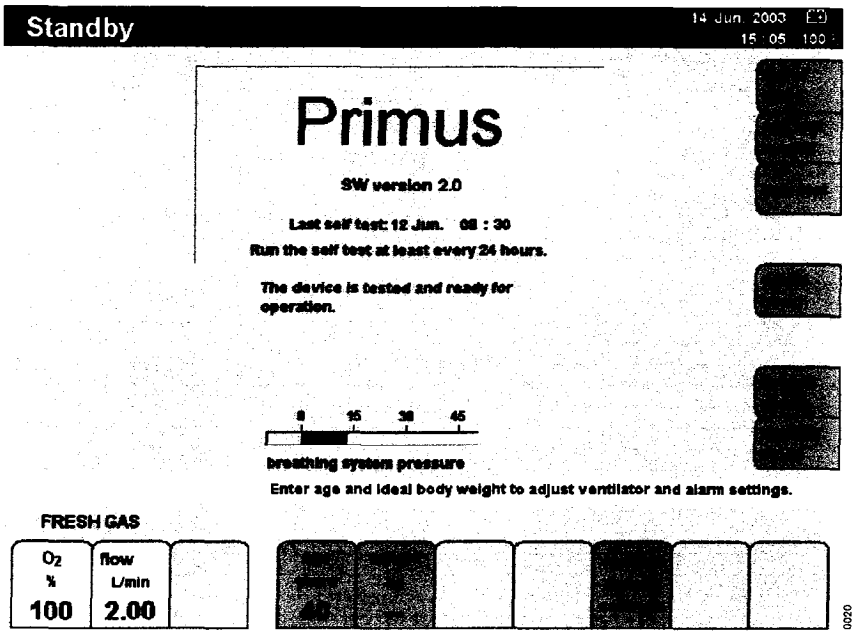
- Press the standby key »⏻« and confirm with the rotary knob.

The functions of the workstation are switched off.
The set patient age, weight, alarm limits, gas delivery settings and ventilation parameters are retained.

To activate the default settings:

- Press the soft key »**restore default settings**« and confirm.

The default settings for gas delivery, ventilation parameters and alarm limits are restored.



Change soda lime

- If the soda lime in the absorber has turned violet.
- If the inspiratory CO_2 concentration is 5 mmHg or more.

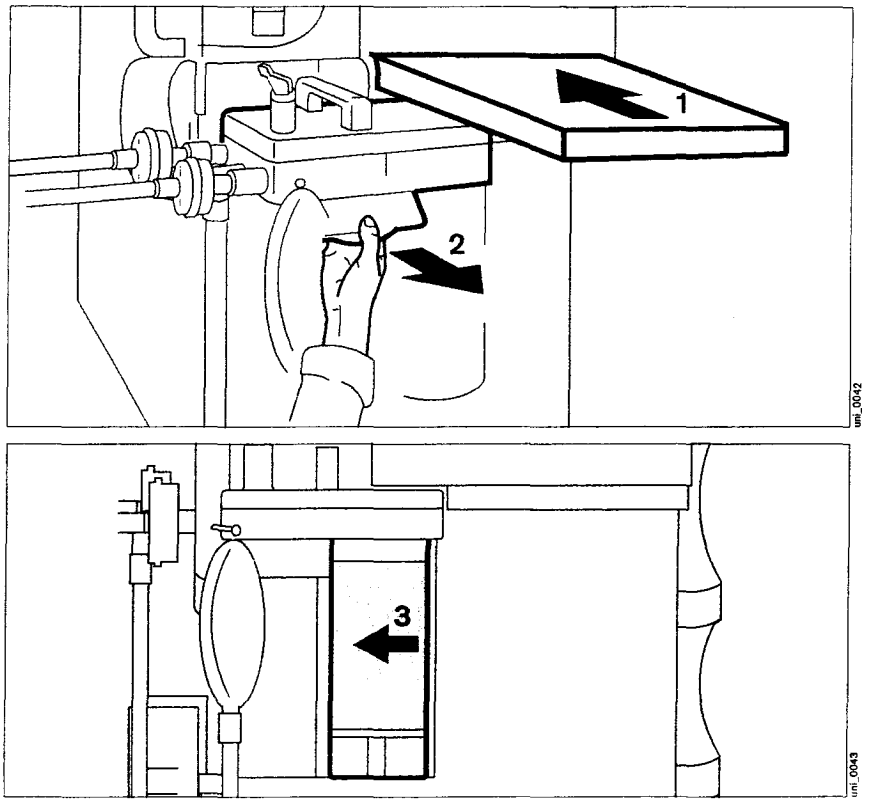
- Press the standby key »⏻« and confirm via the rotary knob.

1 Slide the writing top inwards.

2 Press the release button* on the ventilator unit and pull the unit out.

3 Turn the absorber anticlockwise and pull it down and off.

- Empty out the used soda lime and dispose of it with domestic waste.
- Fill the absorber to the upper mark with fresh soda lime.
- Fit the absorber into the breathing system from below and turn it clockwise as far as it will go.
- Push the breathing system inwards until it clicks into place.
- Pull the writing table out.



* not yet available

Leak test

Do not perform if a patient is connected to the workstation!

- When the soda lime has been changed or
- when the breathing hoses have been changed.
- If the Vapor has been changed or topped up.

- Test with the vaporiser handwheel set to more than 0.2 Vol.%.
- Press the soft key »**leak test**« in the standby mode.

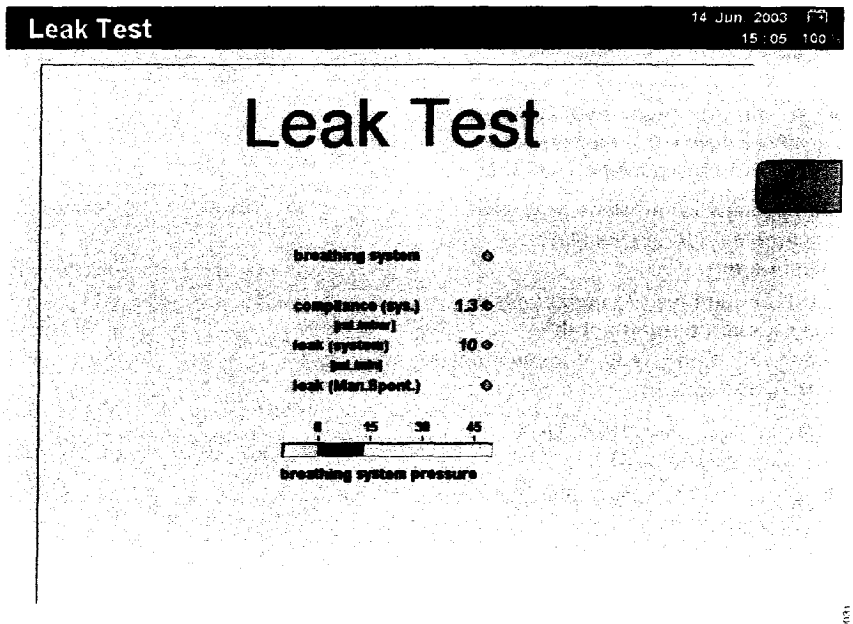
The following prompt is displayed: »**Before starting leak test, seal Y-piece and connect sample line. Press rotary knob to start leak test.**«

Primus performs the leakage test for volume mode/pressure mode in about 30 seconds, then system compliance is determined for volume correction and the overall system is checked for leaks in the breathing system.

The breathing bag and its hose are also tested at the same time.

Leakage is tested in the automatic (mechanical) ventilation line (leakage, system) and in the overall system (leakage Man./Spont.).

Display:



The clock symbol disappears when the test is complete and Primus displays the values for system compliance, leakage (system) and leakage Man. Spont. if applicable (values >150 mL/min), see "Leakage", page 40.

The results of the leak test are displayed on the data screen at all times.

To return to the standby screen:

- Press the soft key »**exit**«. A new screen is displayed.
- Close the vaporiser unit: turn the handwheel to »0«.

End of operation

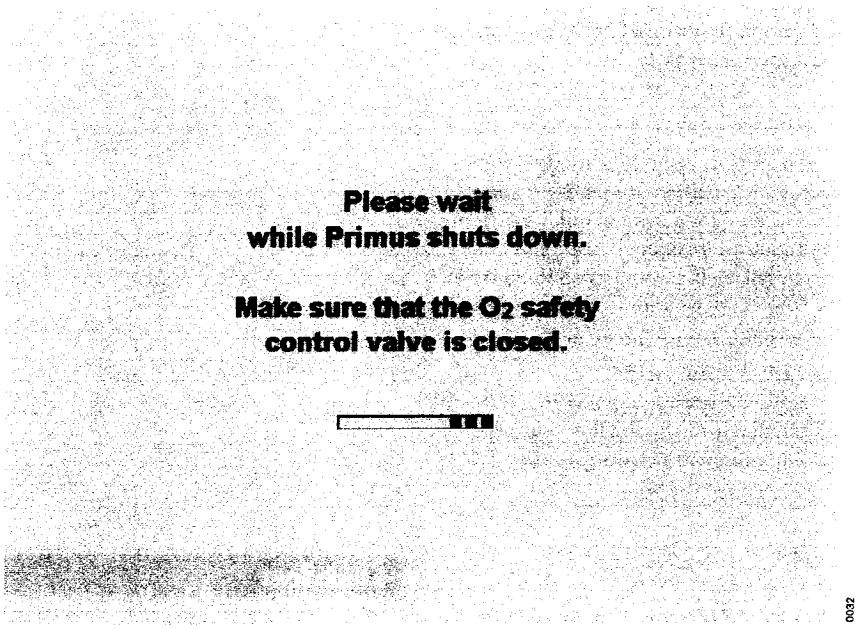
To switch Primus to standby:

- Press the standby key »⏻« and confirm via the rotary knob. The workstation is now in standby. The fresh-gas flow is switched off. **Manual ventilation is possible!**

To switch Primus off:

- Push the power switch »⏻« in completely.

