Instructions for use

# Primus *Infinity Empowered*


**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® | |
| Infinity® | |
| Spirolog® | |
| SpiroLife® | |
| Vapor® | |
| VacuSmart® | |
| WaterLock® | |
| Durasensor® | Nellcor |
| OxiMax™ | Covidien |

| Trademark | Trademark owner |
|---|---|
| Neodisher® Medizym | Dr. Weigert |

## 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

## 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 medical 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 276.

## 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.

## 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 271).

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

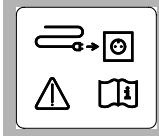
**WARNING**

**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 equipment to the auxiliary outlets on the anesthesia machine may result in increased leakage current. If the protective conductor on one of these devices fails, the leakage current may exceed the permissible values.**

**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 270.**

## 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. Reuse, reprocessing, or resterilization can lead to a failure of the medical device and cause injury to the patient.

## 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.

## Emission of Radio Frequency Energy

For wireless communication with Infinity ID accessories, this medical device is equipped with an RFID (Radio Frequency Identification) system.

Any changes or modifications to the RFID system must be implemented by properly trained service personnel; otherwise patient safety may be negatively affected.

This medical device was developed and produced in such a manner that the emission limits for radio frequency (RF) energy will not be exceeded. These limit values are incorporated in international safety standards such as IEC 60601-1-2 (EN 60601-1-2) and have been defined by regulatory bodies such as the Federal Communications Commission (FCC Rules), Industry Canada (Radio Standards Specifications), and the European Telecommunications Standards Institute (ETSI Standards).

The RFID system in this medical device complies with Part 15 of the FCC regulations and its operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

## 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 fire hazards, 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 $O_2$
If the $O_2$ supply (central supply or gas cylinder) fails, an alarm is issued.

– Supply of the patient with adequately oxygenated breathing gas
If the breathing gas contains insufficient levels of $O_2$, 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

**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 *Infinity Empowered* – 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 $O_2$ 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 ***VT***,

  breathing rate ***freq.***

– Inspiratory and expiratory concentration of $O_2$, $N_2O$, anesthetic gas, and $CO_2$

– $\Delta$***O2***:

  Difference between inspiratory and expiratory $O_2$ concentration

Optional:

– Functional oxygen saturation ($SpO_2$) and pulse rate

## The following parameters can be displayed as mini trends*

– Minute volume $CO_2$ ***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 $O_2$, $CO_2$, 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 $O_2$ and $N_2O$ concentrations

– Inspiratory and expiratory $CO_2$ 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 *Infinity Empowered* 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 *Infinity Empowered* 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.

**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).**

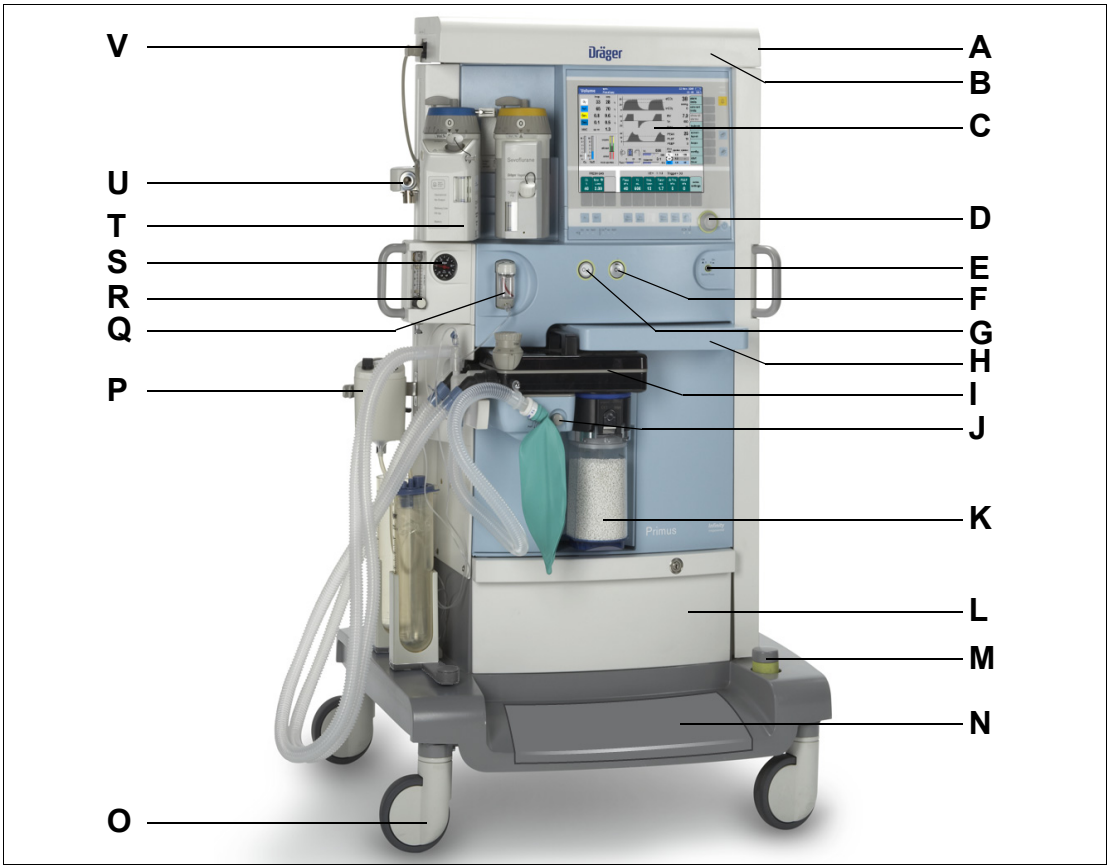
Do not use Primus in the following environments:

