

Instructions for use

Primus



WARNING
To properly use this medical device,
read and comply with these instructions
for use.

**Anesthesia workstation
SW 4.5n**

Typographical conventions

- 1 Consecutive numbers indicate steps of action, with the numbering restarting with "1" for each new sequence of actions.
 - Bullet points indicate individual actions or different options for action.
 - Dashes indicate the listing of data, options, or objects.
- (A) Letters in parentheses refer to elements in the related illustration.
- A Letters in illustrations denote elements referred to in the text.

Any text shown on the screen and any labeling on the device are printed in bold and italics, e.g., ***PEEP, Air, or Alarm Settings***.

The greater than symbol > is used in menu sequences. The main menu is indicated first, then the menu option for selection, and if applicable further submenus, e.g., ***System Setup > Ventilation > Basic Settings***.

Use of terms

Dräger uses the term "Accessory" not only for accessories in the sense of IEC 60601-1, but also for consumable parts, removable parts, and attached parts.

Screen layouts and illustrations of the device

Schematic renderings of screen layouts and illustrations of the device are used, which may differ in appearance or in configuration from the actual screen images.

Trademarks

Trademark	Trademark owner
DrägerService®	Dräger
Drägersorb®	
D-Vapor®	
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Safety information definitions

WARNING

A **WARNING** statement provides important information about a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

A **CAUTION** statement provides important information about a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to the user or patient or in damage to the medical device or other property.

NOTE

A **NOTE** provides additional information intended to avoid inconvenience during operation.

Definition of target groups

For this product, users, service personnel, and experts are defined as target groups.

These target groups must have received instruction in the use of the product and must have the necessary training and knowledge to use, install, reprocess, maintain, or repair the product.

The product must be used, installed, reprocessed, maintained, or repaired exclusively by defined target groups.

Users

Users are persons who use the product in accordance with its intended use.

Service personnel

Service personnel are persons who are responsible for the maintenance of the product.

Service personnel must be trained in the maintenance of medical devices and install, reprocess, and maintain the product.

Experts

Experts are persons who perform repair or complex maintenance work on the product.

Experts must have the necessary knowledge and experience with complex maintenance work on the product.

Abbreviations and symbols

Explanations are listed in chapter "Overview" in the sections "Abbreviations" and "Symbols".

Contents

For your safety and that of your patients . . .	7	Emergency start	87
General safety information	8	Operation	89
Product-specific safety information.	12	Operation.	90
Application	15	Setting fresh-gas concentrations.	91
Intended use.	16	Setting the Vapor.	94
Indications and contraindications	18	Ventilation	95
Further information on application	18	Using non-rebreathing systems.	115
Overview	19	Changing patients	117
Components	20	Alarms	123
Additional functions	28	Alarm displays	124
Abbreviations	29	Alarm priorities and alarm signals	125
Symbols	32	Suppressing alarms.	126
Operating concept	35	Limit-based alarms activated in respective ventilation modes	128
Screen ergonomics.	36	Enabling/disabling CO ₂ alarms	130
Keys with permanent functions (hard keys) . . .	37	HLM mode.	131
Keys with variable functions (soft keys)	38	Enabling/disabling SpO ₂ alarms (optional) . . .	132
Selecting and setting	38	Displaying and setting alarm limits	133
Color concept	41	Monitoring	137
LED indicators of the device.	42	Selecting the standard screen.	138
Menu structure overview	43	Monitoring mode	139
Assembly and preparation	49	Screen layout	139
Before first use	50	Displayed parameters	140
Information about transport within the clinic . .	51	Gas measurement.	143
Accessory weight limits	53	Using the volumeter function.	147
Primus as a wall/ceiling device (optional). . . .	55	Econometer (optional).	148
Connecting the gas supply.	57	Loops (optional).	149
Connecting the anesthetic gas scavenging system AGS	59	Mini trends (optional).	150
Connecting the endotracheal aspiration system (optional)	60	Selecting the data screen	152
Connecting the patient system.	61	Selecting the trend screen.	153
Connecting the flexible arm for the breathing bag (optional)	67	Selecting the logbook	155
Park holder for vaporizer units (optional)	67	Using the timer function.	156
Connecting the electrical connections	68	SpO ₂ measurement (optional).	156
Getting started	71	Configuration	161
Device check	72	Configuring the default settings.	162
Self test.	82	Basic settings and audible signals	163
		Parameters	164
		Interfaces/logbook.	165
		Screen layout	166

Contents

Setting alarm limits	167
Ventilator and gas delivery	170
System information	173
Configuration during operation	175
Setting the patient's age and weight during operation	178
Remedying faults	179
Power failure	180
Gas failure	181
Ventilator failure	183
Fresh gas delivery failure	184
Ventilator and fresh gas delivery failure	185
Gas measurement failure	186
Screen error	186
User interface failure	186
System failure	187
Alarm – Cause – Remedy	188
Cleaning, Disinfection and Sterilization	207
Disassembly	208
Reprocessing Procedure	216
Reprocessing List	219
Assembly	221
Before using on patients on again	228
Maintenance	229
Overview	230
Inspection	231
Preventive maintenance	232
Repair	234
Emptying or replacing the water trap	235
Replacing the O ₂ sensor	236
Disposal	237
Disposing of the medical device	238
Disposal of Non-Rechargeable Batteries	238
Technical Data	239
Technical Data	240
EMC Declaration	262
Device combinations	267
Connections to IT-networks	267
Index	269

For your safety and that of your patients

General safety information	8
Strictly follow these instructions for use	8
Maintenance	8
Accessories	8
Not for use in areas of explosion hazard	9
Connection with other electrical equipment	9
Patient safety	10
Patient monitoring	10
Information on electromagnetic compatibility	10
Sterile accessories	11
Storing the instructions for use	11
Training	11
Product-specific safety information	12
Functional safety	14

General safety information

The following WARNING and CAUTION statements apply to general operation of the medical device.

WARNING and CAUTION statements specific to subsystems or particular features of the medical device appear in the respective sections of these instructions for use or in the instructions for use of another product being used with this device.

Strictly follow these instructions for use

WARNING

Risk of incorrect operation and of incorrect use

Any use of the medical device requires full understanding and strict observation of all sections of these instructions for use. The medical device must only be used for the purpose specified under "Intended use" on page 16 and in conjunction with appropriate patient monitoring (see page 17).

Strictly observe all WARNING and CAUTION statements throughout these instructions for use and the information on medical device labels. Failure to observe these safety information statements constitutes a use of the medical device that is inconsistent with its intended use.

Maintenance

WARNING

Risk of medical device failure and of patient injury

The medical device must be inspected and serviced regularly by service personnel. Repair and complex maintenance carried out on the medical device must be performed by experts.

If the above is not complied with, medical device failure and patient injury may occur. Observe chapter "Maintenance".

Dräger recommends that a service contract is obtained with DrägerService and that all repairs are performed by DrägerService. For maintenance Dräger recommends the use of authentic Dräger repair parts.

Accessories

WARNING

Risk due to incompatible accessories

Dräger has tested only the compatibility of accessories listed in the current list of accessories. If other, incompatible accessories are used, there is a risk of patient injury due to medical device failure.

Dräger recommends that the medical device is only used together with accessories listed in the current list of accessories.

NOTE

Strictly observe the instructions for use of all accessories such as:

- Water traps
- Flow sensors
- CLIC adapter
- CLIC absorber
- Soda lime
- Breathing hoses
- Masks
- Filters
- Endotracheal suction
- Vaporizer
- Manual resuscitator
- AGSS terminal unit

Not for use in areas of explosion hazard

WARNING

Risk of explosion and fire

The medical device is not approved for use in areas where oxygen concentrations greater than 25 Vol%, or combustible or explosive gas mixtures are likely to occur.

Connection with other electrical equipment

WARNING

Risk of electric shock or device malfunction

Any connected devices or device combinations not complying with the requirements mentioned in these instructions for use can compromise the correct functioning of the medical device and lead to an electric shock.

- **Electrical connections to equipment not listed in these instructions for use or these assembly instructions must only be made when approved by each respective manufacturer.**
- **Before operating the medical device, strictly comply with the instructions for use of all connected devices or device combinations.**

For further information, see "Device combinations" on page 267.

Patient safety

The design of the medical device, the accompanying documentation, and the labeling on the medical device are based on the assumption that the purchase and the use of the medical device are restricted to persons familiar with the most important inherent characteristics of the medical device.

Instructions and WARNING and CAUTION statements are therefore largely limited to the specifics of the Dräger medical device.

The instructions for use do not contain any information on the following points:

- Risks that are obvious to users
- Consequences of obvious improper use of the medical device
- Potentially negative effects on patients with different underlying diseases

Medical device modification or misuse can be dangerous.

CAUTION

Risk of patient injury

Do not make therapeutic decisions based solely on individual measured values and monitoring parameters.

Patient monitoring

The user of the medical device is responsible for choosing a suitable patient monitoring system that provides appropriate information on medical device performance and patient condition.

Patient safety can be achieved by a wide variety of means ranging from electronic surveillance of medical device performance and patient condition to direct observation of clinical signs.

The responsibility for selecting the best level of patient monitoring lies solely with the user of the medical device.

Information on electromagnetic compatibility

General information on electromagnetic compatibility (EMC) according to international EMC standard IEC 60601-1-2:

Medical electrical equipment is subject to special precautionary measures concerning electromagnetic compatibility (EMC) and must be installed and put into operation in accordance with the EMC information provided (see page 262).

Portable and mobile radio frequency communication equipment can affect medical electrical equipment.

WARNING

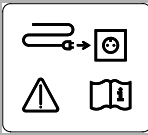
Risk of electric shock



Do not connect connectors with an ESD warning symbol and do not touch their pins without implementing ESD protective measures. Such protective measures can include antistatic clothing and shoes, touching a potential equalization pin before and during connection of the pins, or using electrically insulating and antistatic gloves.

All users concerned must be instructed in these ESD protective measures.

WARNING



Risk of electric shock

Connecting devices to the auxiliary outlets of the anesthesia machine can cause an increase in leakage current beyond permissible values if the protective conductor of a device fails.

Check the leakage current when connecting devices to the auxiliary outlets. If connecting a device (or devices) increases the leakage current to a value which exceeds the permissible value, do not use the auxiliary outlets of the anesthesia machine: use a separate wall socket.

The system must fulfill the requirements for medical electrical equipment in accordance with the relevant standards, see "Technical Data", page 261.

Storing the instructions for use

CAUTION

Risk of incorrect use

Instructions for use must be kept accessible to the user.

Training

Training for users is available from the Dräger organization responsible, see www.draeger.com.

Sterile accessories

CAUTION

Risk of medical device failure and of patient injury

Do not use sterile-packaged accessories if the packaging has been opened, is damaged, or if there are other signs of non-sterility.

Disposable articles must not be reprocessed and resterilized.

Product-specific safety information

WARNING

Risk of malfunctions

Unapproved modifications to the medical device can cause malfunctions.

No modifications must be made to this medical device without the permission of Dräger. Dräger does not accept responsibility for modifications to the device made without the permission of Dräger.

WARNING

Risk due to barely audible alarms

The user must remain within the hearing range of the acoustic alarm signal. This permits quick recognition and handling of the alarm.

Adjust the volume of the alarm signal to the distance from the medical device.

WARNING

Risk due to a noisy environment

When operating in a noisy environment, the volume of the alarm signals must be adjusted to suit.

Always set the volume of the alarm signal sufficiently high.

WARNING

Risk of use error

Various potentially dangerous situations may occur which demand the attention of trained personnel.

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.

WARNING

Risk of fire

In order to prevent a fire hazard, explosive anesthetics, such as ether or cyclopropane, must not be used.

WARNING

Risk of device failure and/or danger to patient

Magnetic fields may negatively influence the proper function of the medical device, thus endangering the patient or user.

The medical device must not be used in the vicinity of magnetic resonance imagers (MRI, NMR, NMI).

WARNING

Risk of explosion, fire

If an oxygen leak is suspected within or near the anesthesia machine, do not initiate operation.

Disconnect all oxygen supplies and contact a trained service technician.

WARNING

Risk of fire

To prevent a fire hazard, drugs or other substances based on inflammable solvents, such as alcohol, must not be introduced into the medical device, particularly into the breathing circuit and the breathing system.

Adequate ventilation must be ensured if highly inflammable substances are used for disinfection.

CAUTION

Risk of patient injury

An incorrect diagnosis or misinterpretation of measured values, or other parameters, may endanger the patient.

Do not base therapy decisions on individual measured values or monitoring parameters only.

WARNING

Risk of patient injury

If ventilation of the patient is no longer ensured due to an obvious fault in the equipment, the patient must immediately be ventilated with a manual resuscitator.

Always keep an emergency manual breathing bag at hand.

WARNING

Risk of burns

Conductive breathing hoses or face masks may cause burns during HF surgery.

Do not use these types of hoses and masks in combination with HF surgery.

CAUTION

Risk of mechanical failure

The shock and vibrations caused by transportation may lead to a mechanical failure. The application of a wall or ceiling mount is designated for buildings.

Do not use the anesthesia machine for mobile facilities such as ambulances, helicopters or ships.

CAUTION

Risk of crushing

Movable parts and attached parts can lead to crushing injuries. Pay special attention to edges, movable parts, and corners when working with the following parts:

- Drawers
- Ventilator module
- Doors
- Writing table
- Swivel arms for mounted devices
- Accessories such as gas cylinders, vaporizers, CLIC absorbers, and CLIC adapters

CAUTION

Risk of device failure

Compressed gas supply (central supply or cylinder): To avoid damaging the device(s) attached to a gas supply, use only medical gases. Pay particular attention to national and international standards regulating the use of medical gases.

Functional safety

The essential performance consists in:

- Supplying the anesthesia workstation with O₂
If the O₂ supply (central supply or gas cylinder) fails, an alarm is issued.
- Supply of the patient with adequately
If the breathing gas contains insufficient levels of O₂, an alarm is issued.
- Patients are not supplied with excessively high anesthetic gas concentrations
If excessively high anesthetic gas concentrations are delivered, an alarm is issued.
- Monitoring the airway pressure and the expiratory minute volume
Alarms are issued depending on the set alarm limits.

Application

Intended use	16
Utilization	16
Ventilation modes	16
The following measured values are displayed	16
The following parameters can be displayed as mini trends	17
The following parameters are displayed as curves	17
The following are displayed as bar graphs. . . .	17
Monitoring.	17
Indications and contraindications	18
Indications	18
Contraindications	18
Further information on application.	18
Environment of use.	18

Intended use

WARNING

Risk of device failure and/or danger to patient

If the intended use of this anesthesia machine is not adhered to, it may fail and/or the patient may be endangered.

Use the anesthesia machine only as specified in the intended use of these instructions for use.

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

Utilization

- Inhalation anesthesia in rebreathing systems
- Inhalation anesthesia in semi-closed to virtually closed systems with "low flow" and "minimal flow" techniques (for minimal gas and anesthetic agent consumption)
- Inhalation anesthesia in non-rebreathing systems, with a separate fresh-gas outlet for connecting, e.g., a Bain system or Magill system, with a fresh-gas flow of 0.2 to 18 L/min (optional).

Optional:

- Operation without nitrous oxide: The device may only be operated with O₂ and air.

Ventilation modes

- Volume-controlled ventilation in **Volume Mode**.
Optional activation of: Synchronization, **Press. Support** (Pressure support) (optional)
- Pressure-controlled ventilation in **Pressure Mode**.

Optional activation of: Synchronization, **Press. Support** (Pressure support) (optional)

- Manual ventilation (Man.)
- Spontaneous breathing (Spont.)
- Pressure-supported spontaneous breathing **Press. Support CPAP** (optional)
- **Volume AF** (Volume Mode AutoFlow) (optional).

Optional activation of: Synchronization, **Press. Support** (Pressure support) (optional)

The following measured values are displayed

- Peak pressure **PEAK**, mean pressure **PMEAN**, plateau pressure **PLAT**, and **PEEP**
- Expiratory minute volume **MV**, difference between insp. and exp. minute volume **MVLEAK**,
- Patient compliance **CPAT**,
Tidal volume **V_T**,
Breathing rate **Freq.**
- Inspiratory and expiratory concentration of O₂, N₂O, anesthetic gas, and CO₂
- Δ O₂:
Difference between inspiratory and expiratory O₂ concentration

Optional:

- Functional oxygen saturation (SpO₂) and pulse rate

The following parameters can be displayed as mini trends*

- Minute volume CO₂ **MV*CO₂**
- **O₂ Uptake**
- **PEEP**, patient compliance **CPAT**

The following parameters are displayed as curves

- Airway pressure **PAW**
- Inspiratory and expiratory flow
- Inspiratory and expiratory concentration of O₂, CO₂, and anesthetic gas

Optional:

- Plethysmogram
- **PAW-V** loops and **V-Flow** loops

The following are displayed as bar graphs

- Inspiratory tidal volume, expiratory tidal volume, and leakage tidal volume
- Volumeter
- Pressure
- Econometer for indicating fresh-gas utilization (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 **PAW**
- Expiratory minute volume **MV**
- Apnea
- Inspiratory and expiratory anesthetic gas concentration
- Detection of anesthetic gas mixtures (simultaneous detection of up to two anesthetic agents)
- Inspiratory O₂ and N₂O concentrations
- Inspiratory and expiratory CO₂ concentrations
- Special alarm behavior in HLM mode
- Automatic agent alarm activation for multiples of **MAC** (xMAC)

Optional:

- Oxygen saturation
- Pulse rate

* optional

Indications and contraindications

Indications

Primus is intended for inhalational anesthesia and/or patient ventilation in accordance with its intended use during surgical or diagnostic procedures.

Contraindications

For patients with suspected malignant hyperthermia: Do not use any volatile anesthetic agents or Primus with residual concentrations of these gases above 5 ppm.

Do not perform long term low-flow anesthesia on patients with ketoacidosis or patients under the influence of alcohol. Otherwise, there is a risk of acetone accumulation in the patient.

Further information on application

Environment of use

Primus is designed for use in areas in which therapeutic or diagnostic procedures can be performed.

Do not use Primus in the following environments:

- Outside buildings
- On intensive care units
- During patient transport
- In vehicles, airplanes, or helicopters

WARNING

Risk of explosion and fire

The medical device is not approved for use in areas where oxygen concentrations greater than 25 Vol%, or combustible or explosive gas mixtures are likely to occur.

WARNING

Risk of device failure and/or danger to patient

Magnetic fields may negatively influence the proper function of the medical device, thus endangering the patient or user.

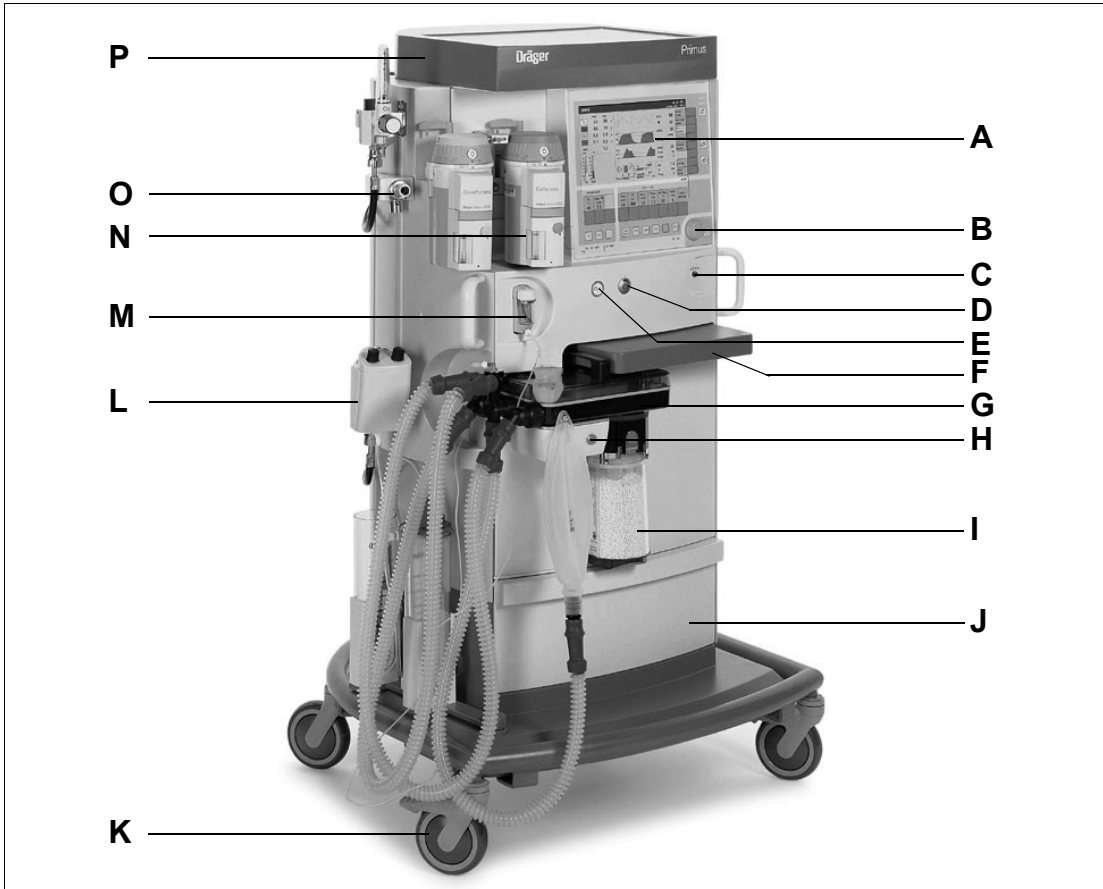
The medical device must not be used in the vicinity of magnetic resonance imagers (MRI, NMR, NMI).

Overview

Components	20
Front	20
Rear	21
Gas inlets	22
Screen with user interface	23
Interface panel	24
Flexible arm for breathing bag (optional)	25
Auxiliary O ₂ flow tube (optional)	26
Gas flow diagram	27
Additional functions	28
MEDIBUS/MEDIBUS.X Protocol	28
Abbreviations	29
List of abbreviations used in the software and on the device	29
List of general abbreviations	31
Units	31
Symbols	32

Components

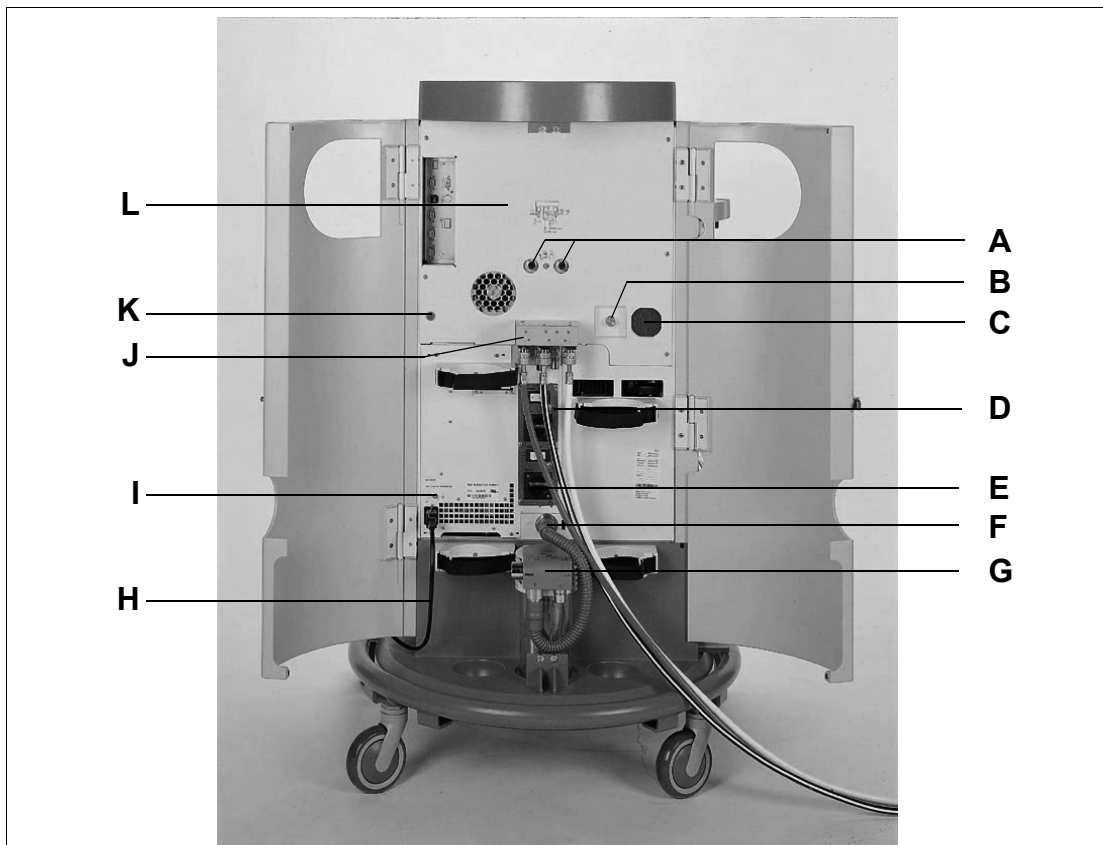
Front



- | | |
|--|--|
| A Screen with user interface | I Absorber
(optional: disposable Dräger absorber
Drägersorb CLIC) |
| B Rotary knob | J Drawer |
| C System power switch | K Castors with locking brake |
| D O ₂ emergency delivery | L Endotracheal aspiration system (optional) |
| E O ₂ flush button O₂+ | M Water trap with sample line connection |
| F Writing table | N Vapor units with Interlock system |
| G Breathing system | O Ext. fresh-gas outlet (optional) |
| H Release button for ventilator module* | P Top shelf (for external monitors) |

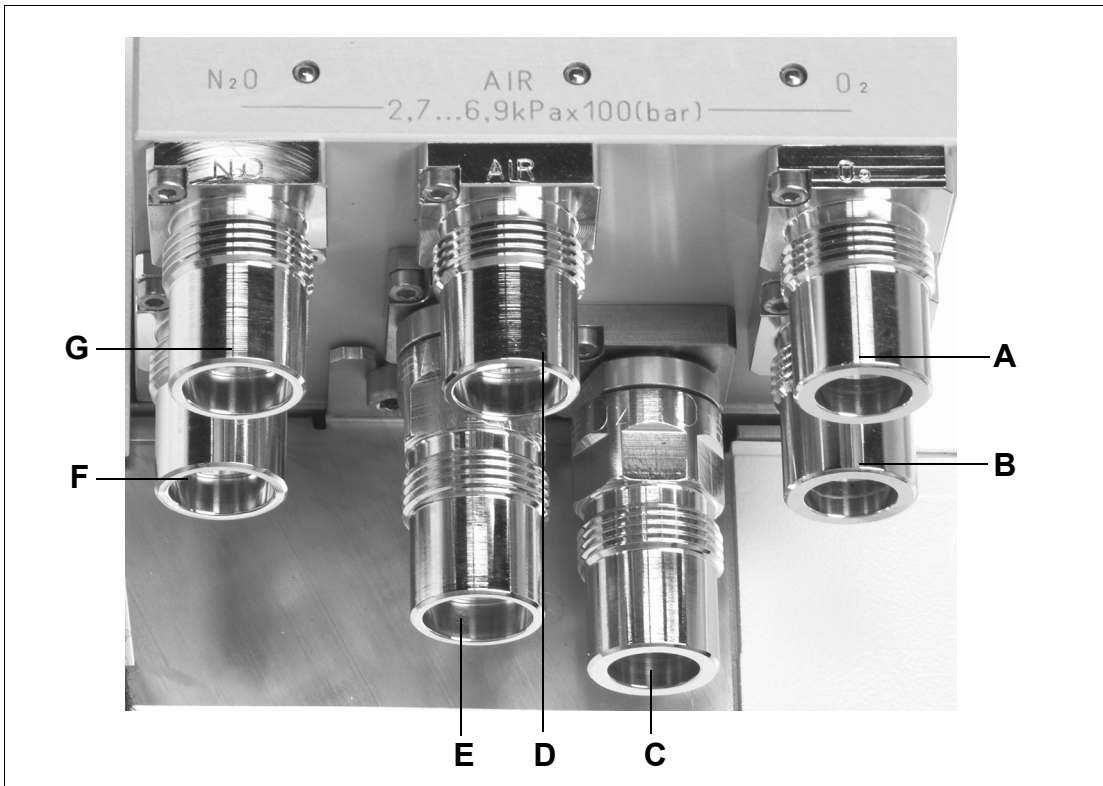
* available since November 2004

Rear



- | | |
|---|--|
| A Connectors for reserve gas cylinder pressure sensors | K Connection for optional halogen light (remove cover before use).
Only use the lamp specified in the list of accessories. |
| B O ₂ sensor
(not applicable for consumption-free O ₂ measurement) | L Interface panel |
| C Filter for fan | |
| D Potential equalization pin for auxiliary systems | |
| E Auxiliary outlets with fuse switches | |
| F Scavenging nozzle | |
| G Anesthetic gas receiving system AGS - only use the AGS specified in the list of accessories. | |
| H Power cord | |
| I Potential equalization pin | |
| J Gas inlets | |

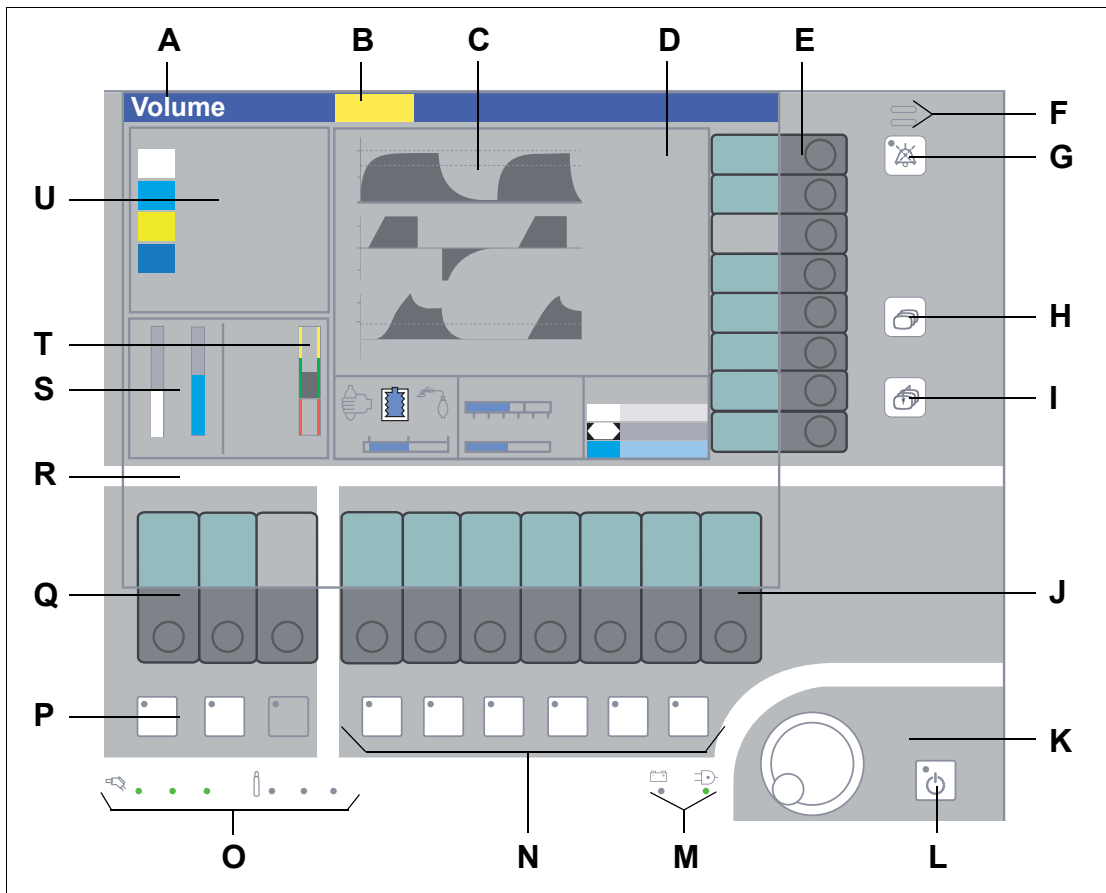
Gas inlets



- A** Connection for central gas supply **O₂**
- B** Connection for **O₂** cylinder
- C** **O₂** outlet for external **O₂** flow tube (optional)
- D** Connection for central gas supply **AIR**
- E** **AIR** outlet for endotracheal aspiration system (optional)
- F** Connection for **N₂O** cylinder*
- G** Connection for central **N₂O** gas supply*

* This connection is not available with the "Operation without nitrous oxide" option.

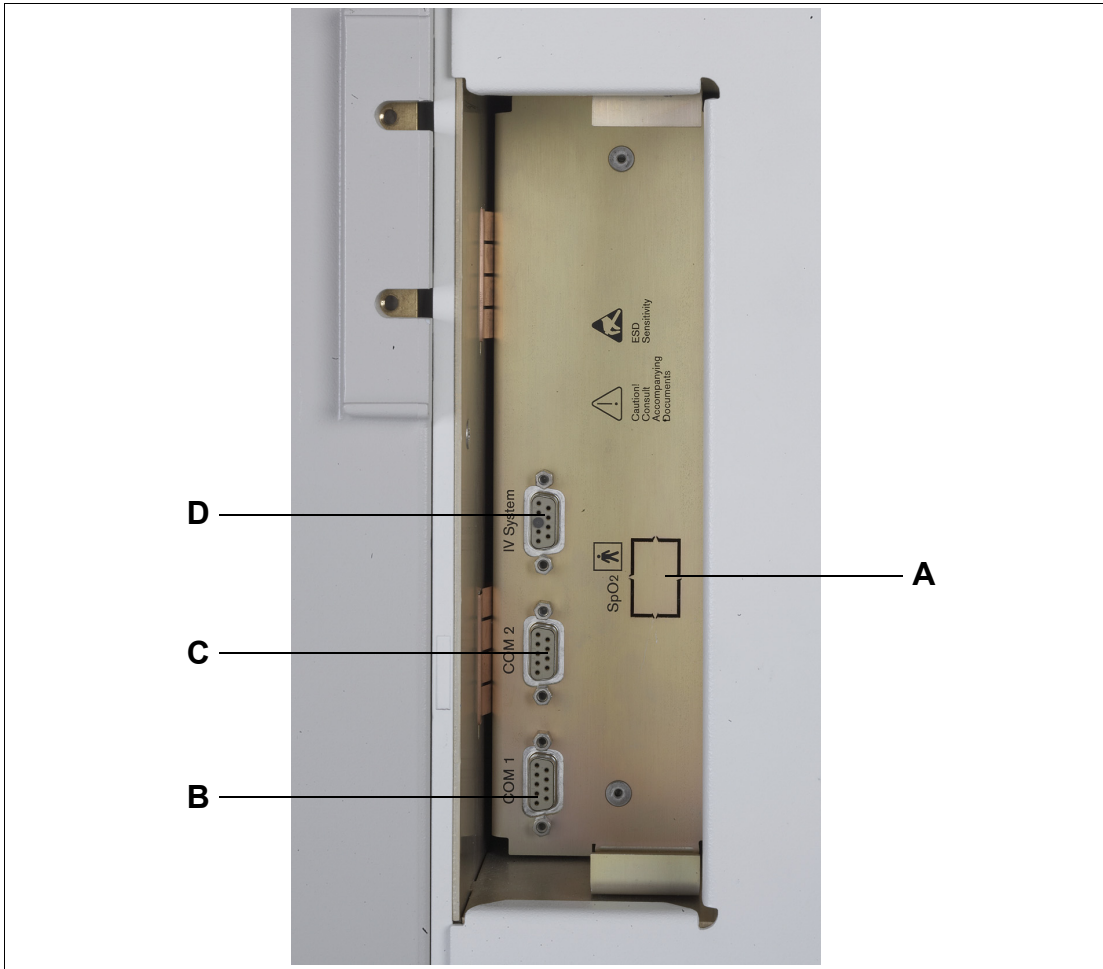
Screen with user interface



- A** Status field for the current ventilation mode
- B** Alarm field for alarms and their class
- C** Curve field for curves and other displayed modules
- D** Numerical field for measured values
- E** Soft keys for monitoring functions
- F** LEDs indicating the alarm status
- G** Key for silencing acoustic alarms for 2 minutes
- H** Key for changing the screen pages
- I** Key for calling up the standard screen
- J** Soft keys for ventilation settings
- K** Rotary knob: "select, set, confirm"
- L** Key for switching over to **Standby**
- M** LEDs for power supply/battery power
- N** Keys for selecting the ventilation mode
- O** LED indicators for the central gas supply and reserve gas cylinders
- P** Keys for selecting the carrier gas (**N₂O** or **Air**)
- Q** Soft keys for fresh-gas delivery settings
- R** Prompt field for user guidance
- S** Bar graph for gas delivery (virtual flow tubes)
- T** Bar graph for fresh-gas utilization (econometer) (optional)
- U** Parameter field for gas monitoring

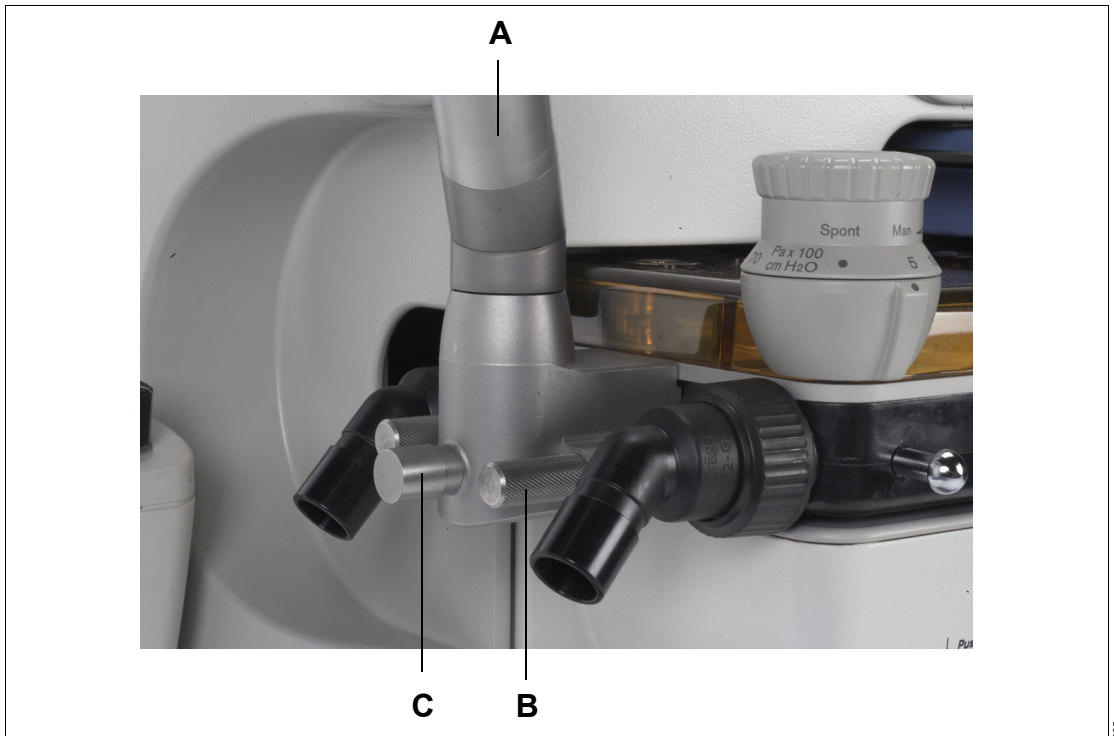
Interface panel

(Available since January 2005, interfaces which are not used were removed.)



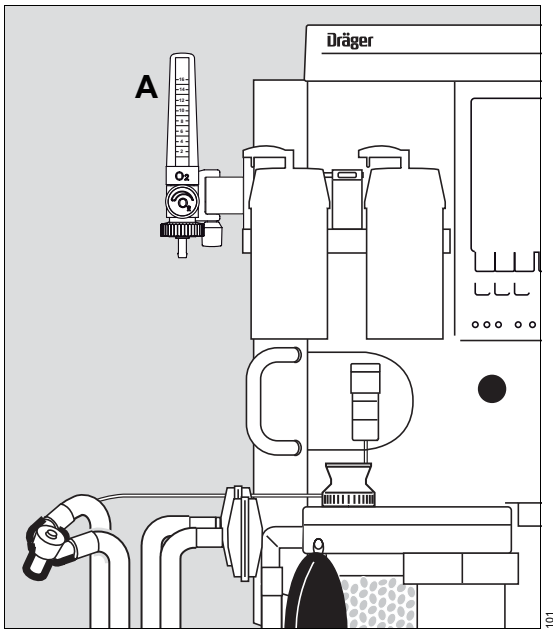
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- | | | | |
|----------|------------------------|------------------------------------|------------|
| A | SpO₂ | Socket for SpO ₂ sensor | (optional) |
| B | COM 1 | MEDIBUS, MEDIBUS.X interface | |
| C | COM 2 | MEDIBUS, MEDIBUS.X interface | |
| D | IV System | Connection for Dräger IV System | |

Flexible arm for breathing bag (optional)

- A** Flexible arm
- B** Knurled screws (for mounting on the breathing system)
- C** Circuit plug (for selftest)

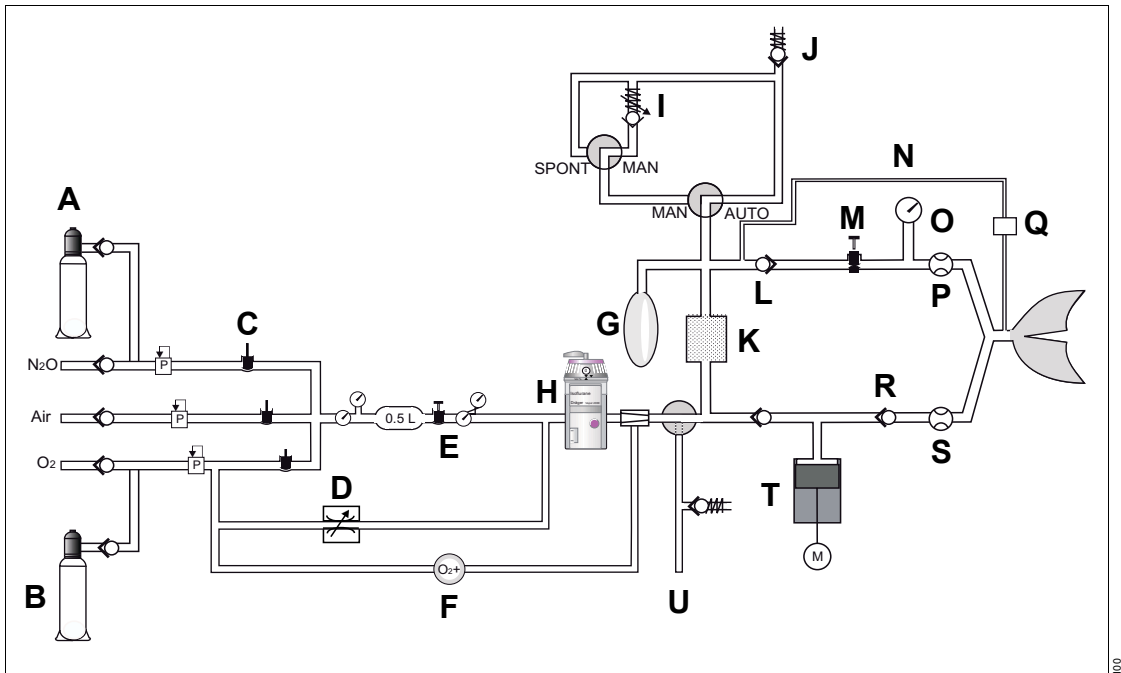
Auxiliary O₂ flow tube (optional)



A Auxiliary O₂ flow tube (optional)

The auxiliary O₂ flow tube delivers pure oxygen at a specified flow, e.g., used for delivering oxygen through a nasal cannula. Auxiliary oxygen can be used in any ventilation mode, in standby mode, or even if the machine is switched off, as long as the central O₂ gas supply is connected.

Gas flow diagram



- A N₂O cylinder
- B O₂ cylinder
- C Gas inlet valves
- D O₂ emergency delivery
- E Flow control
- F O₂-Flush
- G Breathing bag
- H Vapor
- I APL valve
- J Anesthetic gas receiving system AGS
- K Absorber
- L Exp. valve
- M **PEEP/PMAX**
- N Sample line
- O **PAW** sensor
- P Exp. flow sensor
- Q Gas measurement
- R Insp. valve
- S Insp. flow sensor
- T Piston pump ventilator
- U Ext. fresh-gas outlet (optional)

Additional functions

MEDIBUS/MEDIBUS.X Protocol

MEDIBUS and MEDIBUS.X are software protocols for use in transferring data between Primus and an external medical or non-medical device (e.g., hemodynamic monitors, data management systems, or a Windows-based computer) via the RS-232 interface see:

- 9037426, sixth edition or higher

or

- 9052608, third edition or higher.

WARNING

Risk of patient injury

Data transferred via the MEDIBUS/MEDIBUS.X interface are for information only and are not intended as a basis for diagnosis or therapy decisions. The data accessible via this interface are not intended for a decentralized alarm system in accordance with IEC60601-1-8:2012 (in the sense of remote monitoring).

WARNING

Risk of electric shock

Connecting devices to the auxiliary outlets of the anesthesia machine can cause an increase in leakage current beyond permissible values if the protective conductor of a device fails.

Check the leakage current when connecting devices to the auxiliary outlets. If connecting a device (or devices) increases the leakage current to a value which exceeds the permissible value, do not use the auxiliary outlets of the anesthesia machine, but a separate wall socket.

The system must fulfill the requirements for medical electrical equipment in accordance with the relevant standards, see "Technical Data", page 261.

Abbreviations

List of abbreviations used in the software and on the device

Abbreviation	Explanation	Abbreviation	Explanation
Air/AIR	Compressed air for medical use	inDes	Inspiratory desflurane concentration
APL	Adjustable Pressure Limitation	inEnf	Inspiratory enflurane concentration
BW	Body weight	inHal	Inspiratory halothane concentration
CAL	Calibration	inIso	Inspiratory isoflurane concentration
CO₂	Carbon dioxide	inO₂	Inspiratory O ₂ concentration
COM 1	Interfaces used as Medibus,	INOP	Inoperable
COM 2	MEDIBUS.X interfaces.	inSev	Inspiratory sevoflurane concentration
CPAP	Continuous positive airway pressure	insp.	Inspiratory
CPAT	Patient compliance	Iso.	Isoflurane
CSYS	System compliance	Leaksys	System leakage
Des.	Desflurane	MAC	Minimum Alveolar Concentration
ΔO₂	Difference between inspiratory and expiratory O ₂ concentration	Man.Spont., MAN/SPONT	Manual/spontaneous breathing
ΔPPS	Difference in pressure to PEEP in Pressure Support mode	MV	Expiratory minute volume
ΔVT	Difference between inspiratory and expiratory tidal volume	MV*CO₂	Expiratory minute volume CO ₂
Enf.	Enflurane	MVLEAK	Difference between inspiratory and expiratory minute volume
etCO₂	End-expiratory CO ₂ concentration	MVMAND	Mandatory breathed expiratory minute volume
exp.	Expiratory	MVSPON	Spontaneously breathed expiratory minute volume
Ext. Outlet	External fresh gas mode	N₂O	Nitrous oxide
FG	Fresh gas	O₂	Oxygen
Freq./freq.	Frequency	O₂+	O ₂ -Flush
FreqMIN	Mandatory minimum frequency in Pressure Support mode	PAW	Airway pressure
Hal.	Halothane	PAW-V loop	Pressure/volume loop
HLM	Heart lung machine	PEAK	Peak pressure
I:E	Ratio of inspiratory time to expiratory time	PEEP	Positive end-expiratory pressure
inCO₂	Inspiratory CO ₂ concentration		

Abbreviation Explanation

<i>PINSP</i>	Inspiratory pressure in Pressure Mode
<i>PLAT</i>	Plateau pressure
<i>pleth</i>	Plethysmogram
<i>PMAX</i>	Maximum pressure
<i>PMEAN</i>	Mean pressure
<i>Press. Support/ Press. Supp.</i>	Pressure Support mode Pressure-assisted ventilation
<i>Pressure/ Press. Mode</i>	Pressure Mode Pressure-controlled ventilation
<i>Sev.</i>	Sevoflurane
<i>SpO₂</i>	Functional O ₂ saturation
<i>Sync./sync.</i>	Synchronization
<i>TINSP</i>	Inspiratory time
<i>TIP:TINSP</i>	Ratio of inspiratory pause time to inspiratory time
<i>Trigger</i>	Trigger level
<i>TSLOPE</i>	Rise time
<i>V-Flow loop</i>	Volume flow loop
<i>Volume AF</i>	Volume mode AutoFlow
<i>Volume/ Vol. Mode</i>	Volume Mode Volume-controlled ventilation
<i>V_T</i>	Tidal volume
<i>VTINSP</i>	Measured inspiratory tidal volume

List of general abbreviations

Abbreviation Explanation

AC	Alternating current
AGS	to scavenger
AGSS	Anesthetic gas scavenging system
ATPD	Ambient Temperature and Pressure, Dry Ambient temperature and ambient pressure, dry gas
ATPS	Ambient Temperature and Pressure, Saturated Ambient temperature and ambient pressure, 100 % relative humidity
BTPS	Body Temperature and Pressure, Saturated 37 °C (98.6 °F), ambient pressure, 100 % relative humidity
cmH ₂ O	Centimeter of water
CS	Central gas supply / Piped medical gas supply for O ₂ , N ₂ O, AIR, and vacuum
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge
HF surgery	High-frequency surgery
HME	Heat + Moisture Exchange Heat and moisture exchanger
hPa	Hectopascal
in	Inches
IV	Intravenous
kg	Kilogram
kPa	Kilopascal
lbs	Pounds
MAN/AUTO	Manual/mechanical ventilation
mbar	Millibar
mL	Milliliter
mmHg	Millimeter of mercury
MPG	Medizinproduktegesetz (German Law on Medical Devices)

Abbreviation Explanation

NiBP	Non-invasive blood pressure
O ₂	Oxygen
PEIRP	"Equivalent isotropic radiated power" of the adjacent RF transmitter
ppm	Parts per million
PS	Pressure Support
psi	Pounds per square inch
RF	Radio Frequency
SORC	Sensitive Oxygen Ratio Controller
STPD	Standard Temperature and Pressure, Dry 20 °C (68 °F), 1013 hPa, dry gas
TEXP	Expiratory time
UPS	Uninterruptible power supply
V	Volt
VAC	Vacuum (e.g., for endotracheal suction)
Vol%	Percentage gas rate in relation to total gas volume
xMAC	Multiple of MAC

Units

NOTE



















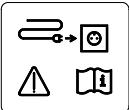









Throughout these instructions for use:
Ventilation pressures: cmH₂O = mbar = hPa.

For readability only the units hPa and cmH₂O are used.

Supply pressures: bar = kPa x 100.

Symbols

Symbol	Explanation	Symbol	Explanation
	Manufacturer		Upper and lower alarm limit disabled
	Date of manufacture		Upper alarm limit disabled
	Suppress alarm tone for 2 minutes, change priority of technical alarms and acknowledge them		Lower alarm limit disabled
	Call up standard screen	--	Alarm limit or measuring function disabled
	Call up basic screens in succession	* * * *	4-digit access code entered
	Standby/operation switch		Protection class type B (body)
	Non-rebreathing system at the external fresh-gas outlet		Protection class type BF (body floating)
	Pulse rate		ESD warning symbol, observe the warning statement, see "Information on electromagnetic compatibility" on page 10
	Fresh gas flowing		Interference
	Action in progress		Connection for potential equalization cable
	Upper and lower alarm limits		Caution! Consult accompanying documentation!
	Upper alarm limit only		Caution! (safety symbol)
	Lower alarm limit only		Consult instructions for use
	Alarm tone suppressed for 2 minutes		Warning! Strictly follow these instructions for use
	Alarm monitoring inactive		Exit menu, return to preceding menu
	Alarm monitoring temporarily inactive		Remaining battery capacity (uninterruptible power supply UPS)
	Apnea alarm disabled		Battery supply

Symbol	Explanation	Symbol	Explanation
	Mains voltage		Ambient pressure
	Manual ventilation		Do not use if package damaged
	Automatic ventilation		Do not reuse
	Connector for central gas supply (CS)		WEEE-labelling, EU Directive 2002/96/EC
	Reserve gas cylinder		Use-by date
	Rotary knob		CO2 absorbent bypass
	UL test mark		O2-Flush
	Plug system for Vapor units		Label on devices fitted with the "Operation without nitrous oxide" option.
	System power switch		Marker on surfaces where there is an increased risk of tipping when moving, leaning on, leaning against, etc. the device.
	Leakage current label; see WARNING on page 11		Marker on surfaces on which there is an increased risk of tipping when sitting.
	Crushing hazard		
	Fuse		
	Order number		
	Serial number		
	Batch designation		
	Protect from sunlight!		
	Temperature limit		
	Relative humidity		

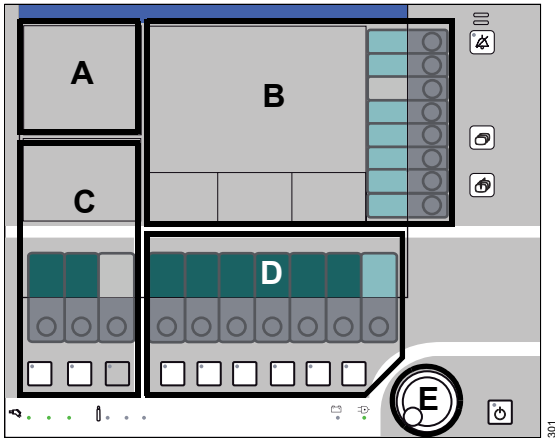
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Operating concept

Screen ergonomics	36
Function fields	36
Rotary knob	36
Keys with permanent functions (hard keys)	37
Keys with variable functions (soft keys) ...	38
Selecting and setting	38
Selecting the ventilation mode	38
Selecting/setting ventilation parameters.....	39
Selecting/setting monitoring functions	39
Selecting/setting configuration parameters ...	40
Color concept	41
Color examples for horizontal soft keys	41
Color examples for vertical soft keys	42
Parameter bar.....	42
LED indicators of the device	42
Menu structure overview	43

Screen ergonomics

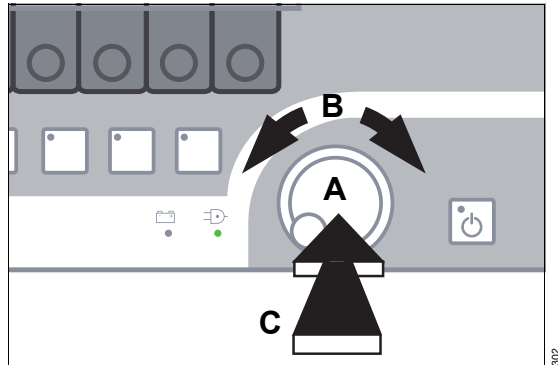
Function fields



The keys are grouped in function fields:

- A** Gas measurement
- B** Monitoring
- C** Fresh-gas delivery
- D** Ventilation
- E** All the settings are entered on the screen using the appropriate keys and the rotary knob.

Rotary knob



A The rotary knob is the main operating control of the device and has the following functions in all setting operations:

- Select/set = turn (B)
Clockwise rotation increases a value, counterclockwise rotation decreases a value.
- Confirm = push (C)
If the selection is not confirmed, the value or parameter will not change.

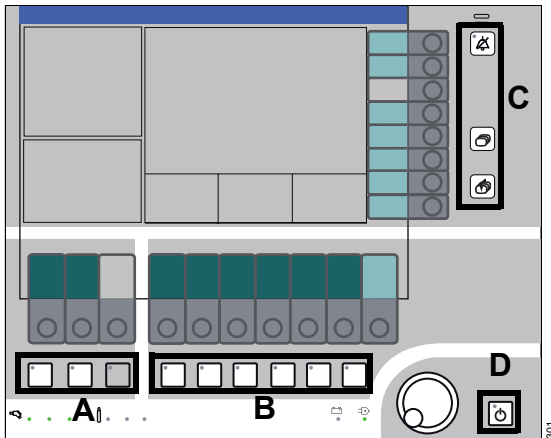
For example

- confirm the selected carrier gas or a ventilation mode
- set and confirm the parameters for fresh gas and ventilation modes
- set and confirm the monitoring functions.

Keys with permanent functions (hard keys)

The main functions for anesthesia, e.g., selecting the carrier gas or ventilation mode, can be achieved directly through keys with permanently defined functions:


- D The Standby key  is used for switching from operation to the **Standby** mode.






- A Keys for selecting the carrier gas (N₂O or Air):

The **N₂O** or **Air** keys are used to select the gas to be mixed with O₂ for the fresh gas.

- B Keys for selecting the ventilation mode:

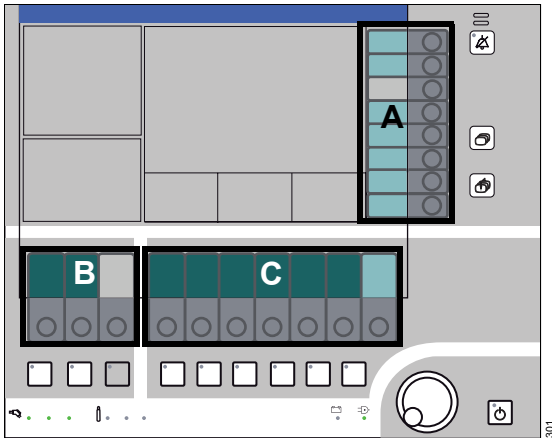
The keys **Man.Spont.**, **Vol. Mode**, **Vol. AF** (optional), **Press. Mode**, or **Press. Supp.** (optional) are used to select the ventilation mode, or  (optional external fresh-gas outlet).

- C Standard function keys

-  – Suppress the acoustic alarm for 2 minutes.
- Change the priority of technical alarms or acknowledge them.
-  Display in succession the three basic monitoring screens: standard screen, data screen, and trend screen.
- Briefly press the key until the required screen is displayed.
-  Return to the standard screen.

Keys with variable functions (soft keys)

These complementary keys have variable functions. They are used to set monitoring functions, configurations, fresh-gas delivery, and ventilation parameters.



A Keys for monitoring/configuration:

The keys for the various monitoring functions and configurations have different functions depending on the monitoring screen selected.

B Keys for fresh-gas delivery:

The keys for setting the O₂-concentration and the fresh-gas flow.