Primus has a power-down delay. When the power switch is pressed, an acoustic signal sounds and for 10 sec. the following message is displayed: **»Please wait while Primus shuts down. Make sure that the O2 safety control valve is closed.«**



During this time, Primus can be restarted immediately by pressing the power switch again.

- Unplug the gas supply hoses from the wall sockets.
- Close the cylinder valves.

If the hoses remain connected to the wall sockets, minute internal leaks may lead to contamination of the gases.

- Leave Primus plugged into the power supply in order to charge the uninterruptible power supply UPS.
- **We strongly recommend switching off the device once a day in order to carry out the power-on self test.**

Remove any water which may have accumulated in the ventilator diaphragm.

Larger quantities of condensation may impair operation of the workstation and/or lead to failure of the equipment.

Switch off the anaesthetic gas scavenging system AGS:

- Disconnect the anaesthetic gas scavenging hose.

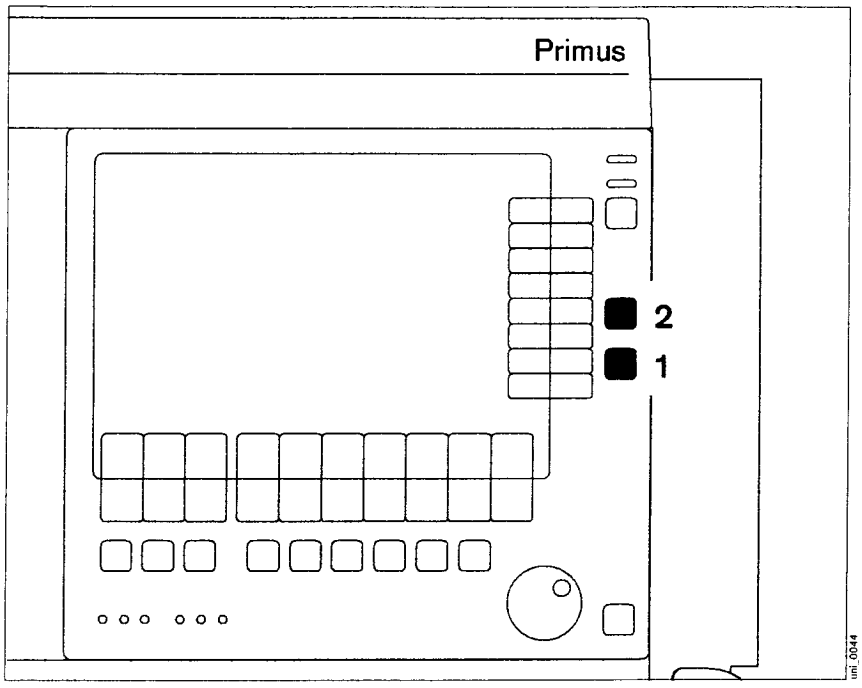
Monitoring

Monitoring

Selecting the standard screen

The standard screen is automatically displayed whenever a ventilation mode is selected (Man.Spont., volume mode or pressure mode). This screen can always be selected during operation:

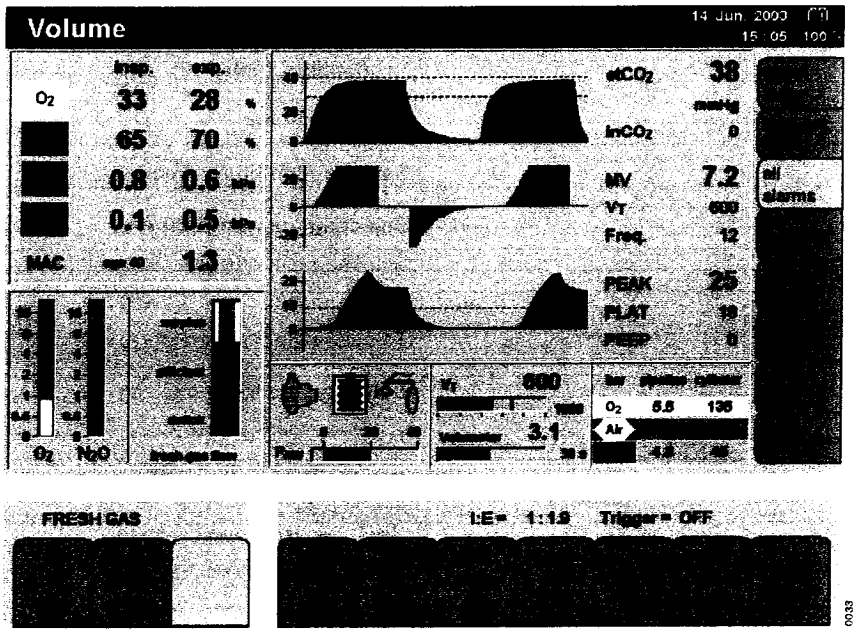
1 Press the »⏻« key,
or
2 Press the »◎« key several times.



Display (example):

The most important parameters are grouped together on the right and left sides of the screen.

The three curves are displayed in the middle (for other standard screens page 85).



Monitoring mode

Monitoring can be activated in standby, for instance for exclusive measurement of the SpO2 value. Gas is not delivered.

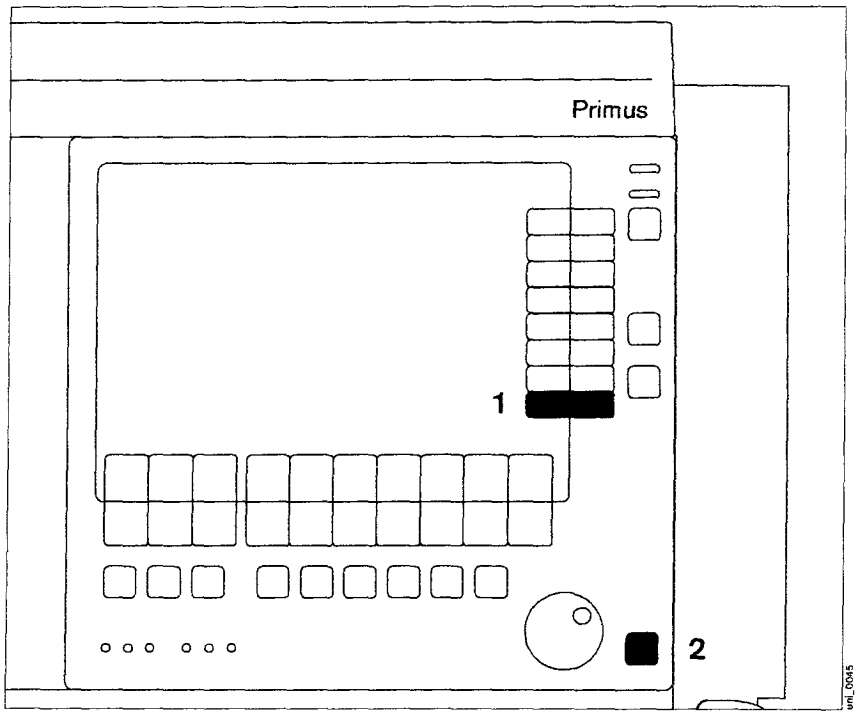
To start the monitoring mode:

1 Press the soft key »**monitor. mode**« or

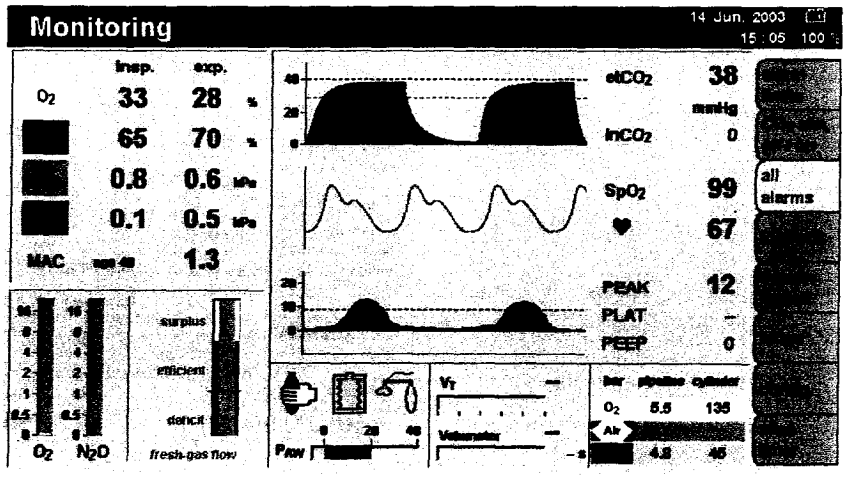
2 Press the »⏻« key.