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

# Overview

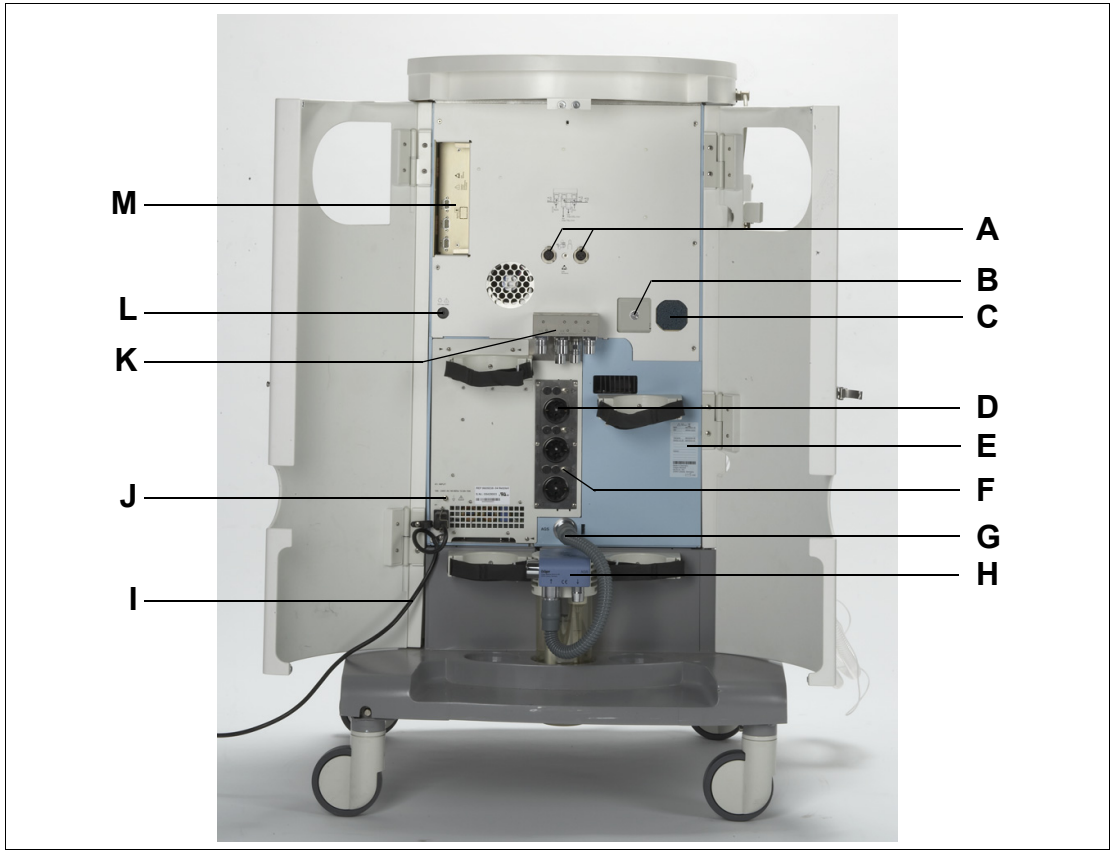
## Components

### Front



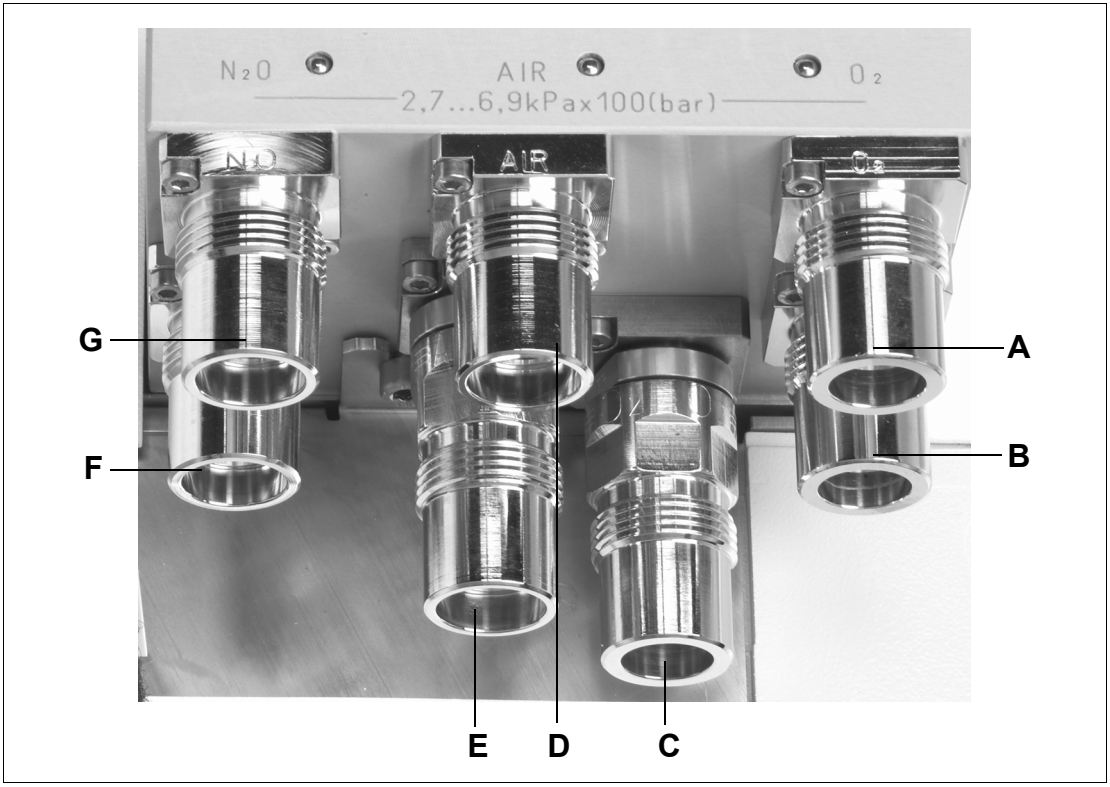

**A** Lighting control (dimmer)
**B** Top shelf (for external monitors)
**C** Screen with user interface
**D** Rotary knob
**E** System power switch
**F** $O_2$ emergency delivery
**G** Button for $O_2$ flush ***O2+***
**H** Writing table
**I** Breathing system
**J** Release button for ventilator module
**K** Disposable absorber Drägersorb CLIC (or reusable absorber)
**L** Drawer
**M** Central brake
**N** Footrest
**O** Castors
**P** Endotracheal aspiration system (optional)
**Q** Water trap with sample line connection
**R** Auxiliary oxygen flow tube (optional)
**S** Mechanical pressure gauge (optional)
**T** Vapor units with Interlock system
**U** Ext. fresh-gas outlet (optional)
**V** Auxiliary power outlet (for desflurane vaporizer)

## Rear




**A** Connectors for reserve gas cylinder pressure sensors
**B** $O_2$ sensor
(not applicable for consumption-free $O_2$ measurement)
**C** Filter for fan
**D** Auxiliary power outlets
**E** Type plate
**F** Potential equalization pin for auxiliary systems
**G** Scavenging nozzle
**H** Anesthetic gas receiving system AGS
Only use the AGS specified in the list of accessories.
**I** Power cord
**J** Potential equalization pin
**K** Gas inlets
**L** Connection for optional halogen light
(Remove cap before use.)
Use the lamp specified in the list of accessories only!
**M** Interface panel