C Keys for the ventilation mode:

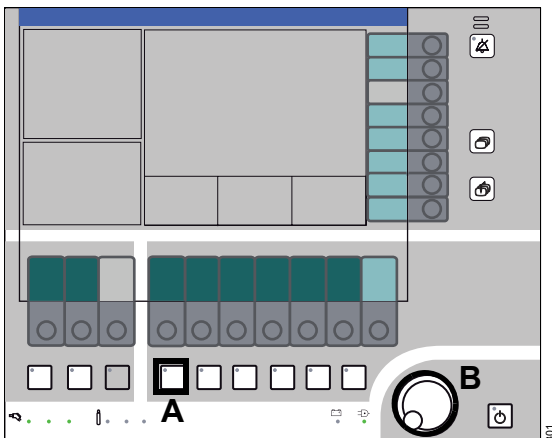
The keys for setting the parameters relevant to the ventilation mode.

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

The current parameter values are displayed.

Selecting and setting

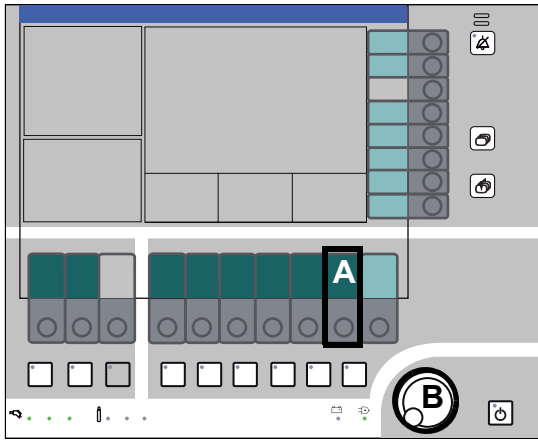
Selecting the ventilation mode



For example *Man.Spont.* mode.

- 1 Push the hard key *Man.Spont.* (A). The LED in the key flashes. In addition, a flashing help text is displayed in the prompt field.
- 2 Confirm = push the rotary knob (B).

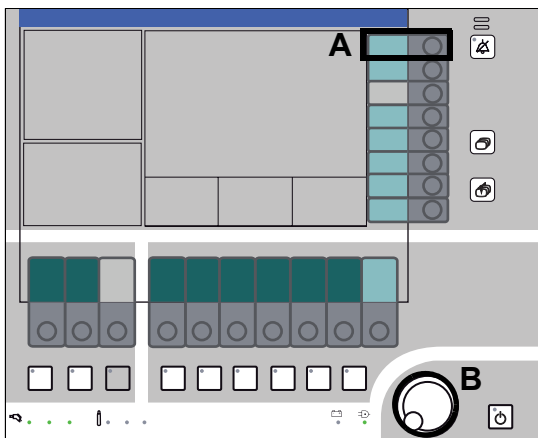
Selecting/setting ventilation parameters



For example **PEEP** ventilation parameter

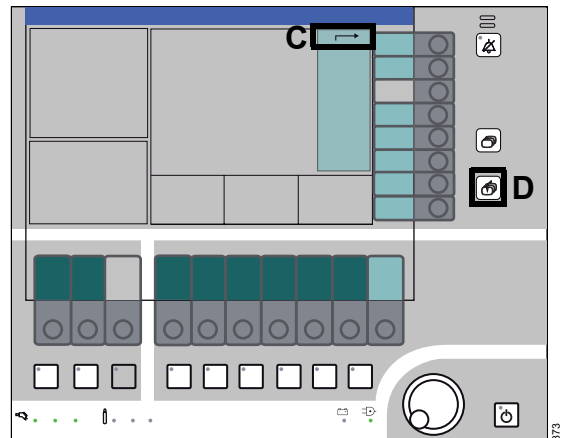
- 1 Push the soft key **PEEP** (A). The color changes from dark green to yellow. In addition, a flashing help text is displayed in the prompt field.
- 2 Set the PEEP value = turn the rotary knob (B). Confirm the PEEP value = push the rotary knob (B). The color changes from yellow to dark green.



Selecting/setting monitoring functions



For example Change the lower alarm limit of the end-expiratory CO₂ concentration.

- 1 Press the soft key **alarm limits** (A). The **alarm limits** menu is displayed on the screen.
- 2 Select the alarm limit = turn the rotary knob (B).
Confirm the selection = push the rotary knob (B).
Set the alarm limit = turn the rotary knob (B).
Confirm the new alarm limit = push the rotary knob (B).
- 3 To exit the **alarm limits** menu:

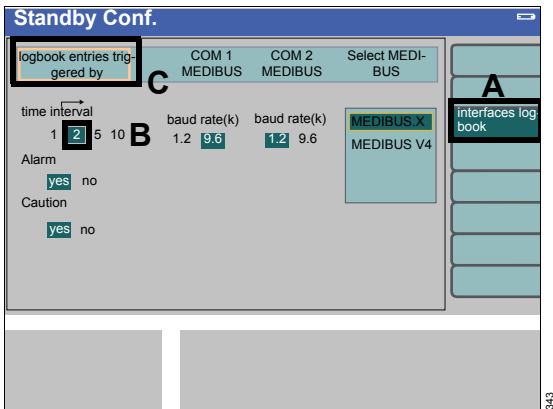


- Confirm the  symbol (C) to exit the menu = push the rotary knob
- or
- Press the  key (D).

Selecting/setting configuration parameters

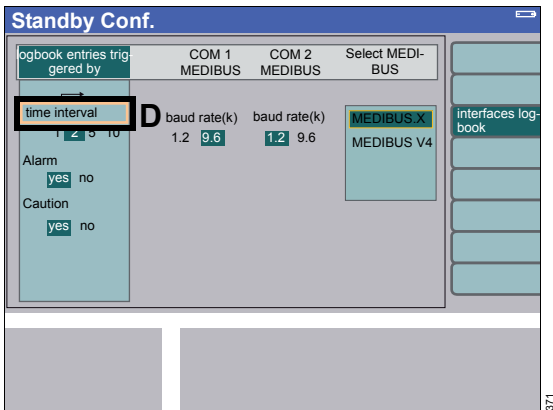
Example: Changing the time interval for the logbook entries from "2" to "5" in **Standby Conf.** menu.

The dark green soft key (A) indicates the currently active submenu **interfaces logbook**. The current **time interval** setting "2" is highlighted in dark green (B).

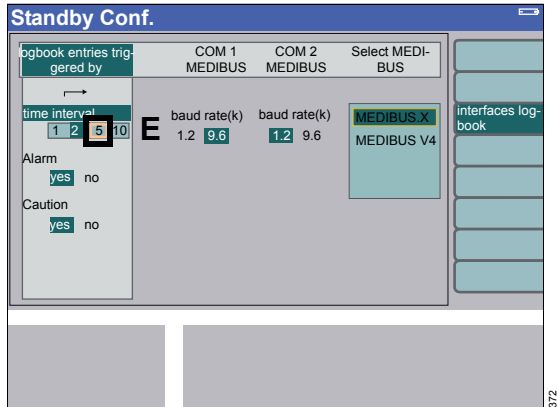


- 1 Select the menu **logbook entries triggered by** and confirm the selection with the rotary knob.

The **logbook entries triggered by** submenu is displayed on the screen.

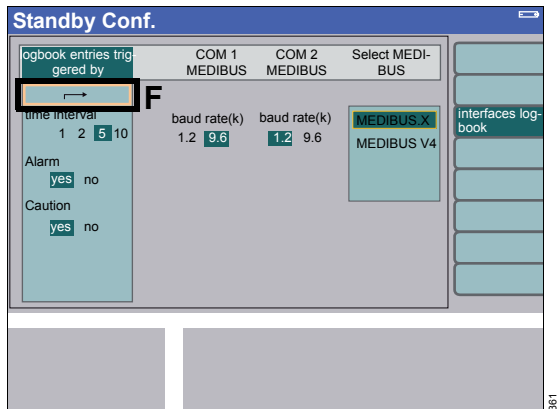


- 2 Turn the rotary knob and select the menu **time interval** (D). Confirm the selection with the rotary knob.



- 3 Turn the rotary knob and select the new time interval (E). Confirm the selection with the rotary knob.

The settings field highlighted in yellow returns to the preceding menu level.



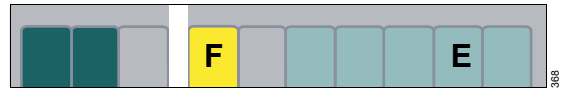
- 4 Select and confirm the \rightarrow arrow (F) to exit the menu.

Color concept

Colors are used to highlight operating sequences. They indicate the status of the soft keys.

- | | |
|-------------|--|
| Light green | – can be operated, leads to another menu or operating function |
| | – not yet active, presets |
| Yellow | – selected, can be changed or set, not yet confirmed |
| Dark green | – active parameter, can be operated |
| | – current selection (configuration menu) |
| Gray type | – cannot be operated |

Keys with presets which are not yet active appear in light green (E).



The selected parameter is yellow (F) and can be changed.

Values shown in gray (G)



- indicate discrepancies between the set and the actual values (e.g., following a failure of the O₂ supply)
- indicate that the specified accuracy is not being maintained.

Color examples for horizontal soft keys

The horizontal soft keys appear dark green (A) when operable.



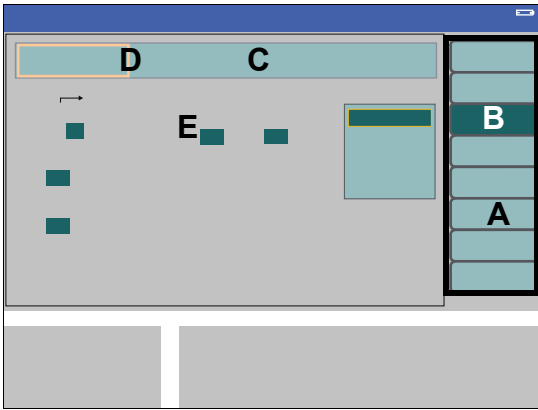
Proceed as follows to set a ventilation parameter:

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



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

Color examples for vertical soft keys



The vertical soft keys (**A**) appear in light green.

- Push the soft key, e.g., *interfaces logbook* (**B**)

The soft key appears in dark green.

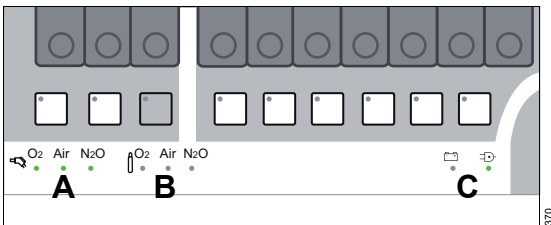
A menu bar with parameters (**C**) is displayed in light green.

Parameter bar

- Orange cursor frame around the menu title (**D**): selected submenu.
- Parameters with dark green background (**E**): current selection.
- Parameters in gray type: inactive and cannot be selected.

LED indicators of the device

To display the status of the gas and power supply of the Primus, several LED indicators are located at the bottom of the screen.



A Central gas supply (CS)

- LED lights up green CS line is connected and the pressure is within the specified range
- LED off The pressure is not within the specified range or no CS line is connected
- LED flashes green Malfunction of the corresponding input pressure reducer

B Reserve gas cylinders

LED lights up green Reserve gas cylinder is connected and the pressure is within the specified range

LED flashes red Reserve gas cylinder is connected, but the pressure is not within the specified range and no central gas supply is connected.

LED off Reserve gas cylinder is connected, but the pressure is not within the specified range,

the central gas supply is connected and within the specified range.

Or

no reserve gas cylinder connected.

C Power supply

The Primus can be supplied via the mains power or via a battery. The LED of the active power supply lights up green.

Menu structure overview

This table provides an overview of allocations for the variable, vertical monitoring and configuration soft keys. Allocations vary depending on the operating mode and device configuration. The operating modes are contained in the headers; the soft keys

are listed below these headers. Where other soft keys are available or the text on/function of a soft key changes after a particular soft key is pressed, information is contained in a separate column to the right of the soft key.

Check List

soda lime changed

undo change

start self test

accept

cancel test

cancel test

Standby

alarm limits

self test results

soda lime changed

undo change

Leak Test

logbook

page 1

page 2

delete trend

do not delete

delete

default config.

After entering the access code the menu **Standby Conf.** is opened with the following submenus:

basic settings audible signals

alarm volume

breathing sound

(optional, only in connection with breathing sound module)

pulse volume

(optional)

date/time language

Parameter

scaling

amplitude

units

Gas measurement

Optional parameters

interfaces logbook

logbook entries triggered by

COM 1 MEDIBUS

COM 2 MEDIBUS


Select MEDIBUS

screen layout

layout 1

layout 2

layout 3

alarm limits	
alarm limits	default alarm limits
	Default limits, anesthetic agents
	alarms in Man.Spont.
misc. alarm settings	therapy related
	device related
	other
ventilator and gas delivery	
ventilator and gas delivery	parameter default values
	gas supply checks
	ventilator default settings
weight related settings	body weight related ventilator settings
system information	General information
	activate option
	trace 1
	trace 2
	trace 3
	remote service 
monitor. mode	

Ventilation modes <i>Man.Spont., Volume, Volume AF, Pressure, Press. Support, Ext. Outlet</i>	
alarm limits	
auto-set limits ¹⁾	
CO₂ alm ON → off ²⁾	
exit HLM ³⁾	
show all alarms	
logbook	
	page 1
	page 2
screen layout	
	brightness
	config. screen
	activate layout 1
	activate layout 2
	activate layout 3
loops	
config.	
	volumes/ alarms
	alarm volume
	breathing sound (optional, only in connection with breathing sound module)
	pulse volume (optional)
	Alarms on/off

1) Only available in modes **Volume, Volume AF, Pressure, Press. Support.**

2) Only available in modes **Man.Spont., Ext. Outlet**

3) Only available, when HLM mode is active

paramet. settings	
	scaling amplitude
	units
	agent monitoring
logbook entries	
	logbook entries triggered by
system info	
	general info
	trace 1
	trace 2
	trace 3
exit config.	
start timer	

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Assembly and preparation

Before first use	50
Inserting O ₂ sensor and flow sensors.	50
Charging the battery for emergency operation.	50
Information about transport within the clinic	51
Accessory weight limits	53
Primus as a wall/ceiling device (optional) . .	55
Characteristics – wall device	55
Characteristics – ceiling device	56
Mounting Primus on the ceiling supply unit . . .	56
Connecting the gas supply	57
Connecting the backup gas cylinders.	58
Caution when handling O ₂ cylinders	59
Connecting the anesthetic gas scavenging system AGS	59
Connecting the endotracheal aspiration system (optional)	60
Connecting the patient system	61
Connecting the flexible arm for the breathing bag (optional)	67
Park holder for vaporizer units (optional) . .	67
Connecting the electrical connections	68
Connecting auxiliary devices	68
Establishing potential equalization	69
Connecting the potential equalization cable. . .	69
Connecting the power supply	70
Fuses for auxiliary outlets.	70

Before first use

Inserting O₂ sensor and flow sensors

Insert the enclosed O₂ sensor, see page 236. (Not applicable for consumption-free O₂ measurement.)

Insert the flow sensors, see page 221.

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 (95 °F).

WARNING

Risk of device failure

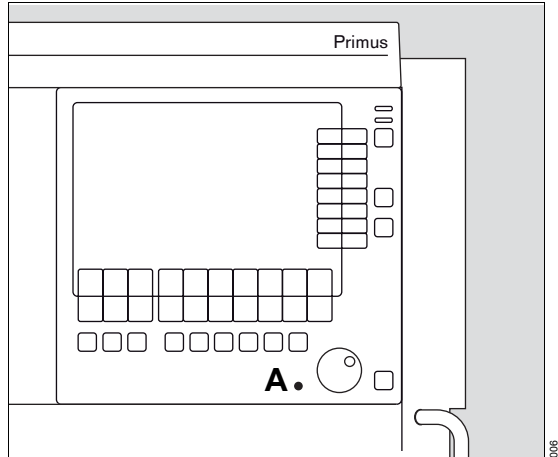
If the batteries have not been sufficiently charged and a power failure occurs, it may not be possible to continue operation for long enough.

Charge batteries for at least 8 hours before first use or after storage.

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

- Plug the mains power plug of the Primus workstation into the mains socket.

The mains voltage must correspond to that specified on the rating plate on the back of the machine.



The green LED  (A) lights up.

Leave Primus connected to the electrical power supply for 10 hours. It does not need to be switched on.

CAUTION

Risk of device failure

In the event of a power failure, any devices connected to auxiliary power outlets will not be powered by the UPS.

Pay special attention to all power indicators of connected devices.

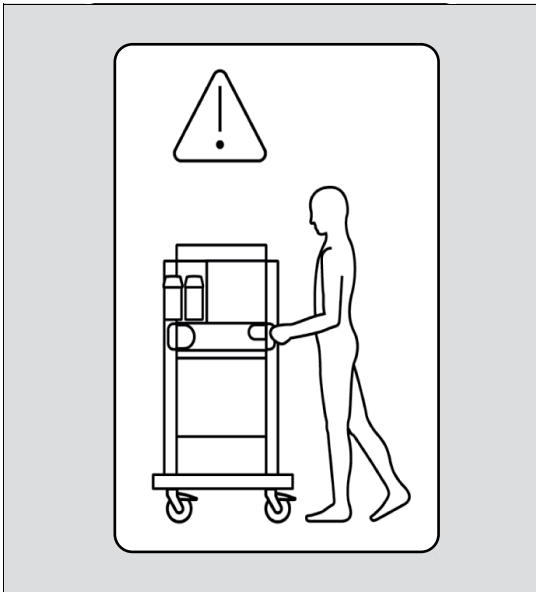
CAUTION

Risk of electric shock and of device malfunction

There is a risk of injury to the user or damage to the device if the device is connected to a power outlet with the wrong mains voltage or without a protective conductor.

The power cable must only be connected to a power socket with a protective conductor, see "Technical Data".

Information about transport within the clinic



Transport is defined as

- moving the device, other than for pure calibration purposes.
- removing the ceiling/wall-mounted device from the corresponding holder.

When transporting the anesthesia device:

- Only move the device using the handles provided for this purpose.
- The anesthesia device should only be moved by persons who are physically able.
- Dräger recommends that the anesthesia device should be moved by two persons. This also helps to improve maneuverability.
- Take special care not to bump or knock the device when moving it over uneven surfaces, around corners or at thresholds (e.g., in doors or elevators).
- Do not attempt to drag the device over hoses, cables, or other obstructions on the floor.

NOTE

Risk of injury

If incorrectly handled, the anesthesia machine may become top-heavy and tip over causing injury to the patient and/or user.

Observe the following points to prevent this hazard.

To increase tipping stability:

- Remove all monitors and devices from the upper storage area.
- Dismantle any additional mounted devices on swivel arms or on the upper side of the device (e.g., patient monitoring, data management systems, syringe pumps, etc.).
- Remove vaporizers and gas cylinders.
- Clear the writing table and push it inwards completely.
- Position the optional flexible arm for the breathing bag close to the device.
- Push in the ventilator module and drawers.

CAUTION

Risk of physical injury

To avoid physical injury, e.g., pinching, pay special attention to edges, moving parts and corners when working with drawers, the ventilator module, doors, the writing tray and/or swivel arms for mounted devices, as well as other accessories, such as gas cylinders, vaporizer units, CLIC absorbers and CLIC adapters.

WARNING

Reduced weight carrying capacity and tipping stability

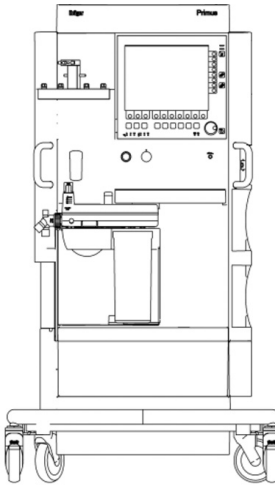
The front castors on the Primus ceiling device are not mechanically designed to take heavy loads. For this reason, the front castors are not suitable for transportation purposes as they are intended solely as a maneuvering aid when connecting the ceiling supply unit. Once a wall or ceiling device is removed from the ceiling supply unit or wall mount it will no longer fulfill the mechanical requirements of ISO 80601-2-13 and IEC 60601-1.

To position the Primus ceiling device, tilt it back and move it on its rear castors.

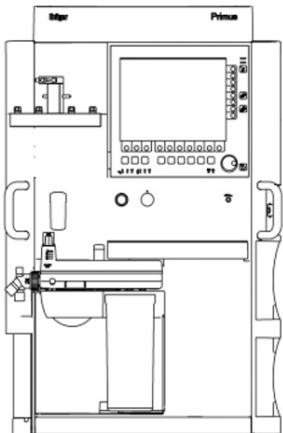
Accessory weight limits

The following figures specify the maximum safe weight limits for accessories mounted to the Primus.

Floor unit

Left side	Top, front, and rear of device		Right side
<p>The maximum permissible weight of accessories is 25 kg (55 lbs).</p> <p>A maximum load of 15 kg (33 lbs) may be applied with a clearance of max. 40 cm (16 in) in the upper position on the lateral mounting rail.</p> <p>The remaining weight must be applied with a clearance of max. 10 cm (4 in)</p>	<p>The maximum permissible weight of accessories on the top cover of the device is 20 kg (44 lbs).</p>  <p>The maximum load on the pull-out writing table is 10 kg (22 lbs).</p> <p>The maximum load on the lateral standard rail is 5 kg (11 lbs).</p> <p>The maximum load on the drawer is 3 kg (6.6 lbs).</p>	<p>The maximum permissible weight of accessories is 25 kg (55 lbs).</p> <p>A maximum load of 15 kg (33 lbs) may be applied with a clearance of max. 40 cm (16 in) in the upper position on the lateral mounting rail.</p> <p>The remaining weight must be applied with a clearance of max. 10 cm (4 in)</p>	
	<p>A maximum weight of 35 kg (77 lbs) may be applied to the rear of the device (gas cylinders, holders and accessories).</p>		

Wall device and ceiling device

Left side	Top, front and rear of device		Right side
<p>The maximum permissible weight of accessories is 25 kg (55 lbs).</p> <p>A maximum load of 15 kg (33 lbs) may be applied with a clearance of max. 40 cm (16 in) in the upper position on the lateral mounting rail.</p> <p>The remaining weight must be applied with a clearance of max. 10 cm (4 in)</p>	<p>The maximum permissible weight of accessories on the top cover of the device is 20 kg (44 lbs).</p>	<p>The maximum load on the pull-out writing table is 10 kg (22 lbs).</p>	<p>The maximum permissible weight of accessories is 25 kg (55 lbs).</p>
		<p>The maximum load on the lateral standard rail is 5 kg (11 lbs).</p>	<p>A maximum load of 15 kg (33 lbs) may be applied with a clearance of max. 40 cm (16 in) in the upper position on the lateral mounting rail.</p> <p>The remaining weight must be applied with a clearance of max. 10 cm (4 in)</p>
	<p>If required, other accessories must be attached to the wall rails.</p>		

CAUTION
 Risk of injury
 If mounting accessories exceed the approved limits, the anesthesia machine may tip over.
 Maximum weight per arm = 15 kg (33 lbs).

CAUTION
 Risk of inadvertent movement
 If not properly secured, the device may move inadvertently during operation.
 Apply the brakes on the device to ensure it cannot be moved accidentally.

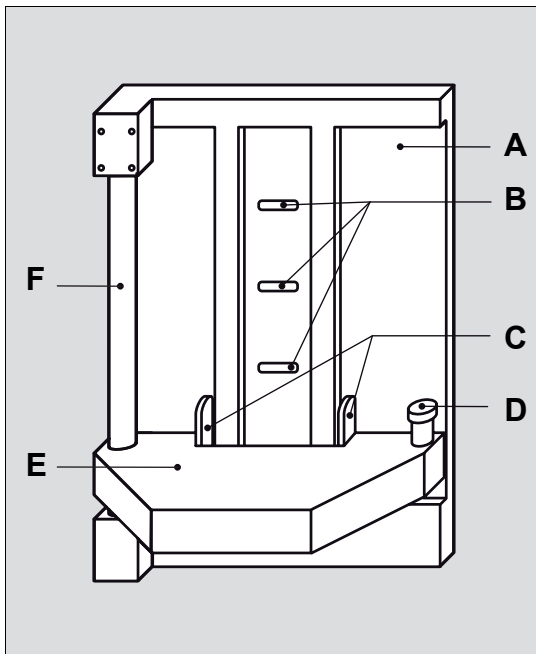
Primus as a wall/ceiling device (optional)

Characteristics – wall device

The wall device is permanently installed and can be delivered as a left swiveling or right swiveling version.

Optionally, a shelf can be mounted above the anesthesia device, which, if required, can be additionally supplemented by a drawer.

Structure of wall holder:



- A Wall plate
- B Cable rest
- C Angle brackets
- D Release knob
- E Swivel shelf
- F Swiveling axis

Access to the back of the device

- The Primus can be swiveled up to 90° from the wall.
Pull the release knob (D) and swivel the anesthesia device up to a maximum of 90° using the handle of the Primus.

Depending on which side of the wall mount support the swiveling axis (F) is on, the release knob (D) can be found on the left or right side.

CAUTION

Risk of collision

Options or accessories mounted on the side swivel arm may collide with other objects or persons in the operating theater during positioning and/or operation.

Take special care when positioning the anesthesia machine.

- Connect the gas supply and the electrical connections, see page 57 and page 68.
- Connect potential equalization cable.
- To route the cable, use the cable rest (B) on the wall mount.

After work is completed on the back of the device

- Swivel the device to the wall again until the release mechanism clicks into the locked position.
- Make certain that Primus is securely fixed to the wall by pulling slightly.

NOTE

Always place the device in the wall position – this is space-saving and a protection against damage.

NOTE

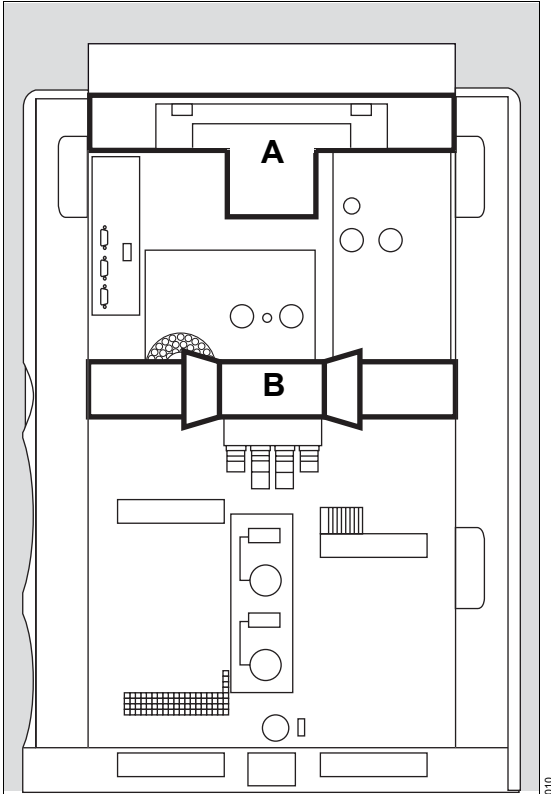
When mounting accessories or adding components at a later date, observe the maximum load of 160 kg (353 lbs) for the wall mount.

Characteristics – ceiling device

In connection with the ceiling supply units Movita lift or Forta lift, the anesthesia device Primus can be used as a ceiling device.

Mounting Primus on the ceiling supply unit

Follow the respective chapters in the instructions for use for Forta lift or Movita lift.



The ceiling supply units can accommodate the anesthesia machine Primus by using the device receptacle M. For this purpose, an upper adapter (A) and a lower adapter (B) are required.

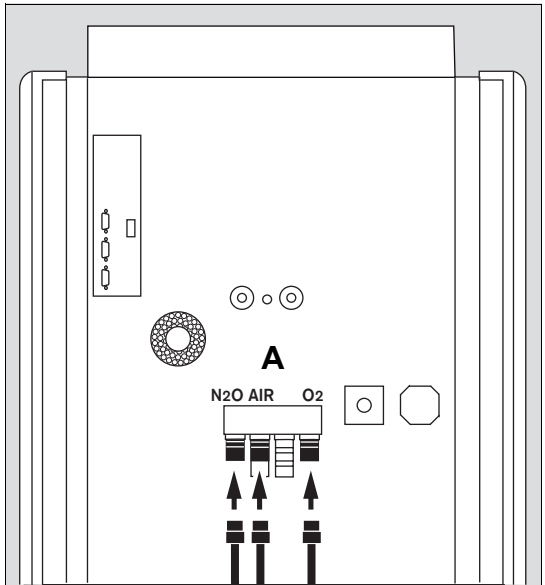
CAUTION

Risk of device failure

If the anesthesia machine is operated when tilted, components may be damaged or may function improperly.

Do not operate the anesthesia machine if it is tilted more than 5°.

Connecting the gas supply



- 1 Screw on the compressed gas hoses of the central gas supply (CS) for **O₂**, **AIR**, **N₂O*** to the front connections of the gas inlet block (A). The two outer ports at the back are reserved for the reserve gas cylinders.

A compressed air outlet for the optional endotracheal suction system and an O₂ outlet for an external O₂ flow tube are optionally available.

- 2 Plug the other end of the compressed gas hoses into the terminal unit.
- 3 Make sure all supplies are connected correctly and functioning properly.

* With the "Operation without nitrous oxide" option connection of an N₂O gas supply is not possible.

CAUTION

Risk of supply failure

If all gas supplies (central and cylinder) are not connected correctly, the reserve system will not be available in the event of a gas supply failure.

Make sure all supplies are connected according to the engraving on the gas inlet block and the illustrations at the back of the machine. After connecting the supplies, ensure proper functionality.

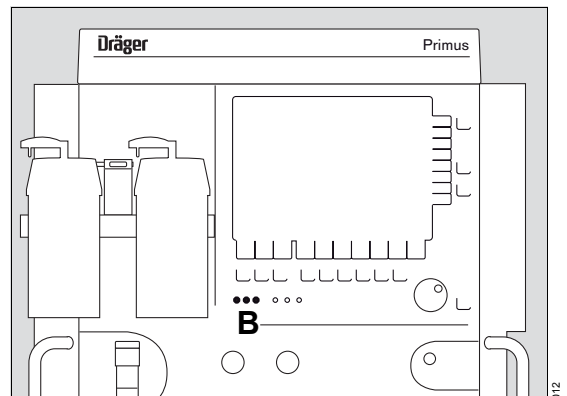
CAUTION

Risk of device failure

In order for the anesthesia machine to operate as specified, the supply pressures at the machine inlet must be within a range of 2.7 and 6.9 kPa x 100.

Make sure this is the case before initiating operation.

- 4 All three LEDs (B) illuminate green. The LEDs do not illuminate if the gas pressure is <2.7 kPa x 100 or if the compressed gas hose is not connected.



Connecting the backup gas cylinders

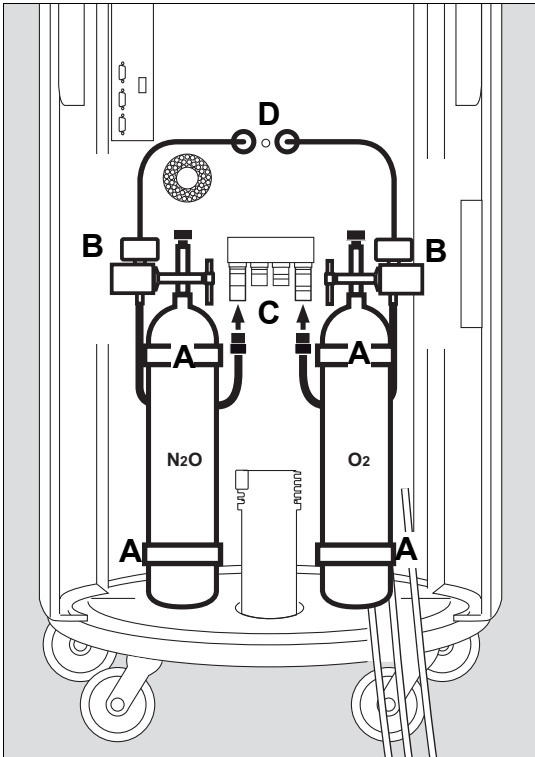
CAUTION

Risk of supply failure

If the central gas supply fails, the gas cylinders on the anesthesia machine will provide a reserve gas supply.

To prevent a complete gas failure, the cylinders should remain on the device with valves closed (see warning below), in reserve even if the anesthesia machine is connected to the central gas supply.

At the back of the workstation:



- 1 Place full cylinders in the cylinder holders (A) and secure them.
With the "Operation without nitrous oxide" option, connection of an N₂O backup gas cylinder is not possible.
- 2 Mount the pressure reducers (B) to the cylinder valves.
- 3 Connect the gas hoses to the corresponding ports of the gas inlets (C).
With the "Operation without nitrous oxide" option, the gas inlet block has sealing caps on the N₂O gas inlets to prevent N₂O being connected by mistake. These sealing caps may only be removed by DrägerService. To start using the device with nitrous oxide again, the device must undergo a full check by DrägerService.
- 4 Connect the pressure sensor lines to the connectors (D) above the gas inlets.
- 5 Open the cylinder valves.

The LEDs indicating the cylinder pressure status should illuminate green. If the LEDs do not illuminate, make sure that the sensor plug and pressure reducer have been connected correctly and that the cylinder pressure is sufficient.

- 6 Close the cylinder valves.

CAUTION

Risk of supply failure

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

Close cylinder valves whenever the central supply is sufficient.

Caution when handling O₂ cylinders

WARNING

Risk of explosion

If the O₂ cylinder valves or O₂ pressure reducing adapters is handled with oily or greasy fingers/hands, the risk of explosion is eminent.

Do not oil or grease the O₂ cylinder valves or O₂ pressure reducing adapters, and do not handle with oily or greasy fingers.

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 trained personnel.

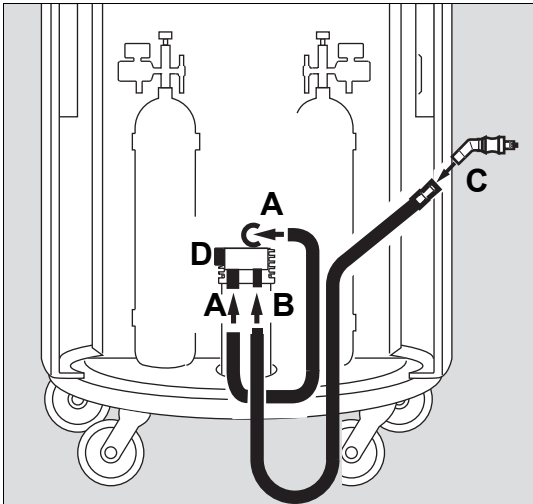
WARNING

Risk of supply failure

If pressure reducers not having the required sensors and measurement features are used instead of Dräger pressure reducers, reserve cylinders and their fill levels will not be covered by alarm and monitoring functionalities during the power-on self test and operation.

Without this monitoring, it cannot be guaranteed that, in the event of a loss of the central supply, the backup functionality of the reserve gas cylinders will be available. If monitoring for the remaining capacity of the backup gas cylinders is not available, the user must take other equivalent measures.

Connecting the anesthetic gas scavenging system AGS



- 1 Connect the gray transfer hose (A) to the scavenging nozzles on the Primus and on the AGS.
- 2 Connect the scavenging hose to the scavenging nozzle (B) of the AGS.
- 3 Connect the scavenging hose to the scavenging connector (C).

- 4 Make sure the second connection to the scavenging system is sealed by a screw plug (D).
- 5 Connect the scavenging connector (C) to the terminal unit of the anesthetic gas scavenging system. The terminal unit indicator is green.
- 6 The AGS is functioning when the float in the flow tube is between the two marks.

Note the instructions for use of the anesthetic gas scavenging system AGS.

WARNING

Risk of patient injury

If the side openings of the receiving system are blocked, negative pressure may result in the breathing system and the patient's lungs.

Always make sure the side openings of the receiving system are not blocked.

The anesthetic gas scavenging system may be connected optionally to the left-hand side of the workstation.

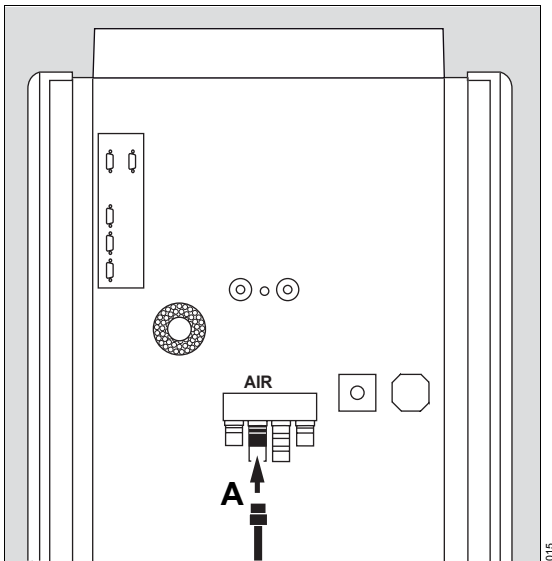
NOTE

If the anesthesia machine is operating on an incline approaching 10°, make certain the AGS is functioning correctly, e.g., by means of visual inspection.

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:

- Secure the Air connecting hose of the endotracheal aspiration system to the central gas supply (CS) for Air.
- Optionally, the Air connecting hose of the endotracheal aspiration system can be connected to the **AIR** outlet (A) at the back of the Primus.

For vacuum-driven aspiration:

- Connect the vacuum hose of the endotracheal aspiration system directly to the terminal unit.

WARNING

Risk of patient injury

If not used correctly, the suction unit may injure the patient.

Prior to use, disconnect the patient from the ventilator, and pay special attention to the instructions for use of the suction unit.

Connecting the patient system

WARNING

Risk of infection

Unpackaged or non-reprocessed components might be contaminated with pathogenic germs.

- **To prevent cross-infection of patients or users, use only new or reprocessed components.**
- **Observe conditioning and assembly instructions.**

WARNING

Risk of burns

Conductive breathing hoses or face masks may cause burns during HF surgery.

Do not use these types of hoses and masks in combination with HF surgery.

WARNING

Risk of strangulation

If not positioned with care, hoses, cables, and similar machine components may endanger the patient.

Take special care when connecting the patient.

WARNING

Risk due to particles and dust

To protect the patient from particles and dust, a filter must be used between the inspiratory limb of the breathing system and the patient.

Use a Y-piece filter or filter on the inspiratory port.

NOTE

Primus (without accessories) is not made with natural rubber latex.

To minimize the risk of exposure to latex, use latex-free breathing bags and breathing hoses.

CAUTION

Risk of inadequate gas concentrations

If the patient system components are not tightly connected, ambient air will be added to the gas mixture.

Make sure all patient system components are tightly connected.

NOTE

Only use original sample line – other lines may change the technical data of the device.

- 1 Select appropriate accessories for the relevant patient category.

	Adults		Pediatric patients	Neonates
tidal volume	>700 mL	201 to 700 mL	50 to 200 mL	<50 mL
Breathing bag	3 L	2 L	1 L	0.5 L
Breathing circuit	Adults		Pediatric	Neonates (or pediatric)
Filter	Filter, HMEF, or HME			Use a filter with a low resistance and compliance.

NOTE

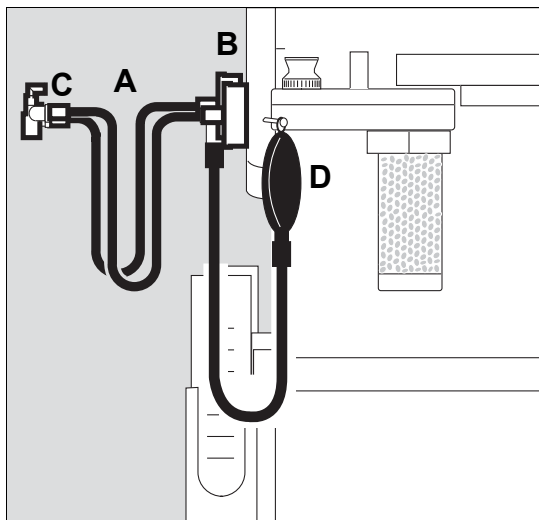
For application within the tidal volume limits of a particular patient category, use a smaller breathing bag and a smaller breathing hose set.

WARNING

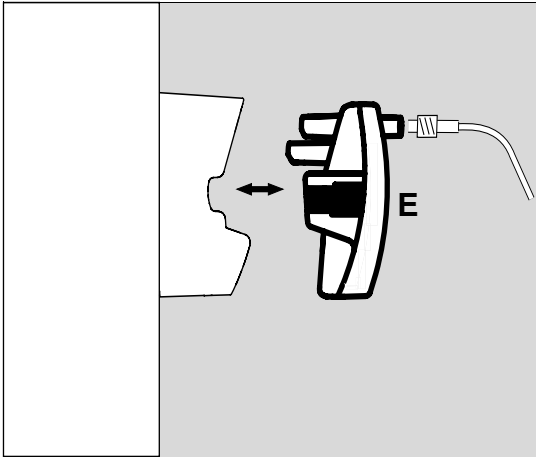
Risk of patient injury

If the breathing hoses are wrongly connected, the patient might be inadequately ventilated and supplied with fresh gas.

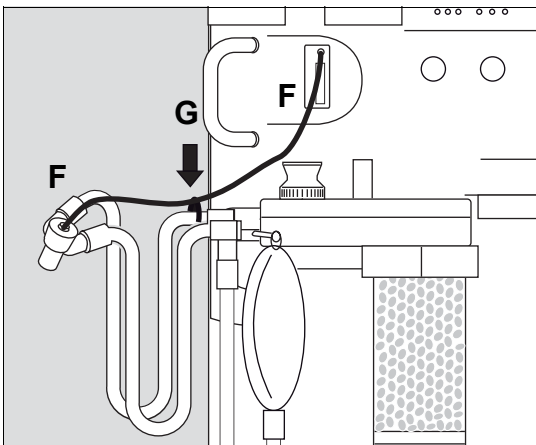
Make sure that all breathing hoses are correctly connected to the breathing system.



- 2 Connect each breathing hose (A) to the inspiratory port and expiratory port, optionally with microbial filter (B).
- 3 Connect both breathing hoses to the Y-piece (C).
- 4 Connect breathing bag (D) to breathing bag hose.
- 5 Attach the breathing bag hose to the bag elbow and hang breathing bag on the hook.

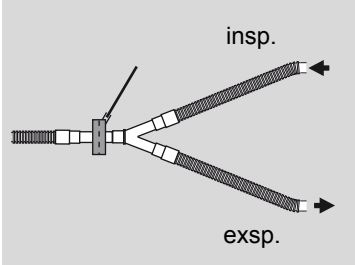
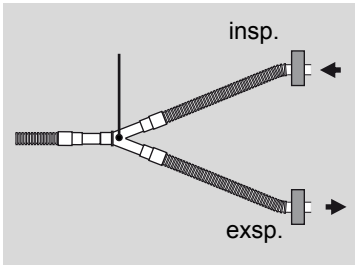
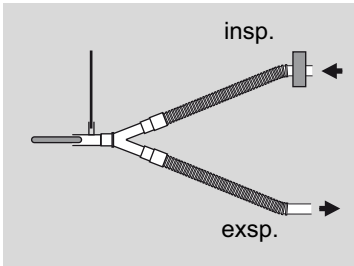


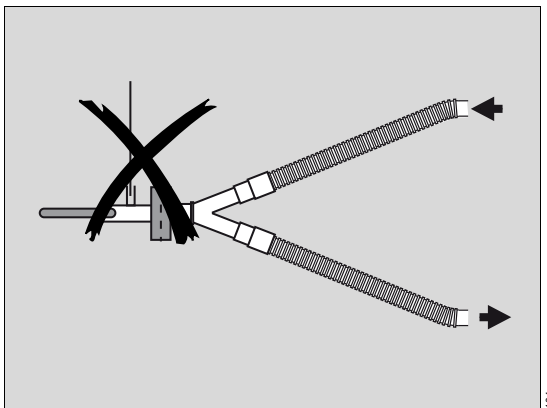
- 6** Fit the water trap (E).



- 7** Connect the sample line (F) to the connector on the Y-piece and to the water trap.
- 8** Use the clip (G) for the sample line to ensure the sample line is correctly routed. This clip should be attached to the expiratory port of the breathing system.

Table with recommended hose configurations*

Adults	Pediatric patients	Neonates
<p>A filter or an HME filter between the Y-piece and patient, connector for sample line on the filter or HME filter:</p>  <p>Or</p> <p>One filter each on the inspiratory port and expiratory port, connector for sample line on the Y-piece:</p> 		<p>One filter on the inspiratory port, connector for sample line as close as possible to the patient:</p>  <p>Side connectors for connecting the sample line support the CO₂ measurement and help to flush the dead space in the Y-piece and tube adapter.</p>



WARNING
Risk of negative lung pressure
 If filters are blocked, the sample gas flow could cause negative lung pressure.
 When ventilating pediatric patients and neonates, do not use HME filters or other filters at the Y-piece if sample gas is being taken at the tube adapter.

* Note the resistance of the breathing system and connected accessories.

For measurement purposes, a permanent side-stream flow runs through the sample line to the patient-gas measurement module. In case of a blocked HME filter or filter in this position at the Y-piece, the measurement system would produce negative pressure situations in the patient's lungs.

Observing the resistance and compliance

WARNING

Risk due to additional components in breathing circuit

When additional components are used or in the case of hose configurations that differ from the standard or recommended hose configurations, the inspiratory and expiratory breathing resistances may exceed the standard requirements.

If such configurations are used, the user must pay particular attention to the measured values. Observe the instructions for use of the additional components.

WARNING

Risk of increased rebreathing

If coaxial hoses are used, leakages between the inner and outer hose cannot be detected during the leak test.

To avoid insufficient gas exchange and rebreathing of CO₂, monitor the measured gas concentration extremely carefully.

WARNING

Risk due to misleading measured values

Replacing the breathing hoses, filters, vaporizers, or soda lime may change the calculated leakage and compliance values of the anesthesia machine and affect the therapy.

- Perform a leakage and compliance test after replacing breathing hoses, particularly extendable hoses, vaporizers, and soda lime.
- Perform a leakage and compliance test after adjusting the length of extendable hoses.

WARNING

Risk when adjusting the hose length

When the hose length is changed, resistance and compliance may change. This can result in an increased or reduced ventilation volume for neonates.

Do not use extendable hoses, particularly for neonates.

During spontaneous breathing, higher resistance values mean that the patient must do more breathing work.

In volume-controlled ventilation, an increased resistance has a slight effect on the applied volume during the inspiration. However, the peak pressure increases at a constant plateau pressure. For this reason, the time constant increases during the expiratory phase. If the expiration times are too short, the lungs might not be emptied completely, resulting in a dynamic overfilling of the lungs (air trapping).

In pressure-controlled ventilation, an increased resistance can reduce the inspiratory or expiratory volume.

Before the selftest is performed, all accessories* to be used must be connected. The extendable hoses must be drawn out to the length required by the user. This is the only way of ensuring that the compliance of the breathing system and breathing hoses is determined correctly and a corrected tidal volume is automatically applied during volume-controlled ventilation.

Calculating the resistance of the breathing system and connected accessories

To keep the patients' work of breathing as low as possible, according to ISO 8835-2 and ISO 80601-2-13 a total inspiratory and expiratory resistance of 6.0 hPa (cmH₂O) at 60 L/min may not be exceeded.

The "Technical Data" chapter states the inspiratory and expiratory breathing resistance of the breathing system, not including the breathing hoses. This allows for the calculation of the resistance of the breathing circuit using different hose sets and/or filters.

The following formula are used to calculate the resistance (R):

$R_{\text{Inspiration}} =$
 $R_{\text{Breathingsystem_insp}} + R_{\text{InspHose}} + R_{\text{BagHose}} + R_{\text{InspFilter(port)}} + R_{\text{InspFilter(Y-piece)}}$

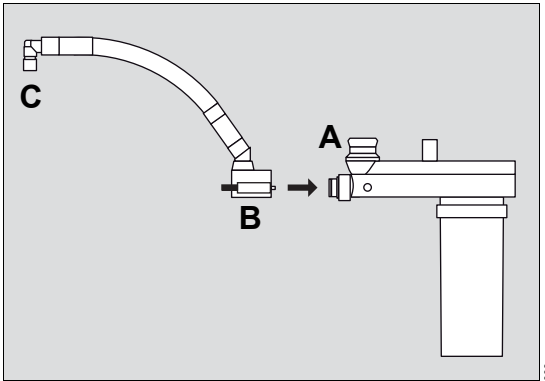
$R_{\text{Expiration}} =$
 $R_{\text{Breathingsystem_exp}} + R_{\text{ExpHose}} + R_{\text{ExpFilter(port)}} + R_{\text{ExpFilter(Y-piece)}}$

When calculating the resistance, only accessory resistance values and peak flows must be used that are applicable for the respective accessory category and patient category, e.g., resistance value for adults (60 L/min), for children (30 L/min), or for neonates (5 L/min).

* If necessary, take into consideration additional parts such as water traps or additional hoses.

Connecting the flexible arm for the breathing bag (optional)

The flexible arm connects the breathing bag to the breathing system. It is used to define the position of the breathing bag.



- 1 If fitted: Remove the connection port (A) for the breathing bag from the breathing system.
- 2 Position the attachment piece of the arm (B) on the breathing system and tighten it with the two knurled screws. Check that the arm is fixed securely!
- 3 Attach the 90° angled connector (C) to the end of the flexible arm.
- 4 Attach the breathing bag to the end of the angled connector.

Park holder for vaporizer units (optional)

CAUTION

Risk of ambient environment contamination and patient injury

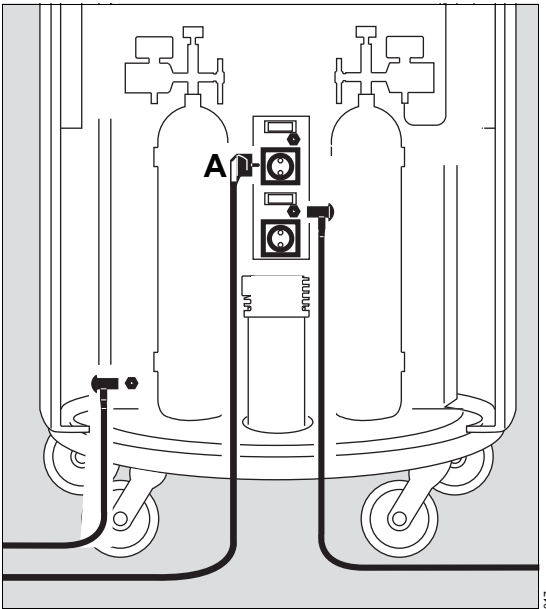
The parked vaporizer may be mistakenly opened if the park holder is positioned right next to the vaporizer mount on the anesthesia machine.

To avoid contaminating the ambient environment and endangering the patient, always double-check to make sure the correct vaporizer is being opened before doing so.

Connecting the electrical connections

Connecting auxiliary devices

The Primus has two auxiliary outlets on the rear of the machine. Each outlet is rated 4 amps and protected by safety fuses.



- 1 Connect to auxiliary outlets (A) at the back of the workstation.
- Install the Desflurane vaporizer in its mount and connect it to the auxiliary outlet at the back of the machine, see page 77.

CAUTION

Risk of device failure

In the event of a power failure, any devices connected to auxiliary power outlets will not be powered by the UPS.

Pay special attention to all power indicators of connected devices.

CAUTION

Risk of device failure

If HF surgical devices are connected to the auxiliary outlets, the leakage current may influence the electronics of the anesthesia machine causing it to fail.

Do not connect HF surgical equipment to the anesthesia machine's auxiliary outlets.

Make sure the maximum power consumption of the auxiliary systems does not exceed permissible values: See the corresponding instructions for use.

WARNING

Risk of electric shock

Connecting devices to the auxiliary outlets of the anesthesia machine can cause an increase in leakage current beyond permissible values if the protective conductor of a device fails.

Check the leakage current when connecting devices to the auxiliary outlets. If connecting a device or several devices increases the leakage current to a value which exceeds the permissible value, do not use the auxiliary outlets of the anesthesia machine. Instead, use a mains power socket on the wall.

The system must fulfill the requirements for medical electrical equipment in accordance with the relevant standards, see "Technical Data", page 261.

Establishing potential equalization

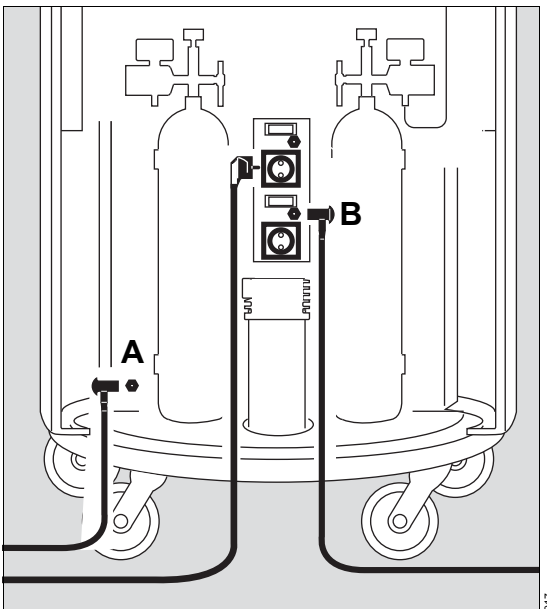
e.g., for intracardiac or intracranial surgery.

Differences in electrical potential between devices can be reduced by potential equalization.

Potential equalization does not replace the protective ground connection.

During operation, the potential equalization connectors must be readily accessible and the connection must be able to be disconnected without the use of tools.

Connecting the potential equalization cable




- 1 Connect the potential equalization cable to the potential equalization pin (A).
- 2 Connect the potential equalization cable to a potential equalization connector of the hospital (e.g., wall, ceiling supply unit, operating table).
- 3 Establish potential equalization to additional devices using the potential equalization pin (B).

Connecting the power supply

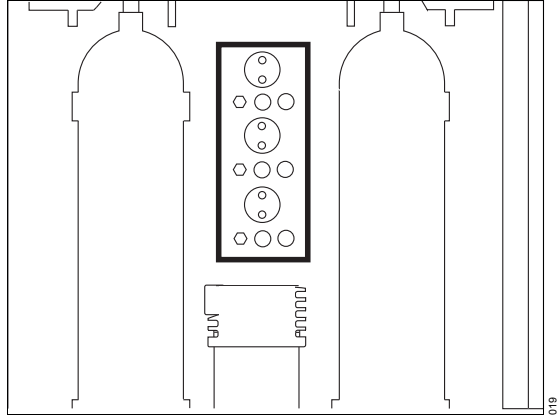
The mains power voltage must correspond to that specified on the rating plate at the back of the workstation:

100 to 240 V

- Plug the mains plug into the mains power socket.
LED  on the front of the workstation lights up green.

NOTE

The mains plug must be readily accessible so that the power supply to Primus can be quickly interrupted if there is a device failure.

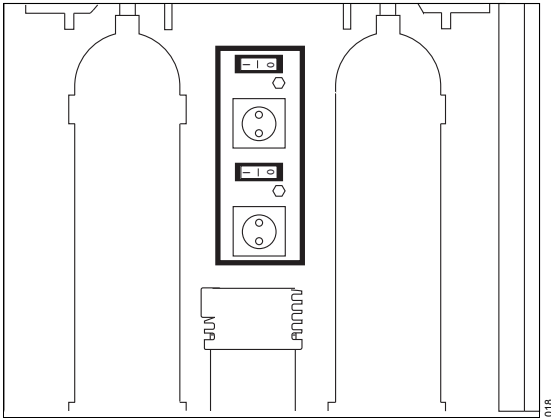


When using the three-fold socket strip* with safety fuses:

- 1 Remedy the fault, then
- 2 have the safety fuse replaced by experts.

Fuses for auxiliary 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 at the automatic fuse to the position I.

The fuse is active again.

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

Getting started

Device check	72
Power on	72
Check List	72
Central gas supply CS	73
Reserve gas cylinders	74
O ₂ -Flush	74
O ₂ emergency delivery	74
Auxiliary O ₂ flow tube (optional)	75
Emergency Resuscitator	75
Vaporizers	76
Breathing system	78
Anesthetic gas scavenging system AGS	79
Emptying the water trap	80
Preparing Primus for the selftest	81
 Self test	 82
System compliance	84
Leakage	84
Locating and eliminating leakages	85
Proposals on how to systematically rule out components when looking for leaks	86
Self test results	86
 Emergency start	 87

Device check

Prerequisites:

The device has been prepared (see "Cleaning, Disinfection and Sterilization" on page 207) and assembled ready for operation (see "Assembly" on page 221).

The gas supply and power supply must be connected.

WARNING

Risk of explosion, fire

If an oxygen leak is suspected within or near the anesthesia machine, do not initiate operation.

Disconnect all oxygen supplies and contact a trained service technician.

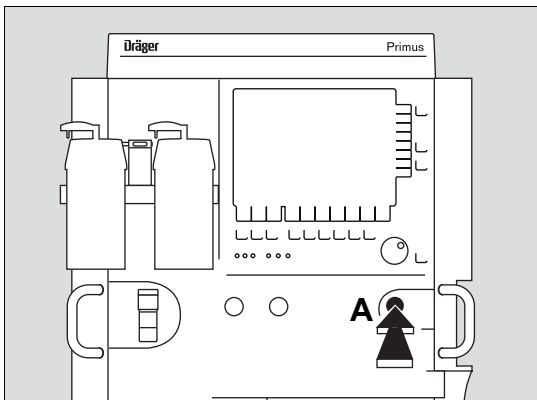
CAUTION


Risk of inadvertent movement

If not properly secured, the device may move inadvertently during operation.

Apply the brakes on the device to ensure it cannot be moved accidentally.

Power on



- 1 Switch on Primus: press the system power switch  (A), an acoustic tone sounds.

After approx. 15 seconds all LEDs and the loud-speaker are tested by Primus.

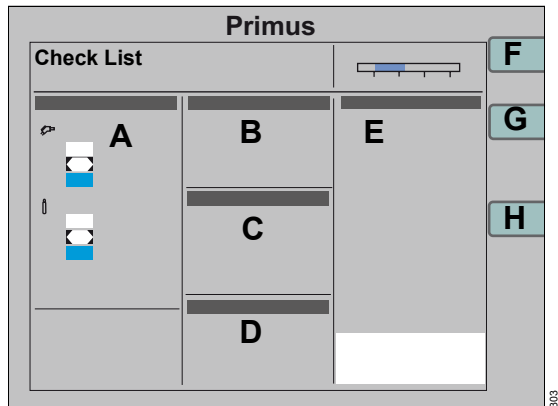
NOTE

If all LEDs do not light up upon initialization, contact DrägerService.

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

Check List

The **Check List** is displayed after about 35 seconds.