To return to standby:

2 Press the »⏻« key again and confirm via the rotary knob.



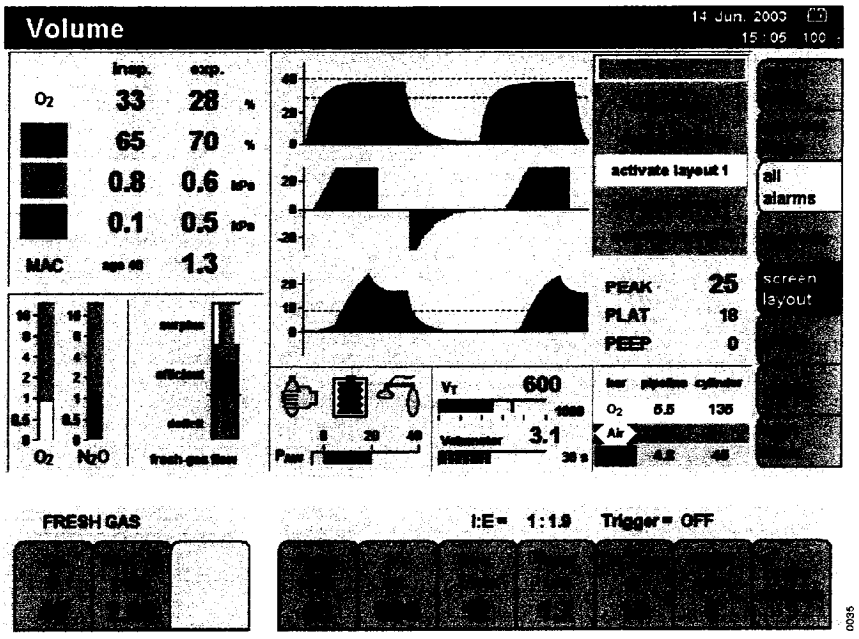
Display (example):



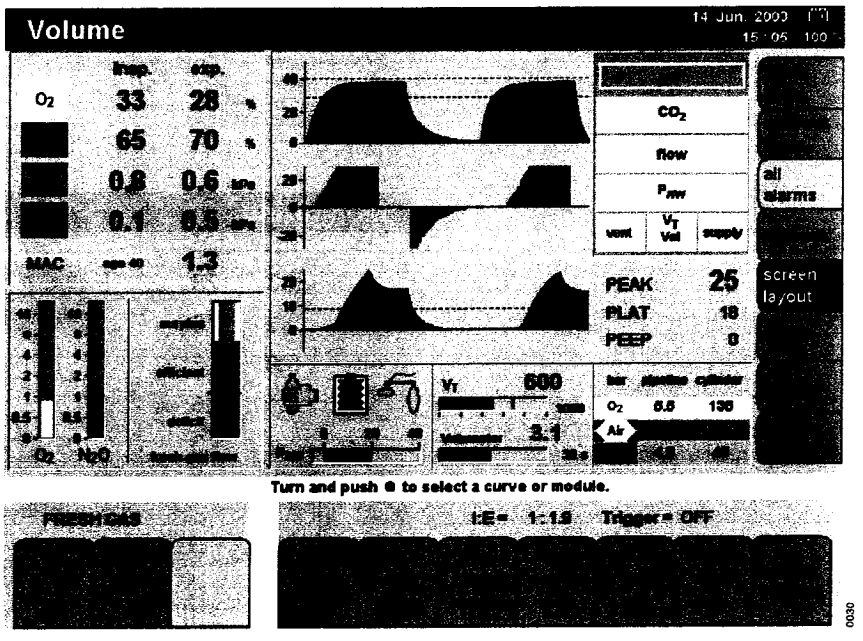
All alarms are active in the monitoring *mode compare* to the ventilation mode Man. Spont., see page 97.

Standard screen

Three screen layouts can be selected via the »**screen layout**« key. The momentarily selected screen layout is highlighted by an orange background.



The active screen layout can be changed via the menu item »**screen config.**« All three screen layouts with three curves and individual modules can only be configured in the standby configuration, see page 110.



Displayed parameters

CO_2 concentration

- Curve display
- Numerical display

  etCO2: End-tidal CO_2 concentration
  inCO2: inspiratory CO_2 concentration
- Trend curve for CO_2

O_2 concentration

- Curve display
- Numerical display

  inO2: *Inspiratory CO_2 concentration*
  exO2: Expiratory CO_2 concentration
  ΔO2: Difference between inspiratory and expiratory O_2 concentration
- Trend curve for O_2

Anaesthetic gas

- Curve display
- Numerical display

  inAgent: Inspiratory anaesthetic gas concentration
  exAgent: Expiratory anaesthetic gas concentration
  MAC: Minimum alveolar concentration
- Trend curve for anaesthetic gases and MAC

Airway pressure

- Curve display (PAW)
- Numerical display

  PEAK : Peak pressure
  PLAT : Plateau pressure
  PEEP : *Positive end-expiratory pressure*
  MEAN (only on the data screen) : Mean pressure
- Bar graph

Flow and volume

- Curve display Flow (insp./exp.)
- Numerical display

  MV : Expiratory minute volume
  VT : Tidal volume
  Freq. : Respiratory rate
  MVLEAK (*only on the* data screen) : Difference between inspiratory and *expiratory minute volume*
  CPAT (only on the data screen) : Compliance des Patienten
- Trend curve for MV and CPAT

SpO_2 concentration (optional)

- Plethysmogram
- Numerical display

  SpO_2: Functional O_2 saturation of the blood

  ♥: Pulse rate
- Trend curve for SpO_2 and pulse

Volumeter[1)]

- Shows the minute volume and tidal volume V_T as bar graphs.

Virtual flow tubes

- Volumeter in combination with bar graphs for the fresh gas flows in L/min for O_2, N_2O and AIR.

Indicators for the active ventilation source


Manual ventilation (Man. Spont.)


Non-rebreathing system at external gas outlet


Automatic (controlled) ventilation

Econometer (optional)[1)]

Presentation of fresh-gas utilisation as a bar graph with the three ranges Excess, Efficient and Deficit.

Loops (optional)[2)]

Two pairs of measured values which are plotted against one another appear as a loop in the ventilation cycle: the PAW-V loop and the V-Flow loop.

Gas measurement

The concentration of O_2, CO_2 and of the anaesthetic agents N_2O, halothane, enflurane, isoflurane, desflurane and sevoflurane is measured.

Calibration

The gas measuring module is calibrated automatically when the workstation is started and then every two hours after that. The O_2 sensor is calibrated when the workstation is started and then every eight hours after that.

Calibration is performed parallel to the gas measuring module every 2 hours during consumption-free O_2 measurement.

CO_2 and O_2

The CO_2 and O_2 concentrations are side-stream measured, thus delaying an indication of the real-time values by approx. 2 seconds. The pressure (and flow) curve, CO_2 and O_2 curves displayed are not synchronized.

If an apnoea occurs, the display for $etCO_2$ is replaced by the message "**Apnoea**". The apnoea time [min:sec] is displayed instead of the measured value.

---

1) See page 83 for a detailed description.
2) See page 84 for a detailed description.

Anaesthetic agents

The anaesthetic agents are side-stream measured in the same way as CO_2 and O_2.

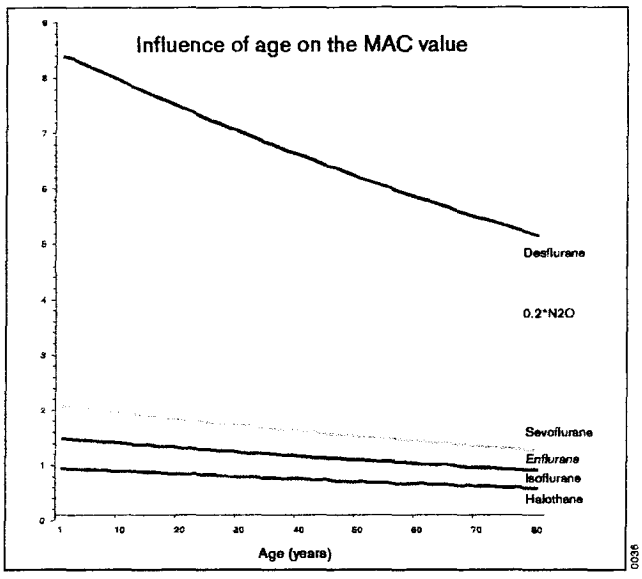
MAC[1] definition

1 MAC is equal to the anaesthetic gas concentration at 1013 hPa at which 50 % of all patients no longer respond to a stimulation of the nerves.

The values listed in the table below are used to calculate the MAC value. These values are merely guideline values and are still subject to debate. The current MAC values listed in the instructions enclosed with the anaesthetic gases are binding!

	1 MAC
Halothane	0.77 %
Enflurane	1.7 %
Isoflurane	1.15 %
Desflurane	6.65 %
Sevoflurane	2.1 %
N_2O	105 %

The MAC value depends on the patient's age. The above values refer to age 40 years.



Primus automatically identifies the anaesthetic agent used and adjusts the measurement and monitoring of the anaesthetic gas concentration to suit the gas identified.

If there is a mixture of two volatile anaesthetic agents, the concentration of the secondary anaesthetic agent is displayed if the MAC value is 0.1 MAC or greater. The gas with the higher expiratory MAC value is displayed above the secondary gas.

A secondary anaesthetic agent becomes the main anaesthetic agent if its MAC value exceeds the MAC value of the main anaesthetic agent by 0.2 MAC.

A mixture of more than two volatile anaesthetic agents cannot be reliably detected.

Calculating the MAC values

The MAC value is a simple navigation aid for determining the dosage of anaesthetic agent.

Primus takes into account age correction, altitude correction and mixture calculation. The influence of other medication (opiates or intravenous hypnotics) is not taken into account when calculating MAC values.

The measured values used for calculating the MAC factor are the end-expiratory concentrations. Partial pressures are taken into account.

The displayed value is calculated for 1013 hPa as follows:

$$f = \frac{\text{exp. conc. agent}_1}{\text{MAC (age) agent}_1} + \frac{\text{exp. conc. agent}_2}{\text{MAC (age) agent}_2} + \frac{\text{exp. conc. } N_2O}{\text{MAC (age) } N_2O}$$

1) Minimum alveolar concentration, MAC

Age-corrected MAC values are calculated according to W.W. Mapleson (British Journal of Anaesthesia 1996, pages 179–185), whose formula only applies for patients >1 year old:

$MAC = MAC\ 40 \times 10^{(-0.00269 \times (age - 40))}$

The formula shows the reciprocal relationship existing between MAC and age.