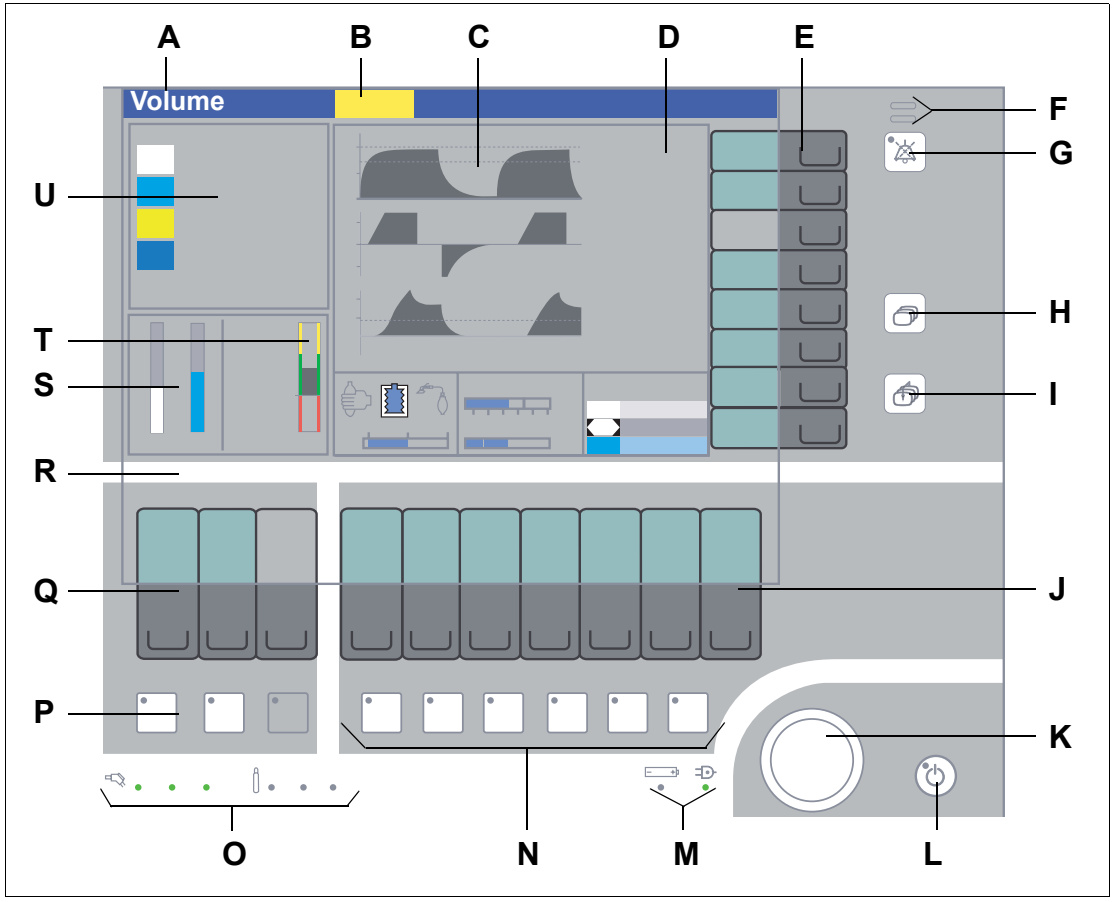
## Gas inlets




**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*

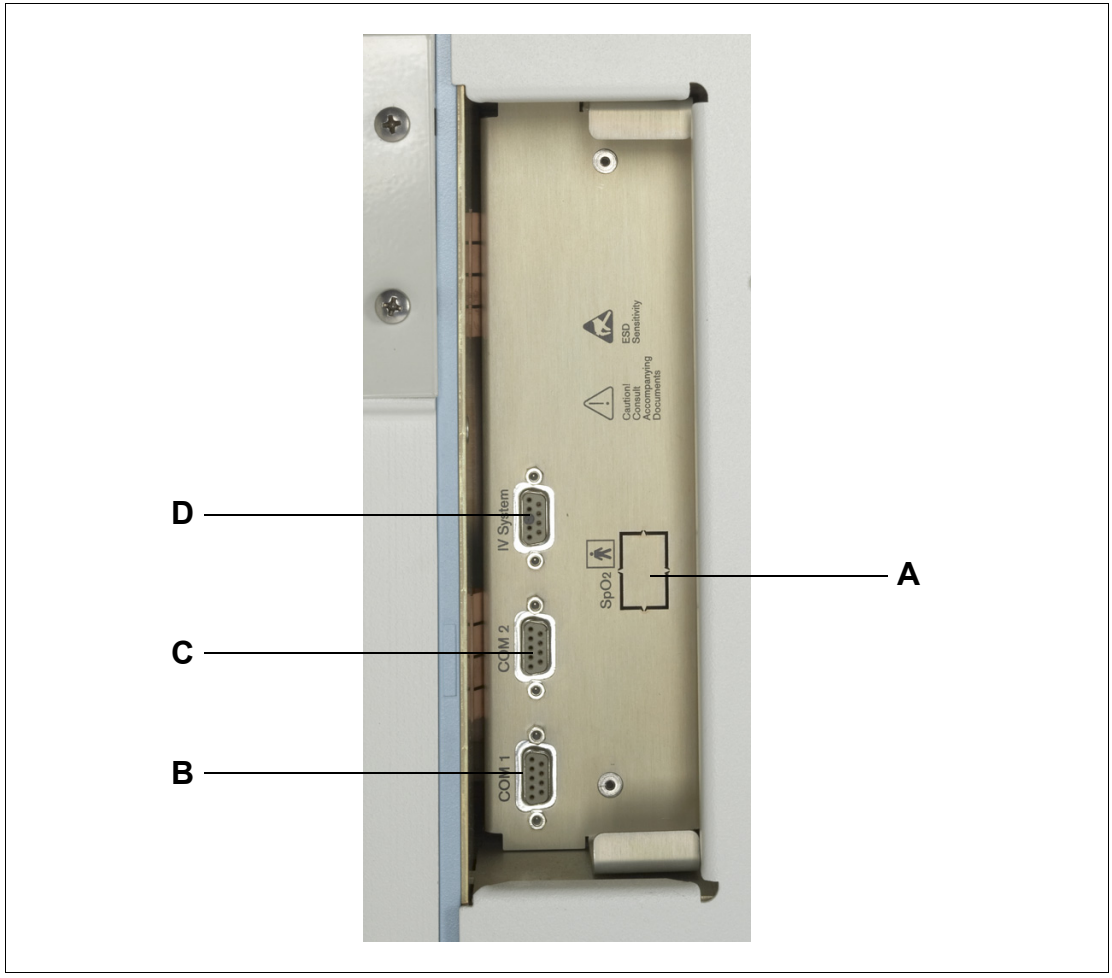
* This connection is not available with the "Operation without nitrous oxide" option.

## Screen with user interface



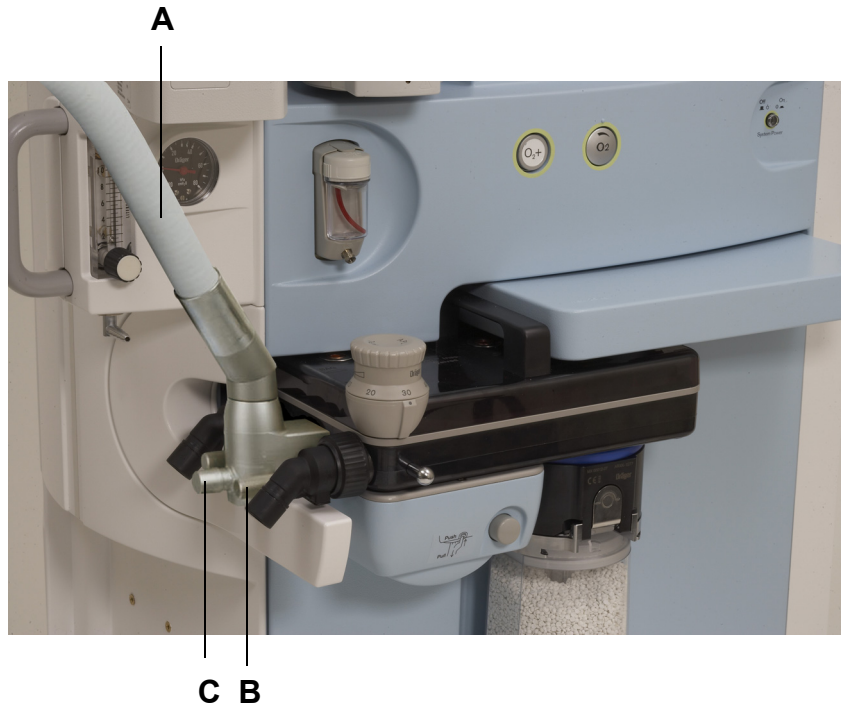

**A** Status field for the current ventilation mode
**B** Alarm field for alarms and their class
**C** Curve field for curves and other displayed modules
**D** Numerical field for measured values
**E** Soft keys for monitoring functions
**F** LEDs indicating the alarm status
**G** Key for silencing acoustic 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 (***$N_2O$*** 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



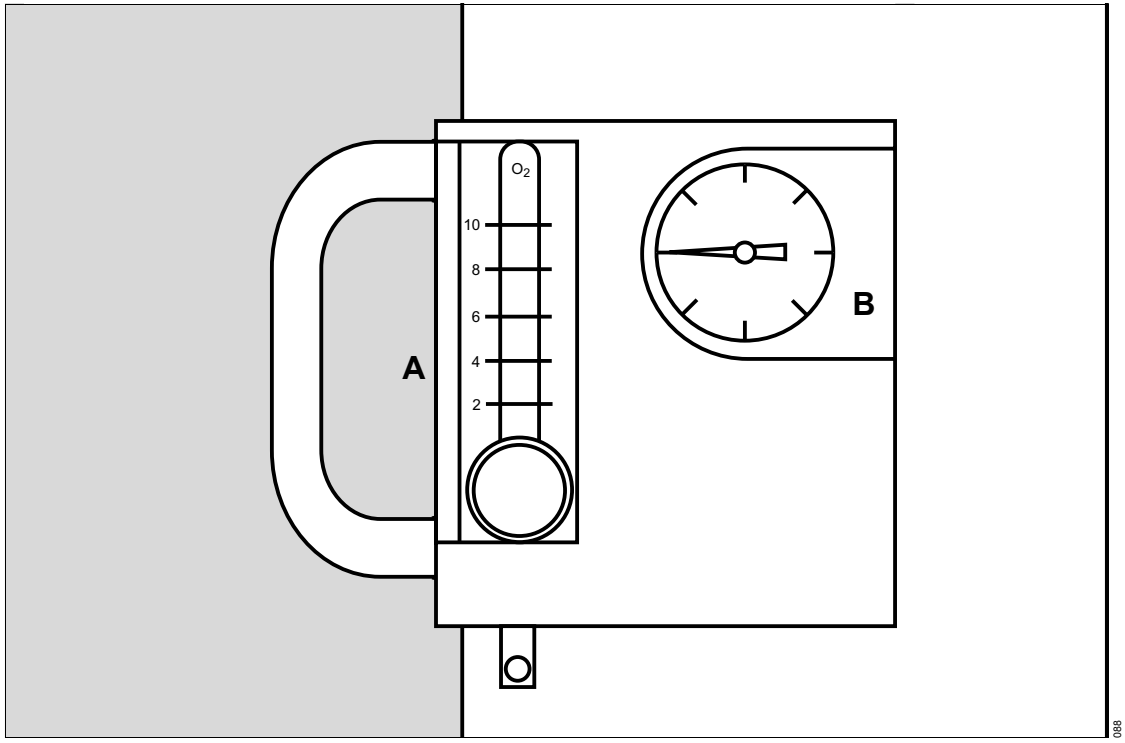

| | | | |
|---|---|---|---|
| **A** | ***SpO2*** | Socket for SpO2 sensor | (optional) |
| **B** | ***COM 1*** | MEDIBUS, MEDIBUS.X interface | |
| **C** | ***COM 2*** | MEDIBUS, MEDIBUS.X interface | |
| **D** | ***IV System*** | Connection for Dräger IV System | |