The test steps to be performed are grouped in five categories:

A Gas Supply

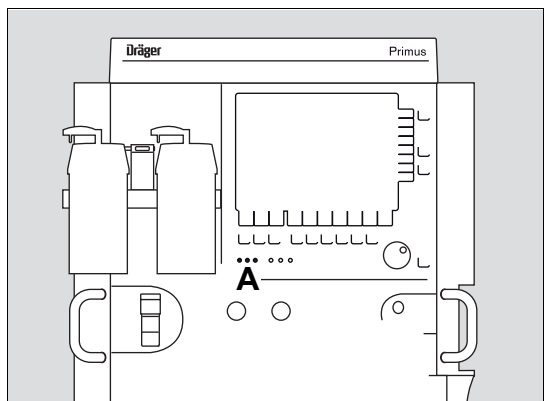
- Pipeline pressure
- Cylinder pressure
- O₂ flush functional?
- Safety O₂ control functional?

- B Vaporizers**
- **Correctly locked in position?**
 - **Set to zero?**
 - **Fill level OK?**
 - **Safety filler locked?**
- C breathing system**
- **Fully assembled?**
 - **Correctly connected?**
 - **Gas scavenger connected and flow adjusted?**
 - **Soda lime OK?**
- D Miscellaneous**
- **Water trap fill level OK?**
 - **Suction OK?**
 - **Emergency resuscitator present and functional?**
- E Prepare for the self test:**
- **Set APL valve to MAN.**
 - **Adjust APL valve to 30.**
 - **Seal Y-piece.**
 - **Connect the sample line.**
 - **Close safety O₂ flow control.**
- Check the components as instructed in the **Check List** on the screen and as described on the following pages 73 to 81.
- F** Confirm the change of the soda lime by pressing the soft key **soda lime changed**.
- G** Start the self test by pressing the soft key **start self test** or the rotary knob.
- If the self test has to be interrupted, e.g., for a quick start in an emergency:
- H** Press the **cancel test** key, see "Emergency start" on page 87.

WARNING**Risk of device failure and/or patient injury**

Canceling the self test may lead to malfunctions; greater attention is required during operation.

Always perform a complete self test, unless acting in an emergency situation. If canceled for an emergency, perform a complete self test as soon as practicable.

Central gas supply CS

Gas pressures:

A All LEDs turn green, the pressure values are between 2.7 and 6.9 kPa x 100.

The LEDs do not illuminate if the gas pressure is <2.7 kPa x 100 or if the compressed gas hose is not connected.

NOTE

If accessories are connected to the optional **O₂** or **AIR** outlets on the gas inlet block, make sure they are working correctly.

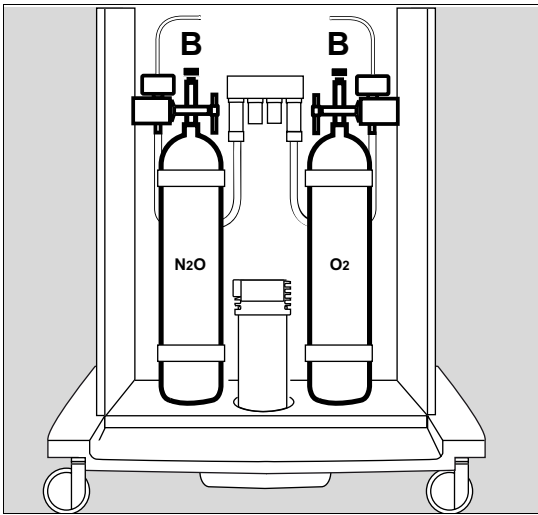
Reserve gas cylinders

CAUTION

Risk of supply failure

If the valves are open when the device is connected to the central gas supply, gas may be withdrawn from the reserve gas cylinders.

Close cylinder valves whenever the central supply is sufficient.



See also the Instruction for Use of the pressure reducers used, e.g., Silverline.

- 1 Slowly open the cylinder valves (B).

LEDs light up green when O₂ pressure is over 20 kPa x 100 and N₂O pressure is over 10 kPa x 100*:

The cylinder pressures are shown on the screen.

- 2 Close the cylinder valves (B) again.

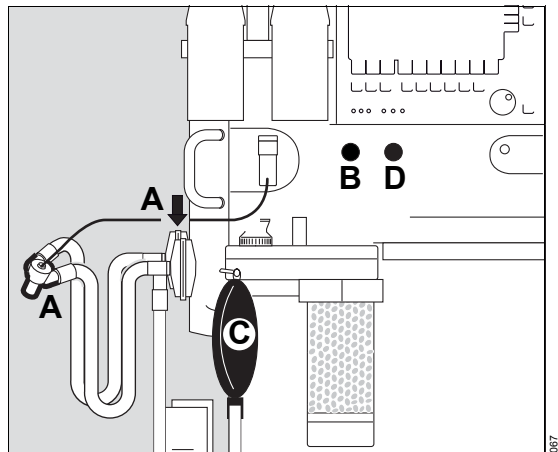
The gas supplies available can be selected in the menu **Standby Conf.**, see page 170. Only these gas supplies will then be checked during the self test and an alarm issued in the event of a fault dur-

ing normal operation. The central O₂ supply and the O₂ backup gas cylinder cannot both be configured as not present at the same time.

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

O₂ must be connected for the following self test.

O₂-Flush



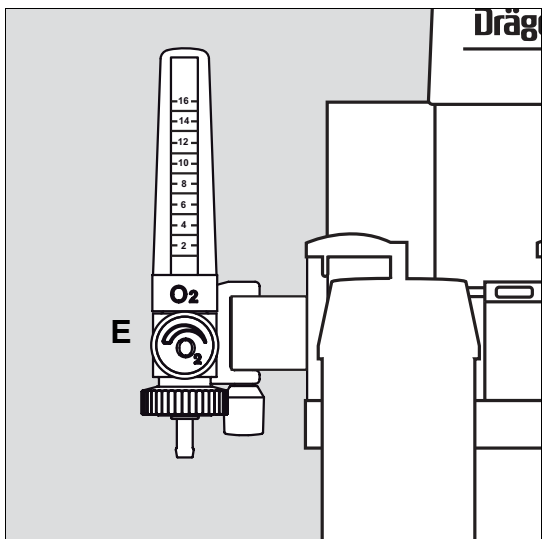
- 1 Close the Y-piece = plug (A) firmly onto the cone.
- 2 Press O₂+ button (B).
- 3 Breathing bag (C) inflates with an audible flow.

O₂ emergency delivery

- 1 Occlude the Y-piece = plug (A) firmly onto the cone.
- 2 Press the safety knob (D) for the O₂ emergency delivery to unlock it and turn it to set the flow.
- 3 Breathing bag (C) inflates with an audible flow.
- 4 Turn safety knob (D) back to its original position to discontinue O₂ emergency delivery and press it inwards.

* See page 258 for precise details on cylinder pressures.

Auxiliary O₂ flow tube (optional)



- Check the auxiliary O₂ flow tube. Adjust the flow knob (E) and make sure the float moves freely over the full range of the flow tube.

CAUTION

Risk of inadequate pressure monitoring

The optional auxiliary outlets are not pressure monitored.

Pressure monitoring must be ensured by the connected device.

WARNING

Risk of fire

Cauterizing close to a source of oxygen can lead to fire. Make sure that all connectors (e.g., Y-piece, breathing hoses including the breathing bag, breathing system, external fresh-gas outlet, oxygen therapy, anesthetic gas receiving system) are leak-free so that oxygen leakage cannot endanger the user or the patient.

WARNING

Risk of patient injury

If the patient is connected to the auxiliary oxygen outlet without a means of pressure relief, high pressure will be applied and the patient endangered.

Do not connect the patient directly to the auxiliary oxygen outlet without ensuring a means of pressure relief.

When finishing oxygen therapy, make sure the flow tube is completely closed:

- Turn the flow knob (E) clockwise until it is completely closed to cut off the oxygen flow.

Emergency Resuscitator

For example Dräger Resucator 2000

- The emergency resuscitator is present on the device and its functionality has been checked.

Note the instructions for use.

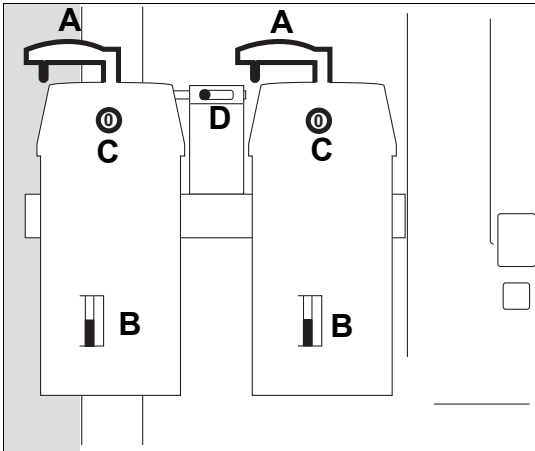
Vaporizers

NOTE

Before operating the vaporizer, pay special attention to the instructions for use of the vaporizer being used. Note especially the vaporizer flow limits.

The vaporizer being used must comply with standard ISO 8835-4 or ISO 80601-2-13. If the internal patient-gas measurement module fails, an independent gas measurement system complying with ISO 21647 or ISO 80601-2-55 must be used.

The Vapor 2000 is shown and described here.



For the Dräger Interlock 2 System:

- Vaporizers are mounted in a level position and seated securely on the mounts.
- 1 Locking levers (A) point to the left = locked position.
 - 2 Check the sight glass (B) and ensure an adequate filling level.
 - 3 Handwheel set to **0** and button (C) engaged.
 - 4 Check the interlock mechanism. Move the selector lever (D) to the left to lock the left vaporizer. Turn the handwheel on the right vaporizer to a position other than **0**, and make sure the left vaporizer remains locked in its **0** position. Repeat test for other vaporizer.
 - 5 Turn both handwheels to **0** positions.

For the Dräger Auto Exclusion System (optional):

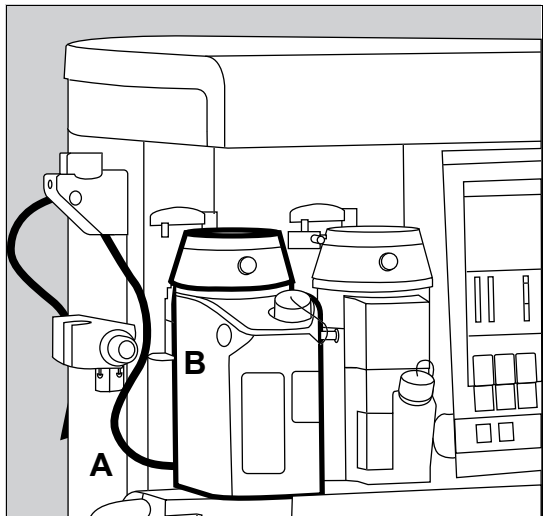
- 1 Vaporizers are mounted in a level position and seated securely on the mounts.
- 2 Locking levers point to the left = locked position.
- 3 Check the sight glass, and ensure an adequate filling level.
- 4 Hand wheel set to **0** and button engaged.
- 5 Check the interlock mechanism.
Turn the hand wheel on one vaporizer to a position other than **0**, and make sure the other vaporizer remains locked in its **0** position. Repeat test for second vaporizer.
- 6 Turn both handwheels to **0** positions.

After filling or changing the vaporizer:

- Perform leak test, see page 119.

Connecting the Dräger Desflurane vaporizer

The Dräger Desflurane vaporizer D-Vapor can be connected to the auxiliary outlets on the rear of the machine.



- 1 Route the cable (A) along the bottom of the back of the D-Vapor (B).
- 2 Insert the D-Vapor at the left (outer) position.
- 3 Connect the power supply.

WARNING

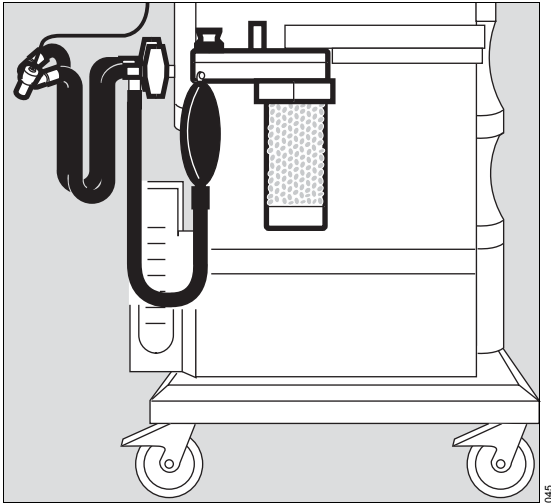
Risk of patient injury

Risk of ambient air contamination

To prevent vaporizer leaks which may lead to low fresh-gas delivery or prevent manual ventilation or contaminate the ambient environment, the D-Vapor must be mounted very carefully.

Avoid catching the D-Vapor power cable behind/underneath the housing. Make sure that the D-anesthetic vaporizer is upright. Always perform a leak test after mounting the vaporizer.

Breathing system



- The breathing system is fully clicked into place, the breathing hoses are correctly and securely connected.
- Insert optional filters.
- Fresh soda lime, without violet discoloration. For information on how to change the soda lime, see "Changing soda lime" on page 117, "Removing the absorber" on page 210 and "Filling and fitting the absorber" on page 223.

Soda lime depletion

In the **Standby Conf.** menu, see page 168, the maximum number of use days can be set for the absorber, based on e.g., clinical hygiene guidelines. Use days monitoring is then available on the **Check List**, during the **Self Test** and on the **Self Test Results** page.

When the time remaining for use is 0 days, the component will be marked conditionally functional during the **Self Test** and an alarm will be generated in **Standby**.

When changing the soda lime, the date and time can be logged by pressing the soft key **soda lime changed** on the **Check List** screen. The label of the key then changes to **undo change**; the key can be pushed again to undo the soda lime change information. Information on when the soda lime has been changed will be logged in the system when the automatic test is started.

NOTE

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

For diaphragm location and disassembly instruction see page 212.

CAUTION

Risk of device failure

The correct operation of the anesthesia machine will be impaired if condensation enters the breathing system and/or the ventilator diaphragm.

If condensation is a frequent problem, install water traps in the breathing hoses.

WARNING**Risk of patient injury**

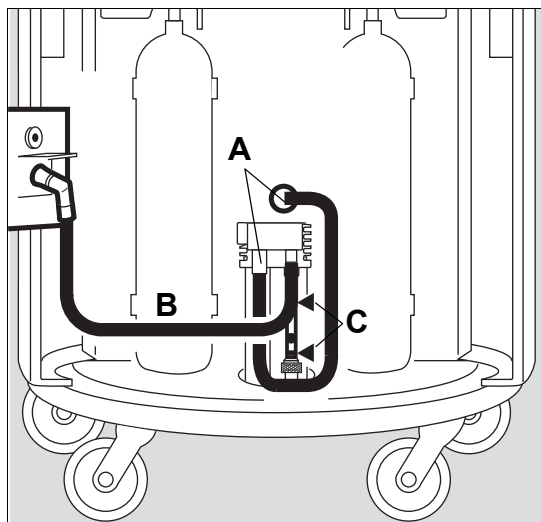
The soda lime loses humidity. Generally, if the humidity falls below a minimum set point, undesirable reactions can occur, independent of the type of lime and the inhalation anesthetic being used:

- reduced CO₂ absorption,
- increased heat build-up in the absorber and thus, an increased breathing gas temperature,
- formation of CO,
- absorption and/or decomposition of the anesthetic agent.

These reactions could pose a danger to the patient.

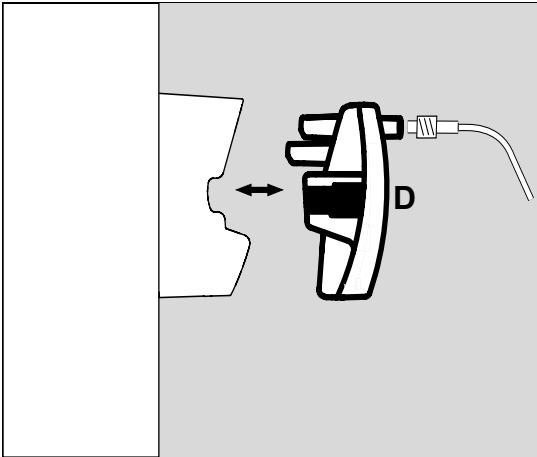
If using dry gases, only flush the anesthesia system briefly, and only if necessary!

Note the instructions for use of the Drägerisorb 800 Plus or Drägerisorb FREE soda lime.

Anesthetic gas scavenging system AGS

- 1 The gray transfer hose (A) from the scavenging nozzle must be connected.
- 2 Make sure that the AGS is connected to the terminal unit of the disposal system via the scavenging hose (B). The operation indicator of the terminal unit is green.
- 3 The AGS is functioning when the float in the flow tube is between the two marks (C).

Emptying the water trap

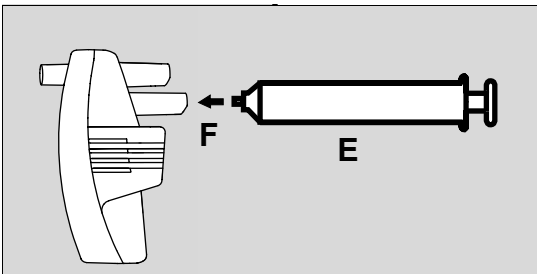


See also the Instruction for Use of the water trap used.

- Check filling level in water trap (D).

When the level reaches the mark:

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



- 2 Insert an empty syringe (E) (minimum volume: 20 mL) without cannula into the connector (F).
- 3 Extract water, remove syringe and dispose of full syringe with ordinary domestic waste.
- 4 Slide the water trap back into its holder until it engages tangibly.

CAUTION

Risk of misleading measured values

Silicone can enter the measuring cuvette and distort the gas measurement.

Do not spray the O-rings of the water trap holder with silicone spray.

CAUTION

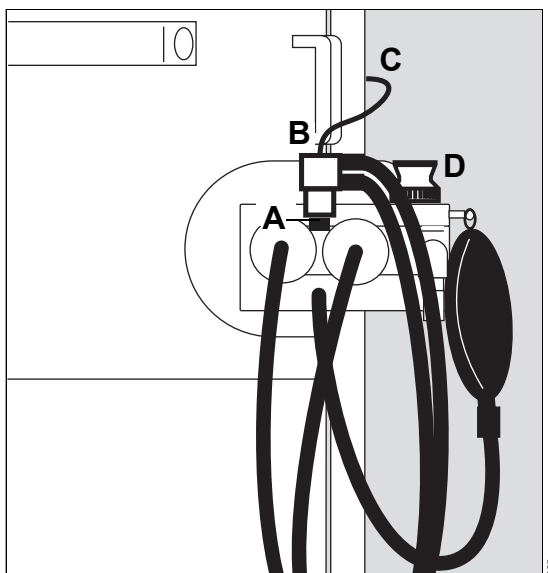
Risk of misleading measured values

Aerosols can damage the diaphragm and the measurement system.

Do not use aerosols in the breathing system. The water trap must not be used in combination with a medication nebulizer!

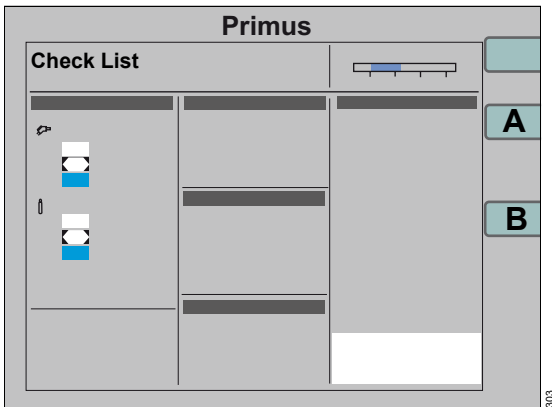
See "Emptying or replacing the water trap" on page 235 for additional information on using the water trap.

Preparing Primus for the selftest



- 1 Fit the Y-piece onto the circuit plug (A).
- 2 Make sure the sample line (B) is connected to the Y-piece and to the water trap (C).
- 3 Set the APL valve (D) to position **Man** and to 30 hPa (cmH₂O).

Self test



Once all test steps in the check list have been carried out, the user can start the automatic selftest.

- 1 Press the **start self test** key (A), or press the rotary knob to start the test.

If the self test has to be interrupted, for example in an emergency situation:

- 2 Press the **cancel test** key (B), and proceed as specified in "Emergency start" on page 87. The self test can be canceled up to ten consecutive times.

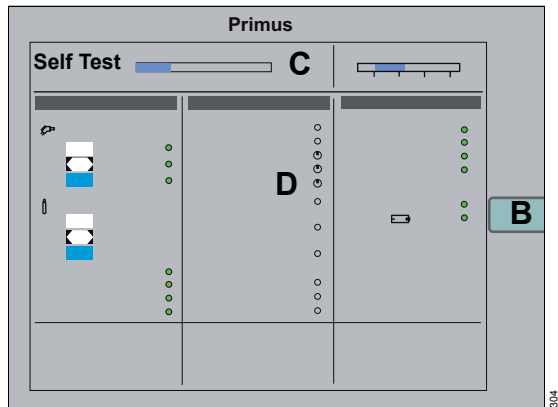
WARNING

Risk of device failure and/or patient injury

Canceling the self test may lead to malfunctions. Special attention is required during operation.

Always perform a complete self test, unless acting in an emergency situation. If canceled for an emergency, perform a complete self test as soon as practicable.

The self test is started. It proceeds automatically and takes approx. 5 minutes.



After the self test has been started, a double tone (speaker test "passed") and a single tone (speaker test in the power supply unit "passed") sound one after the other with the set alarm tone volume.

NOTE

If no tone is sounded, contact DrägerService.

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

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

The clock symbol (D) indicates which test step is currently being tested. Once each component test is completed, the clock symbol is replaced by a color code that indicates the test result.

Errors discovered during the self test are marked with yellow or red behind the respective test result. An advisory window with information on how to remedy the problem is displayed on the screen.

NOTE

Dräger recommends that the device is monitored during the automatic self test. Thus, errors found can be remedied very quickly.

Test results are color-coded:

- Green:** Test completed successfully. The tested component is in satisfactory operational order.
- Yellow:** A non-critical fault was detected. The workstation can be used with restrictions.
- Functions highlighted in yellow can be confirmed with the **accept** soft key which is then displayed, e.g., **SPEAKER FAIL**. The workstation starts operation without this function.
- Red:** A serious fault was detected. Operation impossible or not permitted. The test must be repeated. The test can no longer be canceled.
- Immediately call DrägerService or your local authorized service organization to correct the problem.

Interruption of the test is symbolized by an exclamation mark.

WARNING

Risk of device failure or patient injury

Functions coded yellow do not meet with the specified technical data.

The error should be remedied as soon as possible!

WARNING

Risk of device failure and patient injury

Functions coded red must be remedied before starting, e.g., if there is no O₂ supply.

The device cannot be operated in this state.

WARNING

Risk of inadequate monitoring

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

Special attention is required if operation is initiated.

System compliance

Primus determines the current compliance of the breathing circuit with filters, hoses, and a Y-piece. Typical values for the inspiratory system compliance are between 0.5 and 2.6 mL/hPa (mL/cmH₂O).

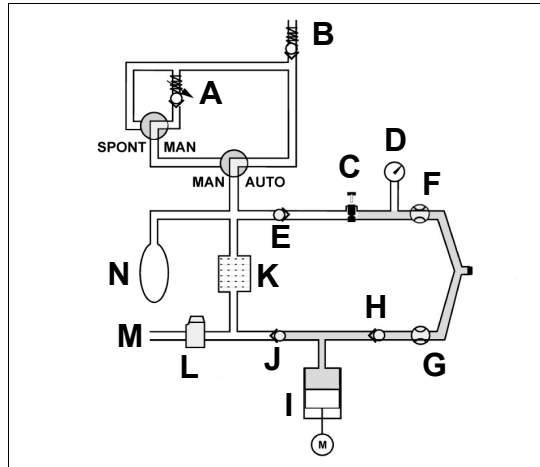
In volume-controlled ventilation, system compliance is compensated. For this purpose, Primus increases the applied tidal volume on the basis of the difference between PEEP and plateau pressure in accordance with the determined compliance value.

Leakage

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

Leakage (System)

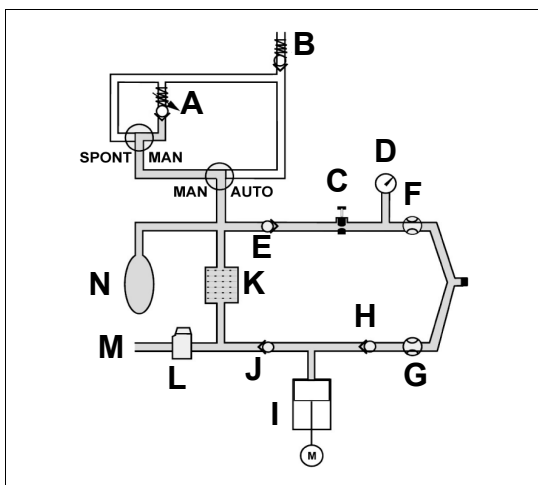
- Leak test in the mechanical ventilation branch.
- Indication of the leak value in mL/min and yellow/green test result indicator.



- A APL valve
- B AGS
- C **PEEP/PMAX** valve
- D **PAW** sensor
- E Exp. valve
- F Exp. flow sensor
- G Insp. flow sensor
- H Insp. valve
- I Piston pump ventilator
- J Fresh-gas decoupling valve
- K Absorber
- L Vapor
- M Fresh gas
- N Breathing bag

Leakage Man.Spont.

- Leak test in the complete system.
- Indication of leakages >150 mL/min and with red/yellow/green test result indicator.



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

NOTE

For leaks of more than 150 mL/min:

Check the components of the breathing system and the breathing hoses. Repair any leaks and repeat the leak test.

Locating and eliminating leakages

The self test incorporates a leak test. If this test is not passed, the leaks must be remedied before continuing the test by pressing the rotary knob. A leak test can also be carried out later in **Standby** with the **leak test** key, see page 119.

Possible causes of leaks include e.g.:

- Absorber not firmly screwed to the breathing system
- APL valve is not firmly fixed to the breathing system cover (damaged) or not set to 30 hPa (cmH₂O)
- Breathing bag, breathing hoses, Y-piece, or microbial filter not connected correctly or damaged
- Flexible arm for breathing bag (optional) not fitted correctly on the breathing system, sealing ring soiled or damaged
- Water trap not connected
- Sample line for gas measurement not connected or leaky (there may be a kinked bend in the connections)
- Connections for the sample line for gas measurement cracked or defective
- O-ring of the inspiratory and expiratory ports missing, soiled, or damaged
- Flow sensors not fitted correctly or damaged, rear O-ring missing
- O₂ sensor not (or not correctly) connected (for electrochemical O₂ measurement only)
- Breathing system cover not mounted correctly, not all five sealing screws closed
- Visible damage on valves or seals of the breathing system metal valve plate
- Breathing system not mounted correctly, not all three sealing screws closed
- Ventilator diaphragm defective or not fitted correctly (Dräger legend must be visible from above)
- 15 mm circuit plug for connecting the Y-piece scratched or damaged
- Vaporizer fill or drain connections leaky or opened, vaporizer not mounted correctly, O-ring missing or handwheel not set to 0.

Proposals on how to systematically rule out components when looking for leaks

Carry out the described measures and perform or continue the leak test:

Exclude the sample line for gas measurement from the leak test

- Remove the sample line for gas measurement and seal the Luer Lock connection on the Y-piece.

Exclude the breathing hoses from the leak test

- Disconnect the breathing hoses from the breathing system. Connect the inspiratory and expiratory ports with a hose that does not leak. Connect the breathing bag directly to the breathing system.

Exclude the vaporizers from the leak test

- Remove the vaporizers from the workstation.

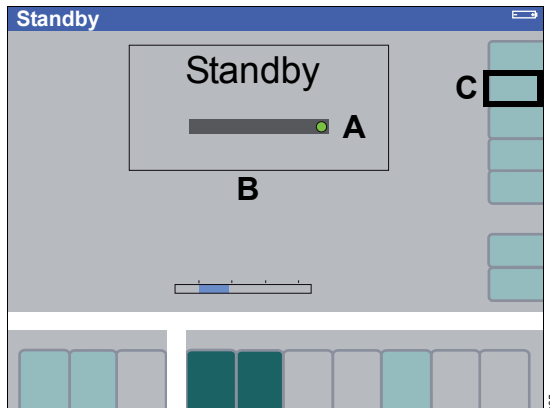
NOTE

Possible cause of leaks:

The vaporizer is not connected properly or the filling device is open.

Self test results

When the self test is completed, Primus switches to **Standby**.



The overall result of the self test is indicated on the screen by a color-coded circle (A):

Green	FUNCTIONAL Every component of the system is in satisfactory operational order.
Yellow	CONDITIONALLY FUNCTIONAL A non-critical fault was detected. Primus may be used, but call DrägerService or your local-authorized service organization.
Empty	The self test was canceled.

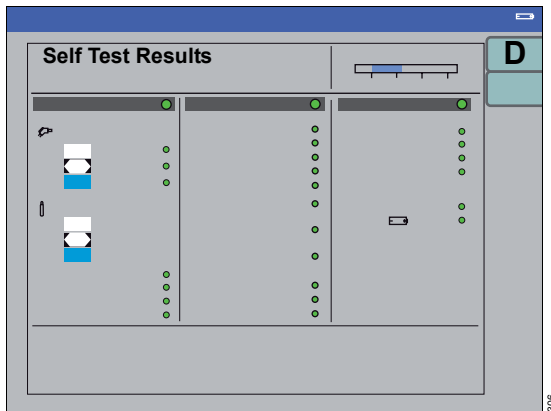
Dräger recommends that a full selftest is carried out before the start of therapy, after restarting the device, and at least once every 24 hours. If the last selftest was more than 24 hours ago, the text below the status display (A) is highlighted in yellow.

In addition, a message containing instructions for further action appears in the middle of the screen (B).

- Press the soft key **self test results** (C) to display more specific results.

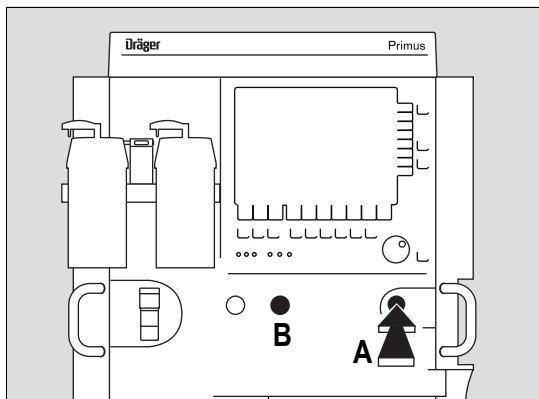
The **Self Test Results** screen is displayed.

The **Self Test Results** screen contains the **soda lime changed** (D) key.



If the soda lime is changed between cases, this key can be pressed to log the date and time. The label of the key then changes to **undo change**. The key can be pushed again to undo the soda lime change information. Information on when the soda lime has been changed will be logged in the system on exiting the **selftest results** screen.

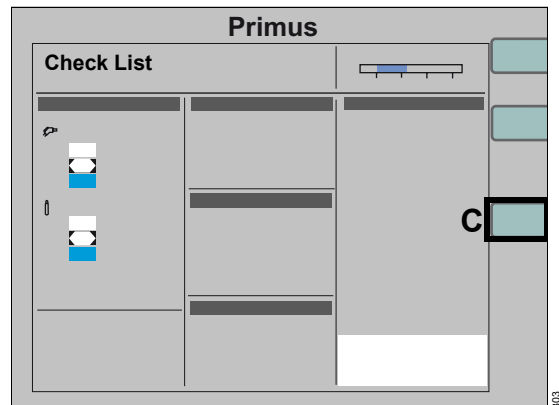
Emergency start



Use only in urgent cases if there is no time for the self test!

- 1 Switch on the workstation (A).
- 2 Check that both vaporizers are closed.
- 3 Set the safety knob (B) for O₂ emergency delivery to the required O₂ flow, between 0 and 12 L/min.
- 4 Start manual ventilation.

Wait for the internal loading of the software and the testing of the electronics. The check list is displayed after about 35 seconds.



- 5 Press the soft key **cancel test** (C).

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 5 minutes.

The leak and compliance test is not performed. The accuracy levels specified in the chapter "Technical Data" on page 239 cannot be guaranteed.

NOTE

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

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

WARNING

Risk of device failure and/or patient injury

Canceling the self test may lead to malfunctions; greater attention is required during operation.

Always perform a complete self test, unless acting in an emergency situation. If canceled for an emergency, perform a complete self test as soon as practicable.

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

To start Primus:

- Set the safety knob for O₂ emergency delivery to **0** and press it inwards.
- Select the fresh-gas setting and ventilation mode, see "Operation" on page 89.

Operation

Operation	90	Leak test	119
Safety Information	90	End of operation	120
Loading default settings	90	Switch off the anesthetic gas scavenging system AGS	121
Entering the patient's age	90	When Primus is not in use	121
Entering the patient's ideal body weight (optional)	90		
Setting fresh-gas concentrations	91		
Selecting the carrier gas	91		
Setting the O ₂ concentration	92		
Setting the fresh-gas flow	92		
SORC (Sensitive Oxygen Ratio Controller)	92		
Fresh gas failure detection	93		
Setting the Vapor	94		
Ventilation	95		
Pressure control valve APL	95		
Pressure control valve APL (up to and including January 2005)	96		
Start manual ventilation/spontaneous breathing	97		
O ₂ -Flush	98		
Volume Mode	99		
Volume Mode AutoFlow – Volume AF (optional)	103		
Pressure Mode ventilation mode	106		
Pressure Support Mode (optional)	110		
Continuous Positive Airway Pressure CPAP – in Pressure Support Mode (optional)	111		
Presetting the ventilation mode	112		
Frequency changes	112		
Changes in PEEP	113		
Changes in T _{INSP}	113		
Changing between ventilation modes	113		
Using non-rebreathing systems	115		
Ending the external fresh gas mode	116		
Changing patients	117		
Changing soda lime	117		
Reusable absorber	118		
Disposable absorber Drägersorb CLIC	118		

Operation

Safety Information

WARNING

Risk of electric shock

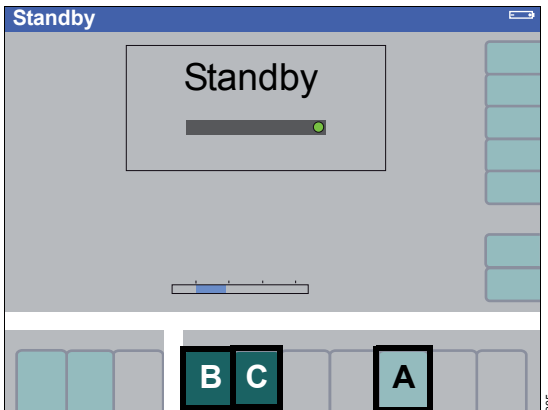
Touching the patient and electrical device contacts could result in an electric shock.

Do not touch the patient and the electrical device contacts at the same time.

Loading default settings

The default settings for fresh-gas delivery, 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 162.



- Press the soft key **restore default settings** (A) and push 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) monitoring, and the automatic volume adjustment of the Breathing Sound Emulator (BSE) module during operation.

In addition, the trigger sensitivities and software algorithms for suppressing artifacts are also modified, thus influencing the quality of ventilation in modes supporting spontaneous breathing.

- 1 Press the soft key **age** (B).
- 2 Set and confirm the age using the rotary knob.

The patient age parameter is available in the **Standby** screen as well as in all ventilation modes. Changing the patient's age during operation immediately influences the parameters described above.

Entering the patient's ideal body weight (optional)

The patient's ideal body weight describes that proportion of the body relevant to 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 **V_T** and frequency **Freq.** as well as the alarm limits for the expiratory minute volume **MV** during operation.

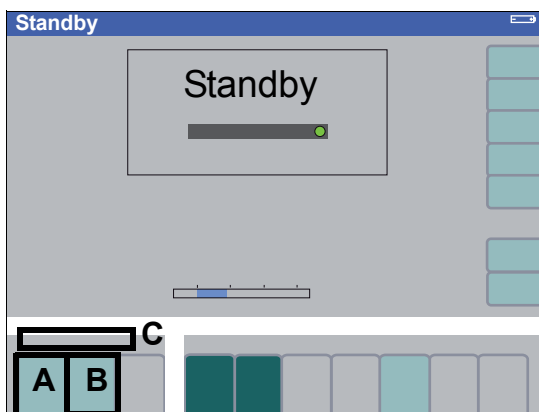
- 1 Press the soft key **weight** (C).
- 2 Set and confirm the weight using the rotary knob.

The patient weight parameter is available in the **Standby** screen as well as in all ventilation modes. Changing the patient's weight during **Volume**, **Volume AF**, **Pressure**, and **Press. Support** has no influence on current ventilation settings.

Setting ranges and factory settings

Parameter	Setting ranges	Factory setting
Age	<1 to 120 years	40
Weight	1 to 120 kg (1 to 240 lbs)	--

Setting fresh-gas concentrations

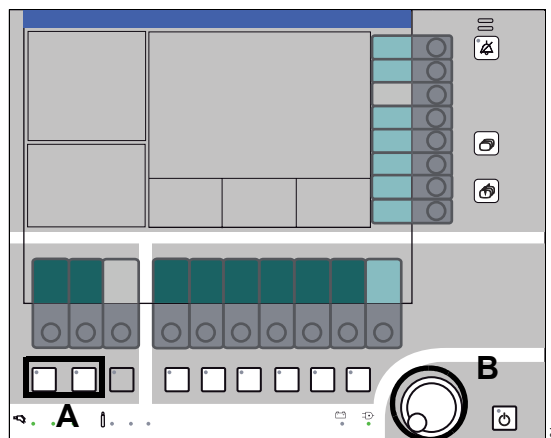


Fresh-gas parameters	Setting ranges	Factory setting
O₂ [%]	21 to 100 for carrier gas Air 25 to 100 for carrier gas N ₂ O	100
Fresh-gas flow [L/min]	0.2 to 18	2

- 1 O₂ concentration **O₂ %** (A)
- 2 Fresh-gas flow **flow L/min** (B).

The fresh-gas settings can be changed before selecting a ventilation mode. Fresh gas does not flow in the **Standby** mode (soft keys = light green). A corresponding text **No fresh-gas delivery!** (C) is displayed. The fresh-gas flow is not enabled until a ventilation mode has been started (soft keys = dark green).

Selecting the carrier gas



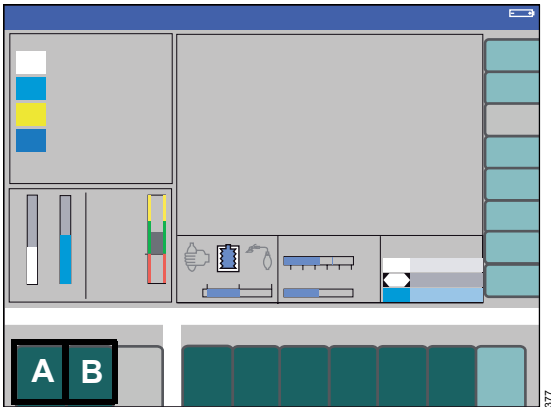
Setting ranges and factory settings

Fresh-gas parameters	Setting ranges	Factory setting
Carrier gas	Air or N₂O	AIR

- 1 Press the hard key **N₂O** or **Air** (A).
The green LED in the key flashes.
- 2 Push the rotary knob to confirm (B). The green LED lights continuously.

The selected fresh gas components are displayed on the screen.

Setting the O₂ concentration



- 1 Press the soft key **O₂** (A).
The key field appears yellow.
- 2 Set and confirm the O₂ concentration using the rotary knob.

Setting the fresh-gas flow

- 1 Press the soft key **flow L/min** (B).
The key field appears yellow.
- 2 Set and confirm the fresh-gas flow using the rotary knob.

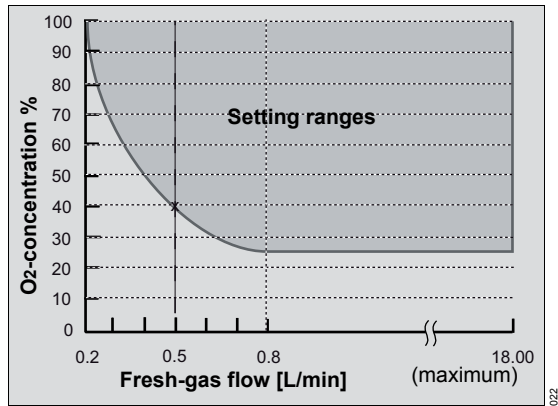
CAUTION

Risk of patient injury

The use of minimum flow or low flow settings may lead to the accumulation of metabolic products (hypoxic gas mixtures) in the breathing system.

After performing minimum or low flow anesthesia, the breathing system should be cleaned and sterilized as described in "Cleaning, Disinfection and Sterilization" on page 207.

SORC (Sensitive Oxygen Ratio Controller)



Primus is fitted with an electronic O₂ minimum delivery system to avoid hypoxic gas mixtures when **N₂O** is selected as carrier gas. For fresh-gas flows greater than 0.8 L/min, the minimum O₂ concentration is limited to 25 %.

For fresh-gas flow settings below 0.8 L/min, the O₂ concentration is automatically increased to a value corresponding to an O₂ flow of 200 mL/min. If this control system is activated, the O₂ % value is also highlighted with a yellow background in addition to the active settable value. The minimum oxygen delivery consequently equals 200 mL/min when using **N₂O** 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 a sufficient level of fresh gas is not possible, the system first displays message **FG LOW OR LEAK**.

In addition, alarm **PINSP NOT ATTAINED** or **VOLUME NOT ATTAINED** is displayed if the system is unable to maintain the defined ventilation.

To ensure continued ventilation, the anesthesia machine will use ambient air to supplement the gas volume if it is too low. This may change the gas composition. Carefully check the gas composition.

WARNING

Risk of patient awareness

If a complete gas supply failure occurs, further operation is guaranteed by supplying the anesthesia machine with ambient air. Anesthetic agents will no longer be delivered and the inspiratory gas composition will be diluted.

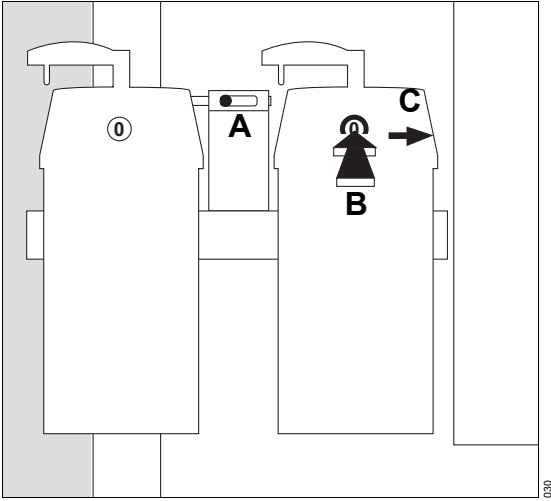
Carefully monitor the gas mixture and, if necessary, use IV anesthetics.

DrägerService can change the behavior of the device so that it does not use ambient air for supplementing the gas volume. The device will then ventilate with limited **VT** or **PINSP**, if possible.

- Increase the fresh-gas flow.
- Seal any possible leaks.

Setting the Vapor

The Vapor 2000 is shown and described here.



For the Dräger Interlock 2 System:

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

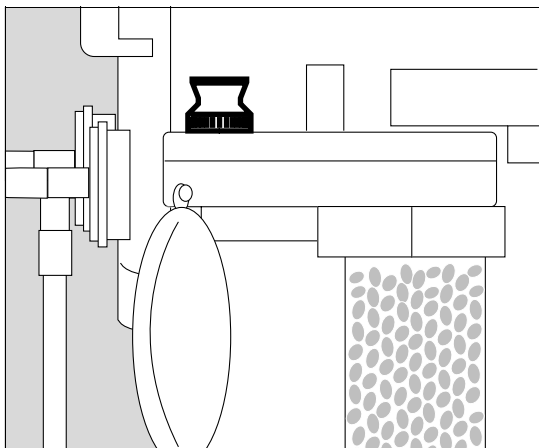
If the handwheel is set to **T**:

- 2 Press **0** key (B), engage handwheel at **0**. Wait 5 seconds for pressure to balance.
- 3 Press **0** key and turn handwheel (C) counter-clockwise to set the required anesthetic gas concentration.

Ventilation

Pressure control valve APL

Man.Spont. ventilation mode



On the pressure control valve APL, you can select between manual ventilation **Man.** and spontaneous breathing **Spont.**

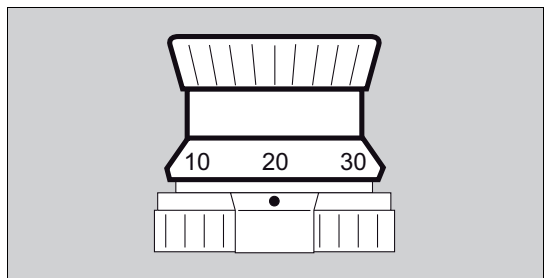
WARNING

Risk of patient injury

If the APL valve becomes blocked due to e.g., lines or cables being caught under the valve head, the patient may be endangered.

Route all cables away from the APL valve. Do not hang lines, hoses or cables, e.g., the sample line, on or near the APL valve.

Manual ventilation



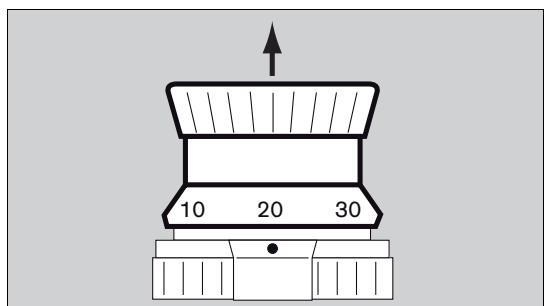
- Adjust the valve to the required maximum airway pressure.

Settings between the stops are also possible.

The patient can be ventilated by hand using the breathing bag. The pressure is limited to the set value.

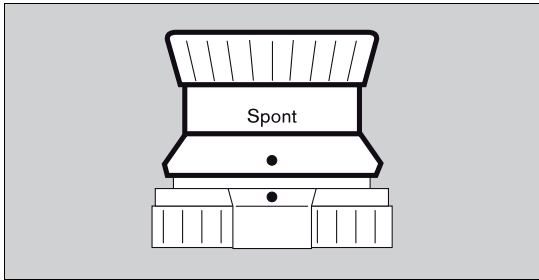
Even in automatic ventilation, the APL valve must be adjusted to a pressure that is safe for the patient!

Quick release



- Release pressure from the breathing system by lifting the valve head.

Spontaneous breathing



034

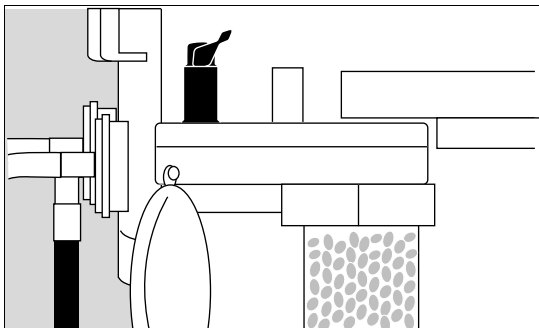
- Turn the APL valve counterclockwise as far as it will go.

The two points are vertically aligned. The valve head is raised.

The pressure limitation is canceled, the valve is open for free spontaneous breathing.

Pressure control valve APL (up to and including January 2005)

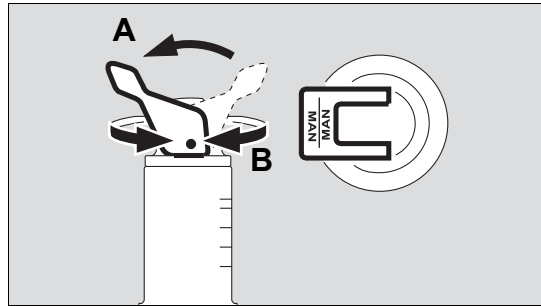
Man.Spont. ventilation mode



035

Choose between manual ventilation and spontaneous breathing on the APL pressure control valve.

Manual ventilation

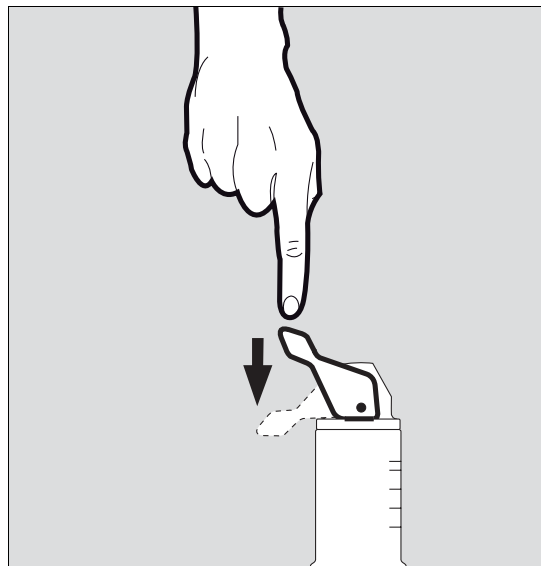


036

- 1 Set the lever (A) of the APL pressure control valve to **MAN** and
- 2 set the pressure limit = rotate lever (B).

The patient can be ventilated by hand using the breathing bag. The pressure is limited to the set value.

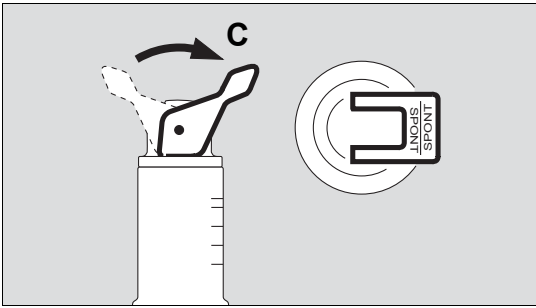
To relieve the pressure quickly:



037

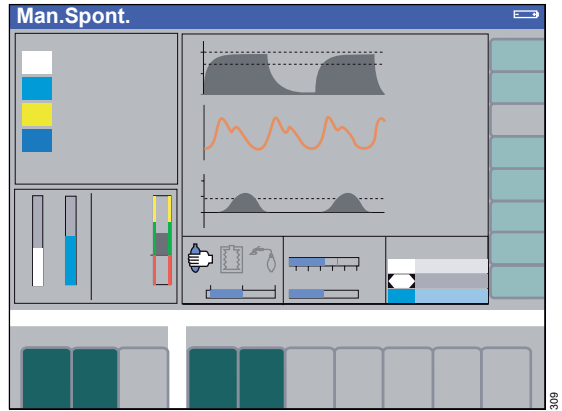
- Press the pop-off valve.

Spontaneous breathing



- Set the lever (C) of the APL pressure control valve to **SPONT.**

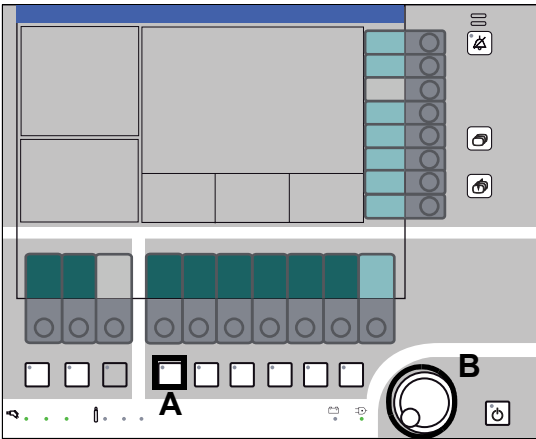
The pressure control valve is now open for free spontaneous breathing, regardless of the set pressure limit.



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

See page 128 for a list of alarms which are active in the **Man.Spont.** mode.

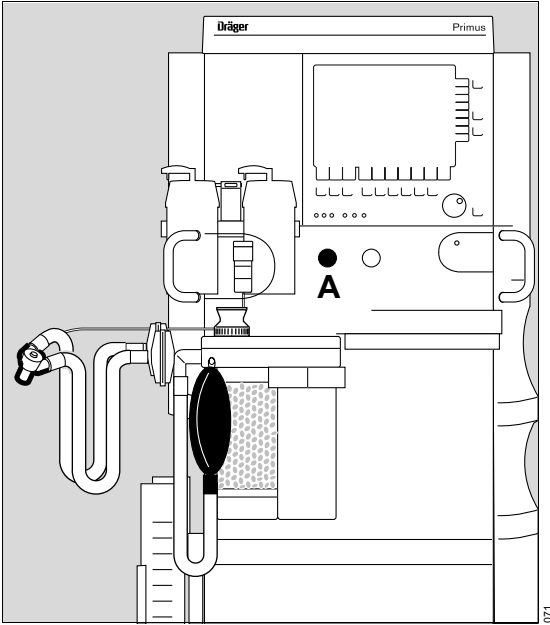
Start manual ventilation/spontaneous breathing



- 1 Press the **Man.Spont.** key (A); its LED and the status line flash.
- 2 Confirm via rotary knob (B).

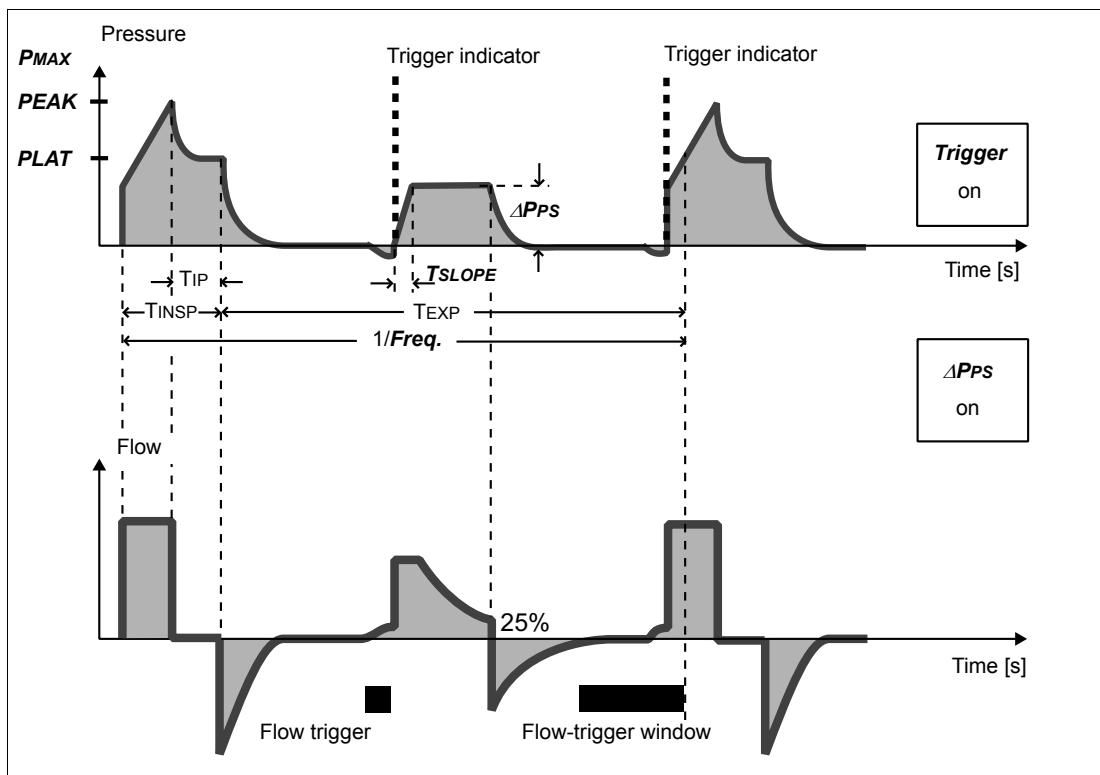
O₂-Flush

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



- Press the **O₂+ (A)** button. O₂ flows into the breathing system without anesthetic agent as long as the button is held down.

Volume Mode



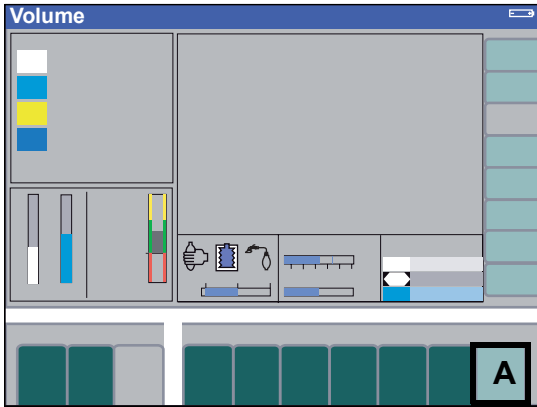
Volume-controlled ventilation mode with fixed mandatory tidal volume V_T and frequency $Freq.$ (formerly IPPV), as well as with optional synchronization (formerly SIMV(VC)) and variable pressure support for spontaneous breaths (formerly SIMV(VC)+PS, optional).

The respiratory cycle is defined through the frequency $Freq.$, the inspiratory time T_{INSPI} , the inspiratory pause time $TIP:T_{INSPI}$ and the tidal volume V_T . 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. To maintain a constant frequency, a time interval triggered prematurely is compensated in the next cycle.

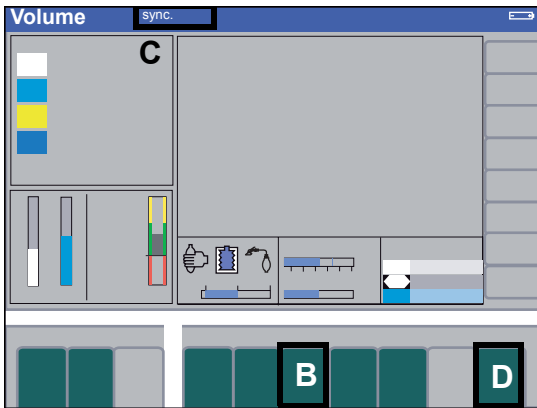
Synchronized volume-controlled ventilation

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

Some settable values are limited or mutually exclusive so that specific combinations of therapy settings are not possible, e.g., T_{INSPI} 6.9 s at $Freq.$ 100/min.



- 1 Press the soft key **extra settings** (A). The trigger sensitivity soft key **Trigger** (B) is displayed.



- 2 Press the soft key **Trigger** (B). The last value set appears as default value when the key is activated.
- 3 Set and confirm the trigger sensitivity with the rotary knob. When finally confirmed, the indication **sync.** in the status area (C) of the ventilation mode lights up steadily instead of flashing.

A mandatory breath 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.