Age 1 is used for calculation if the age is "<1".

Example:

Expiratory concentrations of 0.9 Vol.% isoflurane and 50 Vol.% N_2O are measured for a 60-year-old patient.

1 MAC isoflurane at 60 years equals 1.01 according to the formula above.

1 MAC N_2O at 60 years equals 92.4 according to the formula above.

The total MAC factor is calculated as follows

$$\frac{0.9\ \text{Vol.\% Iso}}{1.01\ (\text{MAC Iso})} + \frac{50\ \text{Vol.\% } N_2O}{92.4\ (\text{MAC } N_2O)} = 1.4$$

In other words, 1.4 MAC are obtained with the current concentration. For a 20-year-old patient, the same concentration yields an MAC factor of 1.1.

Virtual flow tubes

- Indication of the individual flows actually delivered by the fresh-gas mixer.

Lung compliance (CPAT)

- Determined from PLAT and expiratory VT.
  Lung compliance is equal to the measured total compliance $\left(\frac{V_T}{P_{PLAT}}\right)$ minus the system and hose compliance determined in the self test.

Using the volumeter function

To observe and assess ventilation during spontaneous breathing and in manual or mechanical ventilation modes.

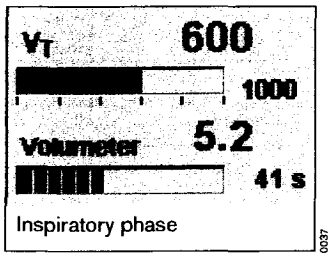
Upper bar graph

Current inspiratory and expiratory tidal volume VT.

Numerical indication of the expiratory tidal volume.

The bar graph follows the inspiratory and expiratory tidal volume VT. The tidal volume delivered at the end of inspiration is represented by a bar.

Minute volume leakage is indicated at the end of the expiratory phase.

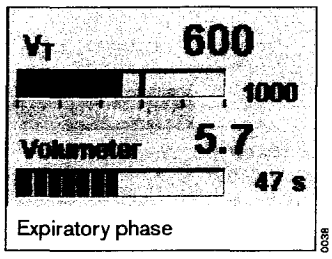


Lower bar graph

Volumeter (minute volume measurement).

Numerical indication of the expiratory minute volume.

The scales of the bar graphs can be configured during operation and in standby, see page 108.

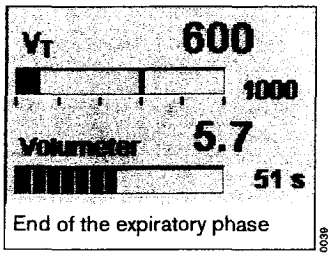


The current expiratory tidal volume is determined for each breathing cycle; the elapsed time in seconds is shown beside the bar graph and the total volume is shown above the bar graph.

Starting the volumeter

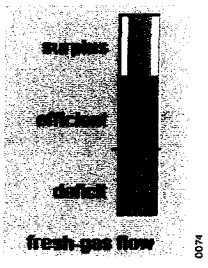
- Push the rotary knob.
  The volumeter is stopped if the rotary knob is pushed again within 60 seconds. The values are deleted and the volumeter restarted when the rotary knob is pushed again.

The individual breaths are indicated by units in the bar graph. The volumeter stops automatically after 60 seconds. The measured values are displayed for four minutes and then deleted.



Econometer (optional)

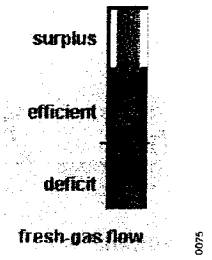
The bar graph indicates the qualitative utilisation of the fresh-gas flow. If the fresh-gas delivery is more than 1 L/min above the gas consumption, the econometer will indicate an "Excess". Below this level, utilisation of the fresh gas is considered "Efficient". If less fresh gas is delivered than is needed by the patient, a fresh-gas deficiency is indicated by the red area in the bar graph. A fresh-gas alarm is output by the workstation.



Gas consumption depends on:

- the uptake by the patient,
- leakage, and
- the CO_2 volume converted in the absorber.

If data for calculation are not available, the legend appears in grey and the bar graph is not active.



Loops (optional)

Press the soft key »**loops**« on the standard screen:

The PAW-V and V-Flow loops are displayed instead of the two lower curves. Each loop remains on display for three breathing cycles; the colour intensity of the loop decreases with each ventilation cycle.

The scale of the PAW and Flow axis depends on the scale selected for the real-time curves. The scale of the volume axis depends on the scale of the volumeter.

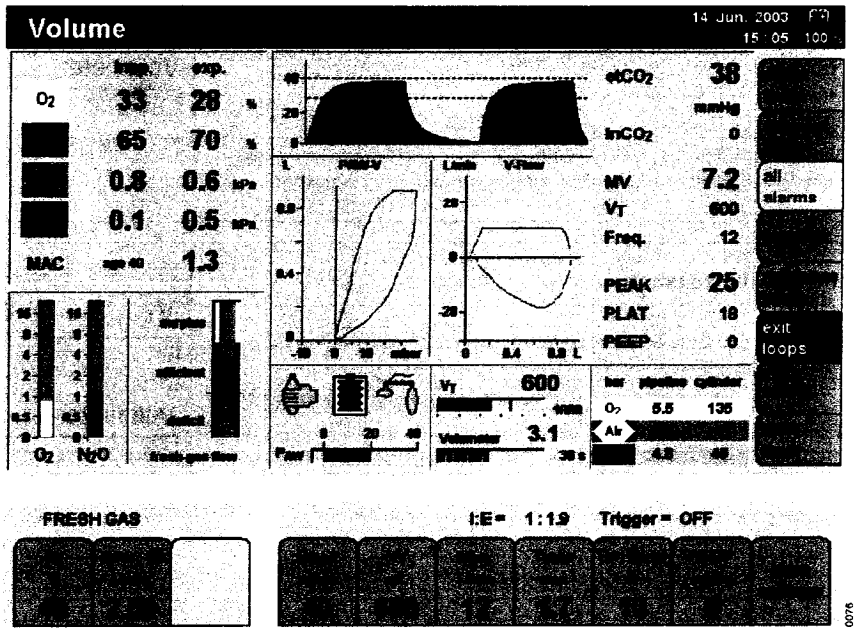
See page 108 with regard to configuration of the scales.

Press the soft key »**reference loops**« the current loop is displayed in a different colour so that it can be used as reference.

Delete the reference loop:

- when changing to standby mode or
- by pressing the soft key »**reference loops**« again.

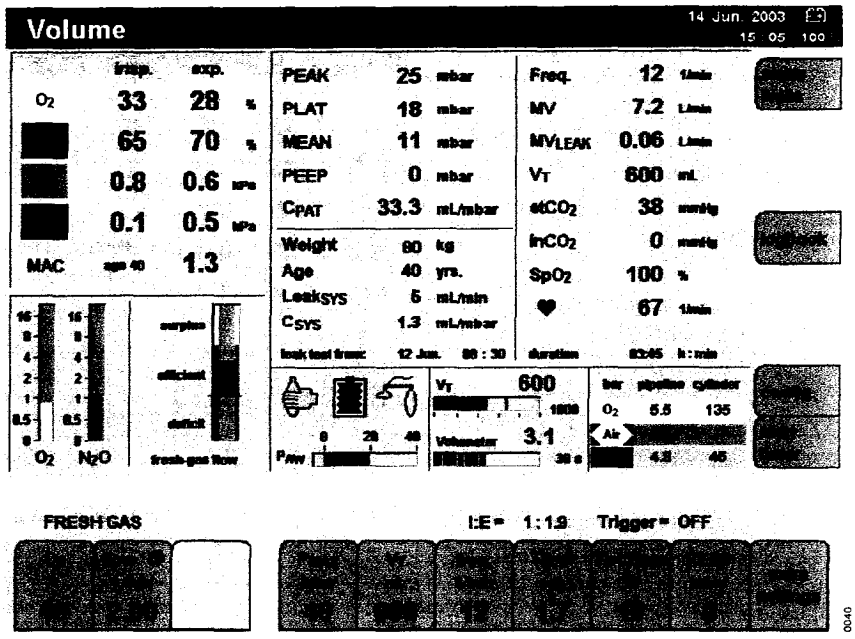
Remove loops from the screen: touch the soft key »**exit loops**«.



Selecting the data screen

- Press the »[⟲]« key several times until the data screen appears.

Display (example):



All numerical values are displayed on the data screen with their units of measurement.

The bar graph at the bottom of the screen shows the current ventilation pressure PAW.

System compliance (CSYS) and leakage (LeakSYS) are displayed with other parameters in the middle left-hand field, together with the time of the last test.

The bottom right-hand field shows the pressure values for the central supply of *O2*, *N2O* and *AIR*, *as well as for the O2* and N2O cylinders.