## Flexible arm for breathing bag (optional)




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

## Auxiliary flowmeter and mechanical pressure gauge (optional)



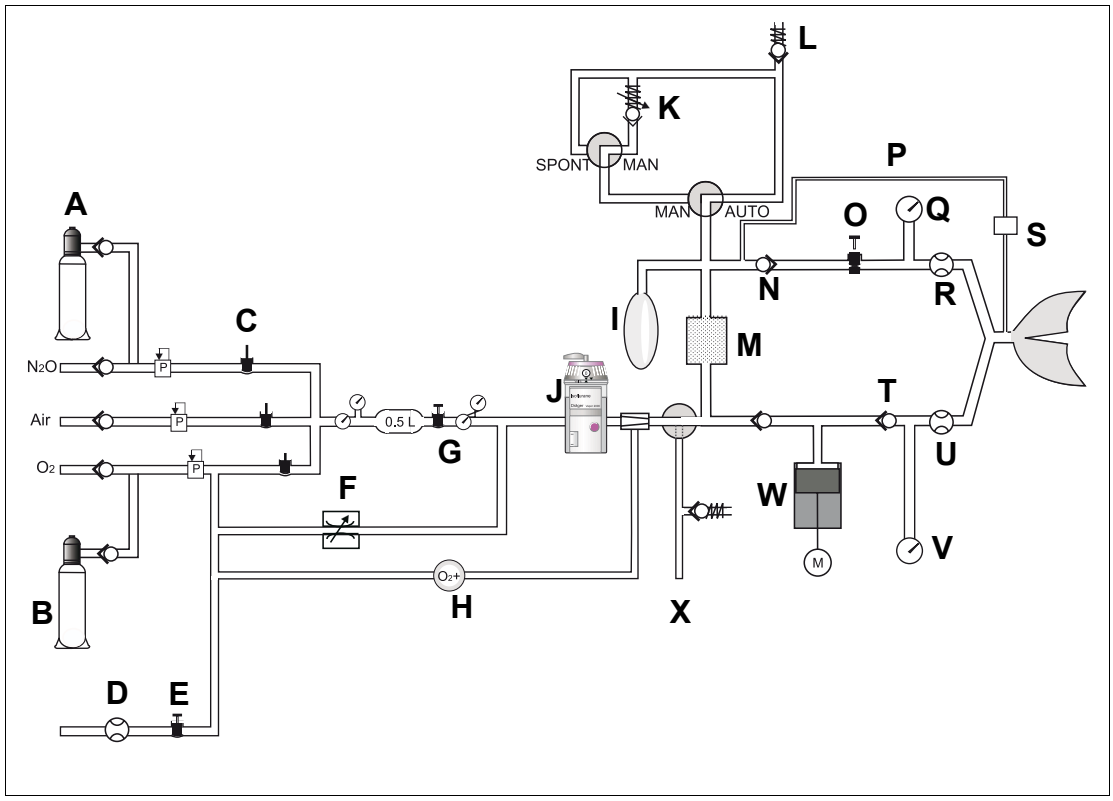

**A Auxiliary $O_2$ flow tube (optional)**

The auxiliary $O_2$ flow tube delivers pure oxygen at a specified flow, e.g., for delivering oxygen through a nasal cannula. Auxiliary oxygen can be used in any ventilation mode, in ***Standby***, or even if the machine is switched off, as long as the device is connected to the central $O_2$ supply.

**B Mechanical breathing pressure gauge (optional)**

The mechanical breathing pressure gauge is, in addition to the electronic pressure measurement feature, a pressure measurement gauge for displaying the inspiratory breathing pressure.

## Gas flow diagram




**A** $N_2O$ cylinder
**B** $O_2$ cylinder
**C** Gas inlet valves
**D** Auxiliary $O_2$ flow tube (optional)
**E** Flow control
**F** $O_2$ emergency delivery
**G** Flow control
**H** $O_2$-Flush
**I** Breathing bag
**J** Vaporizer
**K** APL valve
**L** Anesthetic gas receiving system AGS
**M** Absorber
**N** Exp. valve
**O** ***PEEP/PMAX***
**P** Sample line
**Q** ***PAW*** sensor
**R** Exp. flow sensor
**S** Gas measurement
**T** Insp. valve
**U** Insp. flow sensor
**V** Mechanical pressure gauge (optional)
**W** Piston pump ventilator
**X** Ext. fresh-gas outlet (optional)

# Additional functions

## Infinity ID wireless accessory detection system

– Primus *Infinity Empowered* is equipped with an Infinity ID module capable of exchanging data with Infinity ID accessories.

– Several antennas based on RFID technology (RFID: Radio Frequency Identification) have been integrated into this device to realize this data exchange.

– The Infinity ID accessories are equipped with a chip (RFID tag) that is able to exchange data with the Infinity ID module of the device wirelessly.

– The Infinity ID technology provides additional accessory functionality.

– A detailed description of Infinity ID functionalities and their applications can be found in those chapters of these instructions for use which pertain to Infinity ID accessories.

**WARNING**

**Risk of patient injury**

**Although the anesthesia machine does not exceed the valid limits for electromagnetic fields, some pacemaker wearers may be susceptible to electromagnetic radiation.**

**Wearers of pacemakers should keep a minimum of 25 cm (10 in) between themselves and the anesthesia system.**

## MEDIBUS/MEDIBUS.X Protocol

MEDIBUS and MEDIBUS.X are software protocols for use in transferring data between Primus *Infinity Empowered* 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 decentralized alarm systems conforming to IEC 60601-1-8:2012 (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; use a separate wall socket instead.**

**The system must fulfill the requirements for medical electrical equipment in accordance with the relevant standards, see chapter "Technical data", page 270.**

# Abbreviations

## List of abbreviations used in the software and on the device

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

| Abbreviation | Explanation |
|---|---|
| ***PLAT*** | Plateau pressure |
| ***pleth*** | Plethysmogram |
| ***PMAX*** | Maximum pressure |
| ***PMEAN*** | Mean pressure |
| ***Press. Support/ Press. Supp.*** | Pressure Support mode<br>Pressure-assisted ventilation |
| ***Pressure/ Press. Mode*** | Pressure Mode<br>Pressure-controlled ventilation |
| ***Safety O2*** | $O_2$ emergency delivery |
| ***Sev.*** | Sevoflurane |
| ***SpO2*** | Functional $O_2$ saturation |
| ***Standby Conf.*** | Standby configuration for default values and settings |
| ***Sync./sync.*** | Synchronization |
| ***TINSP*** | Inspiratory time |
| ***TIP:TINSP*** | Ratio of inspiratory pause time to inspiratory time |
| ***Trigger*** | Trigger level |
| ***TSLOPE*** | Rise time |
| ***Vent. mode*** | Ventilation mode |
| ***V-Flow*** loop | Volume flow loop |
| ***Volume AF*** | Volume mode AutoFlow |
| ***Volume/ Vol. Mode*** | Volume Mode<br>Volume-controlled ventilation |
| ***VT*** | tidal volume |
| ***VTINSP*** | Measured inspiratory tidal volume |

## List of general abbreviations

| Abbreviation | Explanation |
|---|---|
| AC | Alternating current |
| AGS | Anesthetic gas receiving system AGS |
| AGSS | Anesthetic gas scavenging system |
| ATPD | Ambient Temperature and Pressure, Dry<br>Ambient temperature and ambient pressure, dry gas |
| ATPS | Ambient Temperature and Pressure, Saturated<br>Ambient temperature and ambient pressure, 100 % relative humidity |
| BTPS | Body Temperature and Pressure, Saturated<br>37 °C (98.6 °F), ambient pressure, 100 % relative humidity |
| $cmH_2O$ | Centimeter of water |
| CS | Central gas supply / Piped medical gas supply for $O_2$, $N_2O$, AIR, and vacuum |
| EMC | Electromagnetic compatibility |
| ESD | Electrostatic discharge |
| HF surgery | High-frequency surgery |
| HME | Heat + Moisture Exchange<br>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) |
| NiBP | Non-invasive blood pressure |
| NTPD | Normal temperature pressure dry (20 °C (68 °F), 1013 hPa (760 mmHg), dry) |
| $O_2$ | Oxygen |
| $P_{EIRP}$ | "Equivalent isotropic radiated power" of the adjacent RF transmitter |
| ppm | Parts per million |
| PS | Pressure Support |
| psi | Pounds per square inch |
| RF | Radio Frequency |
| RFID | Radio Frequency Identification |
| SORC | Sensitive Oxygen Ratio Controller |
| STPD | Standard Temperature and Pressure, Dry<br>20 °C (68 °F), 1013 hPa, dry gas |
| $T_{EXP}$ | Expiratory time |
| TVS | Transfer of ventilaton settings |
| 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**

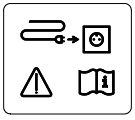
Throughout these instructions for use:
Ventilation pressures: $cmH_2O$ = mbar = hPa.