NOTE

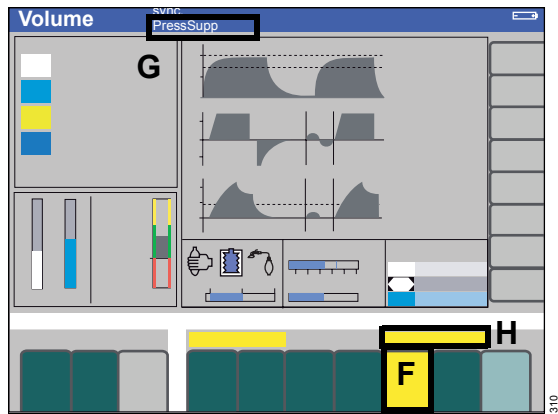
A triggered V_T will be corrected by the volume which the patient spontaneously inhaled prior to beginning volume-controlled ventilation. Independent of that, at least 50 % of the set respiratory volume will always be applied to ensure adequate volume ventilation.

- 4 Press the soft key **extra settings** (D) again, the actual trigger status is shown above the keys for the ventilation parameters (E).



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 .



- 1 Press the soft key ΔPPS (F). 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.
- 2 Set and confirm the value for pressure support with the rotary knob. When finally confirmed, the indication **PressSupp** in the status area (G) of the ventilation mode lights up steadily instead of flashing.

If the patient was 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 current trigger status is shown above the keys for the ventilation parameters (H).

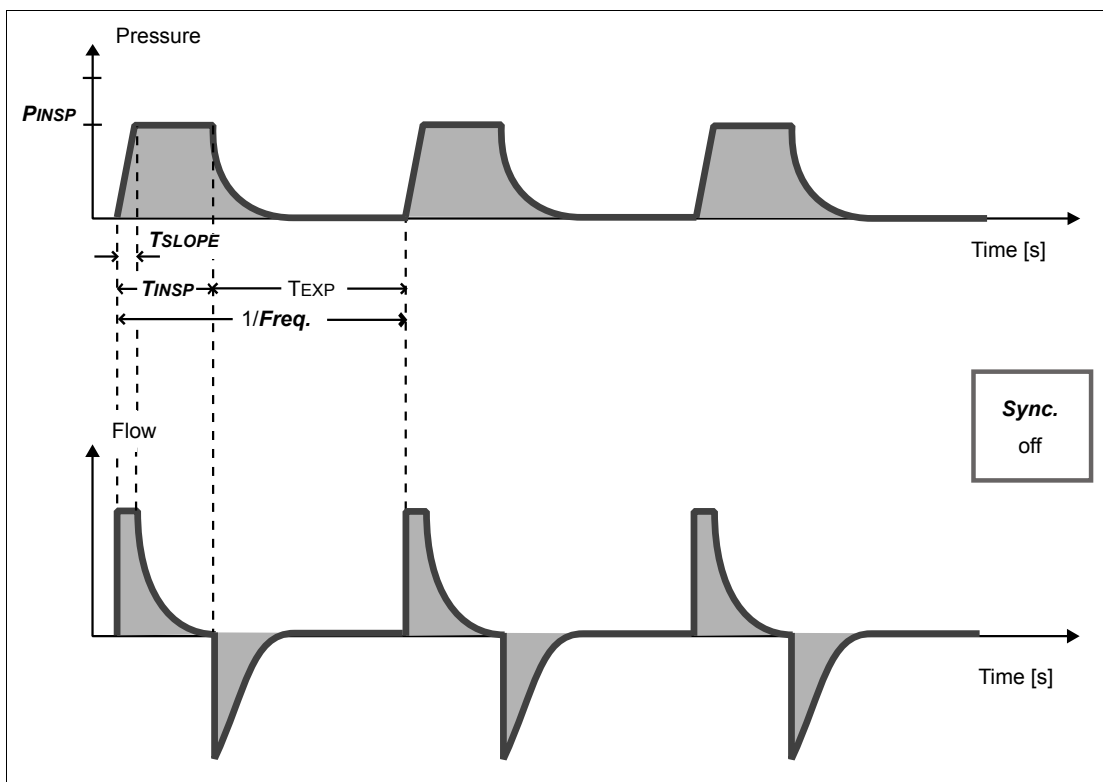
Setting ranges and factory settings

Ventilation parameters	Setting ranges	Factory setting ¹⁾
Pressure limitation P_{MAX} [hPa (cmH ₂ O)]	10 to 70 min. PEEP +10	40
tidal volume V_T [mL]	20 to 1400 ²⁾	600
Frequency Freq. ^{3)0.4)} [1/min]	3 to 100	12
Inspiratory time T_{INSP} ⁴⁾ [sec.]	0.2 to 6.7	1.7
Insp. pause time: Insp. time TIP:T_{INSP} [%]	0 to 60	10
PEEP [hPa (cmH ₂ O)]	0 to 20 max. P_{MAX} –10	0
Trigger sensitivity Trigger [L/min]	OFF , 0.3 to 15	3.0 (Pressure Support) OFF (Volume Mode/Pressure Mode)

Ventilation parameters	Setting ranges	Factory setting ¹⁾
Pressure Support $\Delta PPS^{5)}$ [hPa (cmH ₂ O)]	OFF , 3 to 50 max. P_{MAX} – PEEP	5 (Pressure Support) OFF (Volume Mode/Pressure Mode)
Rise time T_{SLOPE} [sec.]	0.0 to 2.0	0.0
Age [years]	<1 to 120	40
Weight [kg] [lbs]	1 to 120 1 to 240	--

- 1) The default values can be set specifically for the hospital concerned, see page 162.
- 2) Optionally 5 to 1400 mL.
- 3) Depending on the configuration, the inspiratory time **T_{INSP}** 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 170.
- 4) The resultant ratio of inspiration to expiration I:E is also displayed in parallel.
- 5) Optional

Volume Mode AutoFlow – Volume AF (optional)



Volume AF is a pressure controlled ventilation mode with a guaranteed tidal volume V_T and frequency $Freq.$ as well as optional synchronization activation and variable pressure support for spontaneous breathing efforts (optional).

Volume AF combines the advantages of pressure controlled and volume controlled ventilation mode. The set tidal volume V_T is delivered in a pressure controlled ventilation mode. The inspiratory pressure automatically adapts to the set tidal volume, limited by a maximum pressure P_{MAX} . When starting the ventilation with **Volume AF**, the first mandatory breath is volume controlled in order to identify the necessary pressure level, if not known from a previous ventilation mode.

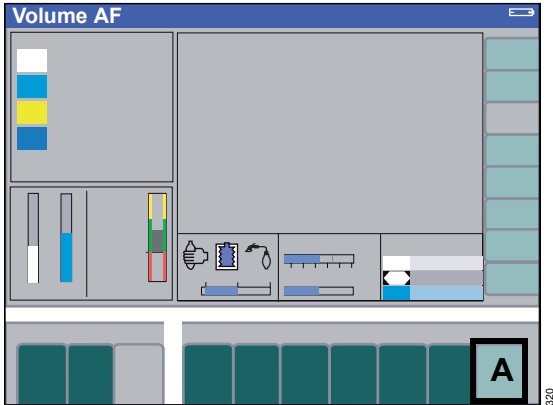
Primus automatically adapts the inspiratory pressure to the changing lung condition from breathing cycle to breathing cycle in steps of max. +3 mbar.

The delivery of tidal volume for one breathing cycle is limited to 130 % of the set tidal volume. If the volume limitation is active, the ventilation pressure for the following breath will be reduced to 75 % of the target pressure, but limited to a maximum of 15 mbar above $PEEP$.

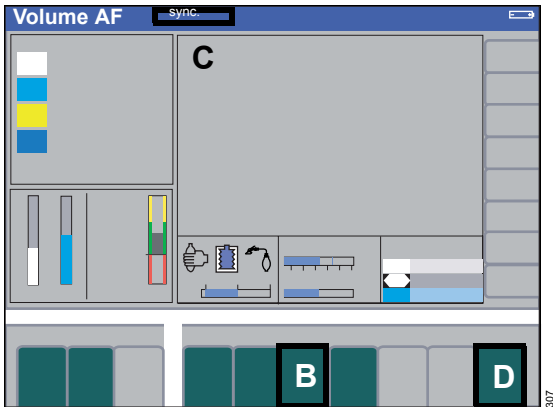
Some settable values are limited or mutually exclusive so that specific combinations of therapy settings are not possible, e.g., T_{INSP} 6.9 s at $Freq.$ 100/min.

Synchronized volume guaranteed 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** (A). The trigger sensitivity soft key **Trigger** (B) is displayed.



- 2 Press the soft key **Trigger**. The last value set appears as default value when the key is activated.
- 3 Set and confirm the trigger sensitivity with the rotary knob. When finally confirmed, the indication **sync.** in the status area (3) of the ventilation mode lights up steadily instead of flashing.

A mandatory breath 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.

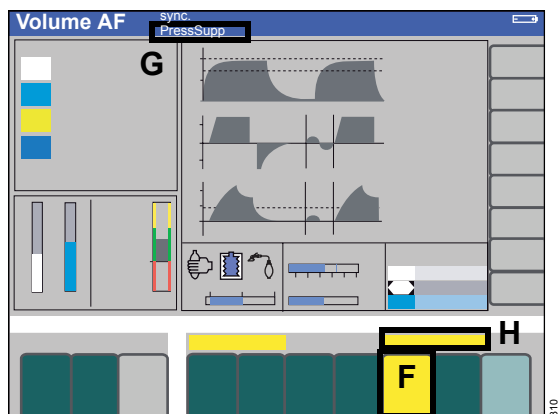
In **Volume AF**, the patient can additionally end the inspiratory phase during the last 50 % of the applicable inspiratory time when synchronization is activated. An inspiratory phase ended by the patient is represented by a continuous vertical black line in the pressure curve and in the flow curve (trigger indicator).

- 4 Press the soft key **extra settings** again. The current trigger status is shown above the keys for the ventilation parameters (E).



Synchronized volume guaranteed ventilation with pressure support (optional)

Pressure support is activated during **Volume AF** by entering a value for the level of pressure support. This can be defined via the soft key ΔPPS .



- 1 Press the soft key Δ **Pps** (F). 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.
- 2 Set and confirm the value for pressure support with the rotary knob. When finally confirmed, the indication **PressSupp** in the status area (G) of the ventilation mode lights up steadily instead of flashing.

If the patient was ventilated without synchronization when pressure support was activated, synchronization will 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 current trigger status is shown above the keys for the ventilation parameters (H).

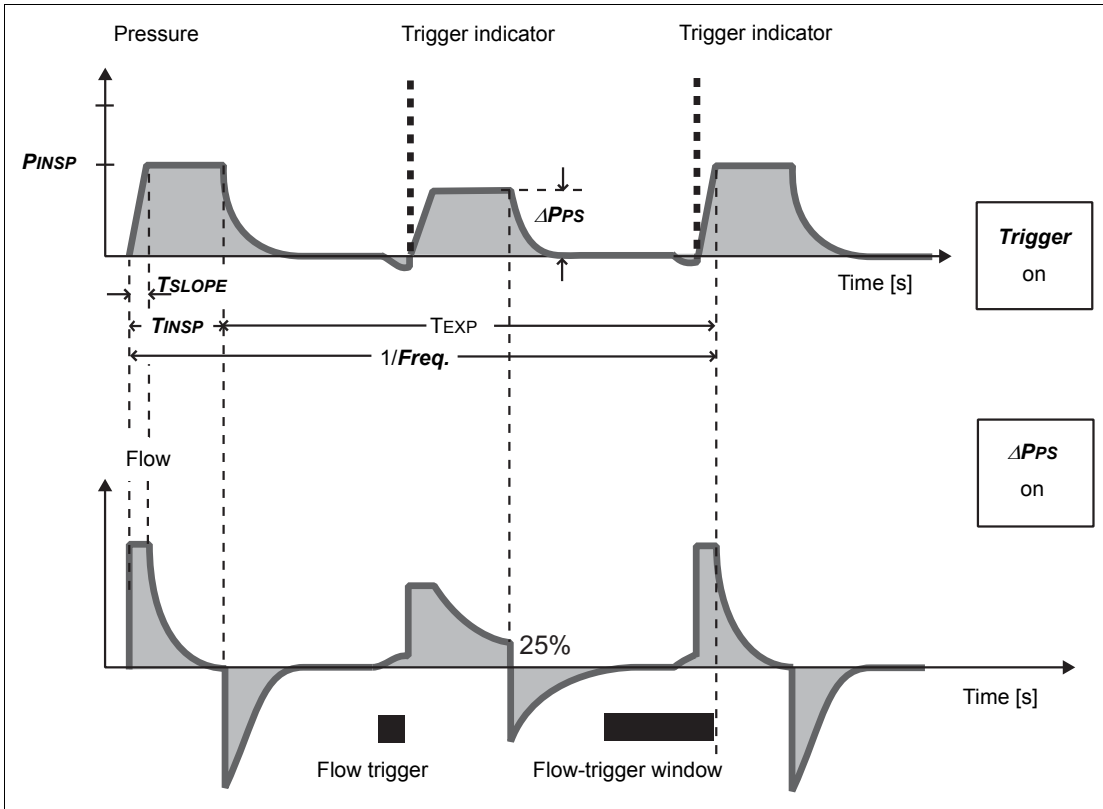
Setting ranges and factory settings

Ventilation parameters	Setting ranges	Factory settings ¹⁾
Pressure limitation P_{MAX} [hPa (cmH ₂ O)]	10 to 70 min. PEEP +10	40
tidal volume V_T [mL]	20 to 1400 ²⁾	600
Frequency Freq. ^{3)0.4)} [1/min]	3 to 100	12
Inspiratory time T_{INSP} ⁴⁾ [sec.]	0.2 to 6.7	1.7
PEEP [hPa (cmH ₂ O)]	3 to 20	0

Ventilation parameters	Setting ranges	Factory settings ¹⁾
Trigger sensitivity Trigger [L/min]	OFF , 0.3 to 15	3.0 (Pressure Support) OFF (Volume AF)
Pressure Support Δ Pps ⁵⁾ [hPa (cmH ₂ O)]	OFF , 0 to 50 max. P_{MAX} – PEEP	5 (Pressure Support) OFF (Volume AF)
Rise time T_{SLOPE} [sec.]	0.0 to 2.0	0.0
age [years]	<1 to 120	40
weight [kg] [lbs]	1 to 120 1 to 240	--

- 1) The default values can be set specifically for the hospital concerned, see page 162.
- 2) Optionally 5 to 1400 mL.
- 3) Depending on the configuration, the inspiratory time **T_{INSP}** 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 170.
- 4) The resultant ratio of inspiration to expiration I:E is also displayed in parallel.
- 5) Optional

Pressure Mode ventilation mode



098

Pressure is a pressure-controlled ventilation mode with fixed pressure limitation P_{INSP} and frequency $Freq.$ (former PCV), as well as with optional synchronization (former SIMV(PC)) and variable pressure support for spontaneous breathing efforts (former SIMV(PC)+PS, optional).

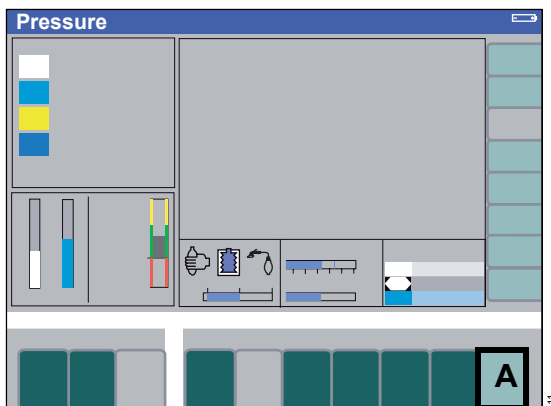
A continuous pressure is applied to the patient during the inspiratory time T_{INSP} . The rate at which the pressure curve rises is pre-set via the rise time T_{SLOPE} . Synchronization and pressure support are controlled by the sensitivity of the flow trigger and the level of ΔPPS . The maximum time interval for controlled ventilation is set via the frequency. 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.

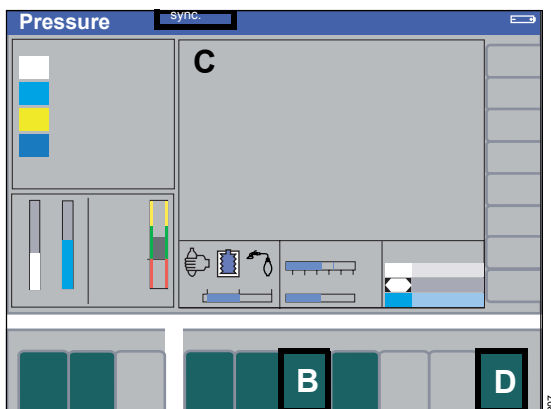
Some settable values are limited or mutually exclusive so that specific combinations of therapy settings are not possible, e.g., T_{INSP} 6.9 s at $Freq.$ 100/min.

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** (A). The trigger sensitivity **Trigger** is displayed.



- 2 Press the soft key **Trigger** (B). The last value set appears as default value when the key is activated.
- 3 Set and confirm the trigger sensitivity with the rotary knob. When finally confirmed, the indication **sync.** in the status area (C) of the ventilation mode lights up steadily instead of flashing.

A mandatory breath triggered by the patient is represented by a continuous vertical black line in the pressure curve and in the flow curve (trigger indica-

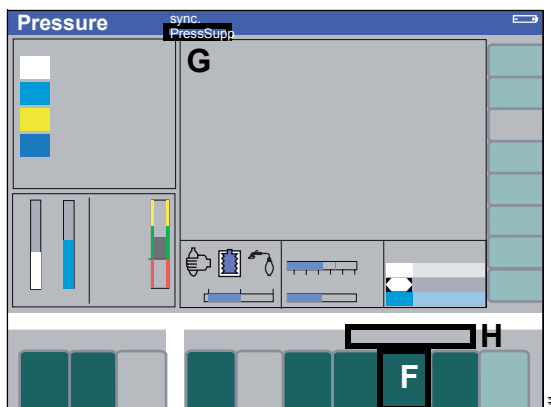
tor). The active window for the stroke triggered by the patient corresponds to the last 25 % of the applicable expiratory time.

- 4 Press the soft key **extra settings** (D) again. The current trigger status is shown above the keys for the ventilation parameters (E).



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 .



- 1 Press the soft key ΔPPs (F). 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.
- 2 Set and confirm the value for pressure support with the rotary knob. When finally confirmed, the indication **PressSupp** in the status area (G) of the ventilation mode lights up steadily instead of flashing.

If the patient was 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 current trigger status is shown above the keys for the ventilation parameters (H).

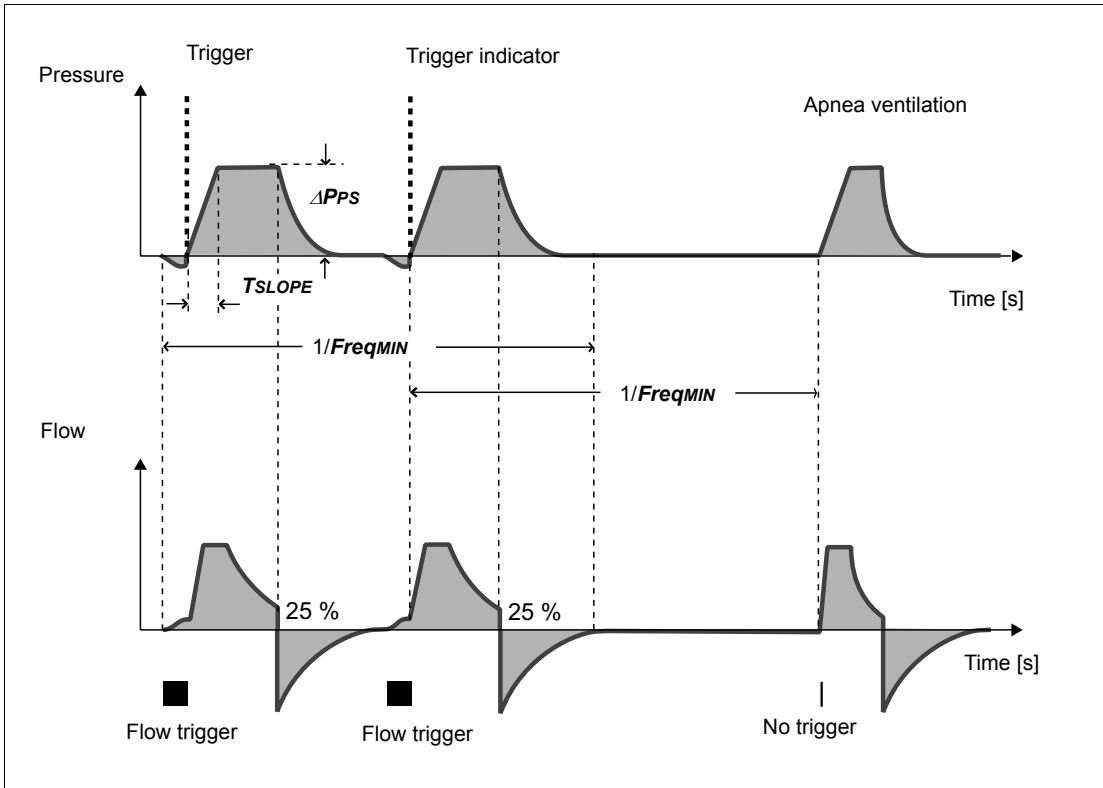
Setting ranges and factory settings

Ventilation parameters	Setting ranges	Factory setting ¹⁾
Pressure limitation P_{INSP} [hPa (cmH ₂ O)]	5 to 70 min. PEEP +5	15
Frequency Freq. ^{2),3)} [1/min]	3 to 100	12
Inspiratory time T_{INSP} ³⁾ [sec.]	0.2 to 6.7	1.7
Insp. pause time: Insp. time TIP:T_{INSP} [%]	0 to 60	10
PEEP ⁴⁾ [hPa (cmH ₂ O)]	0 to 20 max. P_{INSP} -5	0
Trigger sensitivity Trigger [L/min]	OFF , 0.3 to 15	3.0 (Pressure Support) OFF (Volume Mode/Pressure Mode)

Ventilation parameters	Setting ranges	Factory setting ¹⁾
Pressure support Δ PPS ⁵⁾ [hPa (cmH ₂ O)]	OFF , 3 to 50 max. P_{MAX} – PEEP	5 (Pressure Support) OFF (Volume Mode/Pressure Mode)
Rise time TSLOPE [sec.]	0.0 to 2.0	0.0
Age [years]	<1 to 120	40
Weight [kg] [lbs]	1 to 120 1 to 240	--

- 1) The default values can be set specifically for the hospital concerned, see page 162.
- 2) Depending on the configuration, the inspiratory time **T_{INSP}** 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 170.
- 3) The resultant ratio of inspiration to expiration I:E is also displayed in parallel.
- 4) Depending on the configuration, the pressure limit value **P_{INSP}** can also be changed automatically together with adjustment of the **PEEP** value. See "Starting the preset ventilation mode" on page 112 and "Ventilator and gas delivery" on page 170.
- 5) Optional

Pressure Support Mode (optional)

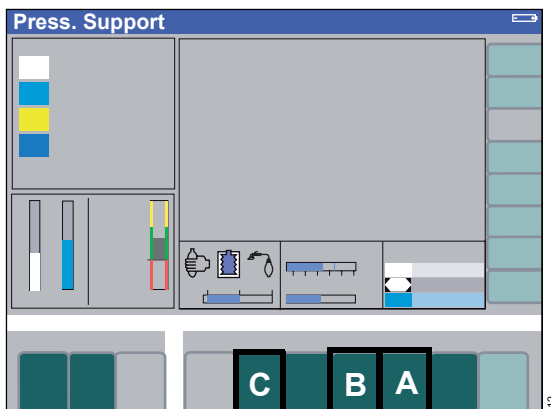


099

Press. Support is a pressure-supported ventilation mode for patients with spontaneous breathing. Synchronization and pressure support for the spontaneous breathing efforts are controlled by the sensitivity of the flow trigger and by the level of ΔPPS (A). The rate at which the pressure curve rises is pre-set by the rise time $TSLOPE$ (B).

The maximum inspiratory time for a spontaneous breath varies according to age: 1.5 seconds for patients aged 4 years and younger, and 4 seconds for patients over 4 years.

Inspiration is ended as soon as the current inspiration flow drops below 25 % of the inspiratory peak flow. Any leakage is compensated simultaneously by means of the actual airway pressure.



Apnea ventilation can additionally be set by means of the minimum frequency **FreqMIN** (C). The ventilator is automatically triggered by **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.

Apnea ventilation can also be deactivated again by means of **FreqMIN** (**OFF** position).

Continuous Positive Airway Pressure CPAP – in Pressure Support Mode (optional)

Spontaneous breathing at an increased pressure level to increase the functional residual capacity. Continuous positive airway pressure is activated in **Press. Support** when the value for the pressure support ΔPps is set ≤ 2 [hPa (cmH₂O)].

At the same time, the minimum frequency **FreqMIN** is set to **OFF** and the rise time **TSLOPE** is set to 0.0. Apnea ventilation with minimum frequency is not applicable in the **CPAP** mode.

Setting ranges and factory settings

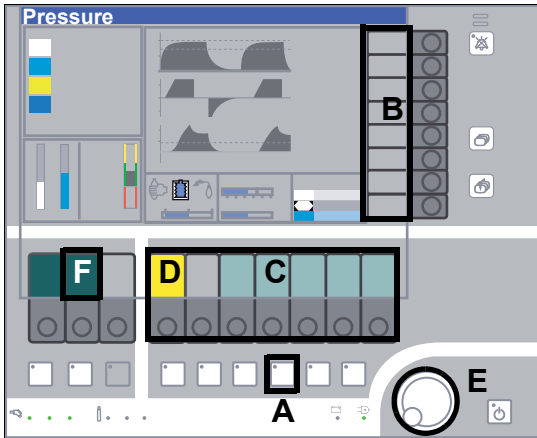
Ventilation parameters	Setting ranges	Factory setting ¹⁾
Minimum frequency ²⁾ FreqMIN [1/min]	OFF , 3 to 20	3
	OFF (CPAP)	
PEEP [hPa (cmH ₂ O)]	0 to 20	0
Trigger sensitivity Trigger [L/min]	0.3 to 15	3.0
Pressure support ΔPps [hPa (cmH ₂ O)]	>2 to 50	5
	0 to 2 (CPAP)	
Rise time TSLOPE [sec.]	0.0 to 2.0	0.0
	0.0 (CPAP)	
Age [years]	<1 to 120	40
Weight [kg] [lbs]	1 to 120 1 to 240	--

1) The default values can be set specifically for the hospital concerned, see page 162.

2) The inspiratory time is limited by adjustment of **FreqMIN** to yield a maximum ratio of 1:1 for I:E, thus ensuring an adequate expiratory time.

Presetting the ventilation mode

e.g., volume-controlled ventilation (**Volume**) is active, pressure-controlled ventilation is preset.



- 1 Press the key **Press. Mode** (A) so that its LED and the status line flash.

The ventilation parameters valid for pressure-controlled ventilation (**Pressure**) are displayed on the screen against a light green background.


- Soft keys for monitoring functions (B) turn to gray with gray type = cannot be operated.
 - Soft keys for ventilation (C) turn light green = parameters are not yet active.
- 2 Press the soft key for the individual ventilation parameters (D) and their color changes to yellow.
 - 3 Set and confirm the ventilation parameters via the rotary knob (E).

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 the preset ventilation mode

- Confirm via rotary knob (E).
Soft keys turn dark green. Pressure-controlled ventilation is active.

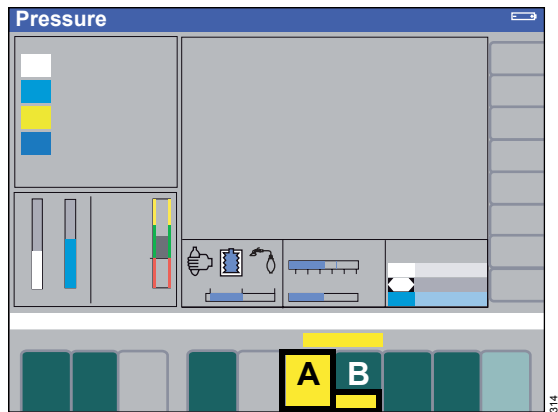
Fresh-gas flows, as indicated by the rotating symbol  in the soft key **flow L/min** (F).

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 **T_{INSP}** 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 171.



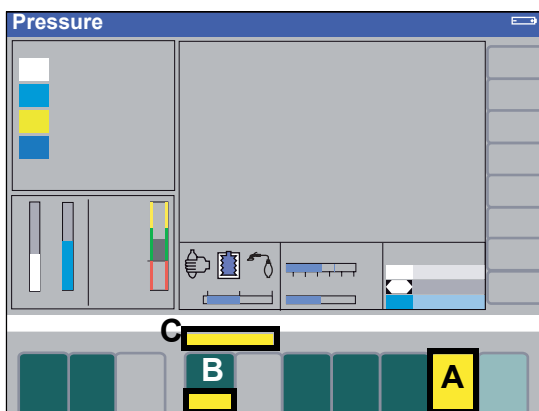
For dependent setting of the change in **T_{INSP}**:

- 1 Press the soft key **Freq.** (frequency) (A); the key lights up yellow.
- 2 Adjust the ventilation parameter Frequency via the rotary knob and push the rotary knob to confirm.

The value for the ventilation parameter **TINSP** (B) 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 value **PINSP** can also be changed automatically when changing the **PEEP** value, see page 171.



For automatic **PINSP** adjustment:

- 1 Press the soft key **PEEP** (A), key lights up yellow.
- 2 Set and confirm the ventilation parameter **PEEP** via the rotary knob.

The value for the ventilation parameter **PINSP** (B) automatically turns yellow and is adjusted at the same time.

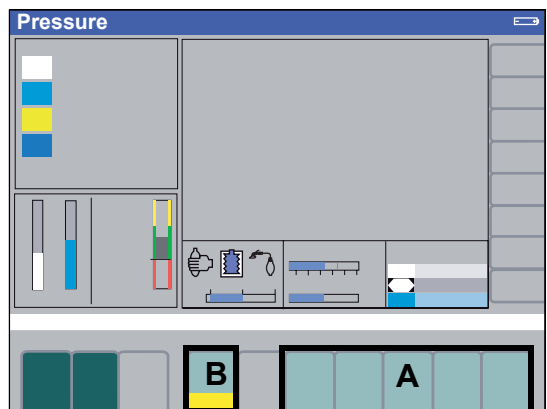
If so configured, the lower alarm limit for the airway pressure **PAW** ▼ (C) will be automatically changed when the **PEEP** value is changed.

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**) (A).

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

The measured parameter **PLAT** is adopted as the new value for **PINSP** (B).

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.

When changing from Pressure Support mode (optional) to automatic ventilation modes:

The set **PEEP**, ΔP_{ps} , and **Trigger** are adopted. The last values set are used for the other parameters and the configured default settings in all other cases.

NOTE

In minimum flow mode the following secondary effects may occur that affect ventilation of the patient:

- Leakage: check the breathing bag is adequately filled.
- Increased condensation: possible impairment of the flow measurement and increased water collection in the upper diaphragm of the ventilator. Check the upper diaphragm on a daily basis and empty if necessary.
- Difference between O₂ setting and inspiratory O₂ concentration: The O₂ consumption of the patient causes a difference between the set parameter and measured value.

Changing from manual ventilation **Man.Spont.** to automatic ventilation modes:

The ventilation parameters correspond to the last values set. When the ventilation mode (e.g., **Volume Mode**) is used for the first time, the pre-configured default settings can be adopted. This also applies when the patient is ventilated in an automatic ventilation mode (e.g., **Pressure Mode**) before switching to manual ventilation **Man.Spont.**.

Using non-rebreathing systems

(only with optional external fresh-gas outlet)

WARNING

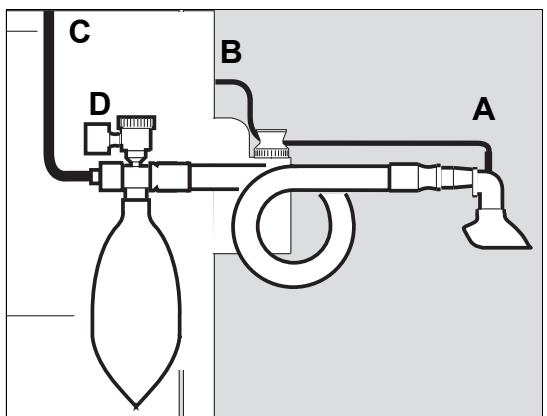
Risk of patient injury

Using a non-rebreathing system may injure the patient if the following is not observed:

- Only use devices with a breathing bag and/or pressure relief valve.
- Check the fresh-gas flow and the state of the breathing bag.
- Do not use the non-rebreathing system if the flow is insufficient.

For example Bain system

- Prepare the Bain system according to the corresponding instructions for use.



To monitor O₂, CO₂ and anesthetic gases:

- 1 Connect the sample line to the Luer Lock connector on the elbow (A) and to the water trap (B) on 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 connector on a filter.

- 2 Connect the fresh gas hose (C) of the Bain system to the fresh-gas outlet.
- 3 To remove exhaled gas, connect the non-rebreathing system connector (D) to the Y-piece.
- 4 Follow the instructions for use included with the Bain system.

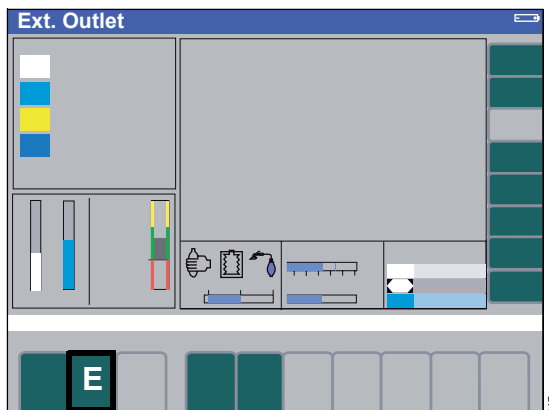
Diverting fresh gas to the ext. FG outlet, starting **Ext. Outlet** mode:

- Press the  key, confirm with rotary knob.

The airway pressure **PAW** and the mandatory frequency **Freq.**, **PEAK**, 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.



- 1 Set the fresh-gas flow (E). 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 artifact, see table on page 128.

CAUTION

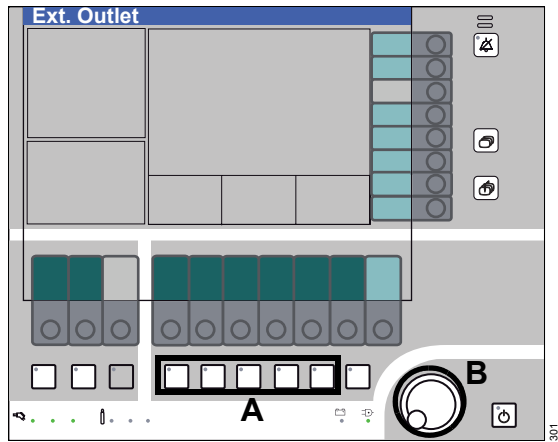
Risk of increased ambient gas concentration

Ambient air may become contaminated with anesthetic agent when using non-rebreathing systems.

Ensure sufficient ambient air circulation.

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

Ending the external fresh gas mode



- 1 Press any ventilation mode key (A).
The LED of the selected ventilation mode and the display in the status line flash.
- 2 Confirm via rotary knob (B).

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.

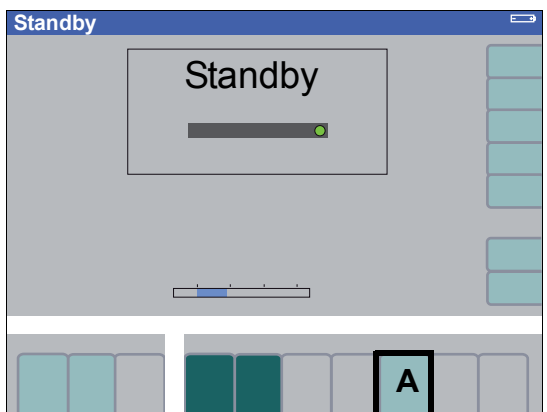
Changing patients

To switch Primus into **Standby**:

- Press the Standby key  and confirm via the rotary knob.

The functions of the workstation are switched off.

The set patient age, weight, alarm limits, fresh gas delivery settings, and ventilation parameters are retained.



To activate the default settings:

- Press the soft key **restore default settings** (A) and confirm.

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

WARNING

Risk of patient injury

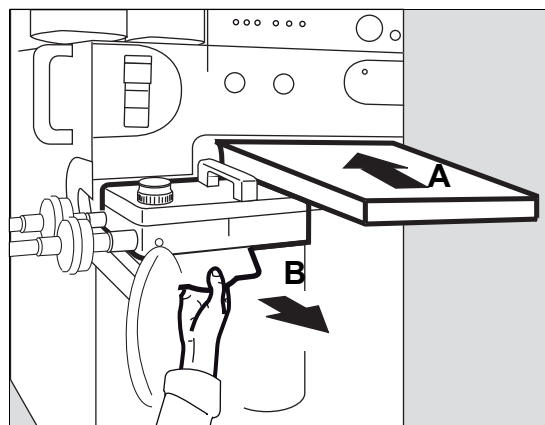
Restored default settings may contain settings inappropriate for a new patient.

After default settings have been restored, make sure the ventilation and monitoring settings are appropriate to the patient connected.

Changing soda lime

A reusable absorber or the disposable absorber Drägersorb CLIC can be used with the Primus. The soda lime must be exchanged, if:

- the soda lime in the absorber has turned violet.
- the inspiratory CO₂ concentration **inCO₂** exceeds the alarm limit.
- the time limit for usage has been reached.

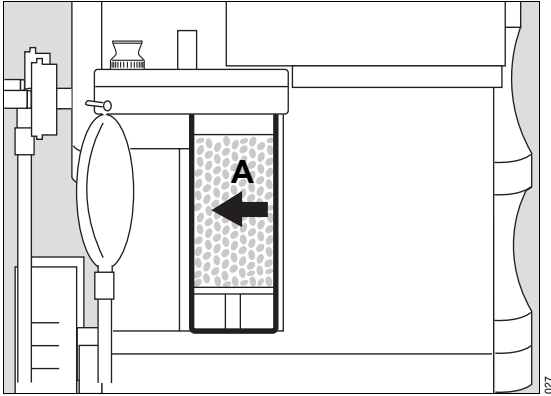


- Press the Standby key  and confirm via the rotary knob.

- 1 Slide the writing table (A) inwards.
- 2 Press the release button* on the ventilator module and pull the module out (B).

* available since November 2004

Reusable absorber



- 1 Turn the absorber counterclockwise (A) and pull it down and off.
- 2 Empty out the used soda lime and dispose of in accordance with the instructions for use of the soda lime.
- 3 Fill the absorber to the upper mark with fresh soda lime.
- 4 Fit the absorber into the breathing system from below and turn it clockwise as far as it will go.
- 5 Slide in the ventilator module until it clicks into place.
- 6 Pull the writing table out.
- 7 Reset the soda lime change log to current date by pressing the soft key **soda lime changed***, see page 87.

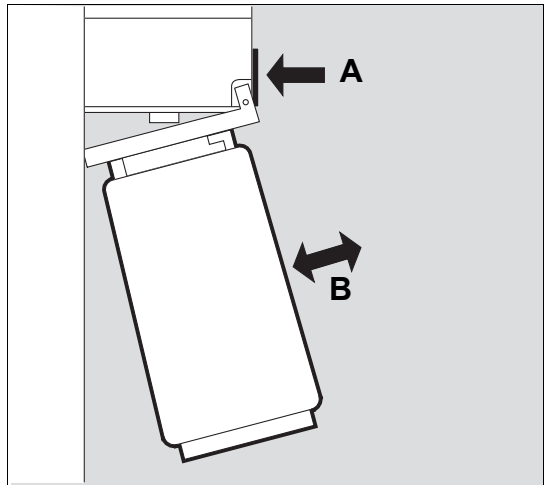
Disposable absorber Drägerorb CLIC

The appropriate adapter must be installed by trained personnel, e.g., DrägerService.

NOTE

The disposable CO₂ absorber must be clicked into place before switching on Primus. This ensures that the absorber is included in the leak and compliance test for the machine.

Remove the spent absorber



- 1 Press the button (A): the mounting swings open sealing the breathing system so that the ventilation can continue.

If the absorber is replaced during ventilation, the inspiratory gas concentrations can drop for a short period.

- 2 Slide the disposable absorber off the mount (B).
- 3 Dispose of the spent absorber.

Refer to the instructions for use of the Drägerorb CLIC absorber for information on disposal.

* Only without configured CLIC absorber.

Install the new absorber

- 1 Before fitting, shake the disposable absorber, e.g., by turning it upside down several times in order to loosen up the soda lime.
- 2 Remove the seal from the new disposable absorber.
- 3 Slide the new disposable absorber into the mount (B).
- 4 Push the absorber into the machine (B) until it engages.

WARNING

Risk of increased inspiratory CO₂ concentrations

When the absorber is swung out, no CO₂ is absorbed.

Always make sure the absorber is clicked into place after installing or replacing.

- 5 Reset the soda lime change log to current date by pressing the soft key **soda lime changed**, see page 87.

Leak test

WARNING

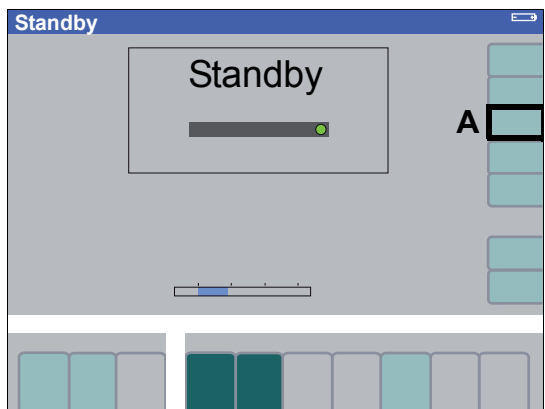
Risk of patient injury

The system will be pressurized during the leak test.

To prevent patient injury, do not perform the leak test with a patient connected to the anesthesia machine.


If the Vapor is to be included in the test:

- 1 Set the vaporizer hand wheel to ≥ 0.2 Vol%.
- 2 Seal Y-piece.
- 3 Connect sample line to Y-piece.



- 4 Press the soft key **leak test** (A) in **Standby**.

The following prompt is displayed:

Before starting the leak test, close the Y-piece and connect the sample line. If vaporizer leaks need to be tested, open respective vaporizer to at least 0.2 Vol%. Press  to start the leak test.

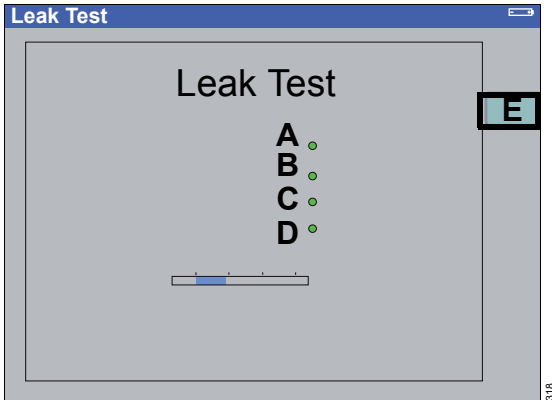
- 5 Push the rotary knob.

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.

NOTE

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

Leakage is tested in the automatic (mechanical) ventilation line (**leak (system)**) and in the overall system (**leak (Man.Spont.)**).



The clock symbol disappears when the test is complete and Primus displays the following test results:

A Breathing system

B system compliance **compliance (sys.)**

C leakage system **leak (system)**

D leakage Man.Spont. **leak (Man.Spont.)**

if applicable (values >150 mL/min), see "Leakage" on page 84.

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** (E).

The **Standby** screen is displayed.


- Close the vaporizer unit, turn the handwheel to **0**.

End of operation

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.

Switch off Primus:

- Push the system power switch  completely.

Primus is equipped with a power-down delay.

NOTE

When the system power switch is pressed, an acoustic signal sounds and for 10 seconds a message is displayed.

This message is displayed:

Please wait while device shuts down. Make sure that the O₂ safety control valve is closed. Push the system power switch to cancel this power-down and return to the previous operational mode.

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

WARNING

Risk of fire

In order to avoid the accumulation of potentially hazardous oxygen concentrations in the anesthesia machine or in the operating room, all oxygen supplies must be closed and the anesthesia machine disconnected from them when the anesthesia machine is not in use.

CAUTION

Risk of supply failure

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

Close cylinder valves whenever the central supply is sufficient.

- 1 Close the cylinder valves.

WARNING**Risk of gas supply contamination**

When the central gas supply is connected, the smallest internal leakage can cause contamination of the supply gases.

Always disconnect the medical gas hoses from the terminal unit when the device is not in use.

- 2 Disconnect the compressed gas hoses from the terminal units.
- 3 Leave Primus plugged into the power supply in order to charge the uninterruptible power supply UPS.
- 4 We strongly recommend switching off the device once a day in order to carry out the power-on self test.

CAUTION**Risk of device failure**

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

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

See "Removing the ventilator diaphragm" on page 212.

Switch off the anesthetic gas scavenging system AGS

- Disconnect the anesthetic gas scavenging hose.

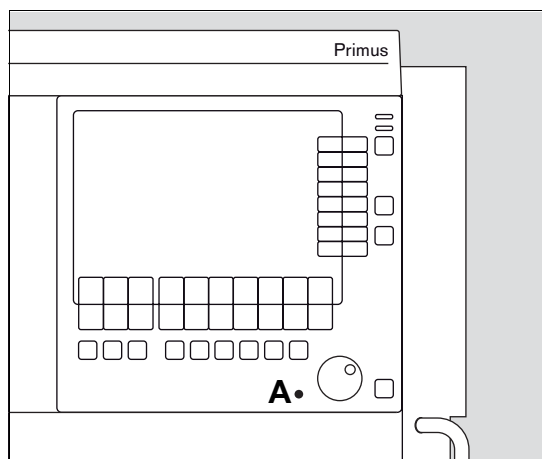
When Primus is not in use


WARNING**Risk of battery failure**

Allowing the battery to run low can damage it. It must be charged at least every four weeks.

If Primus is not used for an extended period:

- Unplug the medical gas hoses from the terminal units of the central gas supply.
- Close the cylinder valves on the reserve gas cylinders.
- Leave the device permanently connected to the electricity supply.



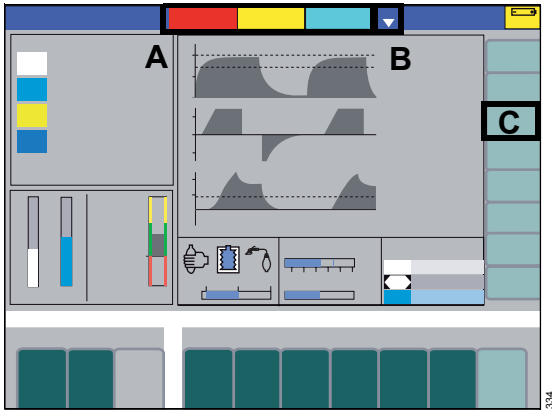
The green LED  (A) lights up.

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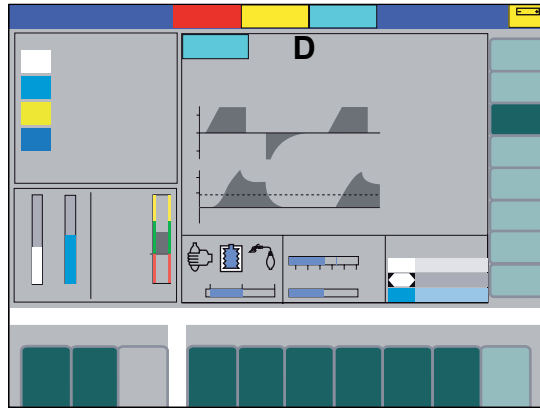
Alarms

Alarm displays	124
Alarm priorities and alarm signals	125
Warning	125
Caution	125
Advisory/technical message	125
Downgrading alarm priorities	126
Suppressing alarms	126
Alarm behaviour when changing ventilation modes	127
Limit-based alarms activated in respective ventilation modes	128
Enabling/disabling CO₂ alarms	130
HLM mode	131
Enabling/disabling HLM mode	131
Flow apnea alarms in HLM mode	132
Enabling/disabling SpO₂ alarms (optional)	132
Displaying and setting alarm limits	133
Opening the alarm limits menu automatically ..	133
Adapting alarm limits	134
Setting the alarm tone	135
Alarms in the Standby mode	135

Alarm displays



334



335

Alarm messages are displayed in the alarm field (A) in order of priority.

All displayed alarms are sorted according to the three classes defined on page 125. Within these classes, the alarms are sorted and displayed according to an internal priority system. A priority of 31 indicates the highest, a priority of 1 the lowest priority. The priority numbers are given in the table "Alarm – Cause – Remedy" on page 188. The internal priorities are not displayed.

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.

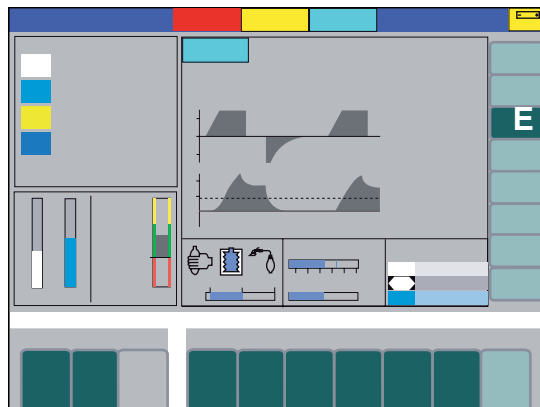
If more than three alarms occur simultaneously, the symbol ^{mehr} ▼ appears (B) to the right of the alarm field and the soft key **show all alarms** (C) is activated on the right-hand side of the screen.

When this soft key is pressed, the upper curve display (D) is replaced by up to six additional alarm fields for 15 seconds.

If more than nine alarm messages are simultaneously active, the lowest priority alarms will not be displayed until the total number of active alarm messages falls below nine.

The alarm tone sequence accompanying a displayed alarm message with the highest priority will always be sounded at least once completely. The alarm tone sequences of alarm messages with lower priorities will not sound if a higher priority alarm is activated, i.e. the tone sequence thereof will sound.

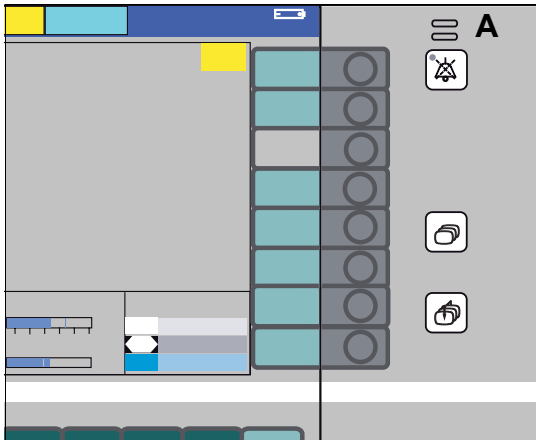
If an alarm message of the same class as an active alarm message is generated, the alarm tone of the new alarm only sounds if the priority is higher than the priority of the previously active alarm.



335

The curve reappears when the soft key **show all alarms** (E) is pressed again or when the 15 seconds have expired.

Alarm priorities and alarm signals



Rather than being displayed immediately, some alarms are shown with a delay after a limit violation. In addition, combinations with other alarms, and the length of time for which the alarm is issued, may cause the priority of an alarm to change, similarly the acknowledgement of a technical alarm.

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

Warning

- Message with highest priority.
- A warning message requires immediate action.
- Text flashes on red background.
- Red LED flashes (A), accompanied by a repetitive tone sequence.

Tone sequence* **Standard:**
E-E-E--E-B^b-----E-E-E--E-B^b**

Caution

- Message with medium priority.
 - A caution message requires immediate action.
 - Text flashes on yellow background.
 - Yellow LED flashes (A), accompanied by a repetitive 3-tone sequence.
- Tone sequence* **Standard:** G-G-G***

Advisory/technical message

- Message with lowest priority.
- Text displayed on cyan background.

Note

- Yellow LED (A) illuminates continuously, accompanied by a single 2-tone sequence.
- Tone sequence* **Standard:** E-E

Technical message

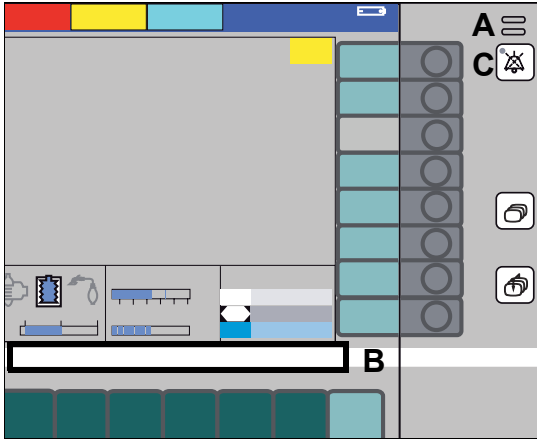
- Yellow LED (A) illuminates continuously without any acoustic tone.
- These messages must be noted and action taken if necessary.

* Explanation of used capital letters and "-" symbols: The letters represent musical notes, the "-" a short time interval.

** In case of a short alarm duration, only half of the sequence (5 tones) is annunciated.

*** The third tone is one octave lower.

Dräger recommends the user to remain close to the anesthesia machine, i.e. within a range of up to four meters (12 feet), to allow for quick recognition and action in the event of an alarm.



Whenever an alarm message is displayed, the alarm LED flashes or lights up continuously (A) and an acoustic tone sequence indicates the alarm priority.

In addition, a flashing help text is displayed in the prompt field (B).

In the case of limit-based alarms, the corresponding measured values will be highlighted by a colored background and will flash.

The color of the background reflects the color-coding of the alarm priority (red, yellow, cyan).

Refer to the chapter "Alarm – Cause – Remedy" on page 188 for a list of alarm messages.

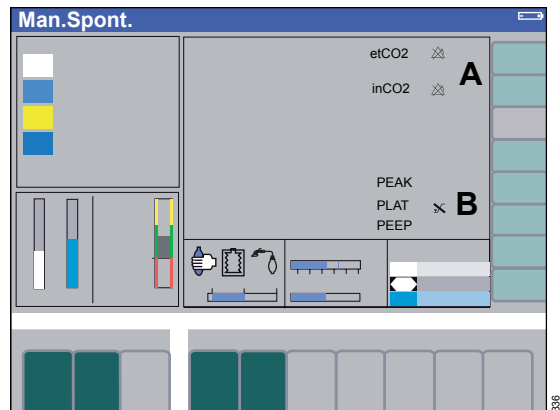
Downgrading alarm priorities


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



- Press the  key (C).


Suppressing alarms


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




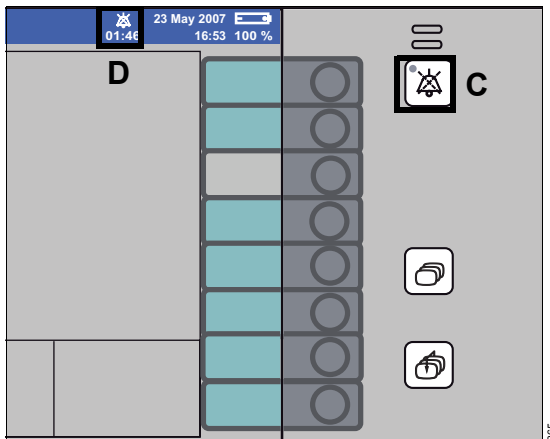
If all the alarms connected to a measurement function have been disabled, the measured value will be marked with the symbol  (A).

If only certain alarm limits have been disabled for a monitoring parameter, one symbol  or  appears next to the parameter (B).


If the upper and lower alarm limits of a monitoring parameter have been disabled, but the respective apnea monitoring feature is still active, the symbol  appears next to the parameter.


If an apnea monitoring feature derived from a specific monitoring parameter has been disabled, that parameter will be marked with the symbol .

A monitoring parameter is always marked with the symbol  if, after switching from **Standby** into a ventilation mode, a valid CO₂ breathing phase has not yet been detected for the parameters O₂, N₂O, MV, or inspiratory and expiratory CO₂, or, respectively, a valid pulse signal for SpO₂. As soon as a breathing phase has been detected or valid pulse signals are available for SpO₂, the symbol disappears.




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

- Press the  key (C), the yellow LED lights up.

The symbol  appears in the system information field (D) next to the date with an indication of the silence time remaining (minutes:seconds).

To enable the alarm tone:

- Press the  key (C), the yellow LED turns off.

Alarm behaviour when changing ventilation modes

The Primus has an automatic suppression of active **MV** low and apnea alarms implemented, when changing ventilation modes.

This suppression applies when the user changes from a ventilation mode with a low mandatory ventilation support, such as **Man.Spont.**, to a ventilation mode with a higher mandatory ventilation, such as **Volume Mode**. After this timeout the alarms will only be generated again if the preconditions are valid.

If the **MV** low alarm is active during such a change, the alarm is suppressed for 45 seconds (no alarm display and no audible tone). The apnea alarms can be suppressed for a certain time, depending on the ventilation settings in the new ventilation mode. If the settings for **Freq./FreqMIN** are <6 1/min, apnea alarms will be suppressed for 30 seconds. With all other settings, the alarms will be suppressed for 15 seconds.

Limit-based alarms activated in respective ventilation modes

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







WARNING

Risk of patient injury

Because anesthesia machines within one care area might have different default alarm limit configurations, make sure the preset alarm limits are appropriate for the new patient. Also make sure the alarm system has not been rendered useless by setting the alarm limits to extreme values or by their being disabled.

See "Configuring the default settings" on page 162.

Alarm	Mode	Volume, Volume AF, Pressure, Press. Support	Press. Support CPAP	Ext. Outlet	Monitoring, Man.Spont.	Factory setting
SpO₂ [%]	✓ [^]	ON	ON	ON	ON	--
	✓ _v	ON	ON	ON	ON	92
Pulse [1/min]	✓ [^]	ON	ON	ON	ON	120
	✓ _v	ON	ON	ON	ON	50
etCO₂ [mmHg]	✓ [^]	ON	ON	1)	1)	50
	✓ _v	ON	ON	1)	1)	--
inCO₂ [mmHg]	✓ [^]	ON	ON	1)	1)	5
MV [L/min]	✓ [^]	ON	ON	OFF	1)	12
	✓ _v	ON	ON	OFF	1)	3.0
inO₂ [Vol%]	✓ [^]	ON	ON	1)	1)	--
	✓ _v	ON	ON	ON	ON	20
inHal [Vol%]	✓ [^]	ON	ON	ON	ON	1.5
	✓ _v	ON	ON	1)	1)	--
inIso [Vol%]	✓ [^]	ON	ON	ON	ON	2.3
	✓ _v	ON	ON	1)	1)	--
inEnf [Vol%]	✓ [^]	ON	ON	ON	ON	3.4
	✓ _v	ON	ON	1)	1)	--

Alarm	Mode	Volume, Volume AF, Pressure, Press. Support	Press. Support CPAP	Ext. Outlet	Monitoring, Man.Spont.	Factory setting
inDes		ON	ON	ON	ON	12.0
	[Vol%] 	ON	ON	1)	1)	--
inSev		ON	ON	ON	ON	4.2
	[Vol%] 	ON	ON	1)	1)	--
P_{AW}		ON	ON	ON	ON	40
	[hPa (cmH ₂ O)] 	ON	ON	OFF	ON	8
APNEA PRESSURE		ON	OFF	OFF	OFF	8
APNEA FLOW		ON	ON	OFF	OFF	---
APNEA CO₂		ON	ON	ON	ON ²⁾	---

1) These alarms can be configured ON or OFF in **Standby** for switching to **Man.Spont.**, **Ext. Outlet**, and **Monitoring**. 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.