Selecting the trend screen

Displays the measured values over an interval beginning with the *measurement's commencement.*

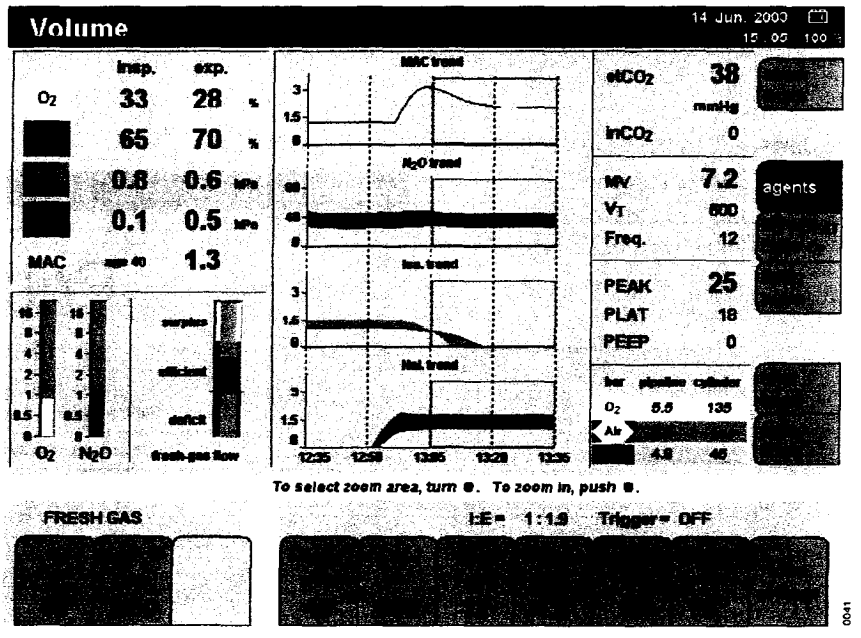
Maximum time for storage: 8 hours.

The following display combinations can be selected:

- agents
- MV/CPAT/CO2/O2
- SpO2 pulse (optional)

- Press the »[⟲]« key several times until the trend screen is displayed.

The trends for MV and compliance are scaled according to the settings in the configuration menu.



Display (example): trend for agents.

Selecting other display combinations

- Press the required soft key: **»agents«**, **»MV/CPAT/CO2/O2«** or **»SpO2 pulse«**
  The soft key does not appear if the SpO2 measuring function is not available.

The trend for inspiratory and expiratory values is represented by bar graphs. The expiratory value is always indicated by a black line.

Zoom function

The trend display can be magnified with the zoom function after half-an-hour's operation.

To select the area:

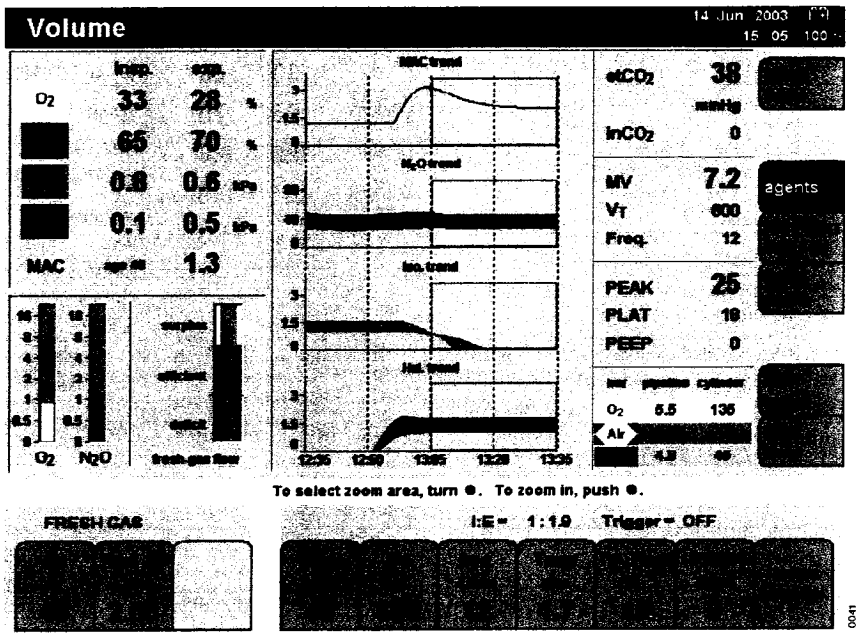
- Turn the rotary knob = the dashed frames move.

To enlarge the selected area to the full width of the display:

- Push the rotary knob.
  A new dashed frame appears after a corresponding period of operation which can also be enlarged.

To return to the trend overview:

- Press the soft key »**total trend**« and the complete trend is displayed again.
  This soft key is ineffective if there are not sufficient trend data available (e.g. less than 30 minutes of operation).



To delete the trend memory

Only possible in standby.

Graphic trend and logbook are deleted simultaneously.

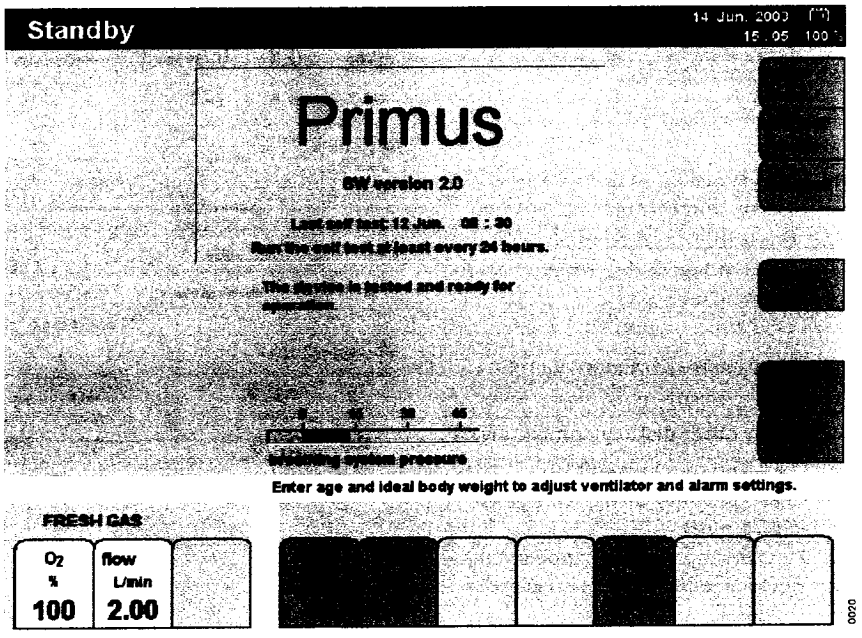
In standby mode:

- Press the soft key »**delete trend**«.

The system requests confirmation that the trend really should be deleted.

To delete:

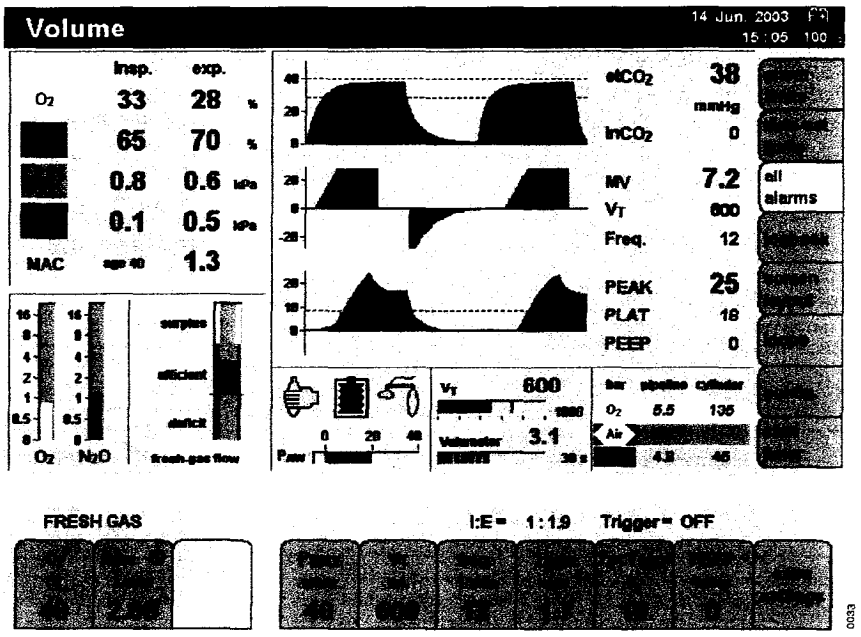
- Press the soft key »**delete trend**«.



Selecting the logbook

For recording ventilation modes, measured values and main anaesthetic agent to facilitate compilation of the anaesthetic record.
The trigger criteria for entries can be configured, see "Interfaces/Logbook" on page 109 and "Logbook entries" on page 121.

- Press the soft key »**logbook**«.



Display (example):
»**page 1**« of the logbook is displayed.

To view the second page:

- Press the soft key »**page 2**«.

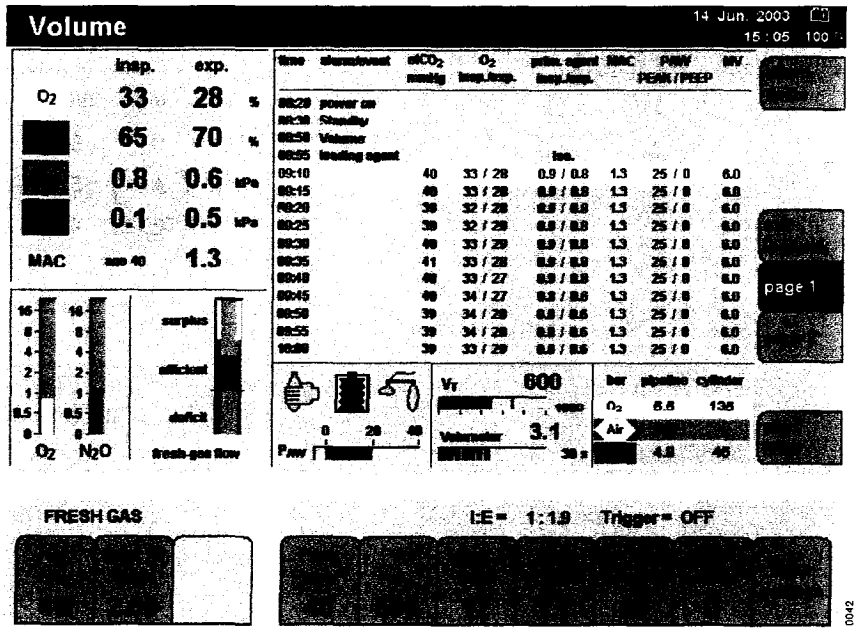
Page 2 contains further data for the optional parameters.
At least one optional parameter must be activated in order to display the second page.