For readability only the units hPa and $cmH_2O$ are used.

Supply pressures: bar = kPa x 100.

## Symbols

| Symbol | Explanation | Symbol | Explanation |
|---|---|---|---|
|  | Manufacturer |  | Upper alarm limit disabled |
|  | Date of manufacture |  | Lower alarm limit disabled |
|  | Suppress alarm tone for 2 minutes, change priority of technical alarms or acknowledge them | – – | Alarm limit or measuring function disabled |
| | | * * * * | 4-digit access code entered |
|  | Call up standard screen | more | More than 3 alarms active |
|  | Call up basic screens in succession |  | Protection class type BF (body floating) |
|  | Standby/operation switch |  | ESD warning symbol, observe the warning statement, see "Information on electromagnetic compatibility" on page 10 |
|  | Non-rebreathing system at the external fresh-gas outlet | | |
|  | Pulse rate |  | Interference |
|  | Fresh gas flowing |  | FCC (Federal Communications Commission) symbol |
|  | Action in progress |  | Connection for potential equalization cable |
|  | Upper and lower alarm limits |  | Light |
|  | Upper alarm limit only |  | Caution! Consult accompanying documentation! |
|  | Lower alarm limit only |  | Caution! (safety symbol) |
|  | Alarm tone suppressed for 2 minutes |  | Consult instructions for use |
|  | Alarm monitoring inactive |  | Warning! Strictly follow these instructions for use |
|  | Alarm monitoring temporarily inactive |  | Exit menu, return to preceding menu |
|  | Apnea alarm disabled |  XX % | Remaining battery capacity (uninterruptible power supply UPS) |
|  | Upper and lower alarm limit disabled |  | Battery supply |

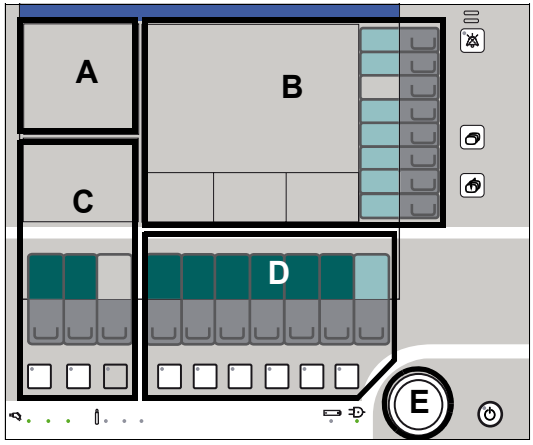
| Symbol | Explanation |
|---|---|
|  | Mains voltage |
|  | Manual ventilation’ |
|  | Automatic ventilation |
|  | Connector for central gas supply (CS) |
|  | Reserve gas cylinder |
|  | Rotary knob |
|  | UL test mark |
|  | Plug system for Vapor units |
|  | System power switch |
|  | Leakage current label; see warning statement on page 11 |
|  | Risk of crushing |
| max. 2A 2x T2A  | Label for auxiliary AC socket (for Desflurane vaporizer) |
|  | Outlet |
|  | Pressure regulator connection |
|  | Fuse |
| REV | Order number |
| SN | Serial number |
|  | Protect from sunlight! |

| Symbol | Explanation |
|---|---|
|  | Temperature limit |
|  | Relative humidity |
|  | Ambient pressure |
|  | Do not use if package damaged |
|  | Do not reuse |
|  | WEEE-labelling, EU Directive 2002/96/EC |
|  | Use-by date |
|  | $CO_2$ absorbent bypass |
|  | $O_2$-Flush |
|  | Label on devices fitted with the "Operation without nitrous oxide" option. |
|  | Marker on surfaces where there is an increased risk of tipping when moving, leaning on, leaning against, etc. the device. |

# Operating concept

# Screen ergonomics

## Function fields




The keys are grouped in function fields:

**A** Gas measurement

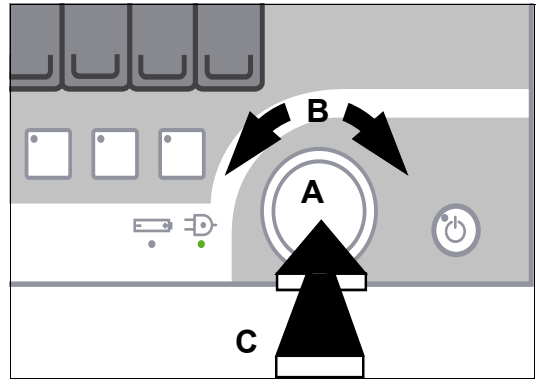
**B** Monitoring

**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.

Example:

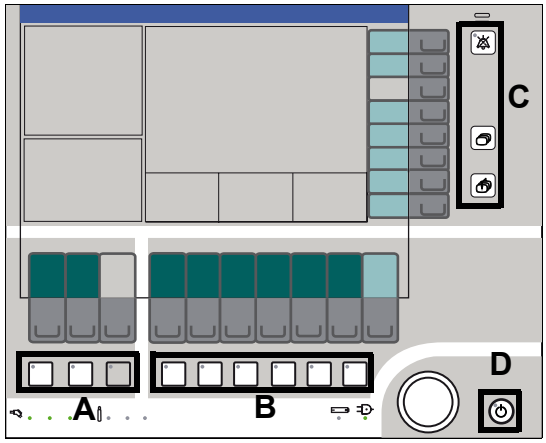
– confirm the selected carrier gas or a ventilation mode

– 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:




**A** Keys for selecting the carrier gas ($N_2O$ or Air):

The ***$N_2O$*** or ***Air*** keys are used to select the gas to be mixed with $O_2$ 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.

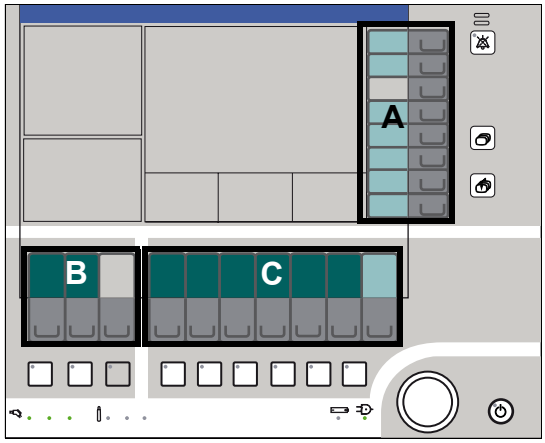
Briefly press the key until the required screen is displayed.

Return to the standard screen.

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

## 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 $O_2$-concentration and the fresh-gas flow.

**C** Keys for the ventilation mode:

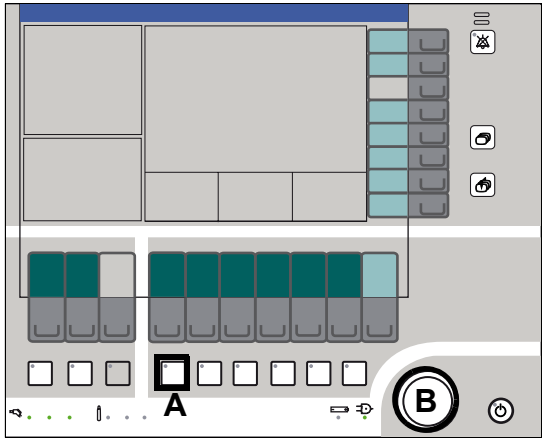
The keys for setting the parameters relevant to the ventilation mode.

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

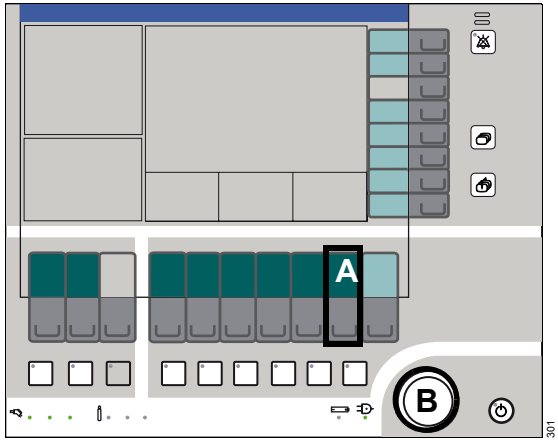



Example: ***Man.Spont.*** Mode

**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



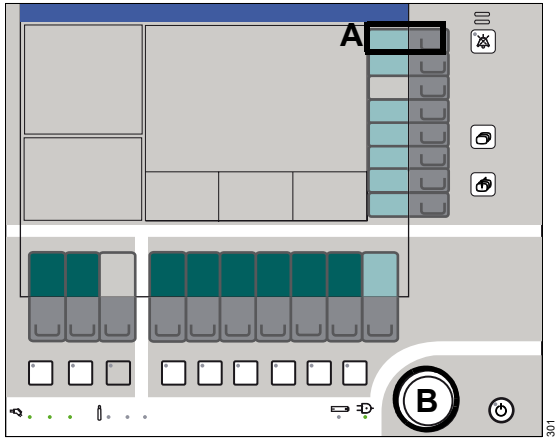

Example: ***PEEP*** ventilation parameter

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




Example: Change the lower alarm limit of the end-expiratory $CO_2$ concentration.