2) In **Man.Spont.**, **Monitoring**, and **Ext. Outlet**, the alarm is issued after 65 seconds.

-- The factory setting is outside the monitored range; the corresponding alarm limit is disabled.

All apnea, apnea pressure, apnea flow, and apnea 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/min or when set to **OFF**.

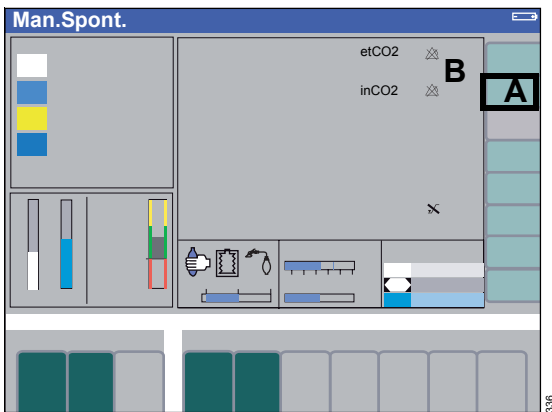
All apnea CO₂ alarms in **Man.Spont.** and in the **Monitoring** mode are only active if ventilation has already been detected (AutoWakeUp).

Enabling/disabling CO2 alarms


The alarm limits for inCO₂, etCO₂, and CO₂ apnea monitoring can be disabled via the soft key **CO₂ alm. ON -> off**. This key is effective in the following operating modes:

- **Man.Spont.**
- **Monitoring**
- **Ext. Outlet**

Disabling CO2 alarms



- Press the **CO₂ alm ON -> off** soft key (A).

The symbol  appears beside the measured values for the end-expiratory and inspiratory CO₂ concentration (B).

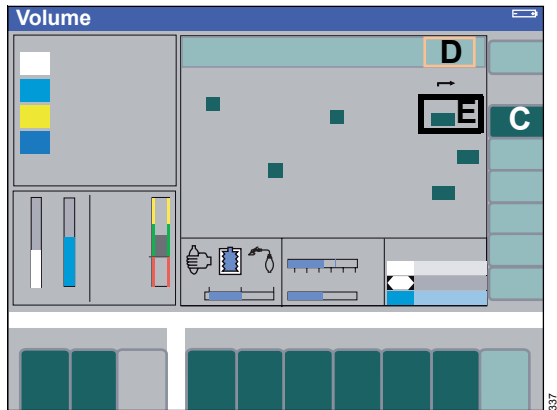
Enabling the CO2 alarms

- Press the **CO₂ alm OFF -> on** (A) soft key again.

Disabled CO₂ alarms are enabled automatically when changing to another ventilation mode.

The alarms for **etCO₂ $\sqrt{\wedge}$** and **inCO₂ $\sqrt{\wedge}$** can be activated or deactivated in **Standby** for switching to **Man.Spont.**

When the alarm limits are enabled the value is adopted from the automatic ventilation mode, see page 167.



CO₂ alarms can also be enabled and disabled in all ventilation modes:

- 1 Press the soft key **config.** on the standard or data screen. The submenu **volumes/alarms** is opened (C).
- 2 Select and confirm the column **alarms on/off** (D) via the rotary knob.
- 3 Select and confirm the line **CO₂** (E) via the rotary knob.
- 4 Select and confirm **on** or **off** via the rotary knob.

CAUTION

Risk of inadequate monitoring

National and international 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.

Only disable this monitoring parameter after consulting national and/or international standards.

HLM mode

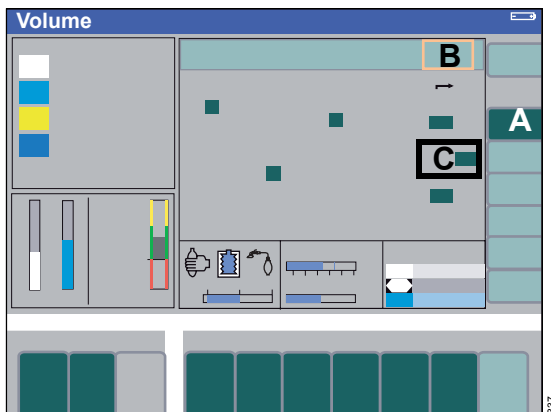
The HLM mode permits patient monitoring without unnecessary alarms during extra-corporal oxygenation of the patient by a heart lung machine (HLM).

In the **HLM mode**:

- All gas concentrations are measured independently of the breathing phase.
- CO₂ apnea and pressure apnea alarms are inactive.
- SpO₂ monitoring alarms are inactive.
- The **MAC LOW?** alarm is inactive.
- MV alarms and flow apnea monitoring can be configured (see page 167).

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

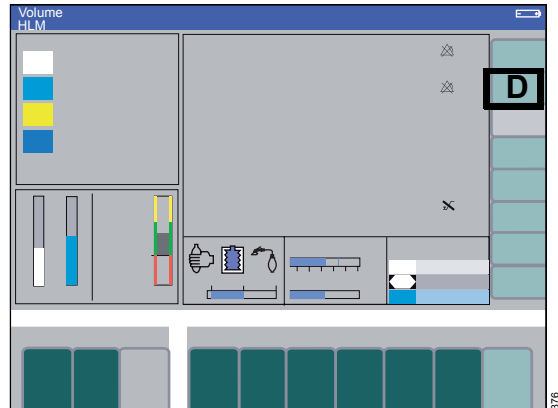
Enabling/disabling HLM mode



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

- 1 Press the soft key **config.** (A) on the standard or data screen. The submenu **volumes/alarms** is opened.
- 2 Select and confirm the column **alarms on/off** (B) via the rotary knob.

- 3 Select and confirm the line **HLM mode** (C) via the rotary knob.
- 4 Select and confirm **on** or **off** via the rotary knob.



- 5 The HLM mode can also be deactivated by pressing the soft key **exit HLM** (D).

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

Deactivating the HLM mode immediately reactivates the CO₂ alarms, but SpO₂ 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 SpO₂ measurement; the last status set is retained.

Flow apnea alarms in HLM mode

CAUTION

Risk of insufficient monitoring

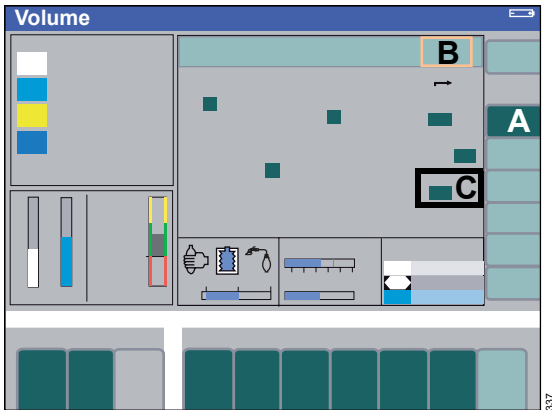
If the setting **MV alarms in HLM?** is set to **no**, MV alarms and flow apnea monitoring are deactivated.

Special attention is required.

In the standby configuration, MV alarms and flow apnea alarms can be configured to be inactive in HLM mode (see page 167). When leaving HLM mode, MV alarm limits and flow apnea alarms are activated again:

- If the MV alarm limits have been changed during HLM mode, these settings are kept.
- If the MV alarm limits have not been changed during HLM mode, the original settings are restored.

Enabling/disabling SpO2 alarms (optional)



CAUTION

Risk of inadequate monitoring

National and international 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.

Only disable this monitoring parameter after consulting national and/or international standards.

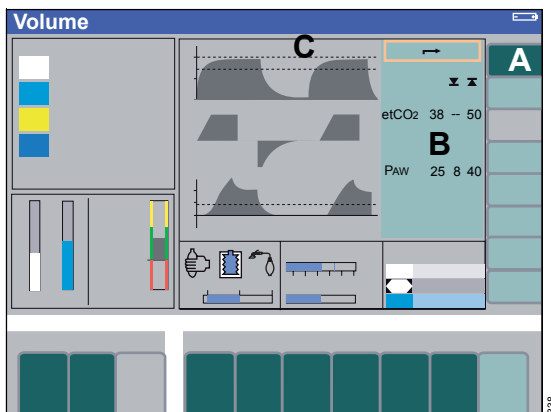
SpO₂ alarms can also be enabled and disabled during operation, see page 175.

- 1 Press the soft key **config**, on the standard or data screen. The submenu **volumes/alarms** is opened (A).
- 2 Select and confirm the column **alarms on/off** (B) via the rotary knob.
- 3 Select and confirm the line **SpO₂** (C) via the rotary knob.
- 4 Select and confirm **on** or **off** via the rotary knob.

Suppressed alarm limits are identified by the symbol $\cancel{\times}$ in the parameter field.

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 "Configuring the default settings" on page 162 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:

- 1 Press the soft key **alarm limits** (A).

Display (example):

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

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

The upper alarm limit (40 hPa (cmH₂O)) and the lower alarm limit (8 hPa (cmH₂O)) are assigned to the measured value **PAW** (25 hPa (cmH₂O)).

A disabled alarm limit (example **etCO₂**) is indicated by two dashes ("--").

To set an alarm limit:

- Place the cursor on the alarm limit by turning the rotary knob and push to confirm.
The alarm limit is highlighted in yellow.

- Set the new value by turning the rotary knob and push to confirm.

The new alarm limit is now active. The cursor returns to the \curvearrowright symbol.

Opening the alarm limits menu automatically

The alarm limits menu is opened automatically whenever an alarm limit is violated.

This can be disabled in the menu **Standby Conf.**, see page 167.

Setting ranges of the alarm limits during operation

Alarm		Setting ranges
SpO₂	\surd^{\wedge}	51 to 99; --
	\surd	[%] 50 to 98; --
Pulse	\surd^{\wedge}	21 to 250
	\surd	[1/min] 20 to 249
etCO₂	\surd^{\wedge}	1 to 75
	\surd	[mmHg] 0 to 74
inCO₂	\surd^{\wedge}	1 to 10
		[mmHg]
MV	\surd^{\wedge}	0.1 to 20.0
	\surd	[L/min] 0 to 19.9
inO₂	\surd^{\wedge}	19 to 99; --
	\surd	[Vol%] 18 to 98
inHal	\surd^{\wedge}	0.1 to 8.4
	\surd	[Vol%] 0 to 8.3
inIso	\surd^{\wedge}	0.1 to 8.4
	\surd	[Vol%] 0 to 8.3

Alarm		Setting ranges
inEnf		0.1 to 9.9
[Vol%]		0 to 9.8
inDes		0.1 to 21.9
[Vol%]		0 to 21.8
inSev		0.1 to 9.9
[Vol%]		0 to 9.8
PAW		5 to 99
[hPa (cmH2O)]		0 to 35

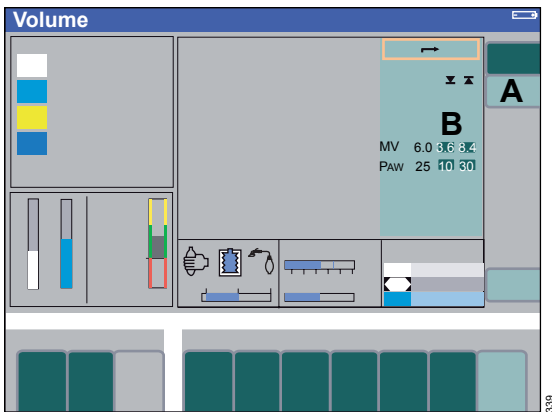
To exit the **alarm limits** menu:

- Place the cursor on and confirm with rotary knob.

or

- Press the key.

Adapting alarm limits



When ventilation settings have been made, Primus can automatically adapt the alarm limits for minute volume **MV** and the airway pressure **PAW** to the current parameters in **Volume Mode**, **Volume AF**, **Pressure Mode**, and **Pressure Support** (optional).

- Press the soft key **auto-set limits** (A).
The alarm limits menu opens automatically.

The alarm limits for **MV** and **PAW** are adapted and highlighted by dark green background (B).

To quit the alarm limits menu:

- Push the rotary knob or the key.

The new alarm limits for **MV** are calculated by Primus from the measured value for the minute volume **MV** in **Volume Mode**, **Volume AF**, **Pressure Mode**, and **Pressure Support** (optional).

	Volume Mode, Volume AF, Pressure Mode, Pressure Support
MV upper alarm limit [L/min]	measured MV x 1.4; at least 2.0
MV lower alarm limit [L/min]	measured MV x 0.6; at least 0.3

The displayed value may differ marginally due to rounding errors, since Primus calculates the values internally with much greater accuracy.

The new alarm limits for **PAW** are calculated by Primus on the basis of the mean values for **PEAK**, **PLAT**, and **PEEP** over the last four machine strokes. Spontaneous breaths by the patient and triggered pressure support strokes are not taken into account.

If the mean of the last (up to four) measured breaths cannot be calculated, the measured value of the last breath is used instead.

	Volume Mode, Volume AF, Pressure Mode, Pressure Support
PAW upper alarm limit [hPa (cmH ₂ O)]	PEAK +5 or PLAT +10, whichever is greater.
PAW lower alarm limit [hPa (cmH ₂ O)]	0.6 x (PLAT – PEEP) + PEEP – 1, but at least 3

To restore individual alarm limits for **MV** and **PAW**:

- see "Setting alarm limits" on page 167.

To restore all default alarm limits:

- see "Operation" on page 90.

Setting the alarm tone

The volume of the alarm tone can be set in the configuration menu, see page 163.

Alarms in the Standby mode

All technical alarms, e.g., failure of device components and a number of special operating states, are also indicated by Primus when in **Standby**.

A corresponding message appears in the alarms field, but without any acoustic warning.

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Monitoring

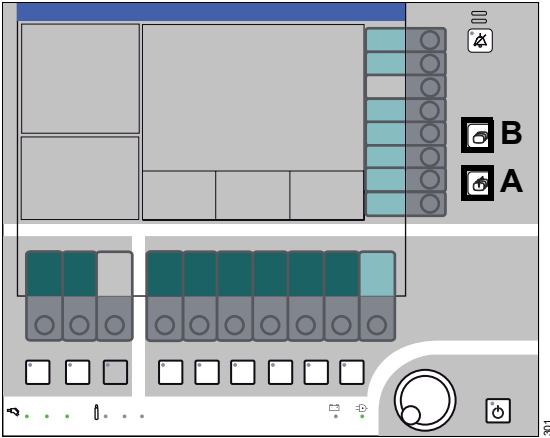
Selecting the standard screen	138	Selecting the trend screen	153
Monitoring mode	139	Selecting other display combinations	153
Screen layout	139	Zoom function	154
Displayed parameters	140	Deleting the trend memory	154
CO ₂ concentration	140	Selecting the logbook	155
O ₂ concentration	140	To delete the logbook	156
Anesthetic gases	140	Using the timer function	156
Airway pressure	140	SpO₂ measurement (optional)	156
SpO ₂ concentration (optional)	140	Selecting a sensor	156
Flow and volume	141	Safety-relevant information	158
Volumeter	141	Applying the Durasensor DS-100 A	159
Virtual flow tubes	141	Test Considerations and Oximeter Accuracy .	160
Indicators for the active ventilation source	142		
Gas supply	142		
Econometer (optional)	142		
Loops (optional)	142		
Mini trends (optional)	142		
Gas measurement	143		
Calibration	143		
MAC definition	143		
Age-dependent MAC values	144		
xMAC display (MAC multiple)	145		
Mixture detection	145		
Automatic agent alarm activation	146		
Using the volumeter function	147		
Upper bar graph	147		
Lower bar graph	147		
Starting the volumeter	147		
Econometer (optional)	148		
Loops (optional)	149		
Mini trends (optional)	150		
Mini trend for MV*CO ₂	150		
Mini trend for O ₂ uptake	151		
Mini trend for CPAT/PEEP	151		
Selecting the data screen	152		

Selecting the standard screen

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

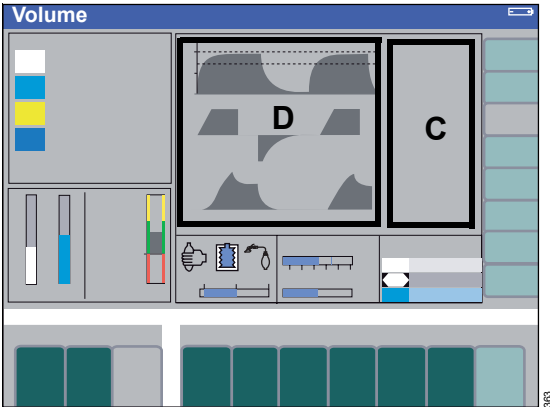
The most important parameters are grouped together on the right (C) and left sides of the screen.

The three curves are displayed in the middle (D) (for other standard screens, see page 152).



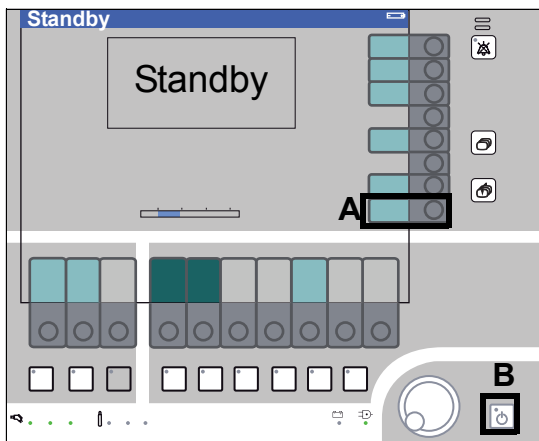
- By pressing the  key (B),
- or
- By pressing the  key (A) repeatedly.

Display (example):




Monitoring mode


Monitoring can be activated in **Standby**, for instance for exclusive measurement of the SpO₂ value. Fresh-gas is not delivered.



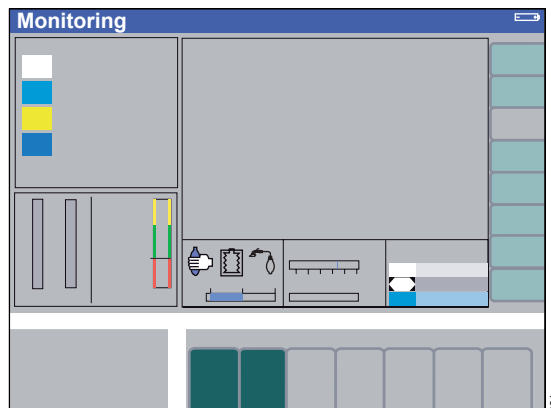
To start the monitoring mode:

- 1 Press the soft key **monitor. mode**
- or
- 2 Press the  key (B).

To return to **Standby**:

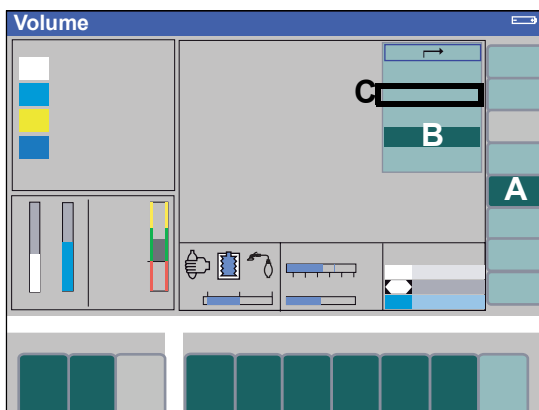
- 2 Press the  key (B) again and confirm via the rotary knob.

Display (example):



All alarms are active in the monitoring mode compared to the ventilation mode **Man.Spont.**, see page 128.

Screen layout



Three screen layouts can be selected via the **screen layout** key (A). The currently selected screen layout (B) is highlighted by a dark green background.

The active screen layout can be changed via the menu item **config. screen** (C).

Select, edit, and confirm the curve or module to be changed and confirm with the rotary knob.

All three screen layouts with three curves and individual modules can only be configured in the menu **Standby Conf.**, see page 166.

Displayed parameters

CO₂ concentration

- Curve display
The color of the curve can be configured by DrägerService.
- Numerical display
 - etCO₂** : End-tidal CO₂ concentration
 - inCO₂** : Inspiratory CO₂ concentration
- Trend curve for CO₂

O₂ concentration

- Curve display
- Numerical display
 - inO₂** : Inspiratory O₂ concentration
 - ΔO₂** : Difference between inspiratory and expiratory O₂ concentration
- Trend curve for O₂

Anesthetic gases

- Curve display
- Numerical display
 - insp.** : Inspiratory anesthetic gas concentration
 - exp.** : Expiratory anesthetic gas concentration
 - MAC** : Minimum alveolar concentration
- Trend curve for anesthetic gases and **MAC**


Airway pressure

- Curve display (**P_{AW}**)
- Numerical display
 - PEAK** : Peak pressure
 - PLAT** : Plateau pressure
 - PEEP** : Positive end-expiratory pressure
 - PMEAN** : Mean pressure

(only on the data screen)

- Bar graph

SpO₂ concentration (optional)

- Plethysmogram
- Numerical display
 - SpO₂** : Functional O₂ saturation of the blood
 -  : Pulse rate
- Trend curve for SpO₂ and pulse

Flow and volume

- Curve display flow (insp./exp.)
- Numerical display
 - MV** : Expiratory minute volume
 - V_T** : tidal volume
 - VT_{INSP}** : Measured inspiratory tidal volume
 - ΔV_T** : Difference between inspiratory and expiratory tidal volume
 - Freq.** : Respiratory rate
 - MVLEAK** : Difference between inspiratory and expiratory minute volume
(only on the data screen)
 - MVSPON** : Spontaneously breathed expiratory minute volume
 - MVMAND** : Mandatory breathed expiratory minute volume
 - CPAT** : Patient lung compliance
Determined from **PLAT** and expiratory **V_T**.
Lung compliance is equal to the measured total compliance $\left(\frac{V_T}{PLAT - PEEP}\right)$ minus the system and hose compliance determined in the self test.
(only on the data screen)

WARNING

Risk of insufficient ventilation

The displayed spontaneous minute volume (**MVSPON**) indicates the volumes of the patient's breathing and the mechanical breathing support. If the mechanical breathing support is triggered by small tidal volumes of the patient, a major portion of the spontaneous minute volume is not achieved by the patient's breathing but the mechanical breathing support. In this case, **MVSPON** indicates a high value although the actual spontaneous minute volume is very low.

Do not make therapy decisions based solely on the displayed value of **MVSPON**.

- Trend curve for **MV** and **CPAT**

Volumeter*

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

Virtual flow tubes

Shows the individual flows actually delivered by the fresh-gas mixer with bar graphs for **O₂** and **N₂O** or **Air**.

* see page 147 for a detailed description

Indicators for the active ventilation source



: Manual ventilation (**Man. Spont.**)



: Non-rebreathing system on external gas outlet (**Ext. Outlet**)



: Automatic (controlled) ventilation

Mini trends (optional)***

The mini trends are located below the waveform area and display a trend over 15 minutes for the following parameters:

- **MV*CO₂**,
- **O₂Uptake** and
- **CPAT/PEEP**.

Gas supply

Shows pipeline and cylinder gas supply pressures in tabular form.

Econometer (optional)*

Presentation of fresh-gas utilization as a bar graph with the three ranges **surplus**, **efficient**, and **deficit**.

Loops (optional)**

Graphical display for the following measured and calculated values:

- **PAW-V**
- **V-Flow**

* see page 148 for a detailed description

** see page 149 for a detailed description

*** see page 150 for a detailed description

Gas measurement

The concentration of O₂, CO₂ and the anesthetic agents N₂O, halothane, enflurane, isoflurane, desflurane and sevoflurane are measured.

The gas concentrations are measured in the side-stream. This results in a delayed indication of the real-time values in contrast to the pressure waveform or the flow waveform.

If an apnea occurs, the display for **etCO₂** is replaced by the message **apnea CO₂**. The apnea time [min:sec] is displayed instead of the measured value.

Calibration

The patient-gas measurement module is automatically calibrated every time the device is started and then regularly with ambient air, as long as the device is switched on (see "Technical Data", page 254).

During calibration, messages informing the user about the calibration appear on the screen, and the measurement values are replaced with the word **CAL**.

MAC definition

1 MAC (Minimum Alveolar Concentration) is the anesthetic gas concentration in the blood at 1013 hPa, at which 50 % of patients no longer respond to a skin incision with movement.

The integrated MAC algorithm is based on the MAC values as indicated on the list. These values are merely guideline values. It is the information on the slip accompanying the anesthetic agents which is binding.

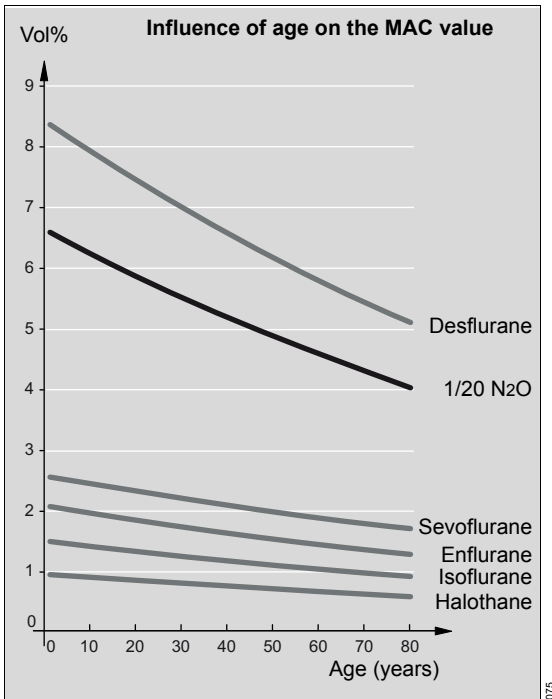
1 MAC corresponds to: (in 100 % O ₂)	
Halothane	0.77 Vol%
Enflurane	1.7 Vol%
Isoflurane	1.15 Vol%
Desflurane	6.0 Vol%
Sevoflurane	2.10 Vol%
N ₂ O	105 Vol%

The MAC values are dependent on the age of the patient. The values indicated in the table relate to an age of 40 years.

Age-dependent MAC values

The MAC values used in Primus are corrected for age. Therefore make sure the patient's age is entered correctly. Calculation follows the equation from W.W. Mapleson (British Journal of Anaesthesia 1996, P. 179-185). The equation applies to patients older than 1 year of age.

$$\text{MAC}_{\text{age-corrected}} = \text{MAC}^* \times 10^{(-0.00269 \times (\text{age} - 40))}$$



Primus automatically adjusts the MAC calculation according to the ambient pressure.

NOTE

The age "1" is used when the age is set to "<1". Special attention is required for patients younger than one year.

* 40 years

xMAC display (MAC multiple)

The MAC value is a simple navigation aid for anesthetic agent metering.

Primus indicates the MAC multiple (xMAC), which is determined from the present expiratory measurements and the age-dependent MAC values. In the case of gas mixtures, the respective multiples for nitrous oxide and the anesthetic agents are added in accordance with the following equation.

$$\text{xMAC} = \frac{\text{exp. conc. agent1}}{\text{MAC}_{\text{age-corrected agent1}}} + \frac{\text{exp. conc. agent2}}{\text{MAC}_{\text{age-corrected agent2}}} + \frac{\text{exp. conc. N}_2\text{O}}{\text{MAC}_{\text{age-corrected N}_2\text{O}}}$$

For example

exp. Sev. = 1.5 Vol%; exp. N₂O = 60 %;
age = 10 years

MAC_{age-corrected} of Sev.: MAC* = 2.2 Vol%

MAC_{age-corrected} of N₂O: MAC* = 125 Vol%

xMAC = 0.7 + 0.5 = 1.2

The influence of other medication (opiates or intravenous hypnotics) is not taken into account when calculating MAC values.

Mixture detection

Primus automatically detects the anesthetic gas used and switches the measurement and monitoring of anesthetic gas concentration to the gas detected.

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

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

A mixture of more than two volatile anesthetic agents cannot be reliably detected. The anesthetic gas values are no longer displayed and an alarm is generated.

NOTE

A mixture of more than two agents may lead to a temporary failure of the measured O₂ value.

WARNING

Risk of patient injury

If the anesthetic agent displayed does not match the label of the anesthetic vaporizer being applied (open), make sure the vaporizer is filled correctly.

* 10 years

Automatic agent alarm activation

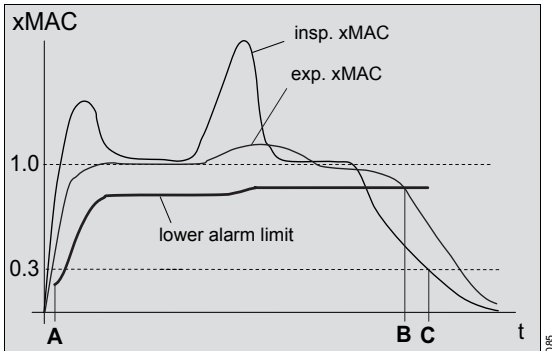
The lower alarm limit of an anesthetic agent is intended to help the user prevent patient awareness during a procedure. Examples of problems which, if ignored or unnoticed, could lead to patient awareness include leaks in the breathing circuit, an incorrectly fitted vaporizer or an insufficient anesthetic gas supply to a vaporizer.

The alarm limits for the anesthetic agents have to be activated manually and are often not used for that reason. Primus provides an alarm management system for the xMAC level which is automatically activated when the expiratory xMAC reaches about 0.3.

The concentration of anesthetic agents and the resulting xMAC value indicate the state of anesthesia. A constant xMAC represents a steady anesthesia and an accurate system performance. A decreasing xMAC indicates that the anesthesia depth is becoming shallower and the patient might awaken.

The alarm management system is deactivated when the inspiratory xMAC value is below 0.3 (C) and the user confirms the alarm message by pushing the rotary knob.

The Automatic Agent Alarm Activation can be configured in the default configuration in **Standby**.



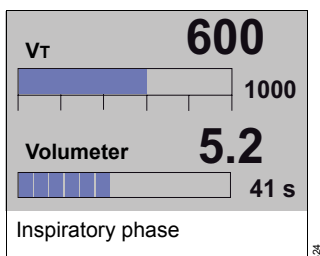
After activation (A), the lower alarm limit automatically adapts to the level of anesthesia supplied. It adapts to increasing concentrations but not to decreasing concentrations. Primus generates an alarm when the expiratory xMAC value falls below the alarm limit (B).

Using the volumeter function

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

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.

Upper bar graph

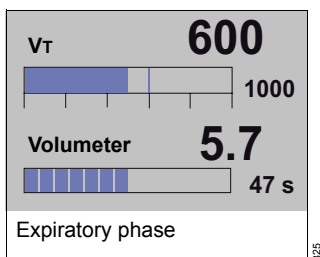


Displays the current inspiratory and expiratory tidal volume V_T , with an additional numerical indication of the expiratory tidal volume.

The bar graph follows the inspiratory and expiratory tidal volume V_T . 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

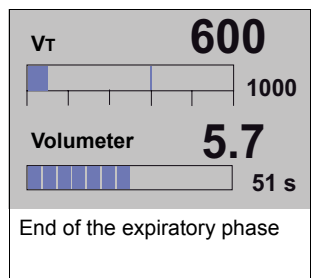


Volumeter (minute volume measurement).

Numerical indication of the expiratory minute volume.

The scales of the bar graphs can be configured during operation and in **Standby**, see page 164.

Starting the volumeter

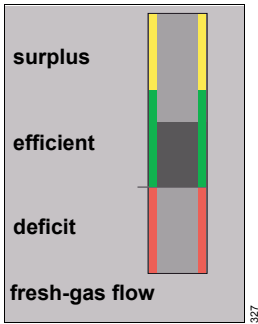


- Push the rotary knob.

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 4 minutes and then deleted.

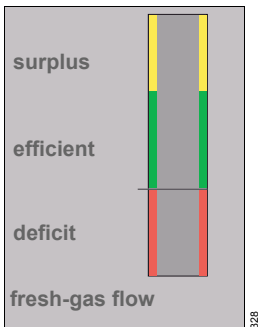
Econometer (optional)



The bar graph indicates the qualitative utilization of the **fresh-gas flow**. If the fresh-gas delivery is more than 1 L/min above the gas consumption, the econometer will indicate **surplus**. Below this level, utilization of the fresh gas is considered **efficient**. If less fresh gas is delivered than is needed by the patient, a fresh-gas **deficit** is indicated by the red area in the bar graph and a fresh gas alarm is generated.

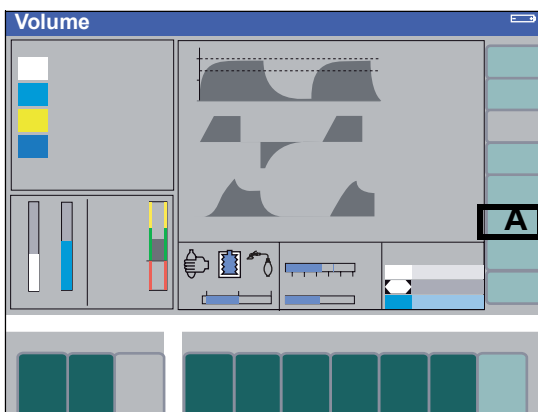
Gas consumption depends on:

- the patient's uptake,
- leakage, and
- the CO₂ volume absorbed.

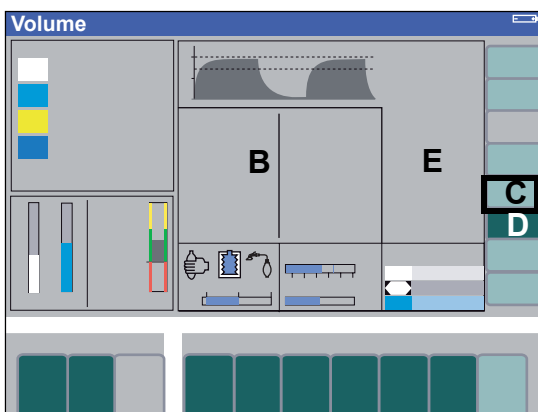


If data for calculation are not available, the legend appears in gray and the bar graph is not active.

Loops (optional)



- Press the soft key **loops** (A) on the standard screen:



The label of the soft key changes to **exit loops** and the **PAW-V** and **V-Flow** loops are displayed with a value table (E) instead of the two lower curves (B). Each loop remains on display for three breathing cycles; the color 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.

In addition to the factory setting for the axis orientation complying with ISO 80601-2-13, inverted display is also available. To change the display setting, contact service personnel.

See page 164 with regard to configuration of the scales.

- Press the soft key (C) **save reference**.

The current loop is displayed in a different color so that it can be used as reference. For the reference loop, the corresponding values of **PEAK**, **VT**, and **CPAT** are saved in the value table and a time stamp is added. The label of the soft key changes to **delete reference**.

The values in the value table are updated with every new breath. These values can be compared with the values of the reference loop.

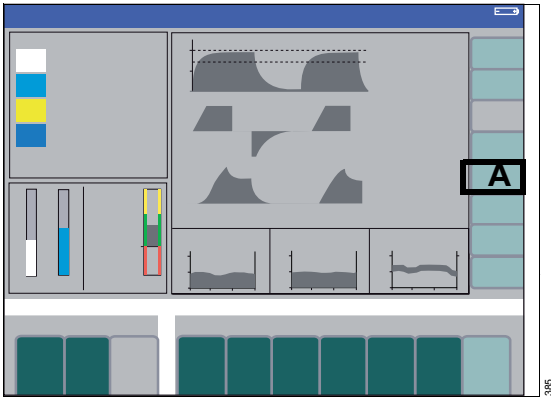
Delete the reference loop, including the attached values in the value table:

- when changing to **Standby** mode or
- by pressing the soft key (C) **delete reference** again.

Remove loops from the screen:

- Press the soft key **exit loops** (D).

Mini trends (optional)



There are 3 different mini trends available that can be displayed below the waveform area:

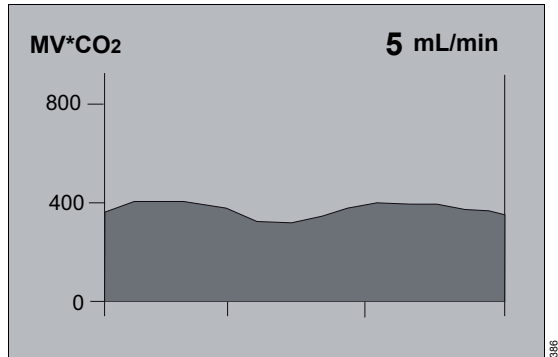
- $MV \cdot CO_2$
- O_2 uptake
- CPAT/PEEP

To configure a mini trend:

- Press the soft key **screen layout** (A).

Select a parameter module and select the corresponding mini trend.

Mini trend for $MV \cdot CO_2$



This mini trend displays the expiratory minute volume in combination with expiratory CO_2 concentration over 15 minutes.

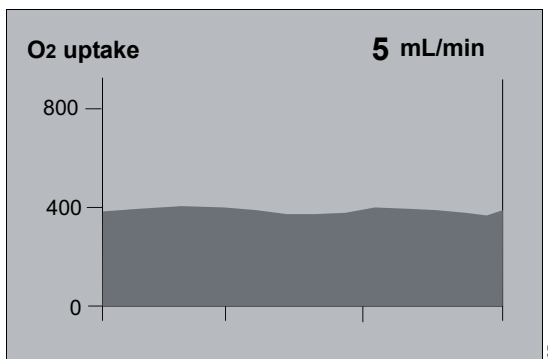
The current value of $MV \cdot CO_2$ is displayed as numeric value above the mini trend.

The parameter $MV \cdot CO_2$ indicates the CO_2 volume that is expired by the patient.

The scaling depends on the expiratory tidal volume VT and is automatically adjusted.

V_T mL	$MV \cdot CO_2$
50	50
150	150
500	500
1000	1000

Mini trend for O₂ uptake

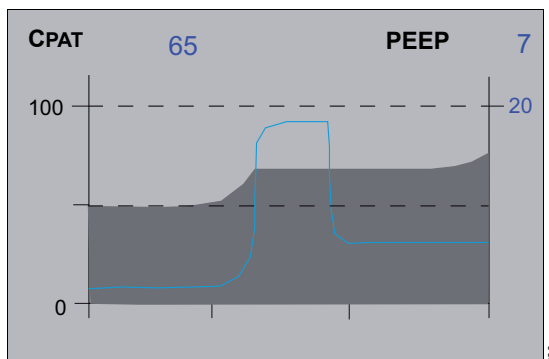


This mini trend displays the difference between the inspiratory and the expiratory oxygen concentration over 15 minutes.

The scaling depends on the expiratory tidal volume **VT** and is automatically adjusted.

VT mL	O ₂ uptake
50	50
150	150
500	500
1000	1000

Mini trend for CPAT/PEEP



This mini trend displays the parameters **PEEP** and **CPAT** over 15 minutes.


PEEP is displayed as a line, patient compliance **CPAT** as filled curve.

The scaling for **PEEP** is set to 20 mbar.

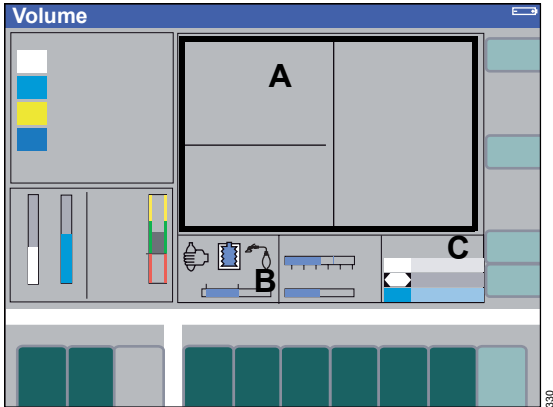
The scaling for **CPAT** depends on the expiratory tidal volume **VT** and is automatically adjusted.

VT mL	CPAT
50	10
150	50
500	100
1000	100

Selecting the data screen

- Press the  key repeatedly until the data screen appears.

Display (example):



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

System compliance **Csys** and leakage **Leaksys** are displayed with other parameters in the middle left-hand field, together with the time of the last leak test.

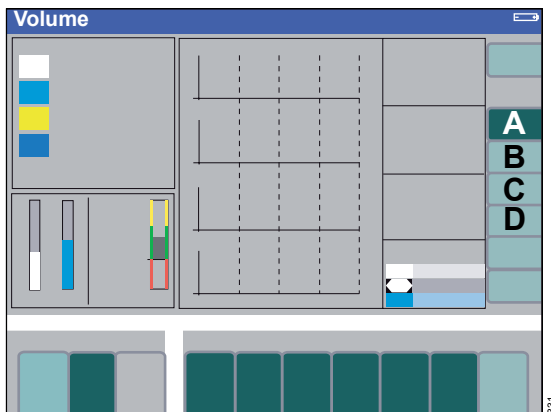
The bar graph at the bottom of the screen shows the current ventilation pressure **PAW** (B).

The bottom right-hand field (C) shows the pressure values for the central supply of **O₂**, **N₂O**, and **Air** as well as for the **O₂** and **N₂O** backup gas cylinders.

Selecting the trend screen

Displays the measured values over an interval beginning with the start of the measurement.

Maximum storage time: 8 hours.




The following display combinations can be selected:

A agents

B *MV / CPAT / CO₂ / O₂*

C *Recruitment* (optional)
CPAT/PEEP trend / *MV*CO₂* trend /
O₂ Uptake trend

D *SpO₂ Pulse* (optional)

- Press the  key repeatedly until the trend screen is displayed. The trend page **agents** (A) is displayed first.

Selecting other display combinations

- Press the required soft key:
 - ***MV / CPAT / CO₂ / O₂*** (B),
 - ***Recruitment*** (C)
or
 - ***SpO₂ Pulse*** (D)

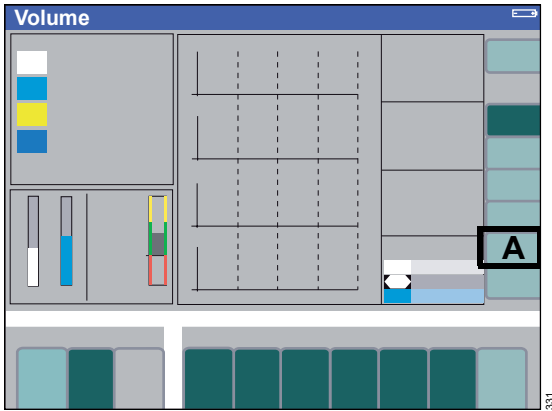
The soft key ***SpO₂ pulse*** does not appear if the SpO₂ measuring function is not available.

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

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

The trends for agents, N₂O and O₂ are displayed with the relevant color coding.

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:

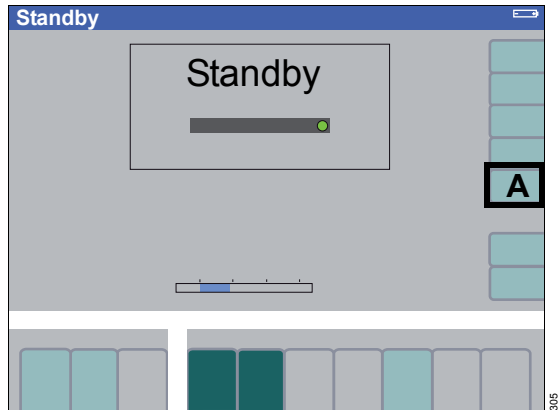
- Press the soft key **total trend** (A). The complete trend is displayed on the screen again.

This soft key is ineffective if there is insufficient trend data available (e.g., less than 30 minutes of operation).

Deleting the trend memory

Deleting is only possible in **Standby**.

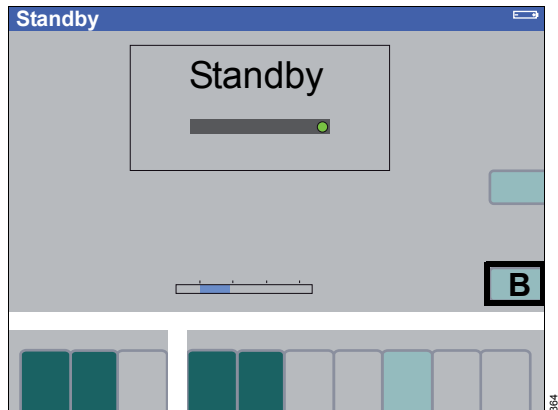
Graphic trend, mini trends (optional) and logbook are deleted simultaneously!



In the **Standby** mode:

- Press the soft key **delete trend** (A).

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



To delete:

- Press the soft key **delete** (B).

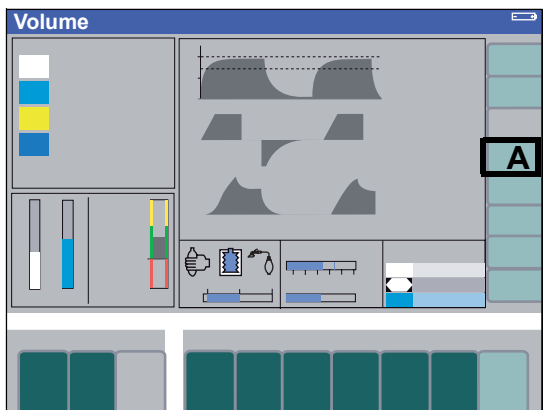
Selecting the logbook

For recording ventilation modes, measured values and primary anesthetic agent to facilitate compilation of the anesthetic record.

Primus automatically records events such as performed or canceled self tests, changes of agent, and changes of ventilation mode (followed by the date). At the end of each case, the case duration, the use of each fresh gas, patient uptake, and total use of anesthetic agent are recorded.

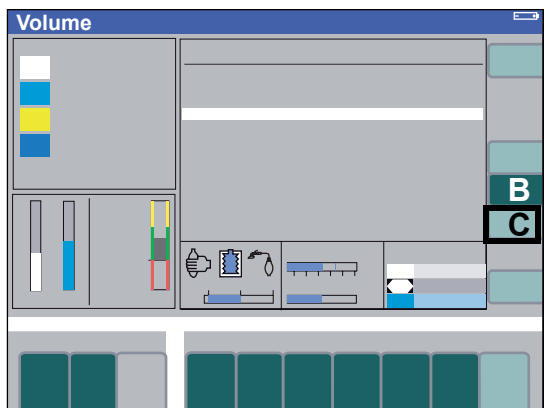
The trigger criteria for entries can be configured, see "Interfaces/logbook" on page 165 and "The menu logbook entries (E) contains the following submenus:" on page 176.

The logbook can be accessed during operation as well as in **Standby**. It consists of two pages: **page 1** lists standard patient parameters; **page 2** lists more standard parameters as well as optional parameters, such as SpO₂ and pulse.



- Press the soft key **logbook** (A).

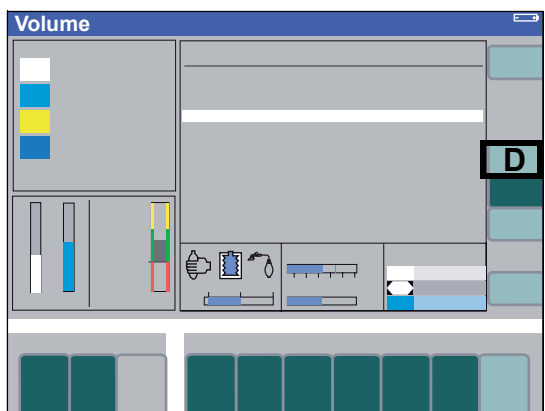
page 1 of the logbook is displayed (B).



To view the second page:


- Press the soft key **page 2** (C).

To return to the standard screen:



- Press the soft key **exit logbook** (D).

or

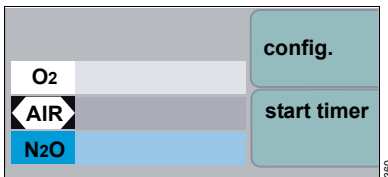
- Press the  key.

To delete the logbook

Logbook and trend memory are deleted simultaneously!

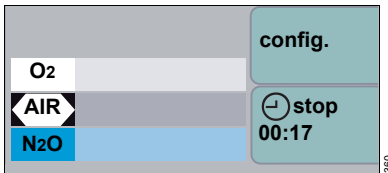
The logbook will be maintained even after switching off the Primus completely. It can only be deleted by using the **delete trend** functionality in **Standby**, see page 154.

Using the timer function



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

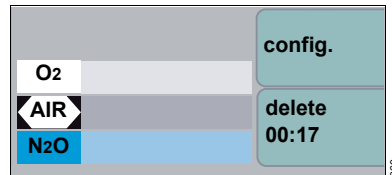
- Press the soft key **start timer** in any operating mode.



To stop the timer:

- Press the soft key **stop**.

The measured time is displayed.

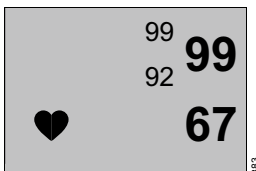


To reset the timer to "00:00":

- Press the soft key **reset**.

SpO2 measurement (optional)

The SpO2 module displays the SpO2 value as well as the corresponding upper and lower alarm limits and the pulse rate.



Selecting a sensor

Only OxiMax sensors or Durasensors from Nellcor must be used (see separate list of accessories).

The OxiMax modules implemented in Primus are only compatible with the 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.

- 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

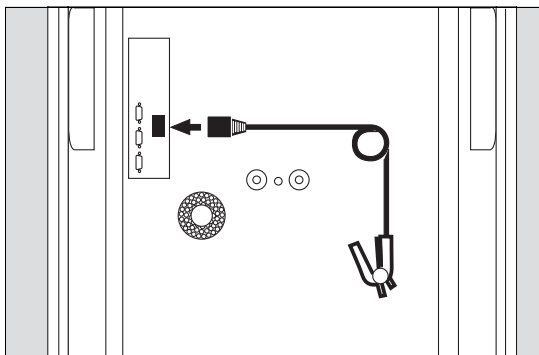
The following table provides a guideline for selecting a specific sensor. The table indicates all available sensors and their characteristic values.

Sensor type	OxiMax MAX N	OxiMax MAX I	OxiMax MAX P	Dura-sensor DS-100 A	OxiMax MAX A	OxiMax MAX R	OxiMax MAX FAST
Age group	Neonates/ Adults	Infants	Children	Adults			
Weight of the patient	<3 to >40 kg (<6.6 to >88 lbs)	1 to 20 kg (2.2 to 44 lbs)	10 to 50 kg (22 to 110 lbs)	>40 kg (>88 lbs)	>30 kg (>66 lbs)	>50 kg (>110 lbs)	>40 kg (>88 lbs)
Duration of use	Short and long-term monitoring			Short-term monitoring	Short and long-term monitoring		
Mobility of the patient	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			Nose	Forehead

- Select the appropriate sensor.

At the back of the workstation:

- Plug the sensor connector into the socket marked **SpO₂**.



Safety-relevant information

WARNING

Risk of electric shock

If the SpO₂ sensor becomes damaged during use, discontinue use, especially if there are uncovered electrical contacts.

WARNING

Risk of patient injury

Incorrectly positioned sensors may result in incorrect measurements which may lead to patient injury.

Only use Nellcor sensors in the recommended positions.

WARNING

Risk of patient injury

High intrathoracic pressure, Valsalva maneuvers, and other consecutive impairments of the venous flow can lead to venous pulsation. The pulse signal might fail.

Do not position the SpO₂ sensor where it might be affected in this way.

WARNING

Risk of patient injury

If the SpO₂ sensor is used in the presence of significant concentrations of dyshemoglobins, such as carboxyhemoglobin or methemoglobin, measurement accuracy may be reduced.

Do not rely on measurement data if the SpO₂ sensor is used under these conditions.

WARNING

Risk of patient injury

If the SpO₂ sensor is used in the presence of intravascular dyes such as e.g., methylene blue, measurement accuracy may be inaccurate.

Do not rely on measurement data if the SpO₂ sensor is used under these conditions.

CAUTION

Risk of misleading data

Immersing the SpO₂ sensor in liquid may lead to a malfunction and thus misleading data.

Do not immerse the SpO₂ sensor in liquid.

CAUTION

Risk of failure or inaccurate data

If positioned close to a bright light source, the pulse signal may fail or the results may be inaccurate.

The sensor must be protected from exposure to bright light (e.g., surgical lamps and direct sunlight).

CAUTION

Risk of failure or inaccurate data

If the sensor is positioned on limbs together with an arterial catheter, blood pressure cuff, or intravascular venous infusion, the pulse signal may fail and measurements may be inaccurate.

Do not position the SpO₂ sensor where it might be affected in this way.

CAUTION

Risk of failure or inaccurate data

Electrocautery can influence the measuring accuracy.

Leads and the SpO₂ sensor should be positioned as far away from the electrocautery and its neutral electrode as possible.

CAUTION

Risk of inaccurate data

Sensor performance may be impaired and lead to inaccurate results if the patient moves violently.

The sensor should be positioned at a quiet/stable site in order to reduce the risk of artifacts due to movement.

NOTE

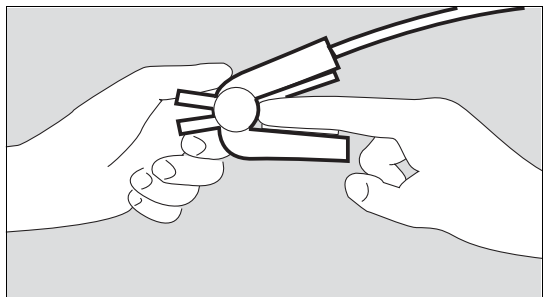
The displayed plethysmogram is a relative indicator of the pulse amplitude. Its scale is not absolute and it should only be used to judge the quality of the SpO₂ measurement.

- The adhesive strips must not be stretched unduly.
- Never use two adhesive straps as this can lead to venous pulsation. The pulse signal might fail.
- In the presence of shock, low blood pressure, severe vasoconstriction, major anemia, hypothermia, arterial occlusion proximal to the sensor and asystolia, the pulse signal may fail.

Applying the Durasensor DS-100 A

Reusable sensor for short-term monitoring of relatively quiet patients weighing over 40 kg (88 lbs).

The sensor is ideally positioned on the index finger, although any of the other fingers may be used, if required. 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.
- Make sure 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!

Test Considerations and Oximeter Accuracy

Functional Testers and Patient Simulators

For functional testing of the pulse oximeter sensors and cables with a functional tester or patient simulator follow the individual testing device's operator's manual, especially regarding the suitability and accuracy of the simulated values.

CAUTION

Risk of inaccurate data

If simulators are used as calibrators, the SpO₂ module may produce incorrect data.

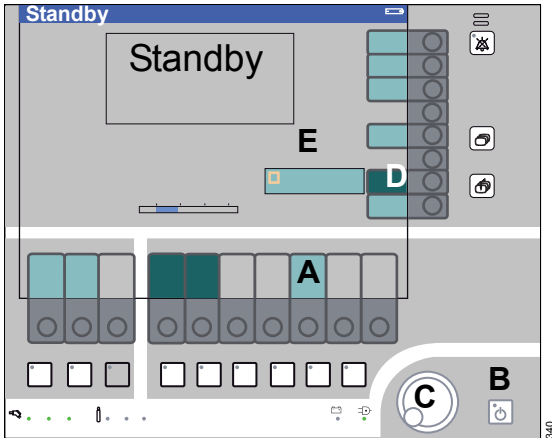
Simulators must not be used as a calibrator.

Configuration

Configuring the default settings	162
Basic settings and audible signals	163
Parameters	164
Interfaces/logbook	165
Screen layout	166
Setting alarm limits	167
Ventilator and gas delivery	170
System information	173
Remote Service	173
Configuration during operation	175
Screen layout	177
Setting the patient's age and weight during operation	178

Configuring the default settings


Default settings describe the settings which the workstation starts with when it is switched on.



The default settings for ventilation, fresh-gas delivery, and monitoring can be activated while in **Standby** by pressing the soft key **restore default settings** (A).

Changes in default settings become active immediately.

The default settings can be configured in **Standby** as follows:

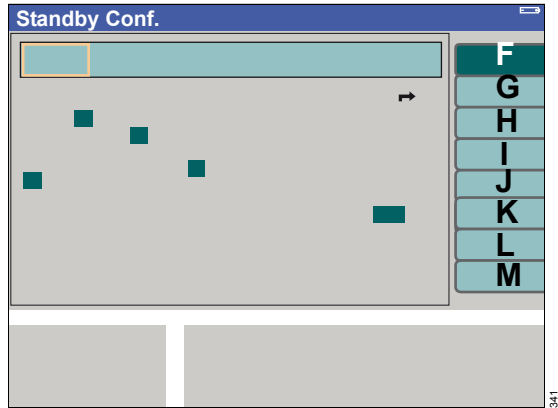
- 1 Press Standby key  (B) and confirm by pushing the rotary knob (C).
- 2 Press the soft key **default config.** (D).

The operator is requested to enter a four-digit password in order to prevent unauthorized changes to the basic functions. This password is allocated when commissioning the workstation.

If desired, the function can be disabled by DrägerService or a new password set.

- 3 Select and confirm the figures successively from the line displayed (E) via the rotary knob. The password is represented by asterisks (* * * *) below the line of numbers.

The menu **Standby Conf.** for selecting the default values is displayed when the password has been entered correctly.





The default values are adopted automatically when the menu is displayed.

Default settings are selected in the same way as described in the operating concept, see page 35.

The following settings can be selected via the vertical soft keys:

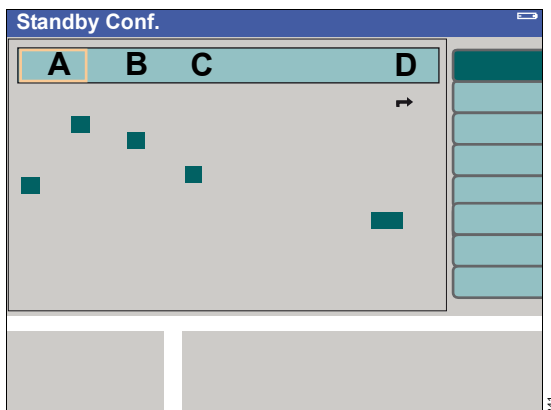
- **basic settings audible signals** (F)
- **parameters** (G)
- **interfaces/logbook** (H)
- **screen layout** (I)
- **alarm limits** (J)
- **ventilator and gas delivery** (K)
- **system information** (L)

Exiting the Standby configuration:

- Press soft key **exit** (M) or hard key  or .