To return to the standard screen:

- Press the soft key »**exit logbook**«

or

- Press the »⏻« key.



To delete the logbook

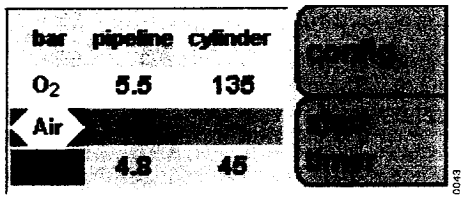
Logbook and trend memory are deleted simultaneously.

Only possible in standby (see page 86).

Using the timer function

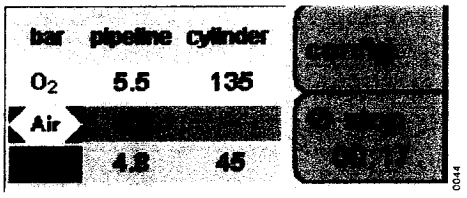
To start the timer (e.g. 00:00):

- Press the soft key »**start timer**« in any operating mode.



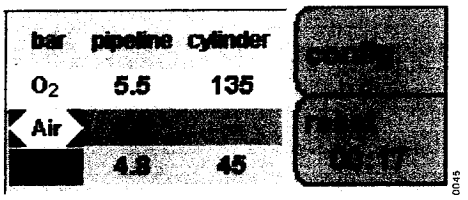
To stop the timer:

- Press the soft key » ⊖ **stop**«.
  The measured time is displayed.



To reset the timer to »00:00«:

- Press the soft key »**reset**«.



SpO2 measurement (optional)

Selecting a sensor

Only Nellcor sensors may be used (see separate order list/list of accessories).

The new Oximax modules implemented in Primus are only compatible with the new Oximax sensors (purple probe or white probe for MAX FAST).

Only the DEC-8 or DEC-4 extension lead (purple plug connector) may be used.

The new sensors are downward-compatible with all modules already used in the field in older Dräger machines.

Note the Instructions for Use of the sensors – incorrect positioning or use may cause injuries.

- Select a sensor in accordance with the following criteria:
- Weight of the patient
- Mobility of the patient
- Possible application point
- Perfusion of the patient
- Duration of use

The following table provides a guideline for selecting specific sensor, shown here with their characteristic values.

Sensortyp	**OXIMAX™ MAX N**	**OXIMAX™ MAX I**	**OXIMAX™ MAX P**	**DURASENSOR™ DS-100 A**	**OXIMAX™ MAX A**	**OXIMAX™ MAX R**	**OXIMAX™ MAX FAST**
Age group	Neonates/ Adults	Infants	Children	Adults	Adults	Adults	Adults
Weight of the patient	<3 kg to >40 kg	1 to 20 kg	10 to 50 kg	>40 kg	>30 kg	>50 kg	>40 kg
Duration of use	Short and long-term monitoring	Short and long-term monitoring	Short and long-term monitoring	Short-term monitoring	Short and long-term monitoring	Short and long-term monitoring	Short and long-term monitoring
Mobility of the patient	Limited activity	Limited activity	Limited activity	Inactive patients only	Limited activity	Inactive patients only, must be checked at least every 8 hours	Limited activity
Preferred measuring point	Ball of the foot	Toe	Finger	Finger	Finger	Nose	Forehead
Sterility[1)]	Sterile packaging	Sterile packaging	Sterile packaging	--------	Sterile packaging	Sterile packaging	Sterile packaging

1) In unopened and undamaged packaging

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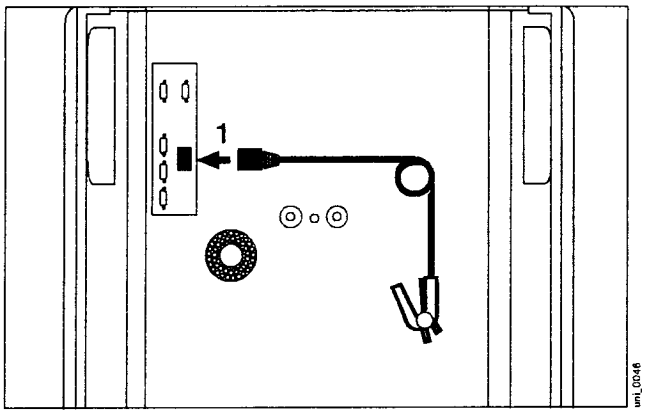
- Select the appropriate sensor.



At the back of the workstation:

1 Plug the sensor connector into the socket marked »**SpO2**«.

Tips to prevent artefacts

Only use Nellcor sensors in the recommended positions, otherwise incorrect measurements and injury may result.

Damaged sensors with exposed electrical contacts must not be used – danger of electric shock.

The adhesive strips must not be stretched unduly. Never use two strips together, as this may lead to venous pulsation and pulse signal failure.

High intrathoracic pressure, pressure on the thorax and other consecutive impairments of the venous flow can lead to venous pulsation and pulse signal failure.

The pulse signal may fail in the presence of shock, low blood pressure, severe vasoconstriction, major anaemia, hypothermia, arterial occlusion proximal to the sensor and asystolia.

The sensor must be protected from exposure to bright light (e.g. surgical lamps and direct sunlight), otherwise the pulse signal may fail or the results may be inaccurate.

The sensor should not be positioned on limbs together with an arterial catheter, sphygmomanometer cuff or intravascular venous infusion, otherwise the pulse signal may fail and measurements may be inaccurate.

Measurement accuracy may be reduced in the presence of significant concentrations of dyshaemoglobins, such as carboxyhaemoglobin or methaemoglobin.

Intravascular dyes, such as methylene blue, may also impair measurement accuracy.

Electrocautery can impair measuring accuracy; the leads and sensor should therefore be positioned as far away from the electrocautery and its neutral electrode as possible.

Sensor performance may be impaired and lead to inaccurate results if the patient moves violently. The sensor should be applied to a quiet/stable site in such cases in order to reduce the risk of artefacts due to movement.

The displayed plethysmogram is a relative indicator of the pulse amplitude. Its scale is not absolute and it is only used to judge the quality of the SpO2 measurement.

The sensor must not be immersed in liquid – this may lead to malfunctions.

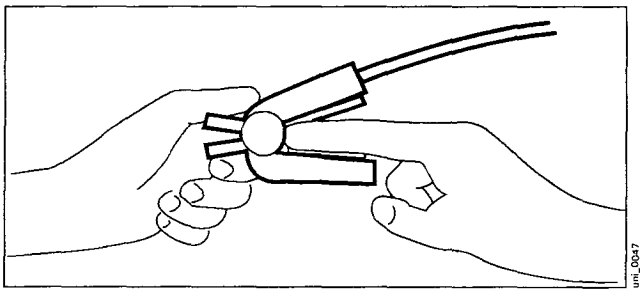
Applying the Durasensor DS-100 A

Reusable sensor for short-term monitoring of relatively quiet patients weighing over 40 kg.

The sensor is preferably positioned on the index finger, although other fingers can also be used. The little finger should be used if the patient is particularly large or obese.

- Open the clip slightly and slide the sensor onto the finger. The tip of the finger must touch the end of the sensor and the soft padding should rest on the nail and tip of the finger. The lead should be on top of the finger.
- Ensure that the finger is not compressed or hurt by the clip.
- Change the application site after not more than 4 hours in order to avoid a build-up of blood pressure (blocked circulation).

Follow the specific Instructions for Use when using other Nellcor sensors!



Alarms

Alarms

Alarm priorities and alarm signals

Alarm messages are colour-coded and assigned to three priority classes by Primus, depending on their urgency:

Warning = highest priority
(red alarm field)
A warning message requires immediate action.

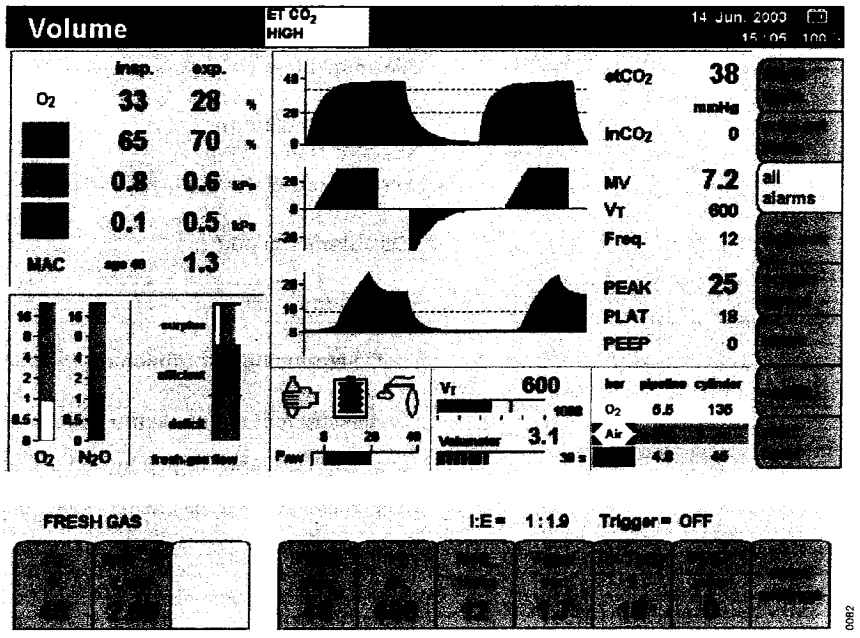
Caution = medium priority
(yellow alarm field)
A caution message requires prompt action.