1 Press the soft key ***alarm limits*** (A). The ***alarm limits*** menu is displayed on the screen.

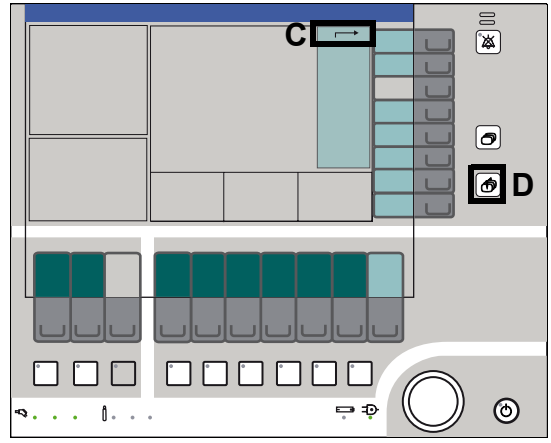
2 Select the alarm limit = turn the rotary knob (B).

  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 (B)

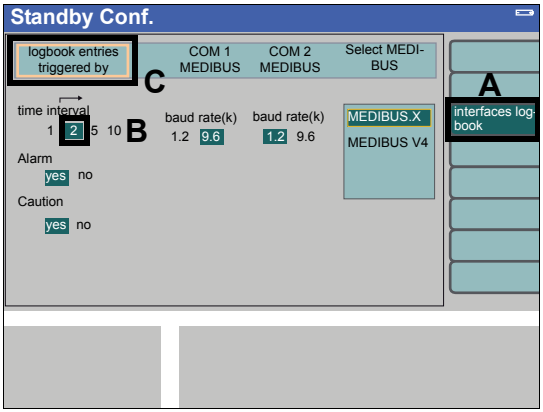
  or

- Press the key (D).

## Selecting/setting configuration parameters

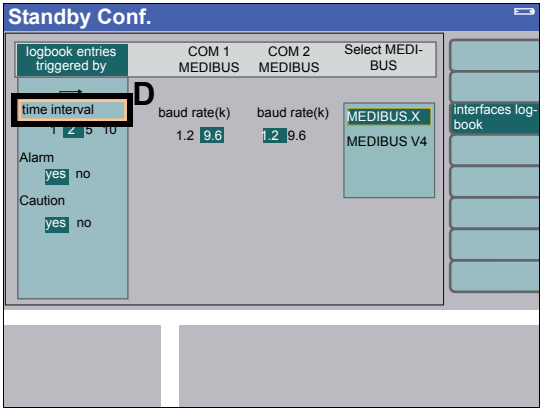
Example: Changing the time interval for the logbook entries from "***2***" to "***5***" in the ***Standby Conf.*** menu.

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).

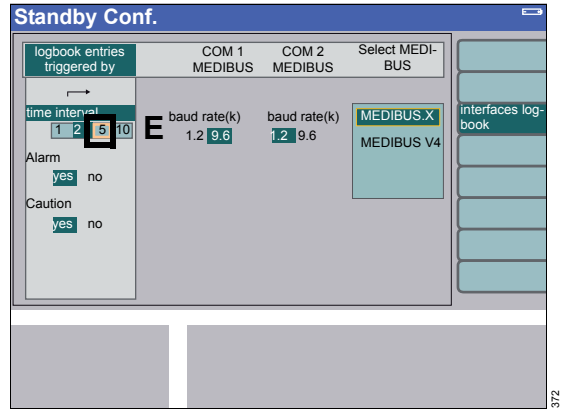



**1** Select the menu ***Logbook entries triggered by*** (C) and confirm the selection with the rotary knob.

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

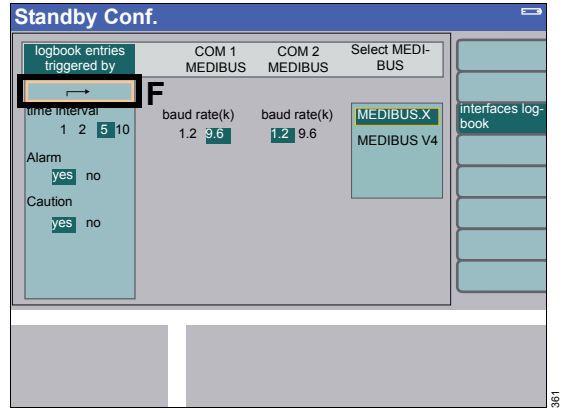



**2** Turn the rotary knob and select the menu ***time interval*** (D). Confirm the selection with the rotary knob.




**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 ⟶ 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, presettings |
| 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 |

### 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 Press 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).

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

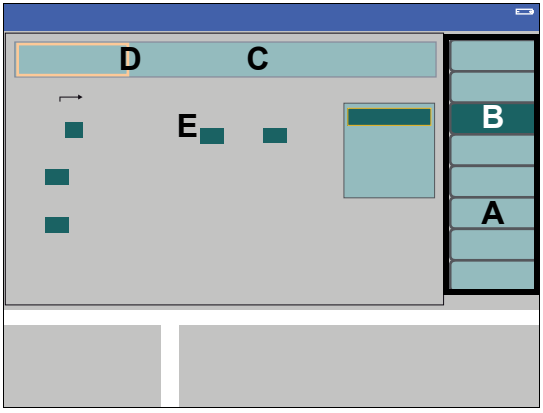

The selected parameter is yellow (F) and can be changed.

Values shown in gray (G)


– indicate discrepancies between the set and the actual values (e.g., following a failure of the $O_2$ supply)

– indicate that the specified accuracy is not being maintained.

## 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.

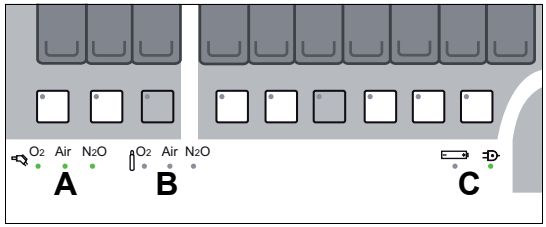
## Parameter bar

– Orange cursor frame (D) around the menu title: 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 *Infinity Empowered*, 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,<br>the central gas supply is connected and within the specified range.<br>Or<br>no reserve gas cylinder connected. |

**C** Power supply

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

## General information about Infinity ID functions

The Primus *Infinity Empowered* is equipped with an Infinity ID module capable of exchanging data with Infinity ID accessories. Primus *Infinity Empowered* supports Infinity ID water traps for the gas measurement system and Infinity ID CLIC absorber.

**WARNING**

**Risk of device failure and patient injury**

**If the anesthesia machine is incorrectly prepared for operation, functionality may be impaired and the patient injured as a result. When checking if the anesthesia machine is completely prepared, do not solely rely on the Infinity ID functionality.**

**Prepare and operate the anesthesia machine as described in the chapters "Assembly and preparation" on page 51 and "Operation" on page 91.**

– Water trap expiration handling

  Automatic monitoring of the maximum period of use is available for Infinity ID Waterlock 2 water traps. For more details please see "Dealing with the water trap exchange interval for the Infinity ID water trap" on page 82.

– Soda lime depletion handling

  Automatic detection when the Infinity ID CLIC absorber is in a locked position and a calculation of the amount of $CO_2$ already absorbed is available. For more details please see "Soda lime depletion" on page 80.

– Breathing hose mismatch control

  When using Infinity ID breathing hoses and breathing bags, a possible mismatch of the breathing hoses and of the breathing bag can be identified and reported by Primus *Infinity Empowered*. Hoses connected incorrectly to the breathing system are designed to automatically trigger an alarm condition.

  In addition, Primus *Infinity Empowered* issues an alarm if not all the expected breathing hoses are connected, e.g., if the breathing bag is missing.

– Incompatibility check

  The Infinity ID breathing hoses can save data about compatibility with ventilation and anesthesia devices. If a not approved breathing hose is connected to the Primus *Infinity Empowered*, the device can give an alarm message.