Basic settings and audible signals

The menu **basic settings audible signals** contains the following submenus:



A Alarm volume

The minimum alarm volume can be set to a value between 1 to 9. The standard alarm volume cannot be set below this limit.

Alarm volume	Factory setting
Minimum: 1 to 9	4
Standard: 1 to 9	5

The standard volume cannot be set lower than the minimum volume.

CAUTION

Risk of use error

If using features like the 'breathing sound' or when operating under loud ambient conditions, the auditory alarm signals may not be heard.

Always set the volume of the alarm signal sufficiently high.

The **NO O₂ SUPPLY** alarm is always announced at the maximum volume.

Primus takes into account the national regulations of certain countries which require a minimum volume of 45 dB (A). For these countries Primus is shipped with factory settings in which the alarm volume cannot be set to values between 1 to 3.

However, the minimum alarm volume can be set to values between 1 to 3 by service personnel, if required.

B breathing sound (optional)*

0 = off
to
9 = maximum volume
Factory setting 0

The breathing sound is generated by a breathing sound module. This module converts the measured inspiratory and expiratory flow values into audible sounds similar to the sound of breathing.

The volume depends on the set patient age. This dependency allows optimal volume at all flow levels.

All alarms are still audible with the breathing sound volume set to the maximum.

C pulse volume (optional)

0 = off
to
9 = maximum volume
Factory setting: 3

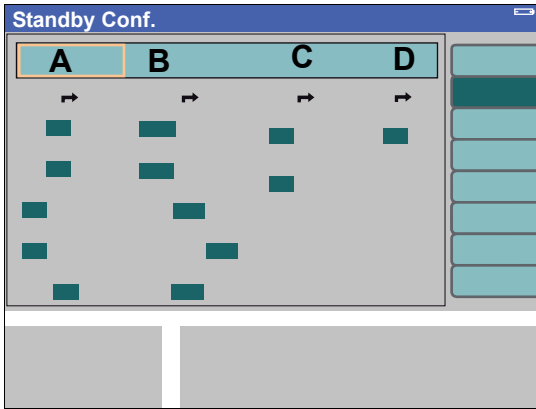
D date/time/language

- **date/time**
month, year
hours: minutes
- **time format**
Factory setting: 24 h
- **language**
of the display texts
Factory setting: English (GB)

* Only in connection with breathing sound module.

Parameters

The menu **parameters** contains the following sub-menus:



A scaling amplitude

Waveform parameters	Factory setting
CO₂: 50, 100 mmHg, auto	auto
PAW: 25, 50, 75 hPa, auto	auto
Flow: 15, 30, 60, 120 L per minute	auto
Tidal volume: 50, 150, 500, 1000 mL, auto	auto
O₂: 100 %, auto	auto

The setting is made automatically or by selecting a pre-set scale.

Tidal volume

auto: A suitable scaling is selected automatically in accordance with the set age.

- 0 to 2 years: 150 mL,
- >2 to 10 years: 500 mL,
- >10 years: 1000 mL.

O₂

auto: Automatic adjustment to the next higher or lower scale after two passes if the scaling frame is exceeded.

B units

Units	Factory setting
CO₂: mmHg, Vol%, kPa	mmHg
PAW: hPa, mbar, cmH ₂ O	hPa
supply pressure: kPa, MPa, bar, psi	kPa
agents: Vol%, kPa	Vol%
weight: kg, lbs	kg

C Gas measurement

Parameter	Factory setting
MAC display: yes/no	yes
Related to age: yes/no	yes

See page 143 for a detailed description of the MAC definition and calculation.

cal. 100 % O₂

(not available with paramagnetic O₂ measurement)

A 100 Vol% O₂ calibration can be performed in order to improve the accuracy when measuring high O₂ concentrations. A separate O₂ source must be used for this purpose, e.g., O₂ from an O₂ flowmeter. Unscrew the sample line from the Y-piece and position it in the continuous flow from the O₂ source.

When calibration has been completed successfully, this item will be highlighted by a green light. Calibration can be repeated or aborted if unsuccessful. A 21 Vol% O₂ calibration is performed automatically if the calibration is aborted.

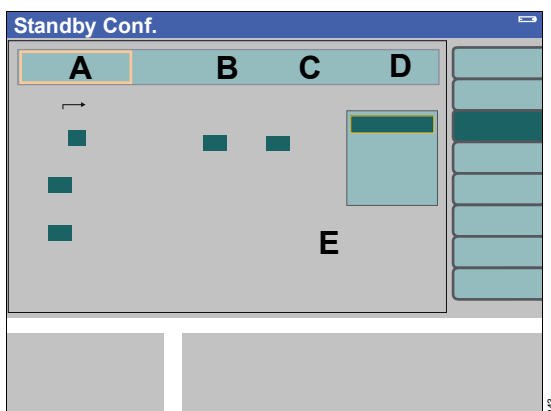
D Optional parameters

Parameter	Factory setting
SpO₂ : yes/no	Automatic setting Option available: yes Option not available: no

For a detailed description of SpO₂ monitoring, see page 156.

Interfaces/logbook

The menu **interfaces logbook** contains the following submenus:



A logbook entries triggered by

Triggered by	Factory setting
time interval (min): 1, 2, 5, 10 min Entries are made after a fixed time interval in minutes.	5 min
warning alarms : yes/no Entries are made when a warning is issued.	yes
caution alarms : yes/no Entries are made when a caution message is issued.	yes

B COM 1 MEDIBUS

1.2, 9.6 kBaud
Factory setting 9.6 kBaud

C COM 2 MEDIBUS

1.2, 9.6 kBaud
Factory setting 1.2 kBaud

– baud rate(k)

Data transmission rate (variable, see instructions for use for the equipment to be connected).

D Select MEDIBUS

Select the MEDIBUS communication protocol:
– MEDIBUS V4
– MEDIBUS.X.

Factory setting: MEDIBUS V4

For detailed information on MEDIBUS.X and MEDIBUS V4, refer to the specific instructions for use (9037426 and 9052608).

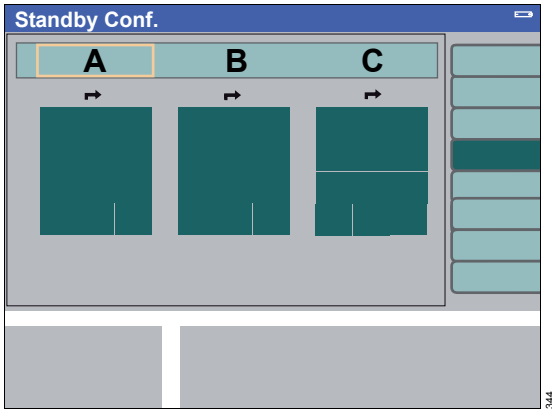
The interfaces can be adapted in line with the equipment to be connected.

E MEDIBUS default configuration: parity, data bits, stop bits

These values cannot be configured; this is information only.

Screen layout

The menu **screen layout** contains three default layouts of the home screen:



A layout 1

B layout 2

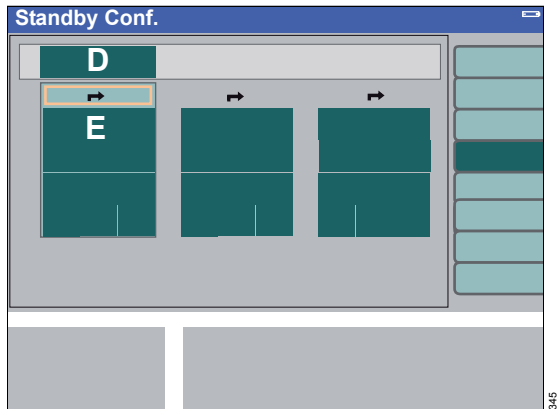
C layout 3

The layouts comprising the following elements can be freely configured:

- Three curves with the associated numerical modules.
The available curves are displayed when a curve module is selected.
- Three modules which may be assigned parameter or status displays.
The available modules are displayed when a module is selected.

Each curve/module can also be configured as being blank.

Each curve/module can only be displayed once. If a curve/module is selected twice, the preceding selection automatically becomes “blank”.



- 1 Select and confirm a layout (D) via the rotary knob.
- 2 Select a module (E) via the rotary knob. Change and confirm the selection via the rotary knob.

Factory settings for layout

layout 1			layout 2			layout 3		
CO2			CO2			CO2		
flow / MV			O2			agent		
PAW			PAW			PAW		
vent.	VT Vol	sup- ply	vent.	VT Vol	MV	vent.	VT Vol	MV

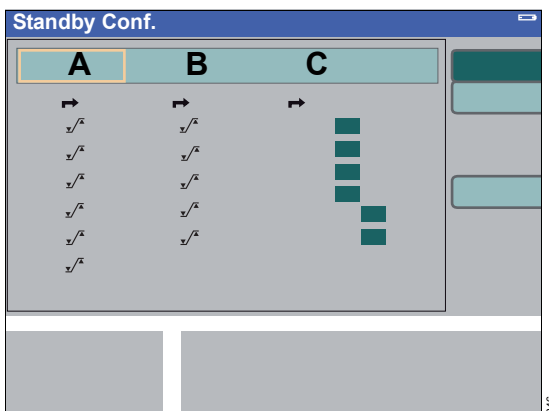
CAUTION

Risk of inadequate monitoring

Certain monitoring options are mandatory depending on the applicable national requirements. Some monitoring options may not be covered by certain screen layout configurations.

Always take national standards into account when configuring the screen layout.

Setting alarm limits



The following limits may be configured in the menu **alarm limits > alarm limits**:

A default alarm limits

Alarm		Setting ranges	Factory setting
SpO₂ [%]	<input checked="" type="checkbox"/>	81 to 99; -- ¹⁾	--
	<input checked="" type="checkbox"/>	80 to 98	92
Pulse [1/min]	<input checked="" type="checkbox"/>	21 to 250	120
	<input checked="" type="checkbox"/>	20 to 249	50
inO₂ [Vol%]	<input checked="" type="checkbox"/>	19 to 99; --	--
	<input checked="" type="checkbox"/>	18 to 98	20
etCO₂ [mmHg]	<input checked="" type="checkbox"/>	1 to 75	50
	<input checked="" type="checkbox"/>	0 to 74	--
inCO₂ [mmHg]	<input checked="" type="checkbox"/>	1 to 10	5
MV [L/min]	<input checked="" type="checkbox"/>	0.1 to 20.0	12.0
	<input checked="" type="checkbox"/>	0 to 19.9	3.0

Alarm		Setting ranges	Factory setting
PAW [hPa (cmH ₂ O)]	<input checked="" type="checkbox"/>	5 to 99	40
	<input checked="" type="checkbox"/>	0 to 35	8

1) --: The corresponding alarm limit is disabled.

B Default limits, anesthetic agents

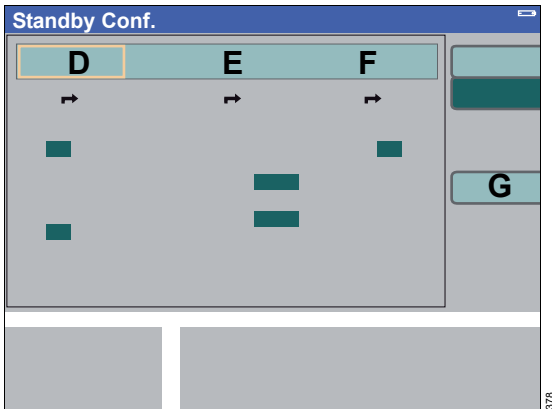
Alarm		Setting ranges	Factory setting
inHal [Vol%]	<input checked="" type="checkbox"/>	0.1 to 8.4	1.5
	<input checked="" type="checkbox"/>	0 to 8.3	-- ¹⁾
inIso [Vol%]	<input checked="" type="checkbox"/>	0.1 to 8.4	2.3
	<input checked="" type="checkbox"/>	0 to 8.3	--
inEnf [Vol%]	<input checked="" type="checkbox"/>	0.1 to 9.9	3.4
	<input checked="" type="checkbox"/>	0 to 9.8	--
inSev [Vol%]	<input checked="" type="checkbox"/>	0 to 9.9	4.2
	<input checked="" type="checkbox"/>	0 to 9.8	--
inDes [Vol%]	<input checked="" type="checkbox"/>	0.1 to 21.9	12.0
	<input checked="" type="checkbox"/>	0 to 21.8	--

1) --: The corresponding alarm limit is disabled.

C alarms in Man.Spont.

Alarm	Factory setting
inO₂ high : yes/no	no
MV : yes/no	yes
inAgent low : yes/no	no
etCO₂ : yes/no	no
inCO₂ : yes/no	no
CO₂ apnea alarm cascade : yes/no	yes

Alarms issued when switching to **Man.Spont.** can be activated or deactivated in **Standby**. When the alarm limits are set to **yes**, the value set in the automatic ventilation mode is adopted. For further information, see "Remedying faults" on page 179.



The following limits may be configured in the menu **alarm limits > misc. alarm settings**:

D therapy related

Therapy-related alarm limits	Factory setting
MAC low alarm enabled? : yes/no	yes
alarm limits (MV, Pulse) pre-sets related to patient weight and age? : yes/no	yes
MV alarms in HLM? : yes/no	yes

If set to **yes**, MV alarms and flow apnea monitoring are activated in HLM mode.
 If set to **no**, MV alarms and flow apnea monitoring are deactivated in HLM mode.

CAUTION
 Risk of insufficient monitoring
 If the setting MV alarms in HLM? is set to no, MV alarms and flow apnea monitoring are deactivated.
 Special attention is required.

E device related

Device-related alarm limits	Factory setting
O2 cylinder low alarm active at: --¹⁾ ; 10 to 31 Determine the pressure at which the warning O2 CYLIND. LOW is to be issued. This menu item only appears if the O2 cylinder has been configured as gas supply, see page 170.	30 kPax100
Soda lime time limit: 1 to 60 days; -- Determine the interval for the period of use of the soda lime. As soon as the interval has expired the advisory message SODA LIME DEPLETED? will be issued.	7 days

1) --: The function is disabled.

F other

Therapy-related alarm limits	Factory setting
open limit menu if alarms occur? : yes/no Determine whether or not the alarm limits menu should appear automatically when an alarm limit is violated.	yes
apnea ventilation low priority only? : yes/no If set to "no", this enables a cascade for the alarm APNEA VENTILATION , see page 191.	no
immediate alarm upon apnea? (patients <6 years) : yes/no Further information, see page 169.	no

***immediate alarm upon apnea?
(patients <6 years)***

If set to **yes**, the following alarms will be raised immediately and as high-priority alarms for patients <6 years:

- **APNEA PRESSURE**
- **APNEA FLOW**

In this case, the flow apnea alarm cannot be configured to be a low-priority alarm (see page 176).

If set to **no**, these alarms will be raised with normal alarm cascade behavior.

- Press **exit** (G), to exit the menu.

Apnea alarm times

Apnea pressure	after 20 seconds
Apnea flow	after 20 seconds
Apnea CO ₂	after 20 seconds (after 65 seconds in Man.Spont. , Monitoring , and Ext. Outlet)

Apnea alarms times of 20 seconds are increased to 35 seconds in 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**.

Further information on setting alarm limits

NOTE

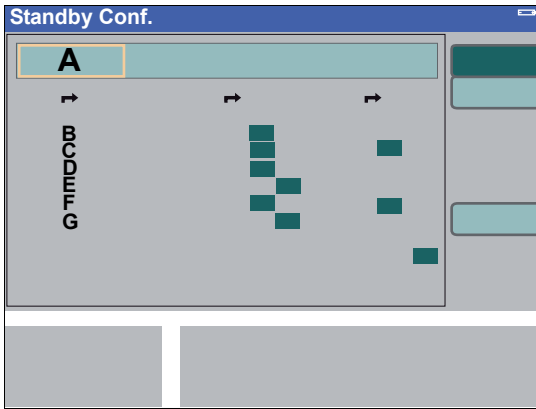
The new default alarm limits are effective whenever the workstation is switched on and after selecting **restore default settings** in **Standby**.

Certain alarms are disabled automatically in **Man.Spont.**, **Monitoring**, and **Ext. Outlet**, see table on page 128.

Ventilator and gas delivery

The following parameters can be set in the menu **ventilator and gas delivery > ventilator and gas delivery**:

A parameter default values



- **Volume Mode** (B)
- **Volume AF Mode** (C)
- **Pressure Mode** (D)
- **Pressure Support** (E)
- **Patient attributes** (F)

- Select mode via rotary knob and confirm. Soft keys for ventilation parameters appear. Set ventilation parameters, see page 38.

The factory settings for ventilation parameters can be found in "Operation".

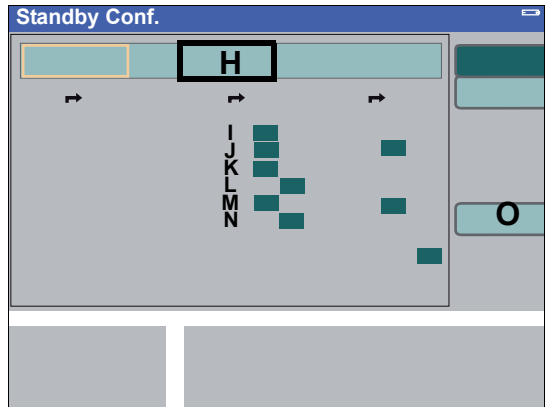
The trigger sensitivity can be set separately in the available ventilation modes.

If the trigger has been pre-set to **OFF** in **Volume Mode**, **Volume AF Mode** or **Pressure Mode**, the value configured under pressure support will automatically be adopted when synchronization is activated during operation. The same also applies with regard to adopting the value for ΔPPS although this cannot be configured in the **Volume Mode**, **Volume AF Mode** and **Pressure Mode**.

- **Gas delivery** (G)
 - Select and confirm via the rotary knob. The soft keys for **O₂** and **Flow** appear. The carrier gas is selected via the **Air** or **N₂O** keys and confirmed via the rotary knob.

H gas supply checks

Which gas supplies have been connected can be determined in this menu:



	Connected gas supplies	Factory setting
I	O₂ line : yes/no	yes
J	Air line : yes/no	yes
K	N₂O line : yes/no	yes
L	O₂ cylind. : yes/no	yes
M	Air cylind. : yes/no	no
N	N₂O cylind. : yes/no	no

E body weight related ventilator settings

- ***V_T* and *Freq.* presetting related to ideal body weight:** (F) **yes/no**

If the settings for ***V_T*** and ***Freq.*** are to be referred to the patient's body weight, the initial value for ***V_T*** can be selected in accordance with the Radford nomogram.

Factory setting: **yes**

- ***preset configuration:*** (G)

- Select, edit, and confirm the ***V_T*** to be changed via the rotary knob.

The settings for ***V_T*** are interpolated for weights between the four predetermined classes.

weight (<i>ideal BW</i>) [kg]	<i>V_T</i> [mL]		<i>Freq.</i> [1/min]
	Setting ranges	Factory settings	
2	10 to 25	15	35
15	60 to 150	110	26
65	300 to 500	450	13
100	550 to 800	700	10

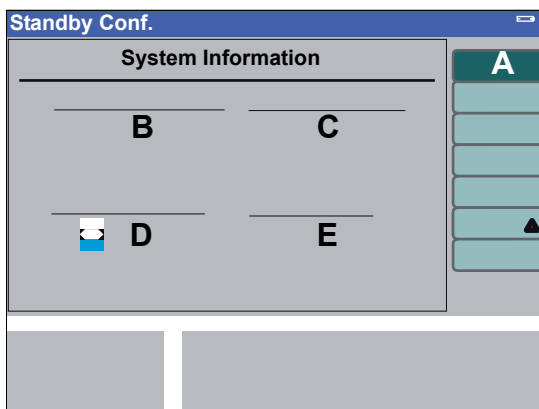
- ***restore factory default presets*** (H).

- Select and confirm to restore the factory settings.

The default settings are activated immediately upon exiting the configuration menu.

- Press **exit** (I), to exit the menu.

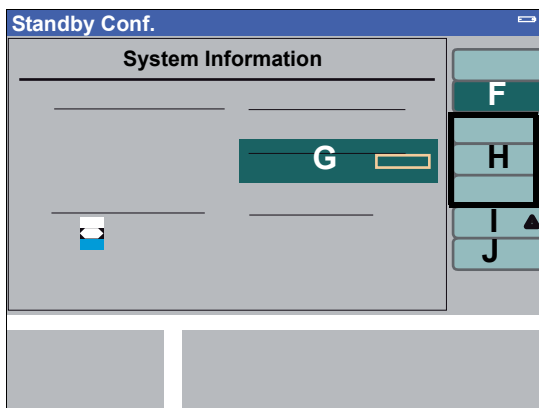
System information



A General information

The system information screens contain information on

- **Software versions** of the individual components (B)
- Enabled **Software Options** (C)
- **Gas Consumption** and sampling rate of the patient gas module (D)
- **Operating Hours** of individual components (E)



F activate option

Software options can be activated by entering a multi-digit code.

Options and the associated activation codes are available from the respective Dräger sales organization.

- Select and confirm the figures successively from the line displayed (G) via the rotary knob. Then activate, select, and confirm the menu item via the rotary knob.

H trace 1, trace 2, trace 3

Description of internal equipment states and parameters.

I remote service

See page 173 for details.

To exit the **System Information** and return to the **Standby Conf.** menu:

- Press **exit** (J), to exit the menu.

Remote Service

An inspection for the technical status of the device can take place by using Remote Service.

WARNING

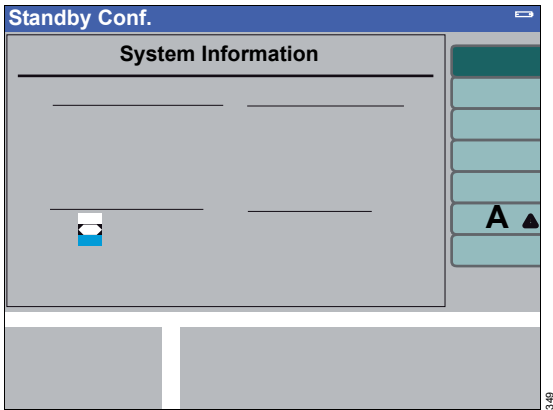
Risk of patient injury

The patient may be injured if connected to the device when the remote service function is active.

Only use the Remote Service Link on medical devices which are not otherwise in use. This is a law according to the MPG.

Before activating the **remote service**

- 1 Perform self test.



- 2 Press the soft key **remote service** Δ (A).

The **remote service** screen is displayed with a prompt advising the operator how to continue:

Please run a self test before connecting the Remote Service Link.

***Connect the Remote Service Link to COM1.
Please refer to the instructions for use of the Remote Service Link.***

Shut down the device after completion.

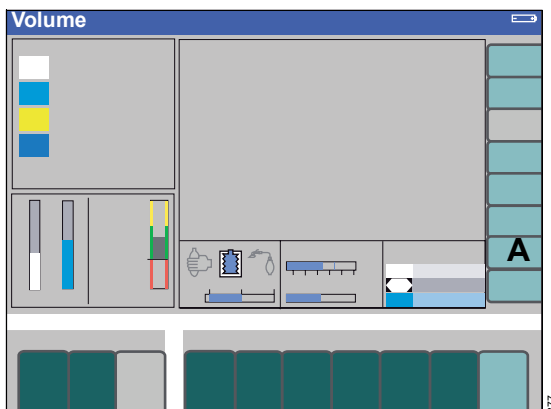
- 3 Connect the Remote Service Link to the COM 1 interface.

The service data of Primus can now be transferred.
For further operation, see instructions for use for the Remote Service Link.

After exiting **remote service**

- 4 Switch off Primus.

Configuration during operation



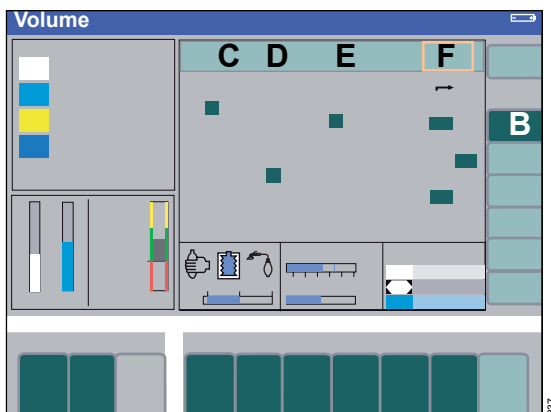
During operation, certain monitoring functions can be selected or changed via configuration menus.

The settings made here remain valid until the workstation is switched off.

On the standard screen or data screen:

- Press the soft key **config.** (A).
The first configuration menu **volumes/ alarms** (B) opens.

The menu **volumes/ alarms** (B) contains the following submenus:



C **alarm volume**

1 = minimum volume
to
9 = maximum volume

CAUTION

Risk of use error

If using features like the 'breathing sound' or when operating under loud ambient conditions, the auditory alarm signals may not be heard.

Always set the volume of the alarm signal sufficiently high.

The **NO O₂ SUPPLY** alarm is always announced at the maximum volume.

Primus takes into account the national regulations of certain countries which require a minimum volume of 45 dB (A). Settings 1 to 3 are not available for these countries. The minimum volume can be adjusted in the default settings.

D **breathing sound** (optional)*

0 = off
to
9 = maximum volume

The breathing sound is generated by a breathing sound module. This module converts the measured inspiratory and expiratory flow values into audible sounds similar to the sound of breathing.

The volume depends on the set patient age. This dependency allows optimal volume at all flow levels.

All alarms are still audible with the breathing sound volume set to the maximum.

E **pulse volume** (optional)

0 = off
to
9 = maximum volume

* Only in connection with breathing sound module.

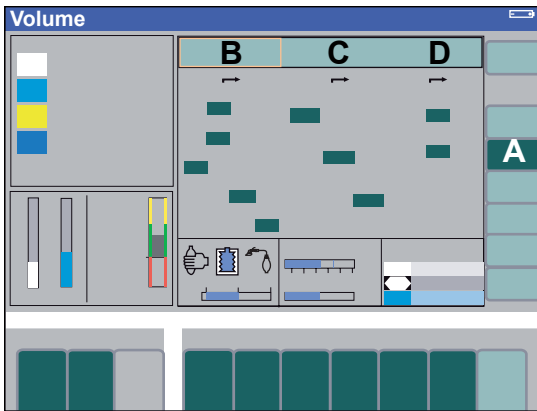
F alarms on/off

CO₂ and SpO₂ alarms (optional) and HLM mode, see page 131, can be enabled and disabled.

The flow apnea alarm can be configured to be a low-priority alarm (technical alarm). This setting remains active until switching to standby and starting a new case.

This configuration is only possible when the setting **immediate alarm upon apnea? (patients <6 years)** is set **no** (see page 168).

The menu **paramet. settings** (A) contains the following submenus:



B Scaling amplitude

- **CO₂, PAW, flow, O₂**
The setting is made automatically or by selecting a pre-set scale.
auto: Automatic adjustment to the next higher or lower scaling after two passes if the scaling frame is exceeded.
- **tidal volume**
auto: A suitable scaling is selected automatically in accordance with the set age.
0 to 2 years: 150 mL,
>2 to 10 years: 500 mL,
>10 years: 1000 mL.

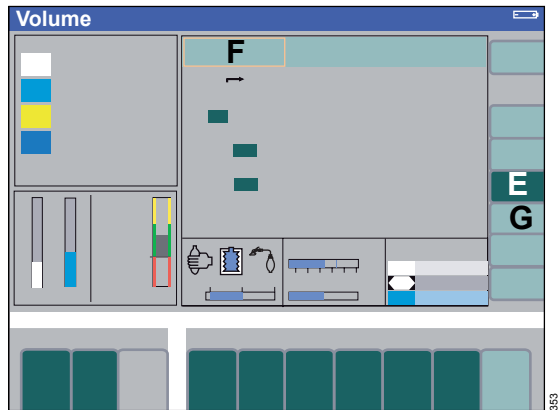
C Units

- **CO₂:** mmHg, Vol%, kPa
- **PAW:** hPa, mbar, cmH₂O
- **agents:** Vol%, kPa

D agent monitoring

- **MAC display**
(See page 143 for a detailed description of the MAC definition and calculation.)
- **Related to age**

The menu **logbook entries** (E) contains the following submenus:



F logbook entries triggered by

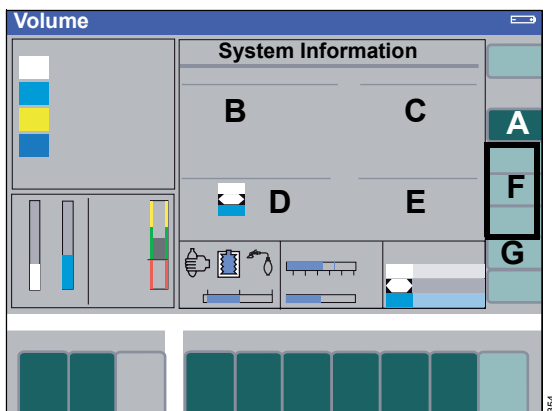
- **time interval (min)**
Entries are triggered when a fixed time interval expires (in minutes).
- **Alarm**
Entries are triggered when a warning is issued.
- **Caution**
Entries are made when a caution message is issued.

Displaying system information

- Press the softkey **system info** (G) to enter the system information.

For more information about the system information screen, see page 173.

A General info



This screen contains information on

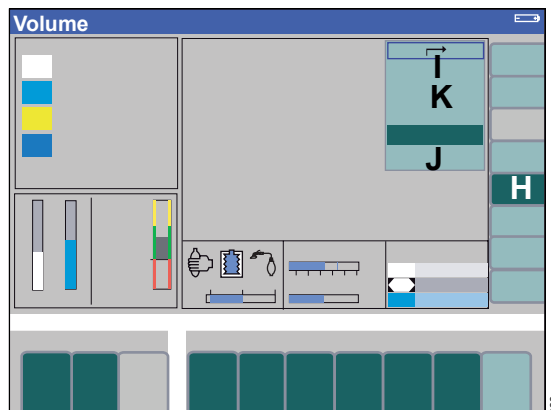
- **Software versions** of the individual components (B)
- Enabled **Software Options** (C)
- **Gas Consumption** and sampling rate of the patient gas module (D)
- **Operating Hours** of individual components (E)

F trace 1, trace 2, trace 3

Description of internal equipment states and parameters.

- Press the soft key **exit sys. info** (G) to exit the system information.

Screen layout



- 1 Press the soft key **screen layout** (H).
- 2 Set the screen brightness via the menu item **brightness** (I).
1 = dark, 16 = bright

Three screen layouts can be selected.

- 3 Select the respective layout, e.g., **activate layout 3** (J), and confirm with the rotary knob.

These layouts can be freely configured in the menu **Standby Conf.**, see page 166.

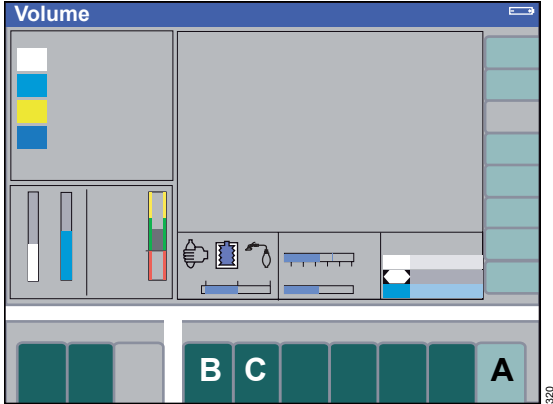
The screen layout can be changed via the menu item **config. screen** (K).

The screens comprise three curve modules with associated numerical modules and three configurable modules.

Setting the patient's age and weight during operation

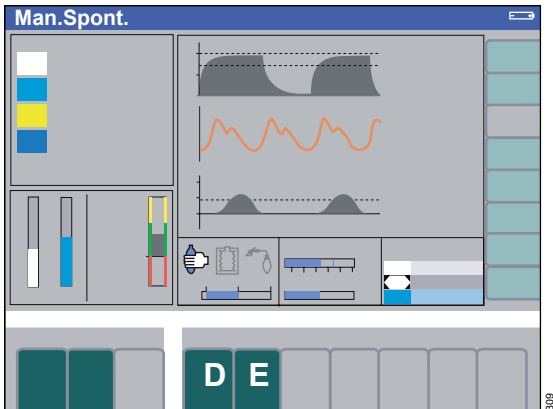
The patient's age and weight can be changed at any time via the soft keys **age** and **weight**.

In automatic ventilation modes:



- 1 Press the soft key **extra settings** (A).
- 2 Select the soft key **age** (B) or **weight** (C) to change and confirm with rotary knob.

In the modes **Man.Spont.**, **Ext. Outlet**, and **Monitoring** the keys are directly accessible.



- Select the soft key **age** (D) or **weight** (E) to change and confirm with rotary knob.

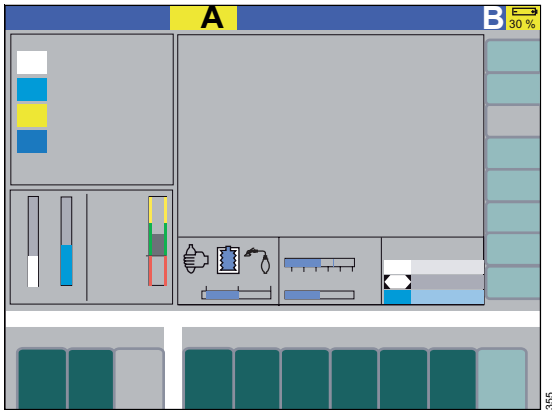
Remedying faults

Power failure	180
Gas failure	181
Ventilator failure	183
Fresh gas delivery failure	184
Ventilator and fresh gas delivery failure . . .	185
Gas measurement failure	186
Screen error	186
User interface failure	186
System failure	187
Alarm – Cause – Remedy	188

Power failure

Primus automatically switches to the built-in uninterruptible power supply UPS. In this case, the auxiliary outlets will not be supplied with power.

Provided that the battery is fully charged, operation can be continued with the current settings for at least 30 minutes (up to 90 minutes, depending on the ventilation parameters).



The message **POWER FAIL** (A) is displayed on the screen, together with the remaining battery capacity in percent (B).

For example



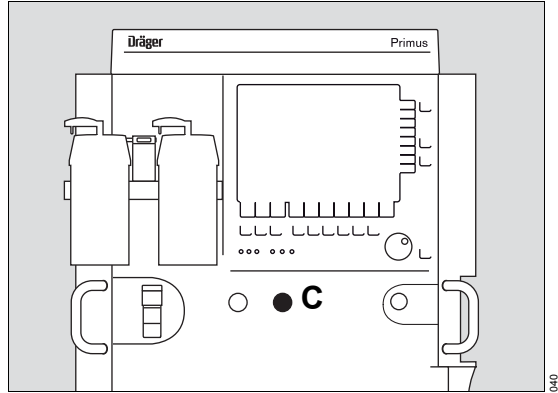
If the battery is almost empty, the message **BATTERY LOW** is displayed.

Primus permits manual ventilation with 100 % O₂ in the event of a power failure and empty batteries. The fresh-gas mixer, ventilator, and monitoring are inactive.

If all electrical power fails, all individual settings, including alarm limits which are not saved in the default settings, will be lost.

If the power supply is restored, the anesthesia machine behaves as described in "Ventilator and fresh gas delivery failure" on page 185; see also the

alarm message **GAS + VENT. FAIL** on page 194. To continue operation for emergency situations, switch the anesthesia machine off and then on again and refer to page 87 of these instructions for use.



- 1 Check vaporizer setting.
- 2 Press the safety knob (C) for O₂ emergency delivery to unlock it and set it to the required O₂ flow. Range: 0 to 12 L/min. This O₂ flows through the vaporizer.
- 3 Ensure adequate substitute monitoring!

WARNING

Risk of patient injury

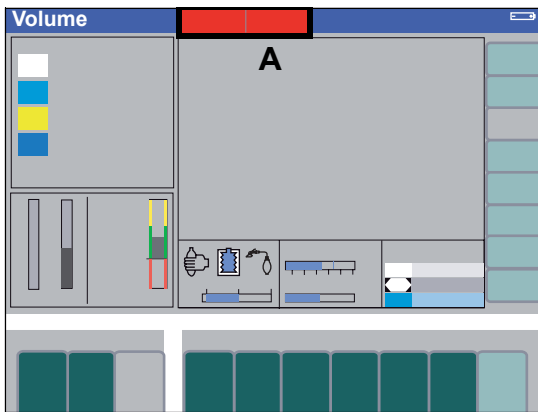
If all power supplies fail, the screen display will be dark and automatic ventilation will cease.

The patient must be ventilated manually!

NOTE

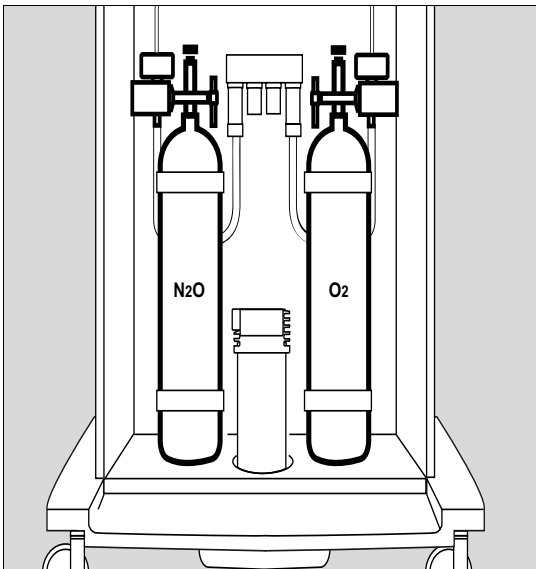
If a D-Vapor is in use and a power failure occurs, refer to the instructions for use of the D-Vapor for a description of system behavior in a power fail situation.

Gas failure



Primus displays a corresponding message (A) if the gas supply fails:

NO O₂ DELIVERY, NO AIR DELIVERY, or NO N₂O DELIVERY.



- Open the valve on the corresponding reserve gas cylinder at the back of the workstation.
- Restore central gas supply.

If there is no backup supply for the failed gas, the corresponding LED below the screen will light up red. Primus then delivers air or O₂ instead of the set gas mixture:

- Primus delivers 100 % Air if O₂ has failed.
- Primus delivers 100 % O₂ if N₂O has failed.
- Primus delivers 100 % O₂ if Air has failed.

The fresh-gas flow (L/min) remains constant.

CAUTION

Risk of patient injury

Primus delivers 100 % O₂ if Air or N₂O has failed.

Note the contra-indications for 100 % O₂.

Fresh-gas delivery remains operational even following a gas failure. This means that **AIR** or 100 % O₂ can be set as carrier gas if **N₂O** fails.

If the central gas supply for O₂ and AIR fails and no backup supply is available, operation can be continued with ambient air in automatic ventilation modes.

This is possible due to the fact that the electrically driven ventilator does not require driving gas for operation. If the fresh-gas volume is insufficient, the missing quantity is refilled with ambient air if the breathing bag is removed.

- 1 Remove breathing bag.
- 2 Perform automatic ventilation.

WARNING

Risk of patient awareness

If a complete gas supply failure occurs, further operation is guaranteed by supplying the anesthesia machine with ambient air. Anesthetic agents will no longer be delivered and the inspiratory gas composition will be diluted.

Carefully monitor the gas mixture and, if necessary, use IV anesthetics.

WARNING

Risk of gas supply contamination

When the central gas supply is connected, the smallest internal leakage can cause contamination of the supply gases.

Disconnect the compressed gas hoses from the terminal unit if the central gas supply fails during operation.

The failure of the central gas supply may lead to the failure of connected devices.

CAUTION

Risk of increased ambient gas concentrations

If the breathing bag is not attached, expiratory anesthetic agents can escape from the breathing system.

Ensure sufficient ambient air circulation.

The cylinder valve on the corresponding reserve gas cylinder must be closed again after restoring the central gas supply.

CAUTION

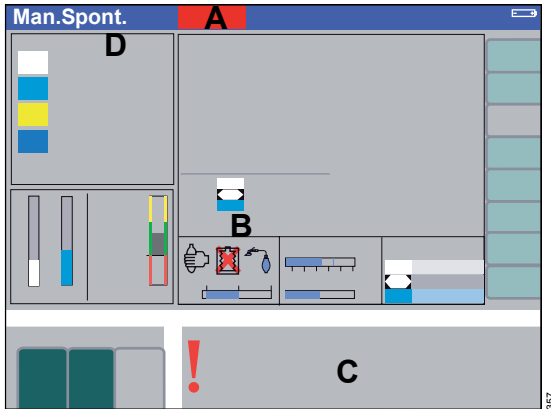
Risk of supply failure

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

Close cylinder valves whenever the central supply is sufficient.

Ventilator failure

The following message is displayed if the ventilator fails: **VENTILATOR FAIL** (A).



This is indicated by a red cross through the ventilator symbol on the screen (B) and disabled soft keys for the ventilation mode.

A prompt appears, advising the operator how to continue:

Ventilator failure. Only manual ventilation available. (C)

Primus automatically switches over to **Man.Spont.** (D).

WARNING

Risk of patient injury

If the ventilator fails, the anesthesia machine switches to the ventilation mode *Man.Spont.*

Set the APL valve to a correct pressure limiting value and ventilate the patient manually.

WARNING

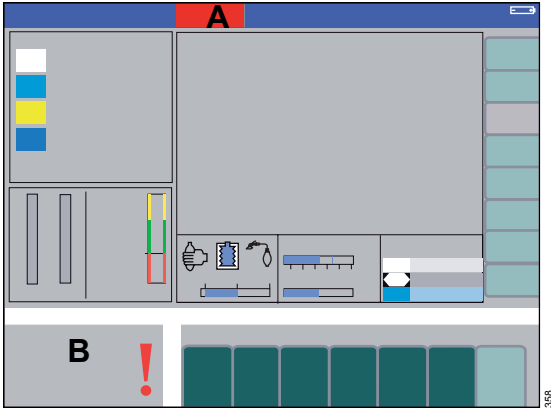
Risk of patient injury

If pressure and volume monitoring fails, the patient cannot be adequately monitored.

Ensure adequate substitution monitoring.

Fresh gas delivery failure

The following message is displayed if the gas mixer fails: **GAS MIXER FAIL (A)**.



The current ventilation mode remains active during a gas mixer failure.

The soft keys for fresh-gas delivery are disabled and a prompt appears, advising the operator how to continue:

Fresh-gas delivery failure. Check vaporizer setting, open safety O₂ control valve and set a sufficient flow. (B)

- 1 Check vaporizer setting.
- 2 Set the safety knob for O₂ emergency delivery to the required flow. Range: 0 to 12 L/min. This flow streams through the vaporizer.

WARNING

Risk of patient injury

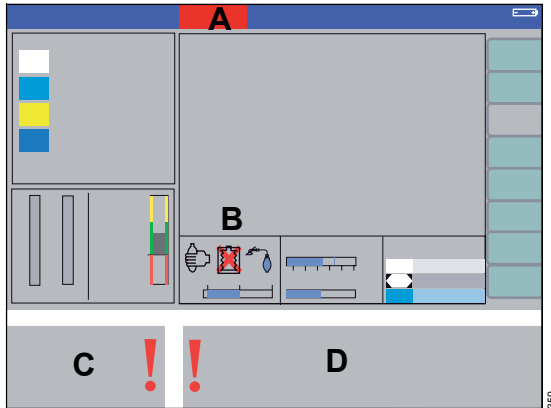
If the fresh-gas delivery fails, the anesthesia machine automatically discontinues the fresh-gas flow.

An O₂ flow must be delivered to the patient. Check vaporizer setting. Set O₂ emergency supply.

Ventilator and fresh gas delivery failure

The following message is displayed if both the ventilator and the gas mixer fail:

GAS + VENT. FAIL (A).



The failure is indicated by a red cross through the ventilator symbol on the screen (B) and disabled soft keys for the ventilation mode, as well as for fresh-gas delivery. Two prompts appear, advising the operator how to continue:

Fresh-gas delivery failure. Check vaporizer setting, open safety O₂ control valve and set a sufficient flow. (C)

Ventilator failure. Manual ventilation available only. (D)

Primus automatically switches to the **Monitoring** mode.

- 1 Check setting of vaporizer unit.
- 2 Set the safety knob of the O₂ emergency delivery to the required flow. Range: 0 to 12 L/min. This flow streams through the vaporizer.

WARNING

Risk of patient injury

If the ventilator and the fresh-gas delivery fail, the anesthesia machine switches to the ventilation mode **Monitoring** and discontinues the fresh-gas flow automatically.

An O₂ flow must be delivered to the patient and the patient must be ventilated manually. Check the vaporizer setting, open the Safety O₂ control, set a sufficient flow, set the APL valve to an adequate pressure limiting value, and ventilate the patient manually.

WARNING

Risk of patient injury

If pressure and volume monitoring fails, the patient cannot be adequately monitored.

Ensure adequate substitution monitoring.

Gas measurement failure

- Ensure adequate substitution monitoring.

Screen error

If the screen display fails:

- 1 Switch off Primus.
- 2 Set the oxygen flow to the desired value with the O₂ emergency delivery.
- 3 Check setting of vaporizer unit.
- 4 The patient must be ventilated manually.
- 5 Ensure adequate substitute monitoring!

User interface failure

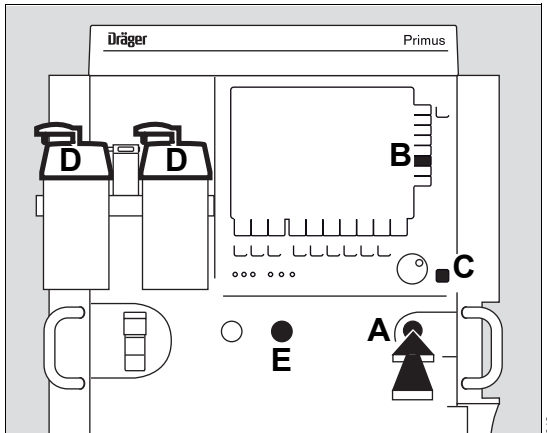
If the soft keys or the rotary knob are not operational:


- 1 Select the Monitoring mode, see page 139
- 2 The patient must be ventilated manually.

System failure

If the system no longer responds to an action:

- **Ventilate the patient by hand!**



- 1 Switch Primus off and on again: press the system power switch  (A).
- 2 Cancel the self test: Press the soft key **cancel test** (B).
- 3 Select the **Monitoring** mode (C), see page 139.

If the system has failed completely:

- 1 Switch Primus off (A).

In both cases, to ensure alternative delivery of 100 % O₂ and anesthetic agent:

- 1 Check the vaporizer setting (D).
- 2 Press the safety knob (E) to unlock it and turn it to set the required flow.

WARNING

Risk of patient injury

If the breathing bag does not fill with fresh gas, the patient cannot be adequately ventilated.

Check the oxygen supply, open cylinder valves if necessary.


If fresh gas is still not delivered or manual ventilation is not possible, close the emergency delivery.

Disconnect the workstation from the patient and use an alternative method of ventilation.

Alarm – Cause – Remedy

Primus divides the alarm messages into three priority classes identified by different colors:

- Warning = Message with high priority (red)
- Caution = Message with medium priority (yellow)
- Note = Message with low priority (cyan)

Technical alarms identified by an asterisk "*" can be downgraded to lower priority or canceled altogether by pressing the  key.

The messages are listed below in alphabetical order. The list is intended to help identify the cause of an alarm message and to remedy the fault rapidly.

Internal priority numbers for ranking alarms within a class (see page 124) are written in parentheses, e.g., (23 / 31), in the table below.

Priority	Message	Cause	Remedy
Note (7)	2 MIXED AGENTS	A second anesthetic agent has been detected.	Wait for the transition phase to end after changing anesthetic agents. Check vaporizer fill level. Flush system if necessary. Check fresh-gas settings.
Caution (15)	3 MIXED AGENTS	A mixture of more than two anesthetic agents has been detected, see page 145.	Check vaporizer fill level. Flush system if necessary. Check fresh-gas settings. Wait for transition phase to end.
Note (1)	AGENT SENSOR FAIL (in <i>Standby</i> only)	Anesthetic gas measurement system has failed.	Use external gas measuring system. Call DrägerService.
Advisory/ – (8/–)	AIR CYLIND. CONNECT.? *	Pressure sensor for reserve gas cylinder not connected.	Check pressure sensor connection.
Caution/ Advisory (24/7)	AIR CYLIND. EMPTY *	AIR reserve gas cylinder empty and central AIR supply not available or not connected.	Use a new AIR reserve gas cylinder. Use the central gas supply.

Priority	Message	Cause	Remedy
Caution (24)	APNEA	Priority in accordance with maximum priority of the individual alarms.	
Warning (31)		Breathing/ventilation has stopped (detected by pressure, volume, and CO ₂ monitoring).	<p>Patient must immediately be ventilated manually!</p> <p>Check patient's spontaneous breathing ability.</p> <p>Check ventilation setting.</p> <p>Check fresh-gas setting.</p> <p>Make sure everything is connected.</p> <p>Check hose system and tube!</p>

Priority	Message	Cause	Remedy
Note (10)	APNEA CO₂	<p>Apnea alarms are graded in time:</p> <p>In automatic ventilation modes:</p> <p>Caution = 0 to 30 sec.</p> <p>Warning = >30 sec.</p> <p>In ventilation modes Man.Spont., Pressure Support, Ext. Outlet:</p> <p>Advisory = 0 to 30 sec.</p> <p>Caution = 31 to 60 sec.</p> <p>Warning = >60 sec.</p>	
Caution (24)		Sample line not connected.	Check sample line.
Warning (31)		No spontaneous breathing.	<p>Patient must immediately be ventilated manually!</p> <p>Check patient's spontaneous breathing ability.</p> <p>Make sure everything is connected.</p> <p>Check hose system and tube.</p>
		Breathing/ventilation has stopped.	<p>Patient must immediately be ventilated manually!</p> <p>Check ventilation setting.</p>

Priority	Message	Cause	Remedy
Caution/ (see page 168)	APNEA FLOW	Breathing/ventilation has stopped.	Patient must immediately be ventilated manually!
Note (see page 176)			
(10)			
Caution (24)			
= 0 to 30 sec.			
Warning (31)			Check patient's spontaneous breathing ability.
>30 sec.			Check ventilation setting.
		Insufficient fresh gas supply.	Check fresh-gas setting.
		Tube kinked.	Check hose system and tube.
		Leak in hose system.	
Caution (24)	APNEA PRESSURE	Breathing/ventilation has stopped	Patient must immediately be ventilated manually!
= 0 to 30 sec.			
Warning (see page 176)		Insufficient fresh gas supply.	Check fresh-gas setting.
(31)		Leak or blockage in tube or hose system.	Check hose system, tube, and microbial filter.
≥0		Patient not connected.	Connect patient correctly.
or			
30 sec.			
Caution/ Advisory (see page 168)	APNEA VENTILATION *	No spontaneous breathing efforts by the patient during the Pressure Support mode.	Check the patient's trigger capability.
(11/9)			Set an adequate trigger.
Caution (13)	BATTERY LOW	The battery capacity (Advisory = 10 to 20 %; Caution = <10 %) of the uninterruptible power supply is almost exhausted.	Connect to mains power. Check patient's condition!
Note (7)			Prepare manual ventilation with 100 % O ₂ .


Priority	Message	Cause	Remedy
Warning (26)	BREATH. SYS. TEMP. HIGH	Temperature of the breathing system is too high.	Check breathing system and breathing gas temperature. Call DrägerService.
Warning/ Caution (31/15)	CHECK VENT. ASSEMBLY	If the Caution APNEA PRESSURE and APNEA FLOW also occur, the priority changes from Caution to Warning. Breathing system installed incorrectly or incompletely.	Check whether breathing system is correctly installed. Check whether upper diaphragm is correctly installed.
Note (7)	CIRCLE LEAK	Leak in patient circle system.	Use another breathing system. Check tube, hoses, and filter.
Note (1)	CO₂ SENSOR FAIL (in <i>Standby</i> only)	CO ₂ gas measurement system has failed.	Use external gas measuring system. Call DrägerService.
Note (1)	COM 1 FAIL COM 2 FAIL	Communication via the corresponding COM port has been interrupted.	Check the plug connection on Primus and the on-line equipment.
Warning (31)	CONTINUOUS PRESSURE	The breathing pressure exceeds the set limit for more than 15 seconds.	Check ventilation and/or spontaneous breathing of the patient. Check breathing hoses, breathing system, and gas scavenging system for correct functionality. Check alarm limit for correct setting.
Caution (18)	ET CO₂ HIGH	The upper alarm limit for the end-expiratory CO ₂ concentration has been exceeded for at least two breaths.	Check ventilation.

Priority	Message	Cause	Remedy
Caution (18)	ET CO₂ LOW	The lower alarm limit for the end-expiratory CO ₂ concentration has been fallen short of for at least two breaths.	Check ventilation.
Note (8)	EXP. FLOW SENSOR FAIL (in <i>Standby</i> only)	Expiratory flow sensor has failed.	Replace flow sensor, see page 213.
Note (6)	FAN FAIL	Fan for evacuating gases inside the device is defective.	Workstation must be switched off! A defective fan together with an internal leak may cause higher O ₂ concentrations inside the workstation. Risk of fire Call DrägerService.
Caution (16)	FG LOW OR LEAK	Fresh-gas setting is too low; the priority of the warning depends on the extent of fresh gas shortage.	Increase the fresh-gas flow. Check anesthetic gas scavenging system.
Warning (31)		Leakage	Repair leak.
Warning/ Note (30/10)	FRESH GAS EXTERN OK? *	Fault when switching over to the external fresh-gas outlet.	Check fresh-gas flow at external outlet. Switch external fresh-gas outlet on and off several times. If breathing bag of the non-rebreathing system does not fill, switch to internal breathing system. Use operational outlet. Call DrägerService.

Priority	Message	Cause	Remedy
Warning/ Note (30/10)	GAS + VENT. FAIL *	Fresh-gas mixer and ventilator are no longer operational.	<p>Patient must immediately be ventilated manually!</p> <p>Check setting of vaporizer unit.</p> <p>Set the safety knob for O₂ emergency delivery to the required O₂ flow, between 0 and 12 L/min.</p> <p>Call DrägerService.</p>
Warning/ Note (29/10)	GAS MIXER FAIL *	Fresh-gas mixer is no longer operational.	<p>Check setting of vaporizer unit.</p> <p>Set the safety knob for O₂ emergency delivery to the required O₂ flow, between 0 and 12 L/min.</p> <p>Make sure the fresh gas flows into the breathing circle used (breathing system or ext. fresh-gas outlet).</p> <p>Call DrägerService.</p>
Note (1)	GAS SENSOR FAIL (in <i>Standby</i> only)	Complete gas measurement system failure.	<p>Use external gas measuring system.</p> <p>Call DrägerService.</p>
Caution/ Advisory (14/10)	INCORRECT FG FLOW	Set fresh-gas flow cannot be delivered.	<p>Check setting of vaporizer unit.</p> <p>Make sure the emergency O₂ delivery is closed.</p> <p>Set fresh-gas flow to between 3 and 10 L/min.</p>

Priority	Message	Cause	Remedy
Caution (11)	INSP. CO₂ HIGH	Soda lime in circle system exhausted.	Increase the fresh-gas flow. Replace soda lime.
		Leak or fault in breathing system.	Replace breathing system!
		High respiratory rates. If the respiratory rates are high, the measured value can no longer follow the gas concentration properly due to the design of the system.	Adjust alarm limits if necessary.
		Dead space ventilation.	Check ventilation settings.
Note (8)	INSP. FLOW SENSOR FAIL	Insp. flow sensor is defective.	Replace flow sensor, see page 221.

Priority	Message	Cause	Remedy
Caution	INSP. HAL. HIGH	Caution (24) = insp. MAC value >3 MAC for >180 seconds.	
Warning	INSP. ISO. HIGH		
Note	INSP. ENF. HIGH INSP. DES. HIGH INSP. SEV. HIGH	Warning (31) = insp. MAC value >5 MAC Warning (31) = insp. MAC value >3 MAC and exp. MAC value >2.5 MAC for >30 seconds. Insp. anesthetic gas concen- tration exceeds 5 MAC. <hr/> Insp. anesthetic gas concen- tration exceeds 3 MAC for more than 180 seconds. <hr/> Insp. anesthetic gas concen- tration exceeds 3 MAC and exp. 2.5 MAC for more than 30 seconds.	Check the vaporizer setting and fresh-gas settings.
		Advisory (10) = insp. gas concentration > up- per alarm limit for 0 to 30 seconds. (preliminary information for the user) Caution (24) = insp. gas concentration > up- per alarm limit for 31 to 180 seconds. Warning (31) = insp. gas concentration > upper alarm limit for > 180 seconds. Insp. anesthetic gas concen- tration exceeds the upper alarm limit for at least 2 breaths.	Check the vaporizer and fresh-gas settings.

Priority	Message	Cause	Remedy
Caution (15)	INSP. HAL. LOW INSP. ISO. LOW INSP. ENF. LOW INSP. DES. LOW INSP. SEV. LOW	The insp. anesthetic gas concentration has fallen below the lower alarm limit for at least 2 breaths.	Check the vaporizer and fresh-gas settings. Check for leakages in breathing system. Check soda lime, (dried out?)
Caution (12)	INSP. N2O HIGH	Inspiratory N2O concentration exceeds the upper alarm limit of 82 %.	Check N2O concentration in the fresh-gas flow. Flush.
Caution (12)	INSP. O2 HIGH	Inspiratory O2 concentration exceeds the upper alarm limit.	Check O2 concentration in the fresh-gas flow.
Warning (31)	INSP. O2 LOW	Inspiratory O2 concentration is below the lower alarm limit.	Check O2 concentration and fresh-gas setting. Check for leakages in breathing system. Check O2 supply.
Warning/ Advisory (29/10)	INTERNAL TEMP. HIGH *	Temperature inside the device is too high.	Check ambient conditions. Ensure air circulation at back of device.
		Fan is defective.	Call DrägerService.
		Extreme, non-physiological ventilation settings.	Check ventilation setting.
Caution/ – (14/–)	LOSS OF DATA *	Data loss of the settings and/or the system configuration.	Check the current settings and the default settings. Repeat settings if necessary. Call DrägerService. Alarm can be canceled by pressing  .