Advisory/technical message = low priority (white alarm field)
These messages must be noted and action taken if necessary.

Messages with low priority may also be indicated by symbols.

Whenever an alarm message is displayed, the alarm lamp flashes or lights up continuously and an acoustic tone sequence indicates the alarm priority class:

If alarm limits are violated, the corresponding measured values will be highlighted by a coloured background and will flash. The colour of the background reflects the colour-coding of the alarm priority (red, yellow, white).



Warning:

1 Warning messages flash on red background.
Red lamp flashes, accompanied by a continuous tone.

Caution:

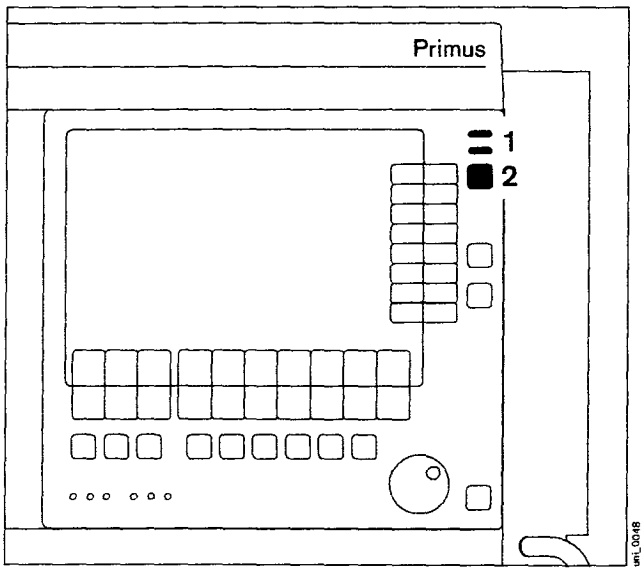
1 Caution messages flash on a yellow background.
Yellow lamp flashes, accompanied by an intermittent tone every 30 seconds.

Advisory:

1 Advisory messages appear on a white background.
Yellow lamp illuminates continuously, accompanied by a single tone.

Technical message:

1 Technical messages appear on a white background.
Yellow lamp illuminates continuously without any acoustic tone.



Refer to the chapter "Fault – Cause – Remedy" on page 155 for a list of alarm messages.

Downgrading alarm priorities

Selected technical alarms can be downgraded to a lower priority or deleted completely once acknowledged.

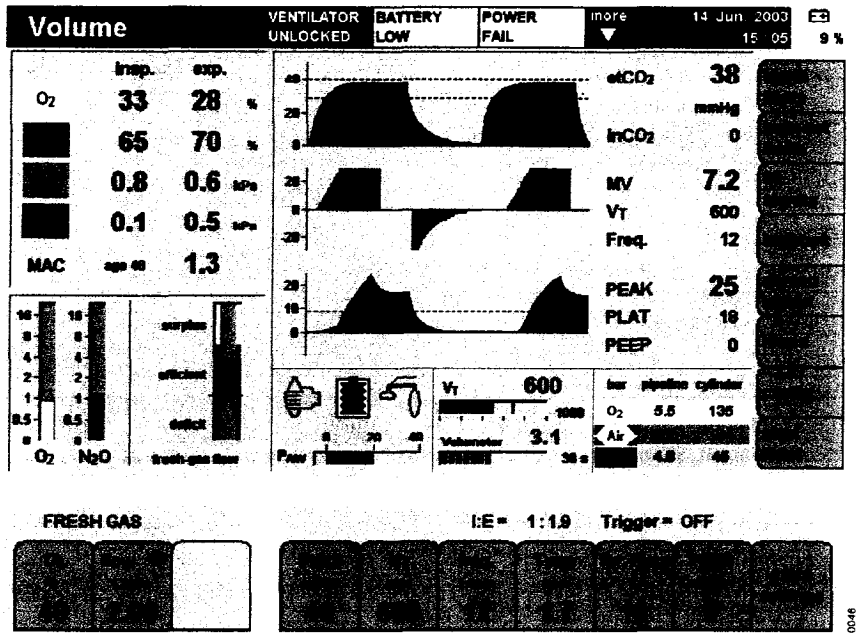
2 Press the »[Ⓐ]« key.

Alarm displays

Alarm messages are displayed in the alarm field in order of priority. Up to three messages can be displayed simultaneously. In some cases, the corresponding measured values are highlighted on the screen by a flashing background in addition to the alarm message.

If more than three alarms occur simultaneously, the symbol »more« appears to the right of the alarm field and the soft key **»all alarms«** is activated on the right-hand side of the screen. When this soft key is pressed, the upper curve display is replaced by up to six additional alarm fields for 15 seconds.

The curve reappears when the soft key **»all alarms«** is pressed again or when the 15 seconds have expired.



Suppressing alarm

Some alarms can be temporarily suppressed. This can be done automatically depending on the ventilation mode or manually in the menu "Standby config." or permanently via the alarm menu

Disabled alarms are identified by the symbol » 🔕 « alongside the corresponding parameter.

If only individual alarm limits have been disabled for a monitored parameter, this is indicated by the corresponding symbol »🔕« or »🔕«.

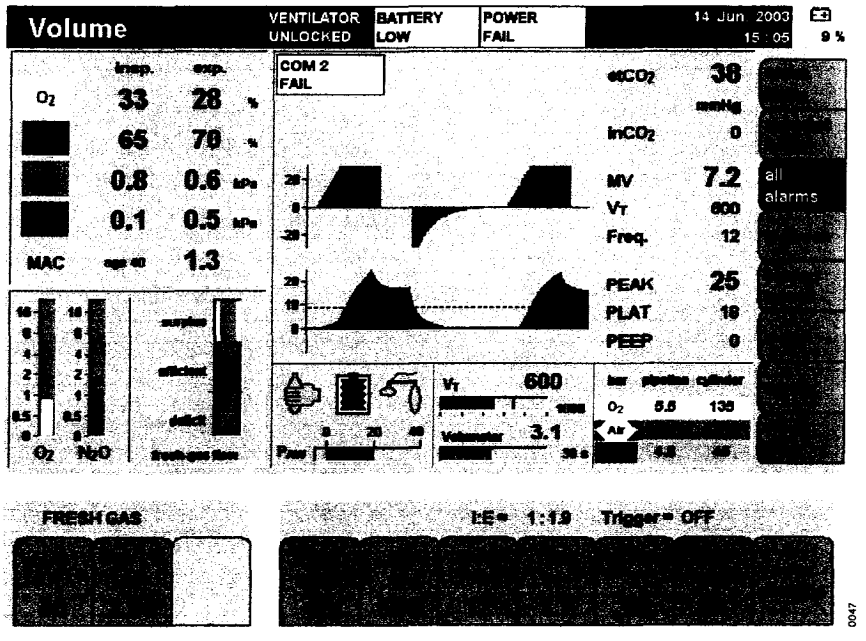
The series of alarm tones can be suppressed for 2 minutes:

- Press the »🔕« key, the yellow LED lights up.

The symbol »🔕« appears in the system information field, with an indication of the time remaining until the alarm is enabled (minutes:seconds).

To enable the alarm tone:

- Press the »🔕« key, the yellow LED goes out.



Limit-based alarms activated in respective ventilation modes

Some alarms can be enabled and disabled individually in different operating modes.

Modus/ alarm		Man. Spont.	Volume Mode	Press. Mode	Press. Supp. Mode	Ext. fresh-gas outlet	Monitoring	Default value upon delivery
SpO2	⎍	ON	ON	ON	ON	ON	ON	--
[%]	⎎	ON	ON	ON	ON	ON	ON	92
Pulse	⎍	ON	ON	ON	ON	ON	ON	120
[1/min]	⎎	ON	ON	ON	ON	ON	ON	50
etCO2	⎍	*	ON	ON	ON	*	*	50 mmHg
[mmHg]	⎎	*	ON	ON	ON	*	*	--
inCO2	⎍	*	ON	ON	ON	*	*	5 mmHg
[mmHg]								
MV	⎍	*	ON	ON	ON	OFF	*	12
[L/min]	⎎	*	ON	ON	ON	OFF	*	3.0
inO2	⎍	*	ON	ON	ON	*	*	--
[Vol.%]	⎎	ON	ON	ON	ON	ON	ON	20
in Hal.	⎍	ON	ON	ON	ON	ON	ON	1.5
[Vol.%]	⎎	*	ON	ON	ON	*	*	--
in Iso.	⎍	ON	ON	ON	ON	ON	ON	2.3
[Vol.%]	⎎	*	ON	ON	ON	*	*	--
in Enf.	⎍	ON	ON	ON	ON	ON	ON	3.4
[Vol.%]	⎎	*	ON	ON	ON	*	*	--
in Des.	⎍	ON	ON	ON	ON	ON	ON	12.0
[Vol.%]	⎎	*	ON	ON	ON	*	*	--
in Sev.	⎍	ON	ON	ON	ON	ON	ON	4.2
[Vol.%]	⎎	*	ON	ON	ON	*	*	--
PAW	⎍	ON	ON	ON	ON	ON	ON	40
[mbar]	⎎	OFF	ON	ON	ON	OFF	OFF	8
Apnoea pressure		OFF	ON	ON	ON	OFF	OFF	8
Apnoea volume		OFF	ON	ON	ON	OFF	OFF	---
Apnoea CO2		ON**	ON	ON	ON	ON	ON**	---

* The alarms for etCO2 ⎎⎍⎎, inCO2 ⎍, MV ⎎⎍, inO2 ⎍ and inAgent ⎎ can be configured »**ON**« or »**OFF**« in standby for switching to Man.Spont. When the alarm limits are set to »**ON**« the value is adopted from the automatic ventilation mode. The default value for this configuration is »**OFF**«.