**NOTE**

If nuisance alarms persist due to Infinity ID components, e.g., in special EMC environment situations, all Infinity ID functionalities can be completely deactivated by a trained service technician.

The Infinity ID functions can be enabled or disabled by DrägerService, either completely or for the following single functionalities: Transfer of ventilation settings (TVS), water trap expiration handling, and the soda lime depletion handling.

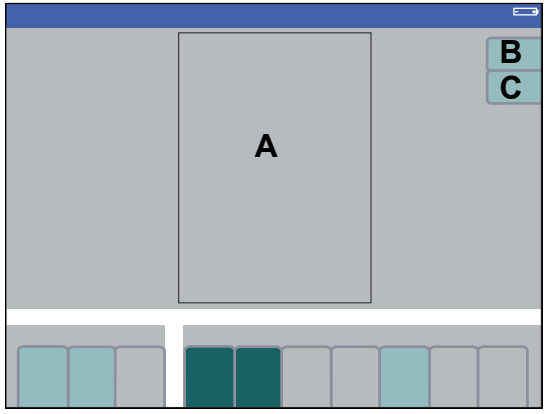
For configuration of the Infinity ID functions in the Standby configuration, see "Configuring the default settings" on page 166.

## Loading therapy-related data from Infinity ID breathing circuits

When an Infinity ID breathing circuit containing valid therapy-related data is connected to the breathing system ports of Primus *Infinity Empowered*, a field (A) listing all the suggested settings is shown in the ***Standby*** mode.* There are black and gray values displayed in the field. All values that are suggested ventilation settings for the transferred ventilation mode (e.g., ***Volume Mode***) are displayed in black (e.g., ***VT***). Derived values of other ventilation parameters are displayed in gray.

The gray values (e.g., ***PINSP***) do not belong to the suggested ventilation mode (e.g., ***Volume Mode***). They are used as suggestions if the ventilation settings have been accepted, but not yet confirmed and another ventilation mode (e.g., ***Pressure Mode***) has been selected.

The gray values are also used as suggestions for ventilation settings when changing the transferred ventilation mode in Standby (e.g., to ***Pressure Mode***).




1 To confirm, touch the ***accept*** softkey (B) and press the rotary knob.

After accepting the suggested settings, the values for the ventilation settings are preconfigured and can be adapted by the user. When confirming the settings and ventilation mode with the rotary knob, the ventilation starts.

The user can reject the suggested parameters from the Infinity ID breathing circuit.

2 Press the soft key ***reject*** (C).

All settings have to be made by the user.

**WARNING**

**Risk of patient injury**

**If incorrect device settings are loaded from Infinity ID breathing circuits, the patient may receive the wrong treatment.**

**The user must always check the settings prior to confirming any data transfers to ensure the integrity of the therapy. The user is also responsible for rejecting or modifying data suggested for transfer prior to activating a ventilation mode if the data is inappropriate for the patient connected.**

Therapy-related data can only be loaded in ***Standby***, ***Monitoring***, ***Man.Spont.***, and ***Ext. Outlet*** mode. Data for fresh-gas settings are not loaded in ***Monitoring***, ***Man.Spont.***, and ***Ext. Outlet*** mode.

During operation of Primus *Infinity Empowered* therapy-related data are periodically transferred to the Infinity ID breathing circuits. The data stored on the Infinity ID hose set only remain valid for two hours, if not used.

* Only available when TVS (Transfer of Ventilation Settings) has been enabled by DrägerService and is in the Standby configuration.

## 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*** [1] | |
| ***undo change*** [1] | |
| ***start self test*** | |
| ***accept*** | |
| ***cancel test*** | |
| ***cancel test*** | |

| ***Standby*** | |
|---|---|
| ***alarm limits*** | |
| ***self test results*** | |
| | ***soda lime changed*** [1] |
| | ***undo change*** [1] |
| ***leak test*** | |
| ***logbook*** | |
| | ***page 1*** |
| | ***page 2*** |
| ***delete trend*** | |
| | ***do not delete*** |
| | ***delete*** |

1) Only without configured CLIC absorber.

| | | |
|---|---|---|
| ***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 ***Man.Spont.*, *Volume*, *Volume AF*, *Pressure*, *Press. Support*, *Ext. Outlet*** | | |
|---|---|---|
| ***alarm limits*** | | |
| ***auto-set limits*** [1] | | |
| ***$CO_2$ alrm 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 with modes ***Volume***, ***Volume AF***, ***Pressure***, ***Press. Support***
2) Only available with 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*** | | |

# Assembly and preparation

## Before first use

**WARNING**

**Risk of patient injury**

**Correct preparation of the anesthesia machine is required to minimize the general risks associated with the anesthesia machine.**

**Use only clean and disinfected parts and always strictly follow the cleaning and assembly instructions contained in these instructions for use to prevent infection of patient or user.**

### Inserting $O_2$ and flow sensors

Insert the enclosed $O_2$ sensor, see page 244. (Not applicable for consumption-free $O_2$ measurement.)

Insert the flow sensors, see page 229.

### Charging the battery for emergency operation

Primus *Infinity Empowered* 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 is automatically recharged when the mains connector is plugged in. However this only takes place up to a maximum ambient temperature of 35 °C (95 °F).

**WARNING**

**Risk of device failure**

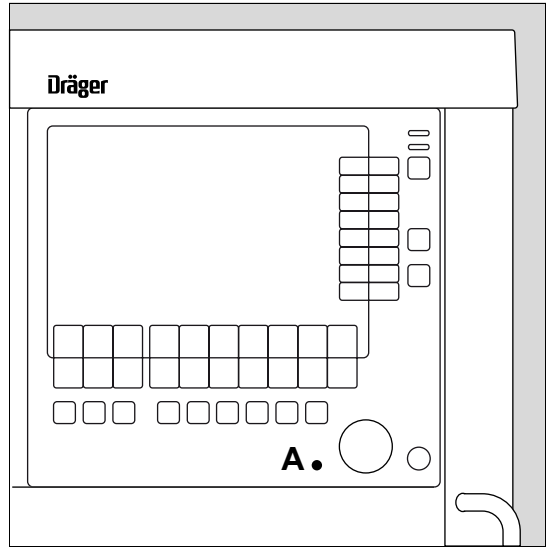
**If the batteries have not been sufficiently charged and a power failure occurs, it may not be possible to continue operation for long enough.**

**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 *Infinity Empowered* 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 *Infinity Empowered* 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.

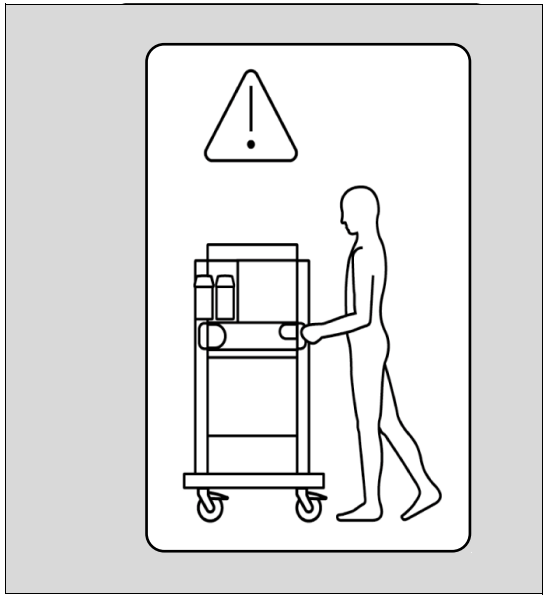
**CAUTION**

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.
- To transport the ceiling unit, pull out the base of the ceiling unit and tighten it with the knurled screw before lowering it to the floor.

**NOTE**

Risk of injury

To avoid tipping over the ceiling unit, pull out the base before lowering it to the floor.

Push the base into the anesthesia machine when mounted to the wall or ceiling supply unit.