Priority	Message	Cause	Remedy
Note (10)	LOW AIR SUPPLY	Compressed air supply has failed.	Open optional Air reserve gas cylinder. Check central gas supply, see page 181.
		The central gas supply is not connected or the compressed air hose is kinked.	Check connection to central gas supply.
		Optional air cylinder is empty or closed.	Connect a full air cylinder or open the cylinder valve.
		Compressed air compressor has failed.	Check compressor.
Note (10)	LOW N₂O SUPPLY	N ₂ O supply has failed.	Open N ₂ O reserve gas cylinder. Check central gas supply, see page 181.
		Probe for the central gas supply not plugged in or N ₂ O hose kinked.	Check connection to central gas supply.
		N ₂ O cylinder empty or closed.	Connect a full N ₂ O cylinder or open the cylinder valve.
Caution (11)	LOW O₂ SUPPLY	O ₂ supply has failed.	Open O ₂ reserve gas cylinder. Check central gas supply.
		Probe for the central gas supply not plugged in or O ₂ hose kinked.	Check connection to central gas supply, see page 181.
		O ₂ cylinder empty or closed.	Connect a full O ₂ cylinder or open the cylinder valve.
Caution/ Advisory (14/7)	MAC LOW? *	The expiratory xMAC value has fallen below the lower alarm limit of the automatic agent alarm.	Check patient condition. Confirm alarm, if case is closed.
			Check vaporizer fill level.
			Check correct position of vaporizer. Check for leakages in breathing system.







Priority	Message	Cause	Remedy
Caution (13)	MINUTE VOL. HIGH	Upper alarm limit for the minute volume has been exceeded.	Correct the tidal volume or breathing rate. Check spontaneous breathing. Correct the trigger level if necessary when using the Pressure Support mode.
Caution (22)	MINUTE VOL. LOW	Lower alarm limit for the minute volume has been fallen short of . Tube sealed/kinked. Leakage Reduced tidal volume through pressure limitation. Fresh-gas flow is insufficient.	Check breathing system. Check ventilation setting. Correct the trigger level if necessary when using the Pressure Support mode. Check the patient's trigger capability. Check tube. Check tube, hoses, filters, bellows, absorber. Correct ventilation settings. Increase the fresh-gas flow.
Advisory/ – (8/–)	N₂O CYLIND. CONNECT.? *	Pressure sensor for reserve gas cylinder not connected.	Check pressure sensor connection.
Warning/ Note (25/7)	N₂O CYLIND. EMPTY *	N ₂ O reserve gas cylinder empty or closed and central N ₂ O supply not available or not connected.	Use a new N ₂ O reserve gas cylinder or open the cylinder valve. Use the central gas supply.
Note (1)	N₂O SENSOR FAIL (in Standby only)	N ₂ O gas measurement system has failed.	Use external measuring system. Call DrägerService.

Priority	Message	Cause	Remedy
Warning/ Note (25/10)	NO AIR DELIVERY *	Compressed air supply has failed.	Open optional Air reserve gas cylinder. Check central gas supply, see page 181.
		The central gas supply is not connected or the compressed air hose is kinked.	Check connection to central gas supply.
		Optional air cylinder is empty or closed.	Connect a full air cylinder or open the cylinder valve.
		Compressed air compressor has failed.	Check compressor.
Warning/ Note (25/10)	NO N₂O DELIVERY*	N ₂ O supply has failed.	Open N ₂ O reserve gas cylinder. Check central gas supply, see page 181.
		Probe for the central gas supply not plugged in or N ₂ O hose kinked.	Check connection to central gas supply.
		N ₂ O cylinder empty or closed.	Connect a full N ₂ O cylinder or open the cylinder valve.
Warning (31)	NO O₂ DELIVERY	O ₂ supply has failed.	Open O ₂ reserve gas cylinder. Check central gas supply, see page 181.
		Probe for the central gas supply not plugged in or O ₂ hose kinked.	Check connection to central gas supply.
		O ₂ cylinder empty or closed.	Connect a full O ₂ cylinder or open the cylinder valve.
Warning (31)	NO SPO₂ PULSE	No pulse signal detected with the SpO ₂ measurement for approx. 10 seconds.	Check patient's condition! Check application of SpO ₂ sensor.
		NiBP measurement on the same arm.	Measure blood pressure on the other arm.
Advisory/ – (8/–)	O₂ CYLIND. CONNECT.? *	Pressure sensor for reserve gas cylinder not connected.	Check pressure sensor connection.

Priority	Message	Cause	Remedy
Note (10)	O₂ CYLIND. LOW	Pressure has dropped below the pressure limit set for the O ₂ cylinder.	Use a new O ₂ reserve gas cylinder. Use the central gas supply.
Warning/ Note (28/7)	O₂ CYLIND. EMPTY*	O ₂ reserve gas cylinder empty or closed and central O ₂ supply not available or not connected.	Use a new O ₂ reserve gas cylinder or open the cylinder valve. Use the central gas supply.
Caution (11)	O₂ SENSOR FAIL (in <i>Standby</i> only)	O ₂ sensor is spent or defective.	Replace O ₂ sensor, see page 236. Ensure adequate substitution monitoring. Call DrägerService.
Caution (14)	PEEP HIGH	Exp. pressure 5 hPa (cmH ₂ O) above PEEP for two breaths or Exp. pressure 5 hPa (cmH ₂ O) above PEEP in Pressure Support mode for more than 30 seconds.	In automatic ventilation modes: Check the set ventilation parameters. Check the anesthetic gas scavenging line.
Caution (12)	PINSP. NOT ATTAINED	The inspiratory pressure set in Pressure Mode is not achieved. Fresh gas shortage.	Check set ventilation parameters, repair leak if necessary. Check fresh-gas setting.
Caution/ Advisory (12/7)	POWER FAIL*	Power failure. Short-circuit in one of the units connected to an auxiliary outlet.	Restore central gas supply. Observe battery capacity. Prepare manual ventilation. Unplug appliance connector from auxiliary outlet. Restore central gas supply.
Note (1)	POWER SPLY. ERROR	Internal fault in the power supply.	Call DrägerService. Operation of the workstation can continue for the time being.
Note (8)	PRESSURE ERROR (in <i>Standby</i> only)	Pressure sensor is defective.	Perform self test. Call DrägerService.

Priority	Message	Cause	Remedy
Warning (27)	PRESSURE HIGH	Upper alarm limit for the airway pressure has been exceeded.	
		Tube kinked.	Check hose system and tube.
		Stenosis.	
		Ventilation settings not correct.	Correct ventilation settings.
Caution (13)	PRESSURE LIMITATION	Ventilator is operating with pressure limitation.	Check ventilation setting.
		Tube kinked/stenosis.	Check tube, hoses, and filter.
		Microbial filter contaminated on inspiration side.	Check microbial filter.
Warning (30)	PRESSURE NEGATIVE	Insufficient fresh gas supply.	Set adequate fresh-gas flow on anesthetic machine. Flush system if necessary.
		Endotracheal aspiration during ventilation.	Check endotracheal aspiration system.
		Negative pressure due to fault in ventilator.	Make sure upper diaphragm is correctly installed. Call DrägerService.
		Anesthetic gas scavenging system is defective.	Check anesthetic gas scavenging system. Call DrägerService.
Note (10)	PRESSURE RELIEF	Internal pressure relief valve opened due to high system pressure. (Standby, Monitoring, Man.Spont.)	Check APL valve settings. Check fresh-gas settings.
Caution (21)	PULSE RATE HIGH	Upper alarm limit for pulse has been exceeded.	Check patient's condition! Correct alarm limit if necessary.
Warning (31)	PULSE RATE LOW	Pulse below lower alarm limit.	Check patient's condition! Check ventilation.
Caution (18)	SAFETY O₂ OPEN	O ₂ emergency delivery is open.	Close O ₂ emergency supply.

Priority	Message	Cause	Remedy
Caution/ – (14/–)	SETTING CANCELLED *	The last settings have not been accepted on account of temporary errors.	Repeat settings. Alarm can be canceled by pressing  .
Note (7)	SODA LIME DEPLETED? (in <i>Standby</i> only)	Time limit for usage reached.	Check soda lime, if necessary replace soda lime.
Note (1)	SPEAKER FAIL	Speaker is defective.	No alarm tone. Call DrägerService.
Note (1)	SPO₂ FAIL (in <i>Standby</i> only)	SpO ₂ measurement system has failed.	Use external measuring system. Call DrägerService.
Caution (21)	SPO₂ HIGH	Upper alarm limit for oxygen saturation has been exceeded.	Check ventilation.
Note (10)	SPO₂ SENS. DISCONNECT	SpO ₂ sensor not connected.	Check sensor connection.
Warning (31)	SPO₂ LOW	Lower alarm limit for oxygen saturation has been fallen short of.	Check ventilation. Check application of SpO ₂ sensor. Check O ₂ concentration of fresh-gas flow.
Warning/ Note (28/10)	VENTILATOR FAIL *	Ventilator is no longer operational.	Patient must immediately be ventilated manually! Adequate substitute monitoring must be ensured if pressure and volume monitoring has failed. Call DrägerService.
Warning/ Note (27/10)	VENTILATOR UNLOCKED *	Ventilator unit has not been locked correctly.	Push the ventilator in until it engages in the right position. Anesthetic gas scavenging system is not active when the ventilator unit is disconnected. The ambient air may become contaminated with anesthetic agents!

Priority	Message	Cause	Remedy
Caution (12)	VOLUME NOT ATTAINED	Set volume is not delivered.	Remove leak. Correct pressure limitation or inspiratory time if necessary. Check fresh-gas flow setting. <hr/> Check fresh-gas flow setting.
Note (7)	WATER TRAP SAMPL. LINE?	Sample line blocked or not connected. Water trap or gas measurement system blocked or not connected.	Check sample line, water trap, gas measurement system, and filter in Y-piece, if applicable; replace if necessary.
	INOP instead of measured values	Values cannot be measured, sensor defective.	Replace sensor if necessary. Ensure adequate substitution monitoring. Call DrägerService.
	CAL instead of measured values	Sensors are being calibrated.	Wait until calibration is complete.
	"- -" instead of measured values	Measurement currently not possible.	Ensure adequate substitution monitoring. Call DrägerService.
	 symbol next to measured values	All CO ₂ and SpO ₂ alarms for the measured values concerned have been disabled.	Enable alarms in configuration menu, see page 167.
	 symbol next to measured values	All alarms for the measured values concerned have been temporarily disabled. The alarm system is waiting for automatic measurement wake-up (AutoWakeUp).	Connect sample line. Connect SpO ₂ Sensor. Connect patient. For more details see page 126.
	 symbol next to measured values	The apnea alarm for the measured value concerned has been disabled. Some apnea alarms are disabled automatically in some ventilation modes. For more details see page 128.	For more details see page 128.
	 ,  , or  symbol next to measured values	One or both alarm limits for the measured value concerned has/have been disabled.	Set alarm limits, see page 167.

Priority	Message	Cause	Remedy
	Grayed out values	The set value differs from the delivered value.	
	Grayed out measured values	The specified accuracy cannot be maintained.	

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Cleaning, Disinfection and Sterilization

Disassembly	208
Observe before disassembly	208
Removing the sample line	208
Removing the water trap container.	208
Removing the breathing circuit.	209
Removing the microbial filter (optional)	209
Pulling out the ventilator module	210
Removing the flexible arm and breathing bag	210
Removing the absorber	210
Removing the breathing system.	211
Removing the ventilator diaphragm	212
Removing the flow sensors	213
Opening the breathing system	213
Removing the anesthetic gas scavenging system AGS	214
Removing the secretion aspiration system (optional).	215
Reprocessing Procedure	216
Classification of medical devices	216
Testing of procedures and agents	216
Uncritical medical devices	216
Semicritical medical devices.	217
Visual inspection.	218
Sterilization.	218
Reprocessing List	219
Assembly	221
Visual inspection.	221
Installing the breathing system.	221
Inserting the flow sensors.	221
Filling and fitting the absorber	223
Installing the flexible arm (optional) and breathing bag	224
Inserting the ventilator module	225
Connecting the breathing circuit.	225
Connecting the anesthetic gas scavenging system AGS	226
Connecting the secretion aspirator.	227
Before using on patients on again	228

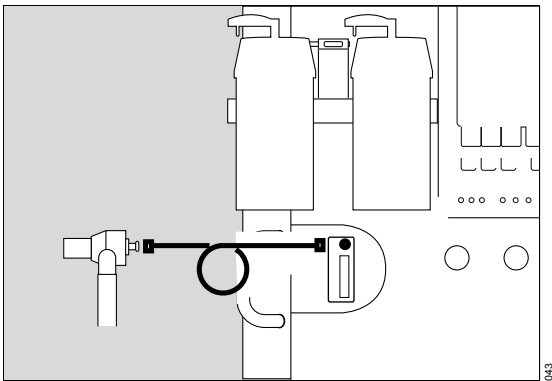
Disassembly

Observe before disassembly

Disconnecting from the mains

- 1 Shut down the device and all additional devices.
- 2 Remove the mains plug.

Removing the sample line



- Unscrew the sample line from the Y-piece and the water trap on the front of the unit.

CAUTION

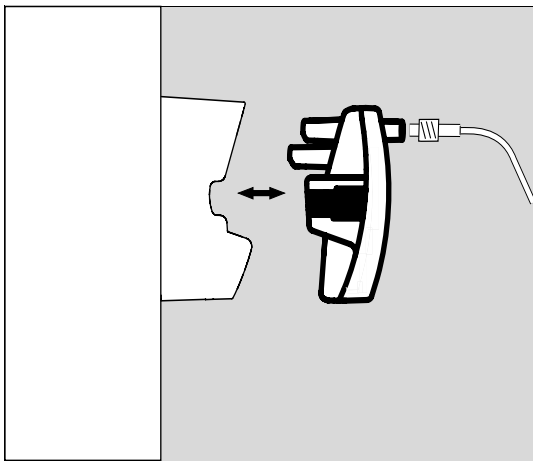
Risk of gas measurement failure and device failure

Disinfectants can damage the sample gas line and the diaphragm of the water trap.

Sample gas lines are single-use articles and must be replaced, not disinfected.

The sample line is a single-use article which must be disposed of in accordance with the hospital's hygiene regulations.

Removing the water trap container



- Pull the water trap out towards the front and empty it, see page 80.

WARNING

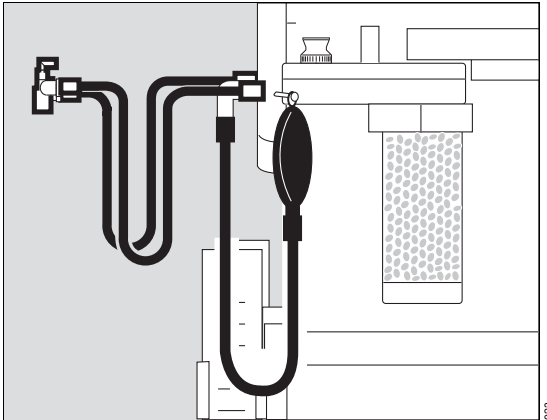
Risk of gas measurement failure and device failure

If the water trap is used longer than intended, the diaphragm may become brittle and allow water and bacteria to enter the measurement system. Such contamination affects the gas measurement which may fail as a result.

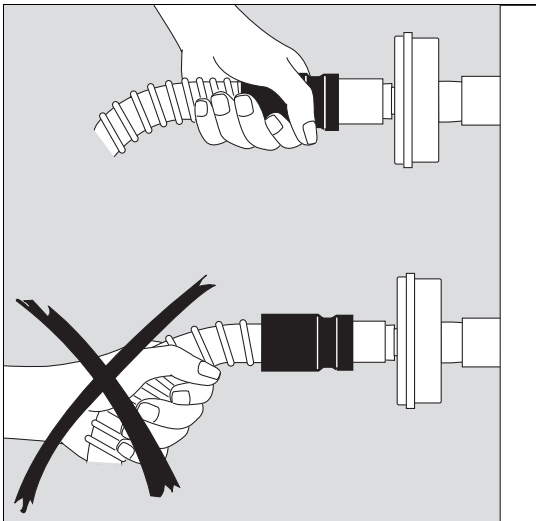
The water trap must be replaced after a service life of four weeks.

For disposal of the old water trap follow the corresponding instructions for use of the water trap WaterLock and comply with the hospital's hygiene requirements.

Removing the breathing circuit



- 1 Disconnect the breathing hoses from the breathing system.



- 2 Disconnect the various parts of the hose system (breathing hoses, Y-piece, connector, and optional Y-piece filter). The filter on the Y-piece is not reusable and can be disposed of with ordinary domestic waste.

Note the regulations of the hospital for infectious patients!

Note the instructions for use.

- 3 Prepare the parts for conditioning in a cleaning and disinfecting machine.

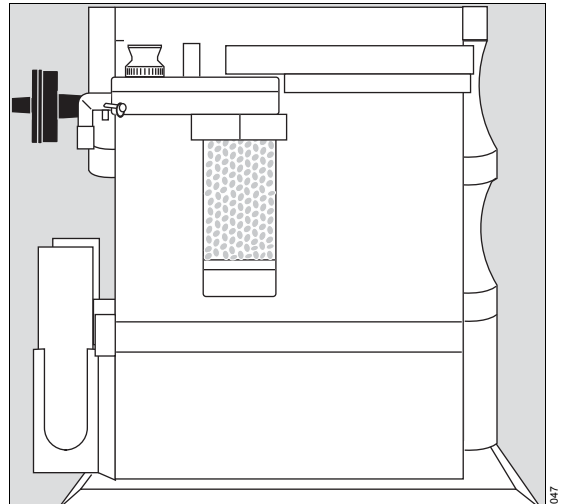
CAUTION

Risk of component damage

If mishandled, the spiral ribbing on the breathing hoses can become detached from the sleeve. Breathing hoses with damaged spiral ribbing can easily be kinked and interrupt the flow of gas!

When attaching or removing the breathing hoses, always hold them by the connection sleeve and not by the spiral ribbing! Always check the breathing hoses for damage prior to use. Damaged breathing hoses must be replaced.

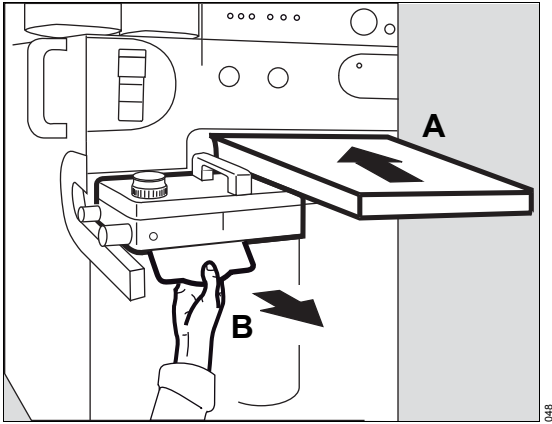
Removing the microbial filter (optional)



On the sleeve of the microbial filter:

- 1 Pull the filter off the nozzle.
- 2 Prepare the microbial filter for conditioning according to the corresponding instructions for use.

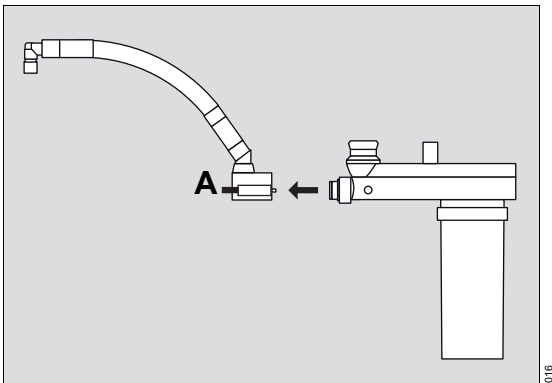
Pulling out the ventilator module



- 1 Slide the writing table (A) inwards.
- 2 Press the release button* on the ventilator module (B) and pull the module out.

Removing the flexible arm and breathing bag

- 1 Take the breathing bag off the arm.

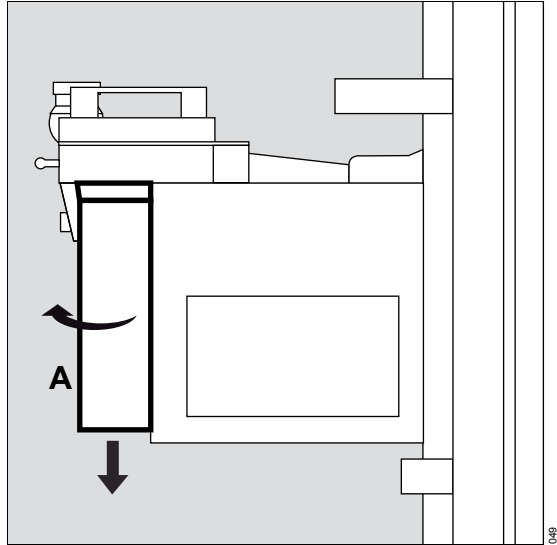


- 2 Unscrew the knurled screws (A) on the socket of the arm.
- 3 Disconnect the arm from the breathing system.

Removing the absorber

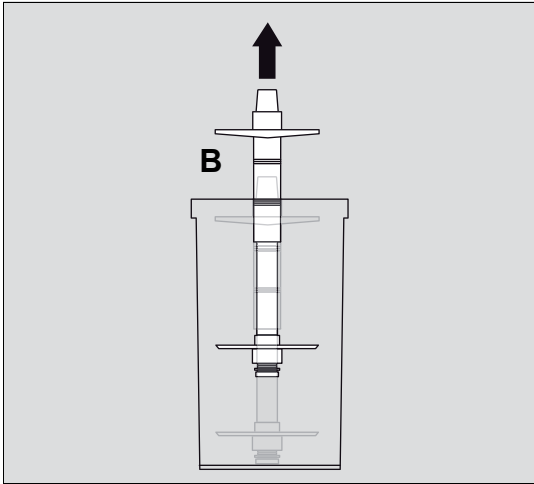
A reusable absorber or the disposable absorber Drägerorb CLIC can be used.

Reusable absorber



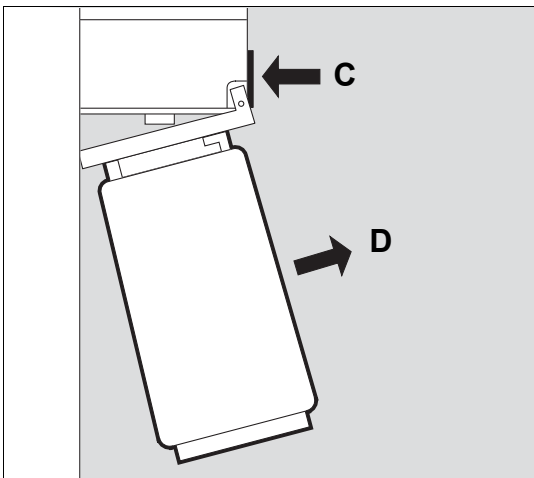
- 1 Turn the absorber counterclockwise and pull it down (A).
- 2 Empty out the soda lime in accordance with the instructions for use of the absorber, see page 118.

* available since November 2004



- 3 Remove the insert from the absorber (B). The inner and outer sealing rings remain on the absorber insert.
- 4 Prepare the absorber for conditioning in a cleaning and disinfecting machine.

Disposable absorber Drägerorb CLIC



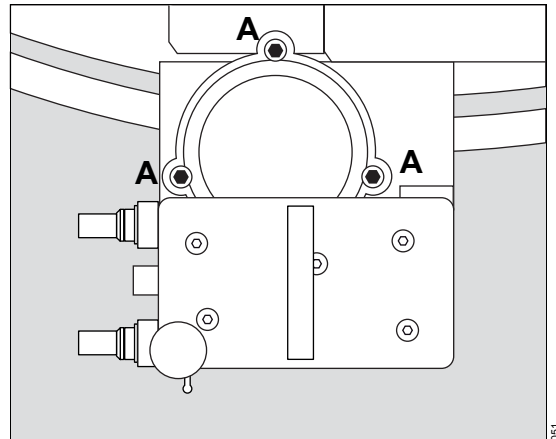
- 5 Press the button (C); the mounting swings open.
- 6 Slide the disposable absorber off the mounting (D).

Note the Drägerorb CLIC instructions for use.

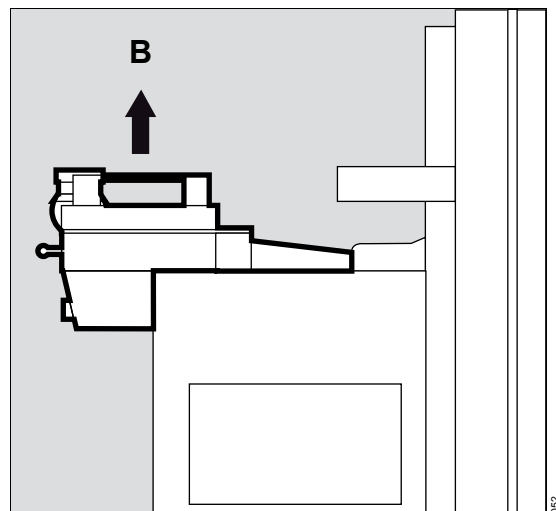
Removing the breathing system

NOTE

Before removing the breathing system, allow it to cool 5 minutes if the anesthesia machine has just been used. The surface may otherwise be hot to the touch.

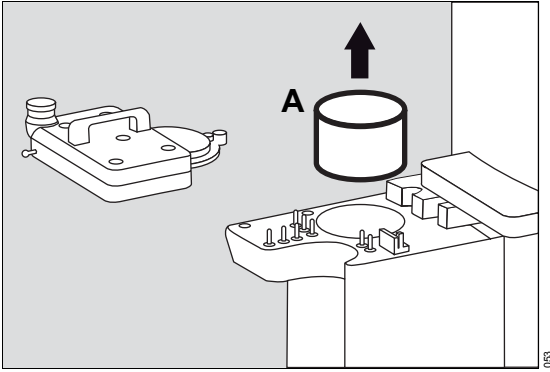


- 1 Loosen the three sealing screws (A) on the ventilator a quarter turn counterclockwise using the key supplied.



- 2 Pull the breathing system up (B) and out by the handle.

Removing the ventilator diaphragm



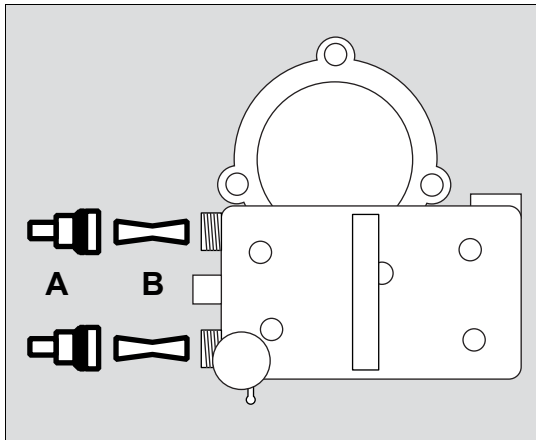
- Remove the upper diaphragm (A) and prepare it for conditioning in a cleaning and disinfecting machine.

NOTE

If the ventilator diaphragm is reprocessed together with light-colored, transparent silicone components, discoloration of these silicone components may occur.

Do not reprocess the specified components together.

Removing the flow sensors



- 1 Unscrew the inspiratory and expiratory ports (A).
- 2 Remove the flow sensors (B).

CAUTION

Risk of flow measurement failure

Disinfecting or cleaning the flow sensors by machine will damage them and cause the flow measurement to fail.

Disinfect and clean the flow sensor as described in the instructions for use of the Spirolog and SpiroLife flow sensors.

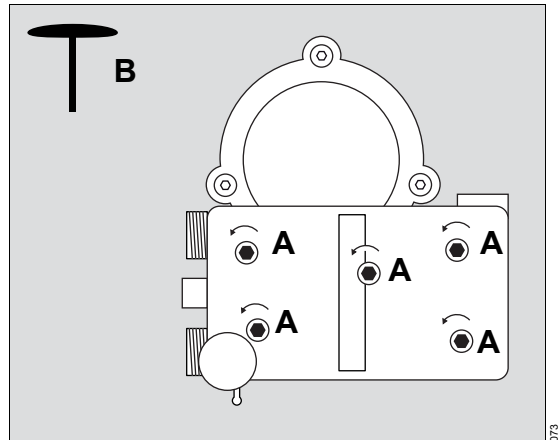
CAUTION

Risk of flow measurement failure

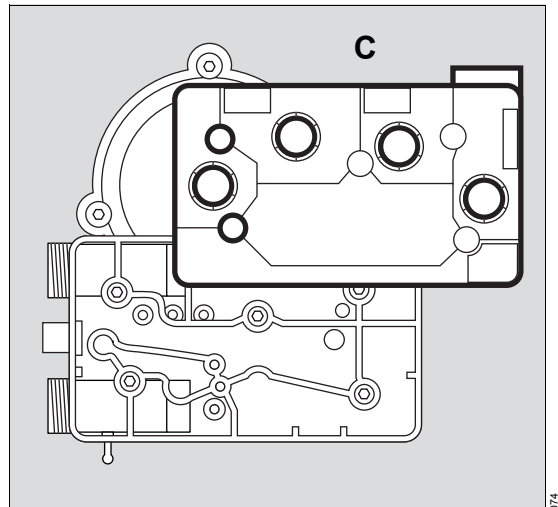
Sterilizing the Spirolog flow sensors in high-temperature steam will damage them and cause the flow measurement to fail.

Disinfect and clean the flow sensor as described in the instructions for use of the Spirolog and SpiroLife flow sensors.

Opening the breathing system

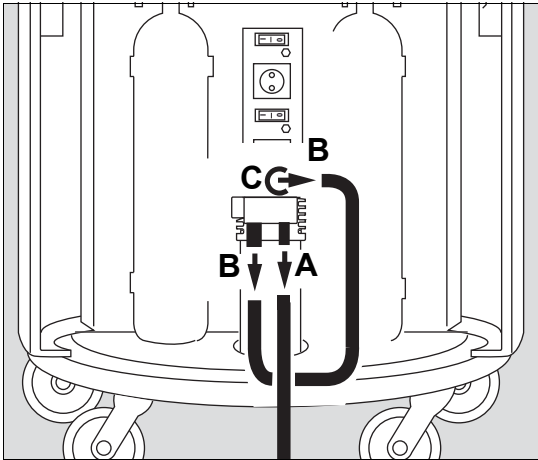


- 1 Loosen the five sealing screws (A) a quarter turn counterclockwise using the key (B) supplied.
- 2 Remove the cover.



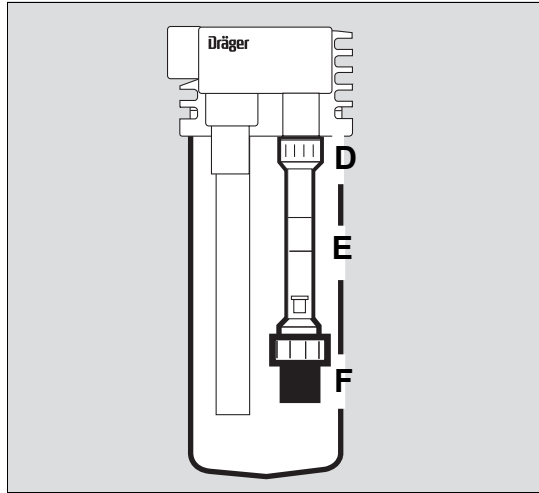
- 3 Lift off the metal valve plate (C).
- 4 Prepare the housing parts for conditioning in a cleaning and disinfecting machine.
- 5 Place the metal valve plate in the cleaning and disinfecting machine.

Removing the anesthetic gas scavenging system AGS



054

- 1 Remove the scavenging hose (A) from the AGS system on the back of Primus.
- 2 Remove the gray transfer hose (B).
- 3 Remove the anesthetic gas scavenging system (C).
- 4 Prepare the individual parts for conditioning in a cleaning and disinfecting machine. Flow tubes must not be placed in the washer!
- 5 Remove the container for buffer volume.



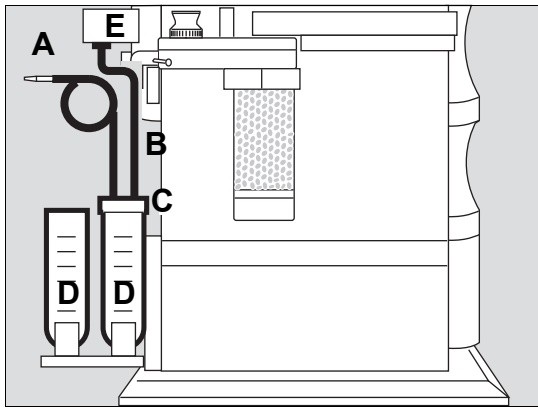
055

- 6 Unscrew the union nut (D).
- 7 Unscrew the flow tube (E).
- 8 Unscrew the union nut and remove the particle filter (F).

The particle filter may be disposed of with ordinary domestic waste after being sealed, see "Maintenance" on page 229.

Note the instructions for use of the anesthetic gas scavenging system AGS.

Removing the secretion aspiration system (optional)



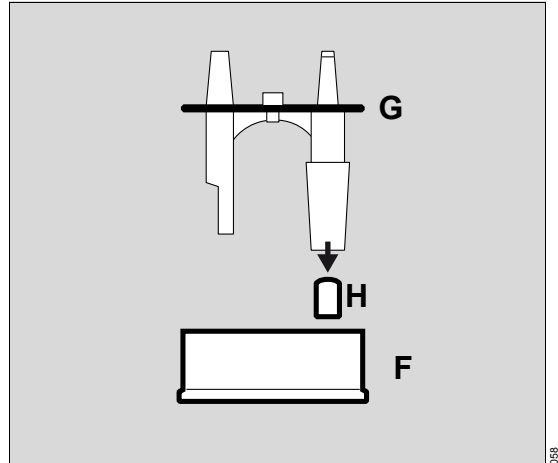
- 1 Remove the suction hose (A) and vacuum hose (B) leading to the endotracheal aspiration system.
- 2 Grip the silicone sleeve (C) of the bottle cap (see details below) and pull it off.
- 3 Remove the secretion collecting bottle (D) and rinsing bottle from the holder and empty them.

Note the hygiene regulations of the hospital. Both secretion collecting bottles may contain infectious secretions.

NOTE

Always wear gloves when emptying the bottles.

- 4 Remove the filter (E) at the bottom of the endotracheal aspiration system. (See "Maintenance" on page 229.)



- 5 Remove the silicone sleeve (F) from the lid (G) of the secretion collecting bottle.
- 6 Remove the float (H) of the overflow protection from the rising pipe.

Prepare associated parts for conditioning in a cleaning and disinfecting machine so that they can subsequently be relocated without difficulty.

When using the disposable VacuSmart container:
Dispose of the VacuSmart container and hose with the infectious secretion.

Note the instructions for use of the suction unit.

The system has been designed and verified for the procedures, chemicals, and values given in this chapter. If other procedures, chemicals, and/or values are used, the user assumes all responsibility.

Reprocessing Procedure

Classification of medical devices

For reprocessing, the medical products are classified by their way of application and the risk resulting from it:

- Uncritical medical devices: surfaces accessible to users and patients, e.g., device surfaces, cables
- Semicritical medical devices: parts conducting breathing gas, e.g., breathing hoses, masks

Testing of procedures and agents

Cleaning, disinfection, and sterilization of medical devices has been tested with the following procedures and agents. At the time of testing, the following procedures and agents showed good material compatibility and effectiveness:

Uncritical medical devices

Manual disinfection and simultaneous cleaning:

- Incidin Extra N by Ecolab
- Incidur by Ecolab

Semicritical medical devices

Manual cleaning:

- Neodisher Medizym by Dr. Weigert

Manual disinfection:

- Gigasept FF by Schülke & Mayr

Machine cleaning:

- Neodisher Medizym by Dr. Weigert

Machine disinfection:

- Thermal, 93 °C (199.4 °F) for 10 min

Sterilization:

- Hot steam, 134 °C (273.2 °F) for 5 min

Observe corresponding instructions for use. The medical device may have been tested with other agents and under other conditions.

Uncritical medical devices

Manual disinfection and simultaneous cleaning

For choosing the appropriate disinfectant, observe country-specific lists of disinfectants. The list of the German Association for Applied Hygiene (Verbund für Angewandte Hygiene VAH) applies in German-speaking countries.

Strictly observe the manufacturer's instructions for using disinfectants. The composition of disinfectants may change.

Procedure:

- 1 Remove dirt immediately with a wipe soaked in disinfectant.

WARNING

Risk of electric shock or device malfunction

Penetrating liquid may cause malfunction of or damage to the device, which may endanger the patient.

Only scrub-and-wipe-disinfect device surfaces and cables and make sure no liquids penetrate into the device.

- 2 Perform surface disinfection (scrub-and-wipe disinfection).
- 3 After the contact time has elapsed, remove disinfectant residues.

Semicritical medical devices

Manual cleaning

Perform manual cleaning preferably under running water and with commercially available cleaning agents (pH value ≤ 12).

Procedure:

- 1 Wash off surface dirt under running water.
- 2 Use cleaning agents in accordance with the manufacturer's instructions. Make sure that all surfaces and interior spaces which must be cleaned are reached. If necessary, use suitable brushes.
- 3 Rinse items thoroughly under running water until cleaning agent residues are no longer discernible.
- 4 Check parts for visible dirt and damage. If necessary, repeat manual cleaning.

Manual disinfection

For choosing the appropriate disinfectant, observe country-specific lists of disinfectants. The list of the German Association for Applied Hygiene (Verbund für Angewandte Hygiene VAH) applies in German-speaking countries.

Strictly observe the manufacturer's instructions for using disinfectants. The composition of disinfectants may change.

Procedure:

- 1 Immerse items in disinfectant.
- 2 After the contact time has elapsed, rinse items thoroughly under running water until disinfectant residues are no longer discernible.
- 3 Check parts for visible dirt and damage. If necessary, repeat manual disinfection.
- 4 Thoroughly shake out residual water. Allow items to dry thoroughly.

Machine cleaning and disinfection

Perform machine cleaning and disinfection using a washer-disinfector in accordance with EN ISO 15883, preferably with a cart for anesthesia accessories and ventilation accessories.

Procedure:

- 1 Observe instructions for use of the washer-disinfector.
- 2 Securely position items in the basket. Make sure that all interior spaces and surfaces are completely flushed and that water can drain off freely.
- 3 Use suitable cleaning agent.
- 4 Select suitable program, preferably anesthesia program.
 - Cleaning must be carried out at 40 °C to 60 °C (104 °F to 140 °F) for at least 5 min.
 - Thermal disinfection must be carried out at 80 °C to 95 °C (176 °F to 203 °F) and with corresponding contact time.
- 5 Carry out final rinsing with deionized water.
- 6 Immediately remove items from the washer-disinfector.
- 7 Check parts for visible dirt and damage. If necessary, repeat program or perform manual cleaning and disinfection.
- 8 Allow items to dry thoroughly.

WARNING

Risk of device failure and patient injury

Correct operation of the workstation may be impaired and lead to failure of the workstation if the control areas in the valve plate are not dried completely.

The valve plate must be sterilized after washing in order to dry it.

NOTE

If the ventilator diaphragm is reprocessed together with light-colored, transparent silicone components, discoloration of these silicone components may occur.

Do not reprocess the specified components together.

Visual inspection

Check all items for damage and external signs of wear, such as cracking, embrittlement, or pronounced hardening, and residual dirt.

CAUTION

Risk of faulty components

Even accessories designed to be reused and removable device parts have a limited service life. Handling and reprocessing can increase wear and markedly shorten service life (e.g., disinfectant residues can attack the material more intensely during autoclaving).

If signs of wear become visible, such as cracks, deformation, discoloration, peeling, etc., affected accessories must be replaced.

Sterilization

Sterilization frees semicritical medical devices from living microorganisms and dries residual water in the items' interior spaces.

- Only sterilize cleaned and disinfected items.

For sterilization, use a vacuum steam sterilizer (in accordance with DIN EN 285), preferably with fractionated vacuum.

Reprocessing List

Applicable to non-infectious patients.

The list contains approximate values only. The instructions of the hospital's infection control officer shall prevail and must be observed by the user!

Items which can be reprocessed	Recommended reprocessing intervals ¹⁾		
	With filter at Y-piece	With microbial filter at inspiratory and expiratory port	Without filter
Primus workstation	Front daily, other sides weekly		
Power cable, compressed gas hoses, potential equalization cable	Monthly		
Breathing hoses	Daily	Per patient	Per patient
Y-piece	Daily	Per patient	Per patient
Breathing bag with connector and hose	Daily	Daily	Per patient
Flexible arm for breathing bag (optional)	Weekly	Weekly	Per patient
Ventilator diaphragm ²⁾	Weekly	Weekly	Per patient
Cover of breathing system with APL valve	Weekly	Weekly	Per patient
Middle and bottom part of breathing system	Weekly	Weekly	Per patient
Expiratory port/inspiratory port	Weekly	Weekly	Per patient
Absorber and insert	Weekly	Weekly	Per patient
Spirolog/SpiroLife flow sensors	Note the instructions for use of the flow sensors		
to scavenger	Note the instructions for use of the AGS.		

- 1) **The conditioning intervals depend on the use and position of the filters. The table is merely intended as a rough guide.
The instructions of the hospital's hygiene officer shall prevail!**
- 2) Drain any water which may have collected in the ventilator diaphragm.
Larger quantities of condensation may impair operation of the workstation and/or lead to failure of the equipment!

Items which can be re-processed	Recommended re-processing intervals	Precleaning	Machine cleaning and disinfection	Manual		Sterilization
				Cleaning	Disinfection	
Primus workstation	Daily	no	no	Outside	no	no
Power cable, compressed gas hoses, potential equalization cable	Monthly	no	no	yes	no	no
Breathing hoses	Daily	yes	yes	Observe corresponding instructions for use.		yes
Y-piece	Daily	yes	yes	no	yes	yes
Breathing bag with connector and hose	Daily	yes	yes	Observe corresponding instructions for use.		yes
Flexible arm for breathing bag (optional)	Weekly	yes	yes	no	yes	yes
Ventilator diaphragm ¹⁾	Weekly	no	yes	no	yes	yes
Cover of breathing system with APL valve	Weekly	yes	yes	no	yes	Yes ²⁾
Middle and bottom part of breathing system	Weekly	yes	yes	no	yes	Yes ²⁾
Expiratory port/inspiratory port	Weekly	yes	yes	no	yes	yes
Absorber and insert	Weekly	yes	yes	no	yes	yes
Spirolog/SpiroLife flow sensors	Note the instructions for use of the flow sensors					
to scavenger	Note the instructions for use of the AGS					

- 1) Drain any water which may have collected in the ventilator diaphragm.
Larger quantities of condensation may impair operation of the workstation and/or lead to failure of the equipment!
- 2) The valve plate must be sterilized after washing in order to dry it. Correct operation of the workstation may be impaired and lead to failure of the workstation if the control areas in the valve plate are not dried completely.

Assembly

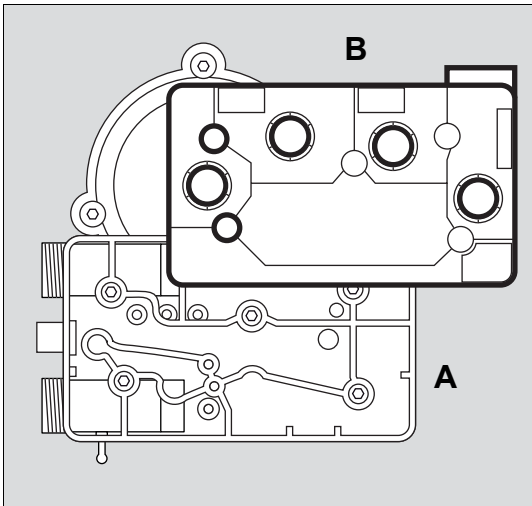
Visual inspection

- Inspect all parts for damage and wear, e.g., cracking, embrittlement or major hardening and residual soiling.
- If necessary, use a dry cloth to remove residual cleaning agent and disinfectants from the valve plate, the ventilator module, and the pins of the breathing system heating.

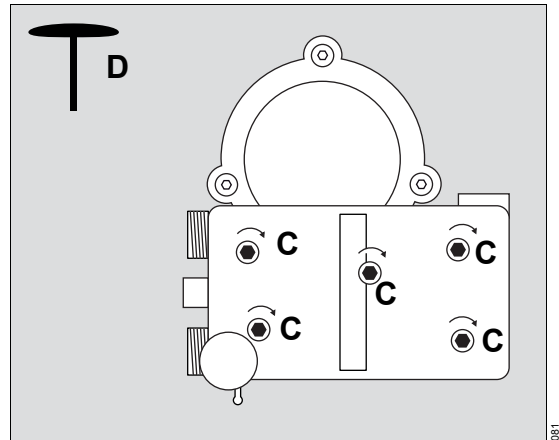
Installing the breathing system

NOTE

Make sure that all blue rubber seals are correctly fitted in the bottom section of the breathing system.

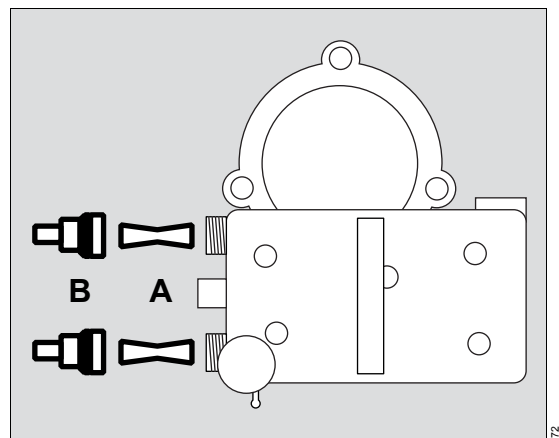


- 1 Place the metal valve plate (breathing system block) (A) on a flat surface.
- 2 Fit the metal valve plate (B) onto the bottom section.



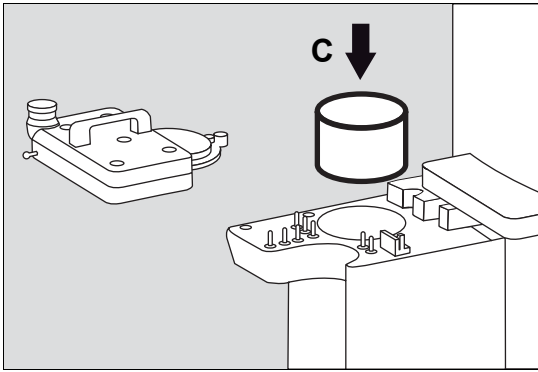
- 3 Tightly fit the cover.
- 4 Tighten all five sealing screws (C) a quarter turn clockwise using the key (D) supplied.

Inserting the flow sensors

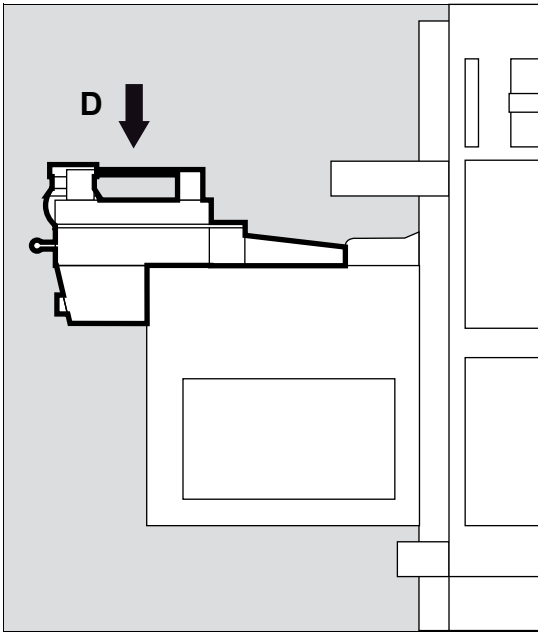


- 1 Insert the flow sensors (A) with the electric connection in the slot.
- 2 Push in the expiratory and inspiratory ports (B), with the nose of the port in the slot.

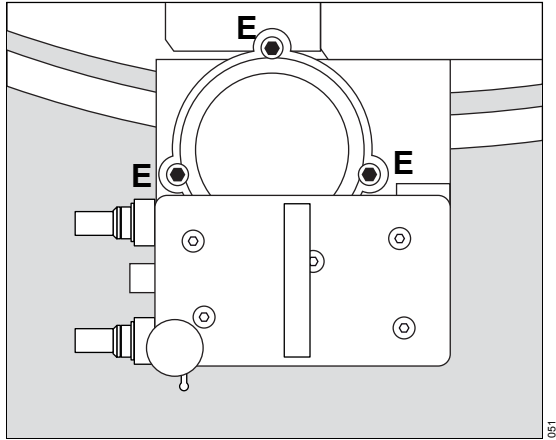
- 3** Tighten the knurled nut by hand.



- 4** Insert the ventilator diaphragm (C) so that the Dräger legend is visible from above.



- 5** Hang the breathing system (D) into the ventilator module.

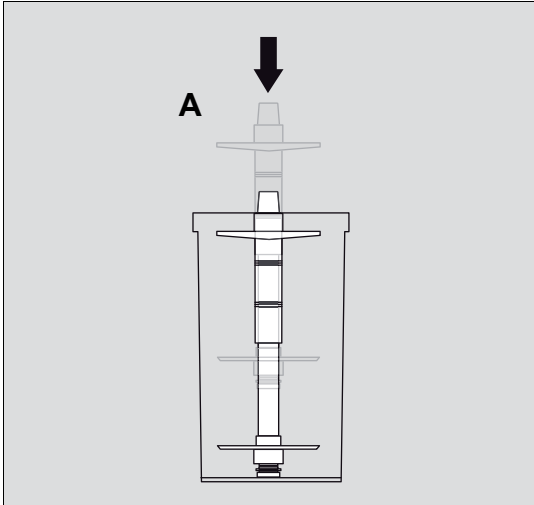


- 6** Tighten the sealing screws (E) on the ventilator cover using the key supplied.

Filling and fitting the absorber

A reusable absorber or the disposable absorber Dräger sorb CLIC can be used.

Reusable absorber



- 1 Push the insert fully into the absorber (A).
- 2 Fill the absorber to the upper mark with fresh soda lime.

WARNING

Risk of injury

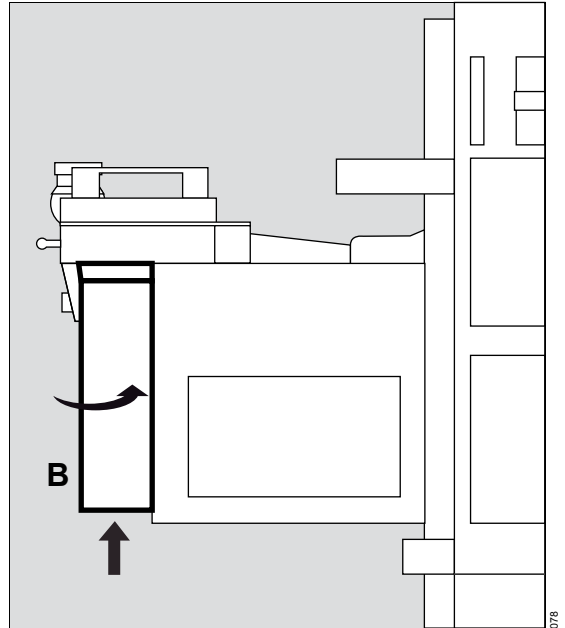
Absorbent is caustic and is a strong eye, skin, and respiratory tract irritant. Use care when handling the absorbent to avoid spills.

Recommendation:

Only use Dräger sorb 800 Plus or Dräger sorb FREE!

NOTE

Do not use powdered lime, as a higher dust load can impair the functionality of Primus.



- 3 Insert the absorber in the breathing system from below (B) and turn clockwise as far as possible. The disposable absorber Dräger sorb CLIC can also be used instead of the reusable absorber described here (see instructions for use of Dräger sorb CLIC).

If the breathing system is not to be used within the next 24 hours:

- Only fill with the soda lime immediately before use!
- Reset the soda lime change log to current date by pressing the soft key **soda lime changed**, see page 87.

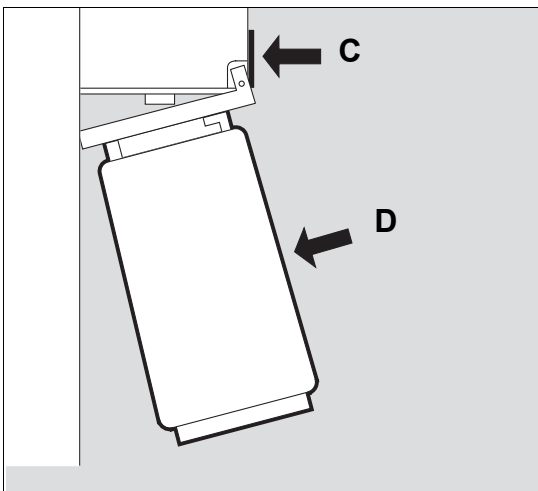
Disposable absorber Drägersorb CLIC

The appropriate adapter must be installed by trained personnel, e.g., DrägerService.

NOTE

The disposable CO₂ absorber must be clicked into place before switching on Primus. This ensures that the absorber is included in the leak and compliance test for the machine.

To click the absorber into place:



- 4 Press the button (C); the mounting swings open.
- 5 Before fitting, shake the disposable absorber, e.g., by turning it upside down several times in order to loosen up the soda lime.
- 6 Remove the seal from the new disposable absorber.
- 7 Slide the new disposable absorber into the mount (D).
- 8 Push the absorber into the machine until it engages.
- 9 Reset the soda lime change log to current date by pressing the soft key **soda lime changed**, see page 87.

WARNING

Risk of patient injury

The soda lime loses humidity. Generally, if the humidity falls below a minimum set point, undesirable reactions can occur, independent of the type of lime and the inhalation anesthetic being used:

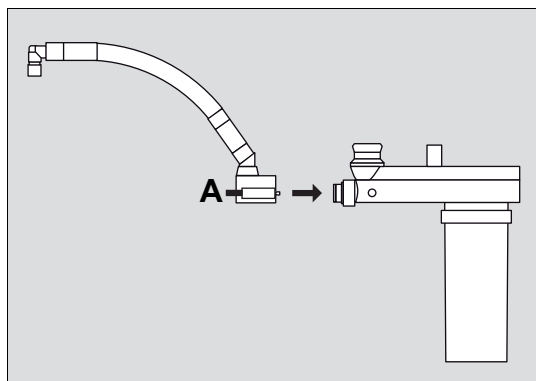
- reduced CO₂ absorption,
- increased heat build-up in the absorber and thus, an increased breathing gas temperature,
- formation of CO,
- absorption and/or decomposition of the inhalation anesthetic.

These reactions could pose a danger to the patient.

If using dry gases, only briefly flush the anesthesia system and only if necessary.

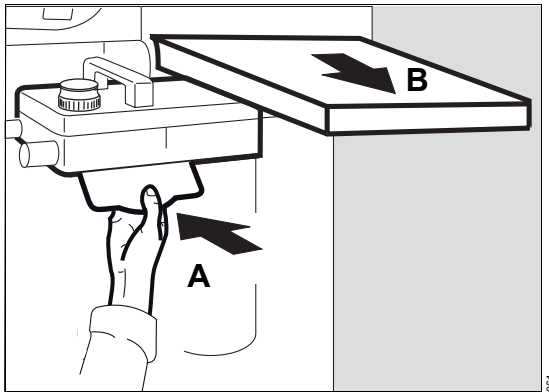
Note the instructions for use of the Drägersorb 800 Plus or Drägersorb FREE soda lime.

Installing the flexible arm (optional) and breathing bag



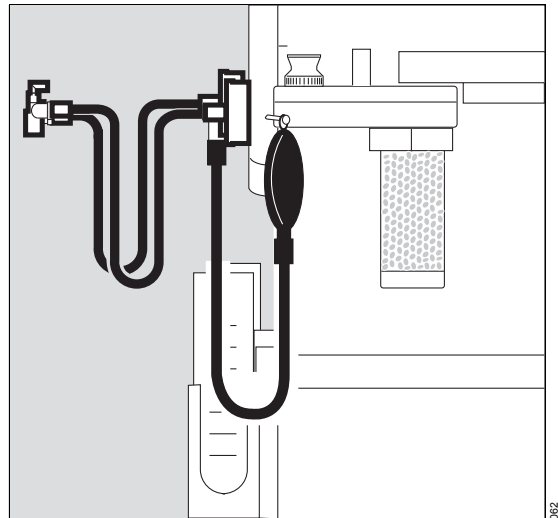
- 1 Position the socket of the arm on the breathing system and tighten it with the two knurled screws (A).
- 2 Check that the arm is fixed securely!

Inserting the ventilator module



- 1 Slowly push in the ventilator module (A) until it engages.
- 2 Check to make sure no hoses or other parts are caught when closing the drawer.
- 3 Pull the writing table (B) out.

Connecting the breathing circuit



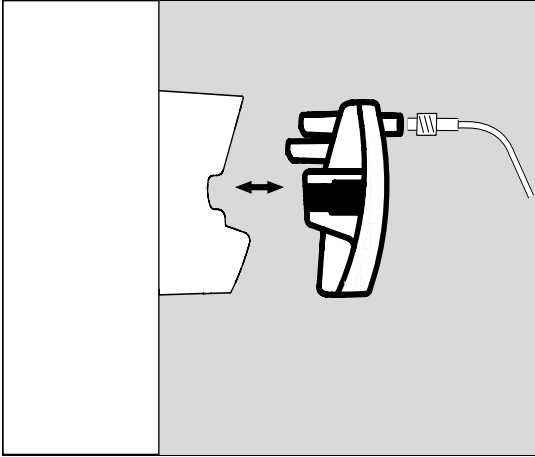
- 1 Fit the microbial filters (optional) on the inspiratory and/or expiratory port of the breathing system until they audibly engage.
- 2 Connect the various parts of the breathing circuit (breathing hoses, Y-piece, connector, and optional Y-piece filter) and hang the breathing bag on the hook.
See "Connecting the patient system" on page 61.

WARNING

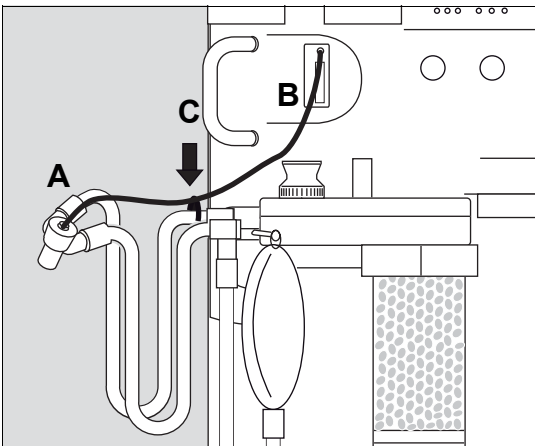
Risk of burns

Conductive breathing hoses or face masks may cause burns during HF surgery.