** In Man. Spont. and in the monitoring mode, the alarm is active after 65 seconds.

-- The default value set upon delivery is outside the monitored range; the corresponding alarm limit is disabled

All apnoea, apnoea pressure, apnoea volume and apnoea CO2 alarms are active after 35 seconds in the mechanical ventilation modes with a frequency of less than 6/minute and in pressure support mode with a minimum frequency FreqMIN of less than 6/minute or when set to "OFF".

All apnoea CO2 alarms in Man. Spont. and in the monitoring mode are only active if ventilation has already been detected (»AutoWakeUp«).

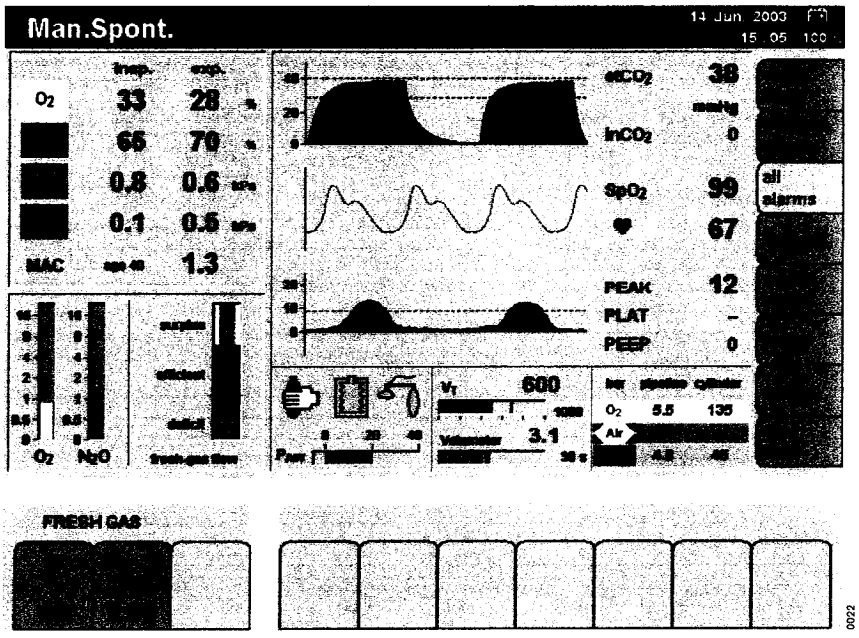
CO2 alarms on/off

The soft key »**CO2 alm. off/on**« is effective in the operating modes

- Man. Spont.,
- Monitoring and
- External Fresh-gas Outlet

The alarm limits for inCO2, etCO2 and CO2 apnoea monitoring can be disabled via this soft key.

In this case, the symbol » 🔕 « appears beside the measured values for the end-expiratory and inspiratory CO2 concentration.



The CO2 alarms are enabled by pressing the soft key again. Disabled CO2 alarms are enabled automatically when changing to another ventilation mode.

The alarms for etCO2 and inCO2 can be configured »**ON**« or »**OFF**« in standby when switching to Man.Spont. When the alarm limits are set to »**ON**« the value is adopted from the automatic ventilation mode, page 111.

CO2 alarms can also be enabled and disabled in all ventilation modes via »Alarm limits« in the configuration menu, page 111.

National and European standards require a minimum monitoring with some alarm functions. These standards may not be met if the alarm function of the etCO2 monitoring parameter is disabled.

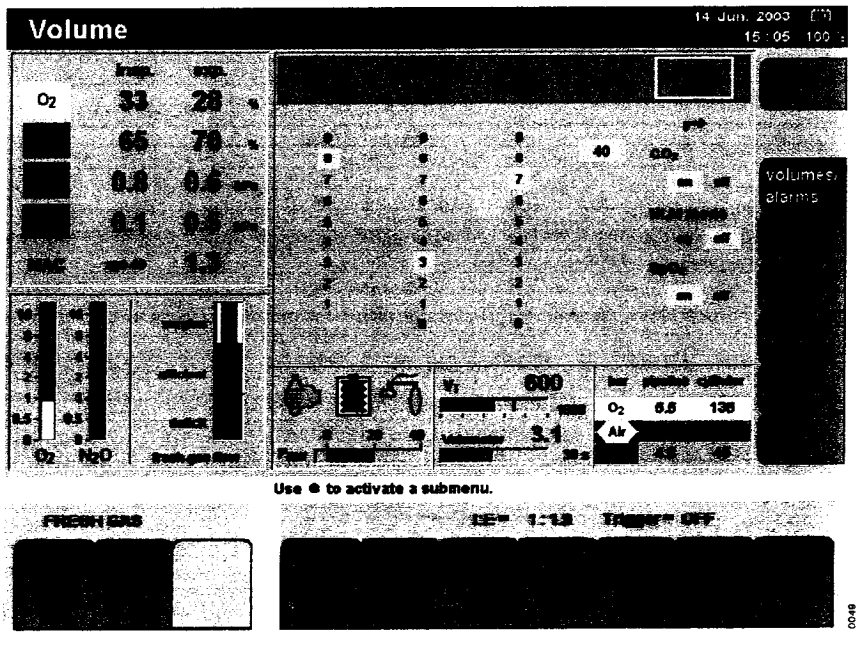
- Select and confirm »**CO2 on**« or »**CO2 off**« via the rotary knob.

HLM mode

The HLM mode permits patient monitoring without unnecessary alarms during extra-corporal oxygenation of the patient by a heart lung machine (HLM).

In the HLM mode:

- All gas concentrations are measured independently of the breathing phase.



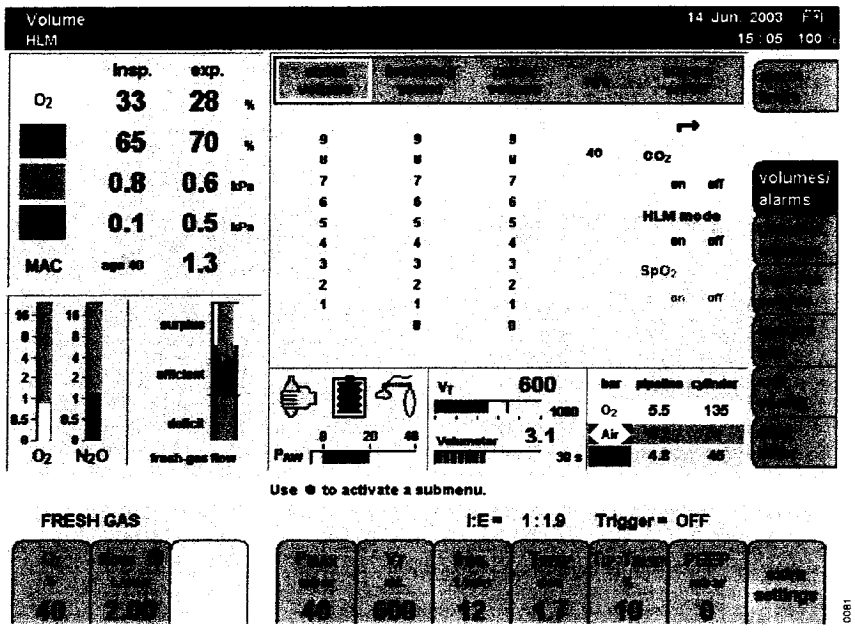
- CO_2 apnoea and pressure apnoea alarms are inactive.
- SpO_2 monitoring alarms are inactive.

The HLM mode can be used in all active ventilation modes.

HLM mode on/off

To activate/deactivate HLM mode in an active ventilation mode:

- Press the soft key »**config.**« on the standard or data screen.
- Select and confirm the column »**alarms on/off**« via the rotary knob.
- Select and confirm the line »**HLM mode**« via the rotary knob.
- Select and confirm »**on**« or »**off**« via the rotary knob.



The HLM mode remains activated when changing ventilation modes; it is deactivated when changing to standby.

Deactivating the HLM mode immediately reactivates the CO_2 alarms, but SpO_2 measurement (optional) is only reactivated when pulse signals have been detected again.

Deactivating the HLM mode has no effect on the "ON" or "OFF" status of SpO_2 measurement; the last status set is retained.

SpO_2 alarms on/off (optional)

To enable/disable all SpO_2 alarms.

SpO_2 alarms can also be enabled and disabled during operation via »alarms on/off« in the configuration screen, page 120.

- Select and confirm »**SpO2 on**« or »**SpO2 off**« via the rotary knob.

Suppressed alarm limits are identified by the symbol » ⚠ « in the parameter field.

National and European standards require a minimum monitoring with some alarm functions. These standards may not be met if the alarm function of the SpO2 monitoring parameter is disabled.

Displaying and setting alarm limits

Alarms can be displayed and set from all three basic screens (standard, data and trend screens) during operation.

There are standard alarm limits configured for the ventilation modes which may be used, as is, see "Setting alarm limits" on page 111 or adjusted individually for the patient concerned.

For this purpose, the alarm limits menu can be selected in standby via the soft key »**alarm limits**«.

To call up alarm limits during operation:

- Press the soft key »**alarm limits**«.

Display (example):

The current measured values and their alarm limits are grouped on the right.

The curves with the alarm limits represented by dashed lines are displayed on the left.

Example etCO2:

The upper alarm limit (50 mmHg) and lower alarm limit (30 mmHg) are shown alongside the measured value (38 mmHg).

A disabled alarm limit is indicated by two dashes (– –).