Do not use these types of hoses and masks in combination with HF surgery.



3 Fit the water trap at the front.



4 Connect the sample line to the Luer Lock connectors on the Y-piece (A) and the water trap (B).

5 Make sure the sample line is guided correctly by using the sample line clip (C). This clip should be attached to the expiratory port of the breathing system.

NOTE

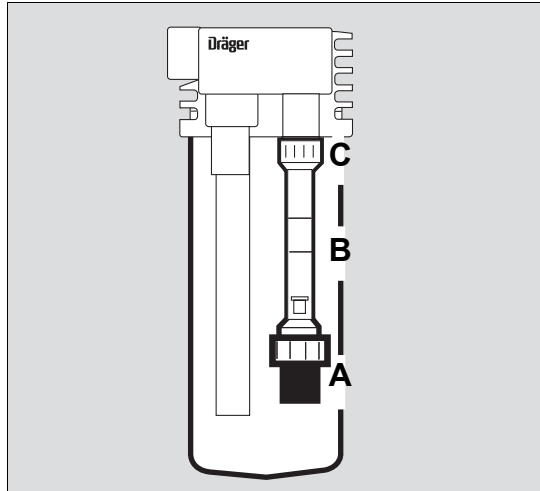
Primus (without accessories) is not made with natural rubber latex.

To minimize the risk of exposure to latex, use latex-free breathing bags and breathing hoses.

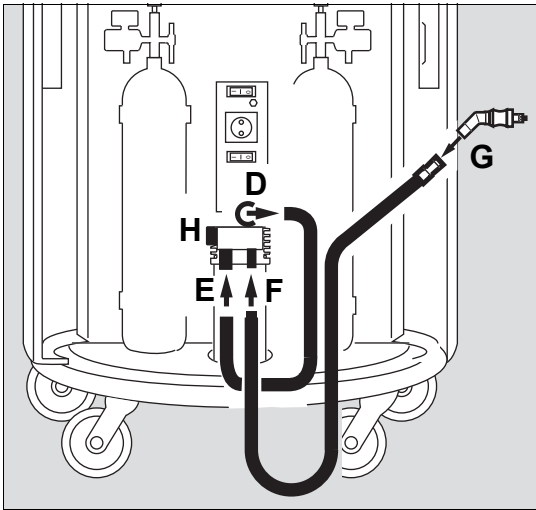
NOTE

Only use original sample line – other lines may change the technical data of the device.

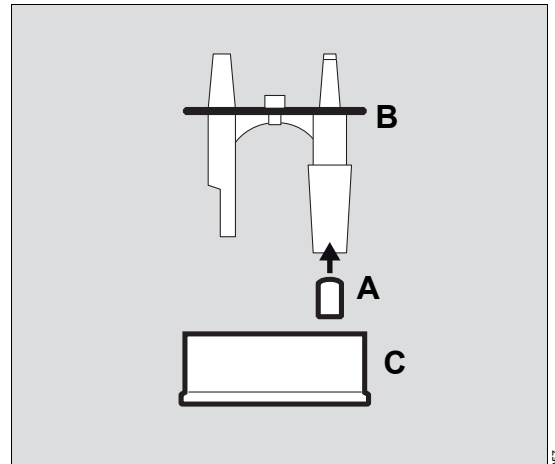
Connecting the anesthetic gas scavenging system AGS



- 1 Install the particle filter (A), tighten the union nut.
- 2 Screw in the flow hose (B).
- 3 Tighten the union nut (C).
- 4 Refit the container for buffer volume.



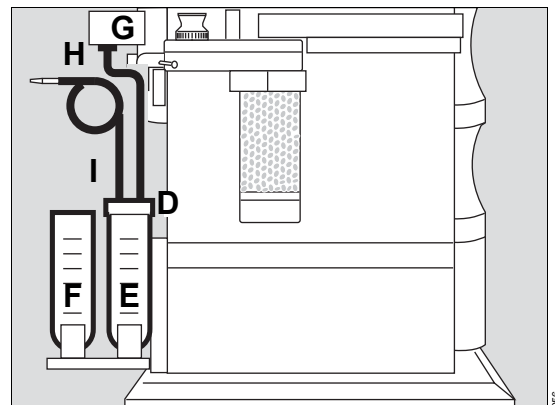
Connecting the secretion aspirator



- 5 Connect the gray transfer hose to the scavenging nozzles (D) on the Primus and on the AGS (E).
- 6 Connect the scavenging hose to the scavenging nozzle (F) of the AGS.
- 7 Connect the scavenging hose to the scavenging connector (G).
- 8 Make sure the second port of the scavenging system (H) is sealed with the screw plug.
- 9 Connect the scavenging connector (G) to the terminal unit of the disposal system. The operation indicator of the terminal unit is green.
- 10 The AGS is functioning when the float in the flow tube is between the two marks.

Note the instructions for use of the anesthetic gas scavenging system AGS.

- 1 Insert the float (A) of the overflow protection into the rising pipe until it clicks into place. The float must move freely without falling out.
- 2 Insert the cover (B) of the secretion collecting bottle into the silicon sleeve (C).



- 3 Grip the silicone sleeve of the bottle cover and fit it on the bottle (D).

- 4 Place the secretion collecting bottle in the inner holder (E) and the rinsing bottle in the outer holder (F).

When using the disposable VacuSmart container:

- Place the VacuSmart container in the secretion collecting bottle and press the sleeve tightly into place.

- 5 Install the filter in the bottom of the endotracheal aspiration system (G).

- 6 Connect the vacuum hose to the filter outlet of the endotracheal aspiration system (H) and to the thin port on the bottle cap.

- 7 Connect the suction hose to the thick port on the bottle cap (I).

Observe the instructions for use of the endotracheal aspiration system.

Before using on patients on again

- 1 Re-assemble all equipment, see "Assembly and preparation" on page 49.
- 2 Check readiness for operation, see "Getting started" on page 71.

Maintenance

Overview	230
Definition of maintenance concepts	230
Inspection	231
Safety checks	231
Preventive maintenance	232
Repair	234
Emptying or replacing the water trap	235
Emptying the water trap	235
Replacing the water trap	235
Replacing the O₂ sensor	236

Overview

This chapter describes the maintenance measures required to maintain the proper functioning of the medical device. Maintenance measures must be performed by the personnel responsible.

WARNING

Risk of infection

Users and service personnel can become infected with pathogenic germs.

Disinfect and clean device or device parts before any maintenance measures and also before returning the medical device for repair.

WARNING

Risk of electric shock

Current-carrying components are located under the cover.

- Do not remove the cover.
- Maintenance measures must be performed by the personnel responsible. Dräger recommends DrägerService to perform these measures.

NOTE

Risk of patient injury

Carrying out maintenance during ventilation will put the patient at risk.

Maintenance must only be carried out when a patient is not connected to the device.

Definition of maintenance concepts

Concept	Definition
Maintenance	All measures (inspection, preventive maintenance, repair) intended to maintain and restore the functional condition of a medical device
Inspection	Measures intended to determine and assess the actual state of a medical device
Preventive maintenance	Recurrent specified measures intended to maintain the functional condition of a medical device
Repair	Measures intended to restore the functional condition of a medical device after a device malfunction

Inspection

Perform inspections at regular intervals and observe the following specifications.

Checks	Interval	Personnel responsible
Inspection	Without Dräger Remote Inspection: Every 6 months With Dräger Remote Inspection: Every 12 months and Remote Inspection every 6 months	Experts
Safety checks ¹⁾	Without Dräger Remote Inspection: Every 6 months With Dräger Remote Inspection: Every 12 months and Remote Inspection every 6 months	Experts

1) Designation applies to the Federal Republic of Germany; corresponds to the "Recurring safety inspection" in the Federal Republic of Austria

Safety checks

Safety checks are no substitute for preventive maintenance measures (including preventive replacement of wear parts) as identified by the manufacturer.

WARNING

Risk of medical device failure

If safety checks are not performed on a regular basis, the proper operation of the medical device can be compromised.

Perform safety checks at the indicated intervals.

- 1 Check accompanying documents:
 - Instructions for use are available
- 2 Perform a functional test of the following features according to the instructions for use:
 - Perform self test.
 - Check O₂ measurement.
- 3 Check that the device combination is in good condition:
 - All labels are complete and legible
 - There is no visible damage
 - Fuses which are accessible from the outside are in compliance with the specified values
- 4 Using the instructions for use, check that all components and accessories needed to use the product are available.
 - Check CO₂ measurement and AGAS measurement.
 - Check flow measurement.
 - Check pressure measurement.
 - Check battery backup for function.
 - Check concentration delivery of anesthetic vaporizer.
 - Check interlock function on vaporizer plug-in system.

- 5 Check the electrical safety according to IEC 62353.
- 6 Check safety features:
 - Correct functioning of the alarm generator

Preventive maintenance

WARNING

Risk of faulty components

Device failure is possible due to wear or material fatigue of the components.

To maintain the proper operation of all components, this device must undergo inspection and preventive maintenance at specified intervals.

WARNING

Risk of electric shock

Before performing any maintenance work, disconnect all electrical connectors and gas connectors from power supply and gas supply.

The following table shows the preventive maintenance intervals:

Component	Interval	Measure	Personnel responsible
CO ₂ absorber	When color changes (specify color)	Replace	Users
AGS filter	Replace when blocked.	Replace	Users
Filter of the endotracheal aspiration system	Replace every two weeks.	Replace	Users
Upper diaphragm of ventilator unit	At least every 12 months	Replace	Users

Component	Interval	Measure	Personnel responsible
Water trap	Replace when soiled or when message WATER TRAP SAMPL. LINE? is displayed (if the sample line is free of blockages and not kinked); at least every four weeks.	Replace	Users
O ₂ sensor – fuel cell	Replace when calibration is no longer possible or when message O₂ SENSOR FAIL is displayed.	Replace	Users
O ₂ sensor – consumption-free	Replacement of O ₂ sensors is not necessary in conjunction with consumption-free O ₂ -measurement (optional).	Replace	Users
Flow sensor	If required, if configuration is no longer possible.	Replace	Users
Filter mat, patient gas module	Every 12 months	Replace	Service personnel
Filter mat, power supply	Every 12 months	Replace	Service personnel
Dust filter, ventilator unit	Every 12 months	Replace	Service personnel
O-rings, vapor plug system	Every 12 months	Replace	Service personnel
O-rings for holder, water trap	Every 12 months	Replace	Service personnel
Nafion hose on patient gas module	Every 12 months	Replace	Service personnel
Filter mat, housing cover	Every 2 years	Replace	Service personnel
Sintered filter, gas inlet	Every 2 years	Replace	Service personnel
PEEP diaphragm, breathing system	Every 2 years	Replace	Service personnel
Man.Spont.-Automatic reversing diaphragm	Every 2 years	Replace	Service personnel
Bacterial/viral filter, patient gas module	Every 2 years	Replace	Service personnel

Component	Interval	Measure	Personnel responsible
Bacterial/viral filter, ventilation and gas controller	Every 2 years	Replace	Service personnel
O-rings between valve plate and diaphragm cover of breathing system	Every 2 years	Replace	Service personnel
Lower diaphragm of ventilator + O-ring	Every 3 years	Replace	Service personnel
Lead gel battery in UPS	Every 3 years	Replace	Service personnel
	Or when message BAT-TERY LOW is displayed.	Replace	Experts

Technical customers documentation according to IEC/EN 60601 is available upon request.

Repair

Dräger recommends that all repairs are carried out by DrägerService and that only authentic Dräger repair parts are used.

Emptying or replacing the water trap

The purpose of the water trap on the front of the device is to prevent condensation and bacterial contamination of the gas monitoring unit.

WARNING

Risk of gas measurement failure and device failure

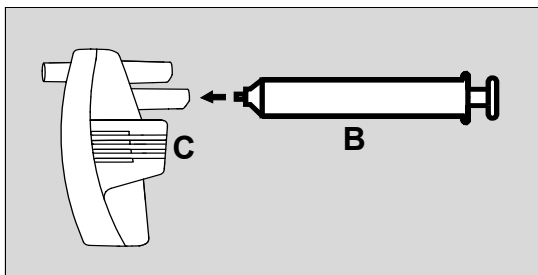
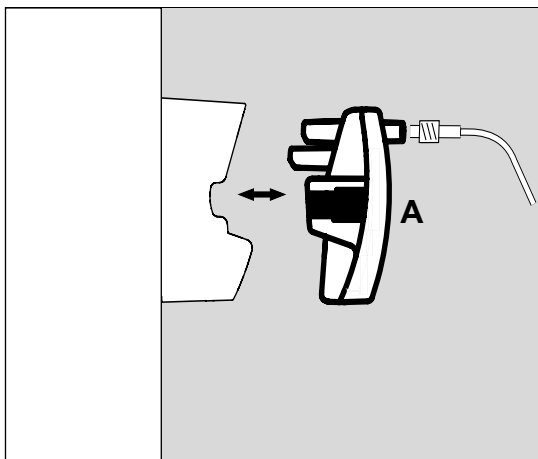
If alcohol or cleaning agents/disinfectants come in contact with the inside of the water trap, they can damage the diaphragm and the measurement system.

Do not use these substances and do not wash, flush, or sterilize the water trap.

The water trap must be replaced if

- the level has reached the upper mark or
 - the monitor displays an error message.
- 1 Pull the water trap (A) off to the front.
 - 2 Insert an empty syringe (B) (minimum volume: 20 mL) without cannula into the blue socket (C).
 - 3 Draw off the water, remove the filled syringe and dispose of it, refer to the instructions for use.
 - 4 Push the water trap into place until it engages.

Emptying the water trap



Replacing the water trap

The water trap must be replaced if

- the monitor continues to display the alarm message after emptying of the water trap
- it is severely soiled.

WARNING

Risk of gas measurement failure and device failure

If the water trap is used longer than intended, the diaphragm may become brittle and allow water and bacteria to enter the measurement system. Such contamination affects the gas measurement which may fail as a result.

The water trap must be replaced after a service life of four weeks.

Proceed as follows:

- 1 Pull the old water trap off to the front, dispose of with domestic waste. Observe the hospital's hygiene regulations!
- 2 Mark the new water trap with the current date. Use the space provided for this purpose.
- 3 Push the new water trap into place until it engages.

Replacing the O₂ sensor

The O₂ sensor can be replaced when the workstation is switched on or off. If you replace the sensor with the device off, perform a self test in order to trigger a new calibration.

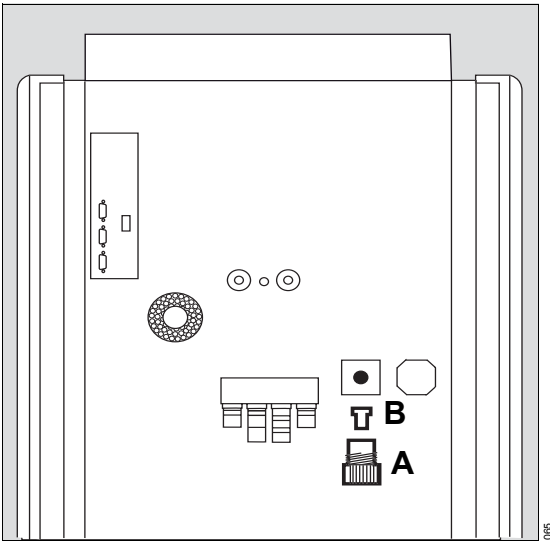
Replacement of O₂ sensors is not necessary in conjunction with consumption-free O₂-measurement (optional).

The O₂ sensor is located on the rear of the device.

It must be replaced if

- the message **O₂ SENSOR FAIL** is displayed or
- the sensor can no longer be calibrated.

Proceed as follows:



- 1 Loosen screw (A).
- 2 Remove the spent O₂ sensor (B) from the screw and insert the new O₂ sensor into the screw.

Screw the screw back into place.

- Dispose of the spent O₂ sensor, refer to the instructions for use.

Disposal

Disposing of the medical device	238
For countries subject to the EU Directive 2002/96/EC.	238
Disposal of Non-Rechargeable Batteries . . .	238

Disposing of the medical device

WARNING

Risk of infection

The device and its components must be disinfected and cleaned before disposal!

At the end of its service life:

- Have the medical device appropriately disposed of in accordance with applicable laws and regulations.

For countries subject to the EU Directive 2002/96/EC

This device is subject to EU Directive 2002/96/EC (WEEE). In order to comply with its registration according to this directive, this device may not be disposed of at municipal collection points for waste electrical and electronic equipment. Dräger has authorized a company to collect and dispose of this device. To initiate collection or for further information, visit Dräger on the Internet at www.draeger.com. Use the Search function with the keyword "WEEE" to find the relevant information. If access to Dräger's website is not possible, contact the local Dräger Organization.

Disposal of Non-Rechargeable Batteries

WARNING

Risk of explosion and of chemical burns

Improper handling of batteries can result in an explosion hazard and chemical burns.

Do not throw batteries into fire. Do not force batteries open.

- Do not recharge batteries.

The battery of this medical device contains pollutant substances.

In the Federal Republic of Germany: end consumers are required under the Batteriegesezt [battery act] to return batteries that contain pollutant substances to the distributor or to a collection point managed by the public authorities responsible for waste management. Therefore, the battery in the device must be removed by a suitably qualified person before disposal of the device. Observe the applicable laws and regulations for battery disposal.

Technical Data

Technical Data	240
General information	240
Ambient conditions	241
Fresh-gas delivery – electronically controlled mixer	241
Ventilator	242
Breathing system	244
Fresh-gas outlet for non-rebreathing systems (optional)	247
Flow tube for oxygen delivery – auxiliary O ₂ flow tube (optional)	247
Measuring systems	248
Interfaces	256
Operating data	257
Classification	260
Use of latex	260
Relevant standards	261
EMC Declaration	262
General information	262
Electromagnetic emissions	263
Electromagnetic immunity	264
Recommended separation distances to portable and mobile radio frequency communication devices	266
Reduced separation distances to portable and mobile radio frequency communication devices	266
Device combinations	267
Connections to IT-networks	267
Information on connecting to the IT-network ..	268

Technical Data

General information

Units of measurement for pressure

1 hPa = 1 mbar = 1 cmH₂O

100 kPa = 0.1 MPa = 1 bar = 1 kPa x 100

All indicated values and accuracy levels apply at 20 °C (68 °F), 60 % relative humidity, and 1013 hPa (760 mmHg).

The accuracy levels indicated below vary depending on ambient pressure, temperature, and relative humidity. If one of the ambient conditions is changed up to the permissible limit, the accuracy of the corresponding value can change by up to 50 %. If more than one of the ambient conditions are changed, the accuracy may change by up to 100 %.

All patient-related volumes and flow values have been standardized to the current ambient conditions (ATPD)

Ambient conditions

During operation

Temperature ¹⁾	15 to 40 °C (59 to 104 °F) max. 35 °C (95 °F) for charging the battery
Humidity ¹⁾	25 to 85 % (no condensation)
Pressure ¹⁾	700 to 1060 hPa (525 to 795 mmHg)
CO ₂ concentration ¹⁾	300 to 800 ppm
Altitude	Up to 3000 m (9842 ft)

Storage/transportation

Temperature ¹⁾	-20 to 60 °C (-4 to 140 °F) O ₂ sensor max. 50 °C (max. 122 °F) battery: min. -15 °C, max. 40 °C (min. 5 °F, max. 104 °F) ²⁾
Humidity ¹⁾	25 to 85 % (no condensation)
Pressure ¹⁾	500 to 1060 hPa (375 to 795 mmHg)
CO ₂ concentration ¹⁾	Not applicable

Fresh-gas delivery – electronically controlled mixer

O₂ concentration	21 to 100 Vol% (for N ₂ O as carrier gas at least 25 Vol% or 200 mL per minute – SORC)
Accuracy	±5 % or 2 Vol%; the greater value applies

Fresh-gas flow	0 and 0.2 to 18 L per minute volumetric flow ³⁾ Standardized to ATPD conditions.
At 0 L per minute	+0.005 L per minute
Within a range of 0.20 to 0.40 L per minute	±0.04 L per minute
Above 0.40 L per minute	±10 %

1) Depending on the type of anesthetic agent delivery unit used, this data may vary.

2) The longer-term storage at a temperature outside this range may shorten the life of the batteries.

3) The maximal permissible fresh-gas flow may be limited depending on the anesthetic agent vaporizer used.

Tidal volume V_T (system compliance compensated)

All values apply under ATPD conditions:

In Volume Mode and Volume AF Mode	20 to 1400 mL ¹⁾
With optional Pressure Support	5 to 1400 mL ¹⁾
Accuracy	
Within a range of 5 to 150 mL	±10 % of set value or at least ±10 mL, the greater value applies
Above 150 mL	±5 % of set value or at least ±15 mL, the greater value applies

Frequency	3 to 100 per minute
Accuracy	±10 % of set value or ±1 per minute, the lower value applies

Minimum frequency **Freq_{MIN}**

In Pressure Support	3 to 20 per minute or OFF
In Press. Support CPAP	OFF
Accuracy	±10 % of set value or ±1 per minute, the lower value applies

T_{INSP}	0.2 to 6.7 seconds
Insp./Exp. ratio I:E	Derived from frequency and T_{INSP} Range: 5:1 to 1:99

Inspiratory pause TIP: T_{INSP}	0 to 60 %
Inspiratory flow	Derived from V_T and T_{INSP}
In Volume Mode	0.1 to 100 L per minute ±10 %
In Volume AF Mode	Max. 150 L per minute +10 %
In Pressure Mode	Max. 150 L per minute +10 %

1) Due to gas measurement sampling, leakage (both at the patient and in the device), and resistance/compliance of the patient and the breathing circuit, the maximum delivered tidal volume may be limited.

PEEP

In Volume Mode and Volume AF Mode	0 to 20 hPa (max. P _{MAX} –10 hPa) [0 to 20 cmH ₂ O (max. P _{MAX} –10 cmH ₂ O)]
In Pressure Mode and Pressure Support	0 to 20 hPa (max. P _{INSP} –5 hPa) [0 to 20 cmH ₂ O (max. P _{INSP} –5 cmH ₂ O)]
Accuracy	±10 % of set value or ±2 hPa (±2 cmH ₂ O), the greater value applies ¹⁾

ΔPPS

In Volume Mode , Volume AF Mode and Pressure Mode	3 to 50 hPa (max. P _{INSP}) [3 to 50 cmH ₂ O (max. P _{INSP})]
In Press. Support	3 to 50 hPa (max. P _{INSP}) [3 to 50 cmH ₂ O (max. P _{INSP})] 0 to 2 hPa (0 to 2 cmH ₂ O) = Press. Support CPAP

Trigger

0.3 to 15 L per minute or **OFF**

TSLOPE

In **Pressure Mode**, **Volume AF Mode** and **Pressure Support** 0 to 2 seconds

Breathing system

Total volume	(without breathing hoses, incl. absorber)
In Man.Spont.	Typical 3.7 L
During automatic ventilation	Typical 4.0 L (incl. piston volume)

Compliance (without breathing hoses)

All values apply under STPD conditions:

In Man.Spont.	Typical 3.7 mL/hPa (3.7 mL/cmH ₂ O)
During automatic ventilation	Typical 2.3 mL/hPa (2.3 mL/cmH ₂ O)

1) Due to gas measurement sampling and leaks (both at the patient and in the device), the end-expiratory **PEEP** value may be lower than specified at the end of long expiratory phases.

Volume absorber

Reusable absorber canister, filled	1.5 L
Clic absorber (Drägersorb CLIC 800 Plus)	1.3 L
Clic absorber (Drägersorb CLIC Free)	1.2 L

Flexible arm for breathing bag

Volume	0.13 L
Compliance	0.13 mL/hPa (0.13 mL/cmH ₂ O)

Total system leak

<150 mL per minute at 30 hPa (30 cmH₂O)
Standardized to BTPS conditions.

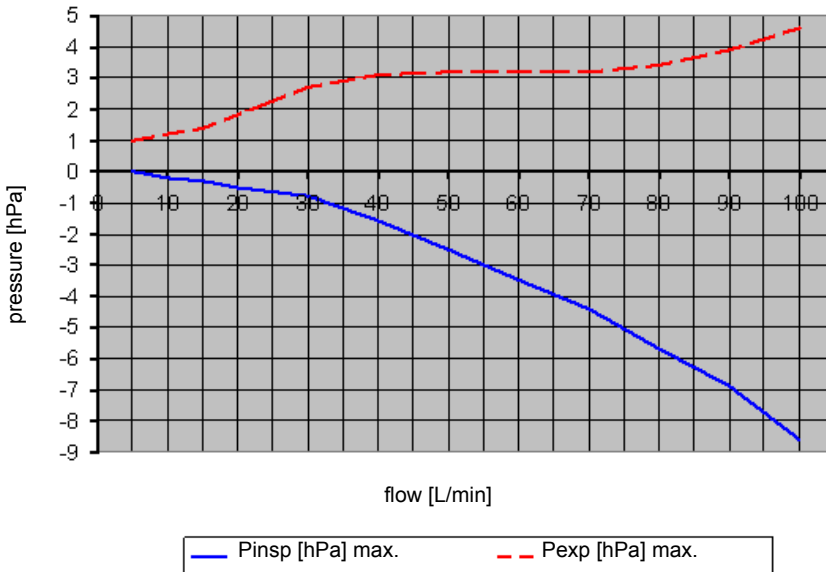
Pressure limitation valve APL

Setting ranges	5 to 70 hPa (5 to 70 cmH ₂ O)
Accuracy, within a range of 5 to 15 L per minute	±15 % of set value or ±3 hPa (±3 cmH ₂ O), the greater value applies
Pressure drop at 30 L per minute	2.8 hPa (2.8 cmH ₂ O) (in Spont position; wet and dry)

Resistance

	Reusable absorber or CLIC absorber with or without flexible bag arm, normal operation (filled with Drägersorb 800 +)	
	Inspiratory	Expiratory
As per ISO 8835-2, dry, max. ±6 hPa (±6 cmH ₂ O), with hose set for adults M30146	-4.4 hPa (-4.4 cmH ₂ O)	4.2 hPa (4.2 cmH ₂ O)
As per ISO 8835-2, dry, sole breathing system without patient hoses	-3.5 hPa (-3.5 cmH ₂ O)	3.2 hPa (3.2 cmH ₂ O)

Pressure and flow characteristics of the breathing system without breathing hoses and filters (in accordance with ISO 8835-2 and ISO 80601-2-13)



384

Minimal Limited Pressure
 (in accordance with ISO 8835-5
 and ISO 80601-2-13)

-3 hPa
 (-3 cmH₂O)

Fresh-gas outlet for non-rebreathing systems (optional)

All values apply under STPD conditions:

Connection	Ø22 mm ISO cone (male) with Ø15 mm ISO cone (female)
Pressure limitation	Max. 80 hPa (80 cmH ₂ O) at 18 L per minute
Fresh-gas flow	0 and 0.2 to 18 L per minute (see fresh-gas delivery for tolerances)

Flow tube for oxygen delivery – auxiliary O₂ flow tube (optional)

All values apply under STPD conditions:

Connection	Graduated connection for use with various hose diameters
Flow range	0 to 10 L per minute
Resolution of the displayed value	0.5 L per minute
Accuracy of the flow display	±10 % of full scale

Measuring systems

Pressure measurement (piezo-resistive)

Respiratory pressure

Measuring range	-20 to 99 hPa (-20 to 99 cmH ₂ O)
Resolution of the displayed value	0.1 hPa (0.1 cmH ₂ O)
Accuracy	±4 % of the measured value or ±2 hPa (±2 cmH ₂ O), the greater value applies

PEEP, PEAK, PLAT, P_{MEAN}

Measuring range	-20 to 99 hPa (-20 to 99 cmH ₂ O)
Resolution of the displayed value	1 hPa (1 cmH ₂ O)
Accuracy	±4 % of the measured value or ±2 hPa (±2 cmH ₂ O), the greater value applies

Respiratory pressure at the external fresh-gas outlet

Measuring range	-20 to 99 hPa (-20 to 99 cmH ₂ O)
Resolution of the measurement	0.1 hPa (0.1 cmH ₂ O)
Accuracy	±8 % of the measured value or ±3 hPa (±3 cmH ₂ O), the greater value applies

PEAK, P_{MEAN} at the external fresh-gas outlet

Measuring range	-20 to 99 hPa (-20 to 99 cmH ₂ O)
Resolution of the displayed value	1 hPa (1 cmH ₂ O)
Accuracy	±8 % of the measured value or ±3 hPa (±3 cmH ₂ O), the greater value applies

Central supply pressure

Measuring range	0 to 9.8 kPa x 100 (0 to 140 psi)
Resolution of the displayed value	0.1 kPa x 100 (1.5 psi)
Accuracy	±4 % or ±0.2 kPa x 100 (±4 % or ±3 psi)

Cylinder pressure¹⁾

Measuring range	0 to 250 kPa x 100 (0 to 3600 psi)
Resolution of the displayed value	1 kPa x 100 (14 psi)
Accuracy	±4 % or ±6 kPa x 100 (±4 % or ±87 psi)

Flow measurement (hot-wire anemometry)

All values apply under ATPD conditions:

Flow

Measuring range	-180 to 180 L per minute
Resolution of the measurement	0.1 L per minute
Accuracy at 60 L/min	±8 % of the measured value

Tidal volume V_T

Measuring range	0 to 9999 mL
Resolution of the displayed value	1 mL
Accuracy	±8 % of the measured value or ±5 mL, the greater value applies

Delta V_T

Measuring range	0 to 9999 mL
Resolution of the displayed value	1 mL
Accuracy	±16 % or ±10 mL, the greater value applies

Volume V_{TINSPI}

Measuring range	0 to 9999 mL
Resolution of the displayed value	1 mL
Accuracy	±8 % of measured value or ±5 mL, the greater value applies

Minute volume MV

Measuring range	0 to 99.9 L per minute
Resolution of the displayed value	0.1 L per minute
Accuracy	±8% of measured value or ±0.1 L/min, the greater value applies

1) Valid for Silverline pressure regulators.

Compliance CPAT

Measuring range	0 to 250 mL/hPa (0 to 250 mL/cmH ₂ O)
Resolution of the displayed value	0.1 mL/hPa (0.1 mL/cmH ₂ O)
Accuracy	±15 % of the measured value or ±0.5 mL/hPa (±0.5 mL/cmH ₂ O), the greater value applies

MVLEAK

Measuring range	0 to 9.99 L per minute
Resolution of the displayed value	0.01 L per minute
Accuracy	±15 % of (MVEXP + MVLEAK) or ±0.1 L per minute, the greater value applies

MVMAND

Measuring range	0 to 99.9 L per minute
Resolution of the displayed value	0.1 L per minute
Accuracy	±8 % of measured value or ±0.1 L per minute, the greater value applies

MVSPON

Measuring range	0 to 99.9 L per minute
Resolution of the displayed value	0.1 L per minute
Accuracy	±8 % of measured value or ±0.1 L per minute, the greater value applies

O₂ Uptake

Measuring range	0 to 9999 mL per minute
Resolution of the displayed value	1 mL per minute
Accuracy	±15 % or ±20 mL per minute, the greater value applies

MV*CO₂

Measuring range	0 to 9999 mL per minute
Resolution of the displayed value	1 mL per minute
Accuracy	±20 % or ±20 mL per minute, the greater value applies

Frequency measurement

Frequency (*Freq.*)

Measuring range	1 to 100 per minute
Resolution of the displayed value	1 per minute
Accuracy	±10 % or ±1 per minute, the lower value applies (6 to 100 per minute) ±0.3 per minute (<6 per minute)

Gas measurement

Sidestream gas measurement

The gas sampled via the water trap is returned to the breathing system and included in measurement and delivery calculations. The inlet of the gas measurement system contains a filter in the water trap and there is a filter in the outlet of the sample gas return. All values are measured under ATPS conditions. The sample flow is standardized to STPD conditions.

The measurement is corrected for ambient pressure.

Due to the T_{10...90} time and the sampling rate, the accuracies of the measured values for O₂, N₂O, and anesthetic agent may deviate at respiratory rates of 75 /min and an I:E ratio of 1:2. The influence of respiratory rate and I:E ratio on accuracy has been verified in a simulated breathing system using a rectangular waveform for the gas concentration.

Endtidal measured values are calculated for each breath from the local maxima and minima of the real-time measurements during expiration. If CO₂ respiratory phases are detected, the sample flow is compensated during ventilation and flow measurement.

Time after switch-on until the specified accuracy is attained - Less than 500 ms

Sensor sampling rate <50 ms

Time until CO₂ measured values are displayed - 95 s

Maximum time until emptying of the water trap is necessary - 41 h (sample gas under BTPS conditions, ambient air 23 °C)

Sample rate ¹⁾	150 mL per minute ±20 mL per minute	200 mL per minute ±20 mL per minute
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Delay for sampling (typical value; depends on sample line used)	Less than 4 seconds	Less than 4 seconds
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1) The respective value depends on the PGM used which is displayed on System Information page.

Response time $t_{10...90}$ O₂

Gas measurement module using fuel cell (ambient temperature ≥ 20 °C)	Less than 650 ms	Less than 650 ms
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Gas measuring module with consumption-free O ₂ measuring	Not applicable	Less than 500 ms
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Response time $t_{10...90}$ CO₂	Less than 500 ms	Less than 350 ms
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Response time $t_{10...90}$ anesthetic gas	Less than 500 ms	Less than 500 ms
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Response time t_{10} to 90 N₂O	Less than 500 ms	Less than 500 ms
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O₂ measurement – electrochemical (fuel cell)

Measuring range	5 to 100 Vol%
------------------------	---------------

Resolution of the measurement	0.1 Vol%
--------------------------------------	----------

Resolution of the displayed value (for insp. O₂, exp. O₂)	1 Vol%
--	--------

Accuracy	When calibrated with air:	When calibrated with 100 Vol% O ₂ :
	± 3 Vol% within a measuring range of 5 to 50 Vol%	± 3 Vol% within a measuring range of 5 to 100 Vol%
	± 5 Vol% within a measuring range of 50 to 100 Vol%	

O₂ measurement – paramagnetic (consumption-free)

Measuring range	0 to 100 Vol%
------------------------	---------------

Resolution of the measurement	0.1 Vol%
--------------------------------------	----------

Resolution of the displayed value (for insp. O₂, exp. O₂)	1 Vol%
--	--------

Accuracy	$\pm(2.5$ Vol% +2.5 % rel.)
-----------------	-----------------------------

CO₂ measurement (infrared spectrometry)

Measuring range	0 to 13.6 Vol% 0 to 13.6 kPa 0 to 102 mmHg (at an ambient pressure of 1013 hPa / 760 mmHg)
Resolution of the measurement	1 mmHg
Resolution of the displayed value (for etCO₂, inCO₂)	1 mmHg
Accuracy	±(0.43 Vol% +8 % rel.) ±(3.3 mmHg +8 % rel.)

Anesthetic gas measurement (infrared spectrometry)

All values given in Vol% at 1013 hPa (760 mmHg) ambient pressure

Measuring range anesthetic gases

Halothane	0 to 8.5 Vol%
Isoflurane	0 to 8.5 Vol%
Enflurane	0 to 10 Vol%
Sevoflurane	0 to 10 Vol%
Desflurane	0 to 20 Vol%
Resolution of the measurement	0.1 Vol%
Resolution of the displayed value (for insp. and exp. anesthetic agent)	0.1 Vol%
Accuracy ¹⁾	±(0.2 Vol% +15 % rel.)

Measuring range N₂O

	0 to 100 Vol%
Resolution of the measurement	0.1 Vol%
Resolution of the displayed value (for insp. and exp. N ₂ O)	1 Vol%
Accuracy	±(2 Vol% + 8 % rel.)

MAC (xMAC)

Range	0 to 9.9
Resolution of the displayed value	0.1
Accuracy	Derived value from gas measurement values

1) At respiratory frequencies up to 60 per minute and an insp./exp. ratio of 1:1.

Interfaces

2 serial interfaces: COM 1 and COM 2

COM 1 and COM 2

Protocol MEDIBUS, MEDIBUS.X¹⁾ (COM 2 without real-time data)
Plug 9-pol Sub-D, galvanic separation 1.5 kV

Only connect devices that meet the requirements of IEC 60950-1 for ungrounded SELV circuits and the requirements of IEC 60601-1 (as of the 2nd edition) for touchable secondary circuits with a maximum nominal voltage of 24 VDC.

Pin allocation

1	NC, not connected
2	TX, transmit
3	RX, receive
4	DTR, data terminal ready
5	GND, ground
6	DSR, data set ready
7	RTS, request to send
8	CTS, clear to send
9	NC, not connected

Shields DTR and DSR, as well as RTS and CTS are internally connected. Hardware handshake is not supported.

Settings

1200 or 9600 Baud
Even parity
8 data bits
1 stop bit

IV System (Dräger Base)

Power supply for IV System

SA bus

For internal use only;
available depending on configuration

SpO₂

For connecting an SpO₂ sensor

1) System alarm delay time = 600 ms (typical value).

Operating data

Operating voltage 100 to 240 VAC, 50/60 Hz

Power consumption

at 230 V~

Standby (without auxiliary outlets)	0.8 A
Typical (without charging the internal battery, without auxiliary outlets)	0.9 A
Maximum (with auxiliary outlets)	12.8 A

at 110 V~

Standby (without auxiliary outlets)	1.6 A
Typical (without charging the internal battery, without auxiliary outlets)	1.8 A
Maximum (with auxiliary outlets)	12.8 A

Power input

Standby	180 W
Typical	200 W
Maximum (with power consumption on auxiliary outlets)	2.5 kW

Internal battery

Type	Lead-gel battery Sealed, maintenance-free
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Backup time with new and fully charged battery (auxiliary outlets not supplied)

At least	30 minutes
Maximum	90 minutes (depending on ventilation parameters)
Charging time (to reach full power)	At least 10 hours
Charging power	Maximum 70 W

Auxiliary power outlets

2 outlets with automatic circuit breakers rated at 4 A each or 3 outlets with fuses rated at 2 A each

Compressed gas supply at workstation pipeline pressure inlet

All values apply under ATPD conditions:

Supply pressure for O₂, N₂O, and Air	2.7 to 6.9 kPa x 100 (39 psi to 100 psi)
Short-term peak inlet flows	approx. 55 L/min, approx. 18 L/min, averaged over 10 s
Scavenging flow for anesthetic gas re- ceiving system	30 to 50 L per minute
Dew point	>5 °C (>41 °F) under ambient temperature
Oil content	<0.1 mg/m ³
Particles	Dust-free air (filtered with pores: <1 µm)

Driving gas consumption None

Noise emissions

Sound pressure level (measured in a free field in accordance to ISO 3744) at a height of 1.5 m in a distance of 1 m to the front of the anesthesia system:

L _{pmin} (Standby)	≤35 dB(A)
L _{pmax} ("Peak" during ventilation)	≤46 dB(A)
Leq (5 cycles)	≤42 dB(A)


Dimensions¹⁾ (W x H x D)

Primus	80 cm x 137 cm x 80 cm (approx. 31.5 in x 53.9 in x 31.5 in)
Primus ceiling/wall device	64 cm x 97 cm x 54 cm (25.2 in x 38.2 in x 21.3 in)
Top shelf (W x D)	43 cm x 29 cm (16.9 in x 11.4 in)
Breathing system (W x H x D)	37.5 cm x 40.5 cm x 34.5 cm (14.8 in x 15.9 in x 13.6 in)

1) Deviations possible depending on the configuration.

weight

Nominal configuration	Approx. 140 kg (309 lbs)
Floor unit: consisting of basic device, plug-in connector for 2 vaporizers, breathing system, CLIC adapter and CLIC absorber, breathing hoses, central supply hoses (5 m (16.4 ft)), scavenging hose (5 m (16.4 ft))	
Various attached parts (e.g., baskets, flexible breathing bag holder, park holder for vaporizer, cylinder pressure reducers, gas cylinder holder, halogen light)	Approx. 10 kg (22 lbs)
Writing table XXL	+ approx. 3 kg (7 lbs)
Endotracheal aspiration system with swivel arm and accessories	+ approx. 6 kg (13 lbs)
Swivel cupboard	+ approx. 13 kg (29 lbs)
Oval pole swivel arm	+ approx. 4 kg (9 lbs)
Pump mount	+ approx. 6 kg (13 lbs)
Permitted total weight	300 kg (662 lbs)
Nominal configuration	Approx. 110 kg (309 lbs)
Ceiling/wall device: consisting of basic device, plug-in connector for 2 vaporizers, breathing system, CLIC adapter and CLIC absorber, breathing hoses, central supply hoses (5 m (16.4 ft)), scavenging hose (5 m (16.4 ft))	
Various attached parts (e.g., baskets, flexible breathing bag holder, park holder for vaporizer, cylinder pressure reducers, gas cylinder holder, halogen light)	Approx. 10 kg (22 lbs)
Media docking	+ approx. 14 kg (31 lbs)
Writing table XXL	+ approx. 3 kg (7 lbs)
Oval pole swivel arm	+ approx. 4 kg (9 lbs)
Pump mount	+ approx. 6 kg (13 lbs)
Permitted total weight	300 kg (662 lbs)
Breathing system without soda lime	4.4 kg (9.7 lbs)

Screen	Flat screen, color, TFT, 12.1" screen diagonal, 800 x 600 pixels
Life span	10 years
Protection class	
Workstation	I, as per IEC 60601-1
IP class as per IEC 60529	IPX0
SpO ₂ sensor (breathing system nozzles)	Type BF  electrically isolated from protective conductor
Electromagnetic compatibility	Tested as per IEC 60601-1-2
Classification	
as per Guideline 93/42 EWG, Annex IX	Class II b
UMDNS Code	
Universal Medical Device Nomenclature System – nomenclature for medical de- vices	10-134
GMDN code	
Global Medical Device Nomenclature – global nomenclature for medical devices	37710
Use of latex	Primus is not made with natural rubber latex.

Relevant standards

In addition to the standards listed here, the medical device also complies with various other standards, e.g., standards concerning special national requirements.

IEC 60601-1 2nd ed. Medical electrical equipment	Part 1: Requirements for safety
IEC 60601-1-2 Medical electrical equipment	Part 1-2: General requirements for safety, Collateral standard: Electromagnetic compatibility; Requirements and tests
IEC 60601-1-8 Medical electrical equipment	Part 1-8: General requirements for safety, Collateral standard: General requirements, tests and guidance for alarm systems in medical electrical systems
IEC 60601-2-13 Medical electrical equipment	Part 2-13: Particular requirements for the safety of anaesthetic systems
ISO 8835-2 Systems for inhalational anaesthesia	Part 2: Anaesthetic breathing systems
ISO 8835-3 Systems for inhalational anaesthesia	Part 3: Transfer and receiving systems of active anaesthetic gas scavenging systems
ISO 8835-4	Part 4: Anaesthetic vapour delivery devices
ISO 8835-5 Systems for inhalational anaesthesia	Part 5: Anaesthetic ventilators
ISO 9919 Medical electrical equipment	Particular requirements for basic safety and essential performance of pulse oximeter equipment for medical use
ISO 21647 Medical electrical equipment	Particular requirements for basic safety and essential performance of respiratory gas monitors

For devices from production date July 2015 the following also applies:

IEC 60601-1 3rd ed. Medical electrical equipment	Part 1: General requirements for basic safety and essential performance
IEC 60601-1-2 Medical electrical equipment	Part 1-2: General requirements for safety - Collateral standard: Electromagnetic compatibility - Requirements and tests

IEC 60601-1-8	Part 1-8: General requirements for safety including essential performance characteristics - Collateral standard: Alarm systems - General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
ISO 80601-2-13 Medical electrical equipment	Part 2-13: Particular requirements for basic safety and essential performance of an anaesthetic workstation
ISO 80601-2-55	Part 2-55: Particular requirements for the basic safety and essential performance of respiratory gas monitors

EMC Declaration

General information

The EMC compliance of the product has been evaluated with the external cables, transducers, and accessories specified in the list of accessories.

Other accessories which do not affect EMC compliance may be used if no other reasons forbid their use (see other sections of the instructions for use). The use of noncompliant accessories can result in increased emissions or decreased immunity of the medical device.

The medical device may only be used adjacent to or stacked with other devices when the configuration is approved by Dräger. When use adjacent to or stacked with other devices is absolutely necessary without the configuration being approved by Dräger, the correct operation of the device in this configuration must be tested before the product is used. In any case, strictly observe the instructions for use of the other devices.

Electromagnetic emissions

Electromagnetic environment

The medical device is intended for use in an electromagnetic environment as specified below. The user must ensure that the medical device is used in such an environment.


Emissions	Compliance according to	Electromagnetic environment
RF emissions (CISPR 11)	Group 1	The medical device uses radio frequency energy only for its internal function. Therefore, its radio frequency emissions are very low and are not likely to cause any interference in nearby electronic equipment.
	Class A	The medical device is suitable for use in all establishments other than domestic establishments and those directly connected (without transformer) to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions (IEC 61000-3-2)	Not applicable	
Voltage fluctuations / flicker (IEC 61000-3-3)	Not applicable	

Electromagnetic immunity

The medical device is intended for use in an electromagnetic environment as specified below. The user must ensure that the medical device is used in such an environment.

Immunity against	IEC 60601-1-2 test level	Compliance level (medical device)	Electromagnetic environment
Electrostatic discharge, ESD (IEC 61000-4-2)	Contact discharge: ±6 kV Air discharge: ±8 kV	±6 kV ±8 kV	Floors should be wood, concrete, or ceramic tiles. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transients / bursts (IEC 61000-4-4)	Power supply lines: ±2 kV Longer input lines/ output lines: ±1 kV	±2 kV ±1 kV	Mains voltage quality should be that of a typical commercial or hospital environment.
Surges on AC mains lines (IEC 61000-4-5)	Common mode: ±2 kV Differential mode: ±1 kV	±2 kV ±1 kV	Mains voltage quality should be that of a typical commercial or hospital environment.
Power frequency magnetic field 50/60 Hz (IEC 61000-4-8)	3 A/m	3 A/m	No equipment with extraordinarily strong power frequency magnetic fields (power transformers, etc.) should be operated in close vicinity to the medical device.
Voltage dips and short interruptions on AC mains input lines (IEC 61000-4-11)	Dip >95 %, 0.5 periods Dip 60 %, 5 periods Dip 30 %, 25 periods Dip >95 %, 5 seconds	>95 %, 0.5 per. 60 %, 5 per. 30 %, 25 per. >95 %, 5 sec.	Mains voltage quality should be that of a typical commercial or hospital environment. If the user of the medical device requires continued operation during mains power supply interruptions, it is recommended that the medical device is powered from an uninterruptible power supply or a battery.
Radiated RF (IEC 61000-4-3)	80 MHz to 2.5 GHz: 10 V/m	10 V/m	Recommended minimum distance to portable and mobile radio frequency transmitters with transmission power PEIRP to the medical device including its lines: $(1.84 \text{ m} \times \sqrt{\text{PEIRP/W}})^1$ $(6.04 \text{ ft} \times \sqrt{\text{PEIRP/W}})^1$

Immunity against	IEC 60601-1-2 test level	Compliance level (medical device)	Electromagnetic environment
RFcoupled into lines (IEC 61000-4-6)	150 kHz to 80 MHz: 10 V inside ISM bands ²⁾ 150 kHz to 80 MHz: 3 V outside ISM bands ²⁾	10 V 3 V	Recommended minimum distance to portable and mobile radio frequency transmitters with transmission power PEIRP to the medical device including its lines: (1.84 m x \sqrt{PEIRP}) ¹⁾ (6.04 ft x $\sqrt{PEIRP/W}$) ¹⁾

- 1) For PEIRP, insert the highest possible "equivalent isotropic radiated power" of the adjacent radio frequency transmitter. In the vicinity of equipment marked with the symbol , interference can occur. Field strengths from fixed, portable, or mobile radio frequency transmitters at the location of the medical device should be less than 3 V/m in the frequency range from 150 kHz to 2.5 GHz and less than 1 V/m above 2.5 GHz.
- 2) ISM bands in this frequency range are: 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; 40.66 MHz to 40.70 MHz.

Recommended separation distances to portable and mobile radio frequency communication devices

The following separation distances are in accordance with the specifications of IEC 60601-1-2.

Maximum PEIRP (W)	150 kHz to 2.5 GHz	All other frequencies	Examples
0.03	0.32 m (1.05 ft)	0.96 m (3.15 ft)	WLAN 5250/5775 (Europe)
0.10	0.58 m (1.90 ft)	1.75 m (5.74 ft)	WLAN 2440 (Europe)
0.17	0.76 m (2.49 ft)	2.28 m (7.48 ft)	Bluetooth, RFID 2.5 GHz
0.20	0.82 m (2.69 ft)	2.47 m (8.10 ft)	WLAN 5250 (not in Europe)
0.25	0.92 m (3.02 ft)	2.76 m (9.06 ft)	UMTS mobiles
0.41	1.18 m (3.87 ft)	3.53 m (11.58 ft)	Cordless DECT devices
0.82	1.67 m (5.48 ft)	5.00 m (16.40 ft)	RFID 13.56 MHz
1.00	1.84 m (6.04 ft)	5.52 m (18.11 ft)	WLAN 5600 (not in Europe)
1.64	2.36 m (7.74 ft)	7.07 m (23.20 ft)	GSM 1800/GSM 1900
3.28	3.33 m (10.93 ft)	10.00 m (32.81 ft)	GSM 900 mobiles, RFID 868 MHz

Reduced separation distances to portable and mobile radio frequency communication devices

The following separation distances are based on additional tests performed by Dräger to determine the minimum separation distances absolutely necessary. These reduced separation distances are valid only for mobile radio frequency communication devices using the standards listed.

Mobile radio frequency communication device using ...	Separation distance
GSM 850, GSM 900, RFID 868 MHz (limited to 2 W ERP)	0.54 m (1.8 ft)
GSM 1800, GSM 1900 (limited to 1 W ERP)	0.38 m (1.2 ft)
UMTS, DECT (limited to 0.25 W ERP)	0.19 m (0.62 ft)
Bluetooth, WLAN 2450, RFID 2450 (limited to 0.1 W ERP)	0.20 m (0.66 ft)

Device combinations

This device can be operated in combination with other Dräger devices or with devices from other manufacturers. Observe the accompanying documents for the individual devices.

If a device combination is not approved by Dräger, the safety and the functional state of the individual devices can be compromised. The operating organization must ensure that the device combination complies with the applicable editions of the relevant standards for medical devices.

Device combinations approved by Dräger meet the requirements of the following standards:

- IEC 60601-1, 3rd edition (general requirements for safety, device combinations, software-controlled functions)
- IEC 60601-1-2 (electromagnetic compatibility)
- IEC 60601-1-8 (alarm systems)

Or:

- IEC 60601-1, 2nd edition (general requirements for safety)
- IEC 60601-1-1 (device combinations)
- IEC 60601-1-2 (electromagnetic compatibility)
- IEC 60601-1-4 (software-controlled functions)
- IEC 60601-1-8 (alarm systems)

Connections to IT-networks

Data can be exchanged across an IT-network by using hard-wired and wireless technologies. An IT-network can be any data interface (e.g., RS232, LAN, USB, printer interface) that is described in standards and conventions.

During operation, this device can exchange information with other devices and support the following functions by means of IT-networks:

- Display of waveforms and parameter data
- Signaling of alarms
- Transfer of device settings and patient data

Connecting this device to a network that incorporates other devices or making subsequent changes to that network can lead to new risks for patients, users, and third parties. Before the device is connected to the network or the network is changed, these risks must be identified, analyzed, and evaluated, and appropriate measures taken.

Examples of subsequent changes to the network:

- Changing the network configuration

- Removing devices from the network
- Adding new devices to the network
- Performing upgrades or updates on devices that are connected to the network

Information on connecting to the IT-network

Prerequisites

This device must only be connected to the network by service personnel. The IT representative of the hospital must be consulted in advance.

The following documents must be observed:

- Accompanying documents of this device
- Descriptions of the network
- Description of the network-based alarm systems

Dräger recommends complying with IEC 80001-1 (risk management for IT-networks with medical devices).

Serial ports

The following interfaces are supported:

- RS232 interfaces conforming to EIA RS-232 (CCITT V.24/V.28) for the following applications:
 - MEDIBUS, MEDIBUS.X
 - Connections with third party medical devices

Consequences of using an inappropriate network

If the network does not meet the requirements, hazardous situations can result. The following situations can occur with this device:

- Due to an insecure decentralized alarm system:
 - Alarms are not transmitted.
 - Alarms or data is transmitted with a delay.
 - False alarms are triggered.
- During an interruption of the network connection:
 - Alarms are not transmitted.
 - Suppressed alarms or alarm tones are not reactivated, but remain suppressed.

- Without firewall and antivirus software:
 - Data are not protected.
 - Device settings are changed.
 - The device generates false alarms or does not generate alarms.
- Data are sent incomplete, sent to the wrong device, or not sent at all.
- Patient data are intercepted, falsified, or damaged.
- Data have incorrect time stamps.

Requirements on the electrical characteristics of connected devices and networks

The serial ports are only suitable for connection of devices or networks that have a rated voltage of at most 24 V DC on the network side and that meet the requirements of one of the following standards:

- IEC 60950-1: Ungrounded SELV circuits
- IEC 60601-1 (as of 2nd edition): Touchable secondary circuits

Index

A

Absorber	20
Accessories	8
Adapting alarm limits	134
Agent monitoring	176
Agents	140, 143
AGS anaesthetic gas scavenging system	79
Airway pressure	140
Alarm displays	124
Alarm priorities	125
Alarm signals	125
Alarm volume	163, 175
Alarms	123
APL valve	96
Test	81
Audible signals	163

B

Bar graphs	17
Basic settings	163
Breathing hose configurations	64
Breathing resistances	65

C

Calibration	143
Ceiling device	56
Central gas supply CS	73
Changes in PEEP	113
Changing between ventilation modes	113
Changing patients	117
Changing soda lime	117
Charging the battery for emergency operation	50
CO ₂	
Alarms	130
Concentration	140
Color concept	41
Configuration	
Default settings	162
During operation	175
Connecting	
Electrical connections	68
Gas Supply	57
to scavenger	59, 226
Connecting auxiliary devices	68
Contents	5
Continuous positive airway pressure	111

Controlled ventilation	99
CPAP	111
Curves	17

D

Data screen	152
Default limits, anesthetic agents	167
Default values	101, 108, 111
Deleting the logbook	156
Device check	72
Device combinations	267
Displaying alarm limits	133
Downgrading alarm priorities	126
Durasensor DS-100 A	159

E

Econometer	142, 148
EMC Declaration	262
Emptying the water trap container	208
End of operation	120
Entering	
Patient's age	90
Patient's body weight	90
External fresh-gas outlet	115

F

Filling and fitting the absorber	223
First use	50
Flexible arm for breathing bag	61
Flow/volume measurement	141
Frequency changes	112
Fresh gas delivery failure	184
Fresh gas failure detection	93
Fuses	70

G

Gas delivery	170
Gas failure	181
Gas inlets	22
Gas measurement	164
Getting started	71
Operation	50
Resuscitator	75
Start	87

H

- HF surgical devices 68
- HLM mode 131

I

- Installing the breathing system 221
- Interfaces 165, 256
- IT networks 267

L

- Latex 61, 226
- Leak Test 119
- Leakage 84
 - Causes 85
 - Locating and eliminating 85
- Limit-based alarms 128
- Loading default settings 90
- Logbook 155
- Loop scale 164
- Loops 142, 149
- Lung compliance (CPAT) 143

M

- MAC definition 143
- MAC display 176
- Maintenance 8
- Maintenance intervals 229, 237
- Manual ventilation' 95, 96
- Measured values 16
- Monitoring 123, 137, 139

N

- Non-rebreathing systems 115

O

- O₂ concentration 140
 - Setting the 92
- O₂ emergency delivery 74
- O₂-Flush 98
- Operating concept 35
- Operation 89
 - Without nitrous oxide 22, 57, 58
- Optional parameters 165

P

- Parameter settings 176
- Password 162
- Patient safety 7
- Patient system
 - Connecting 61, 225
 - Removing 209
- Potential equalization 69
- Power failure 180
- Power on 72
- Power-down delay 120
- Preparing the self test 81
- Presetting the ventilation mode 112
- Pressure Mode 106
- Pressure Support 110
- Protection class 260

R

- Related to age 164, 165
- Release button for ventilator module 117
- Remedying faults 179
- Remote service 173
- Replace
 - Water trap 235
- Replacing the
 - O₂ sensor 236
- Reserve gas cylinders 57, 74
- Rotary knob 23, 36

S

- Screen
 - Layout 43, 166, 177
 - Standard layout 139
- Screen layout 43
- Secretion aspiration system 60
- Selecting
 - Logbook 155
 - Standard screen 123, 138
- Selecting the carrier gas 91
- Self Test 82
- Self test results 86
- Series of alarm tones 127
- Setting
 - Alarm limits 133, 167
 - Fresh-gas flow 92
- Setting fresh-gas concentrations 91
- Soda lime 79
- Soft keys
 - Horizontal 41
 - Vertical 42

SORC (Sensitive Oxygen Ratio Controller)	92	Virtual flow tubes	141, 147
SpO ₂	165	Volume Mode	99
Alarms on/off	132	Volume mode AutoFlow	103
Concentration	141	Volume of breathing sound	163
Measurement	156	Volume-controlled ventilation	99
Spontaneous breathing	96, 97	Volumeter	141
Standard screen	123, 138, 139		
Standby/operation switch	37	W	
Starting		Wall/ceiling device	55
Manual/spontaneous breathing	97	Water trap	80
Ventilation mode	112	When Primus is not in use	121
Suppressing alarm	126		
Switch off		X	
to scavenger	121	xMAC display	145
Synchronization	100, 104, 107		
System compliance	84	Z	
System information	177	Zoom function	154
System power switch	72		
T			
Timer function	156		
Tipping stability	51		
To scavenger	79		
Transport	51		
Trend screen	153		
U			
UPS	50		
V			
Valve head	95		
Vapor			
Setting the	94		
Vaporizer – park position	67		
Vaporizers	76		
Ventilating children	117		
Ventilation	95		
Pressure-controlled	106		
Volume-controlled	99		
Volume-controlled, synchronized	99, 104		
with pressure support	100, 107		
Ventilation mode			
Man.Spont.	95		
Pressure Mode	106		
Pressure Support (optional)	110		
Ventilation source	142		
Ventilator and fresh gas delivery failure	185		
Ventilator and gas delivery	170		
Ventilator failure	183		
Ventilator module	210, 222		


These instructions for use only apply to **Primus SW 4.5n** with the Serial No.:

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


This document is provided for customer information only, and will not be updated or exchanged without customer request.




Directive 93/42/EEC
concerning Medical Products


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