**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**

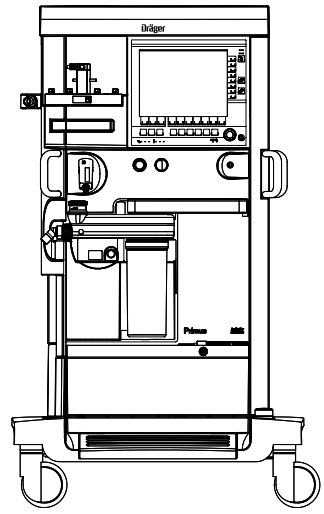
**The front castors on the Primus *Infinity Empowered* ceiling device are not mechanically designed to take heavy loads. For this reason, the front castors are not suitable for transportation purposes as they are intended solely as a maneuvering aid when connecting the ceiling supply unit. Once a wall 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 *Infinity Empowered* ceiling device, tilt it back and move it on its rear castors.**

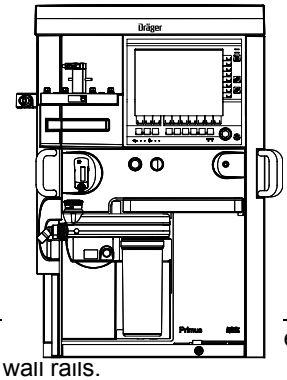
## Accessory weight limits

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

**Floor unit**

<table>
<tr><th>Left side</th><th colspan="2">Top, front and rear of device</th><th>Right side</th></tr>
<tr><td rowspan="4">The maximum permissible weight of accessories is 25 kg (55 lbs).<br><br>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.<br><br>The remaining weight must be applied at a distance of 10 cm (4 in) max.</td><td colspan="2">The maximum permissible weight of accessories on the top cover of the device is 20 kg (44 lbs).</td><td rowspan="4">The maximum permissible weight of accessories is 25 kg (55 lbs).<br><br>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.<br><br>The remaining weight must be applied at a distance of 10 cm (4 in) max.</td></tr>
<tr><td rowspan="3">  </td><td>The maximum load on the pull-out writing table is 10 kg (22 lbs).</td></tr>
<tr><td>The maximum load on the lateral standard rail is 5 kg (11 lbs).</td></tr>
<tr><td>The maximum load on the drawer is 3 kg (6.6 lbs).</td></tr>
<tr><td colspan="2">A maximum weight of 35 kg (77 lbs) may be applied to the rear of the device (gas cylinders, holders and accessories).</td></tr>
</table>

**Wall device and ceiling device**

<table>
<tr><th>Left side</th><th colspan="2">Top, front and rear of device</th><th>Right side</th></tr>
<tr><td>The maximum permissible weight of accessories is 25 kg (55 lbs).</td><td colspan="2">The maximum permissible weight of accessories on the top cover of the device is 20 kg (44 lbs).</td><td>The maximum permissible weight of accessories is 25 kg (55 lbs).</td></tr>
<tr><td rowspan="3">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.<br><br>The remaining weight must be applied at a distance of 10 cm (4 in) max.</td><td rowspan="3">  </td><td>The maximum load on the pull-out writing table is 10 kg (22 lbs).</td><td rowspan="3">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.<br><br>The remaining weight must be applied at a distance of 10 cm (4 in) max.</td></tr>
<tr><td>The maximum load on the lateral standard rail is 5 kg (11 lbs).</td></tr>
<tr><td colspan="2">es must be attached to the wall rails.</td></tr>
</table>

**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.

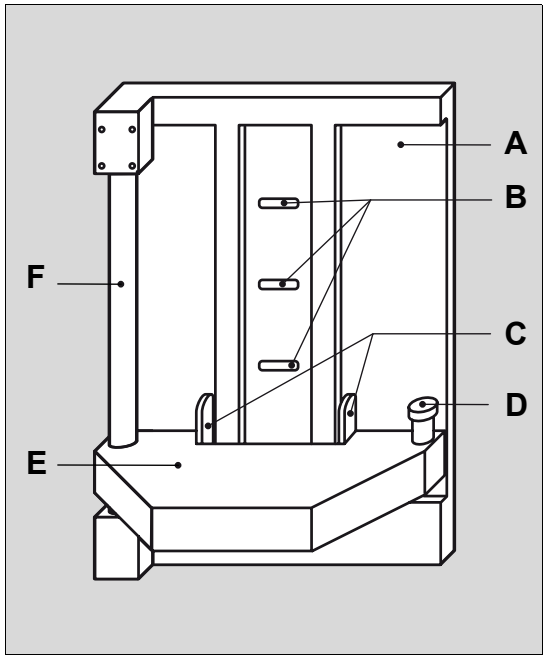
# Primus *Infinity Empowered* as a wall/ceiling device (optional)

## 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 *Infinity Empowered* 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 *Infinity Empowered*.

  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 59 and page 70.
- 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 *Infinity Empowered* is securely fixed to the wall by pulling slightly.

**NOTE**

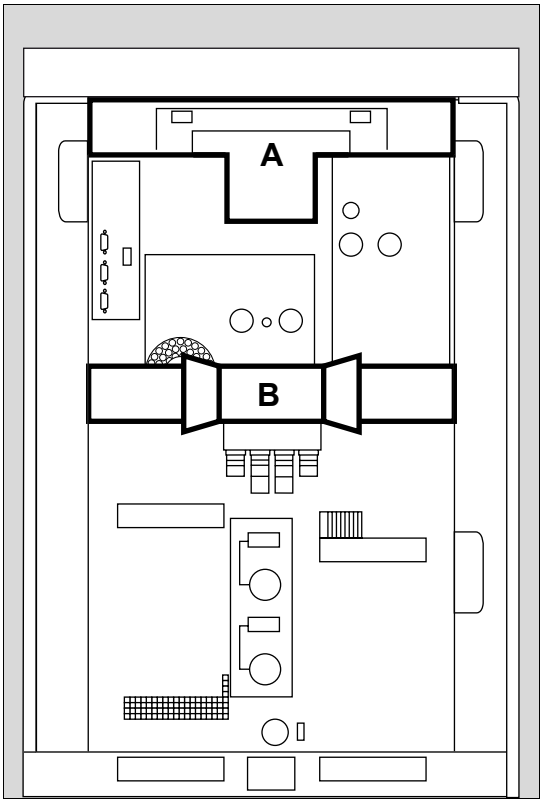
Always place the device in the wall position – this is space-saving and a protection against damage.

**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 *Infinity Empowered* can be used as a ceiling device.




The ceiling supply units can accommodate the Primus *Infinity Empowered* anesthesia machine if device receptacle M is used. An upper adapter (A) and a lower adapter (B) are required for this.

**CAUTION**

Risk of device failure

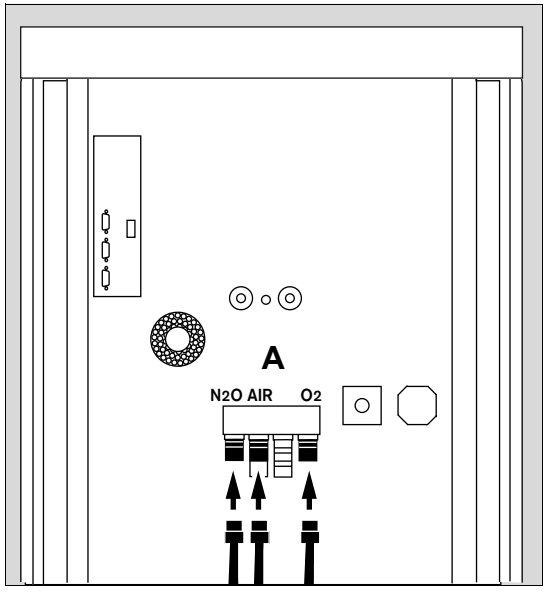
If the anesthesia machine is operated when tilted, components may be damaged or may function improperly.

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

## Mounting Primus *Infinity Empowered* on the ceiling supply unit

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

## 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 $O_2$ outlet for an external $O_2$ flow tube are optionally available.

**2** Connect the compressed gas hoses to the terminal units.

**3** Make sure all supplies are connected correctly and functioning properly.

**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.

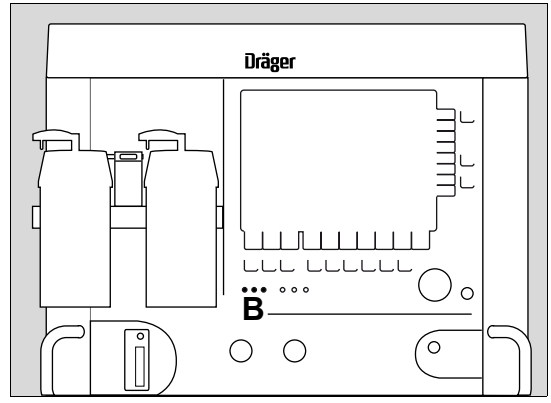
**CAUTION**

Risk of device failure

In order for the anesthesia machine to operate as specified, the supply pressures at the gas inlet must be within a range of 2.7 to 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.




* With the "Operation without nitrous oxide" option, connection of an $N_2O$ gas supply is not possible.

## Connecting the backup gas cylinders

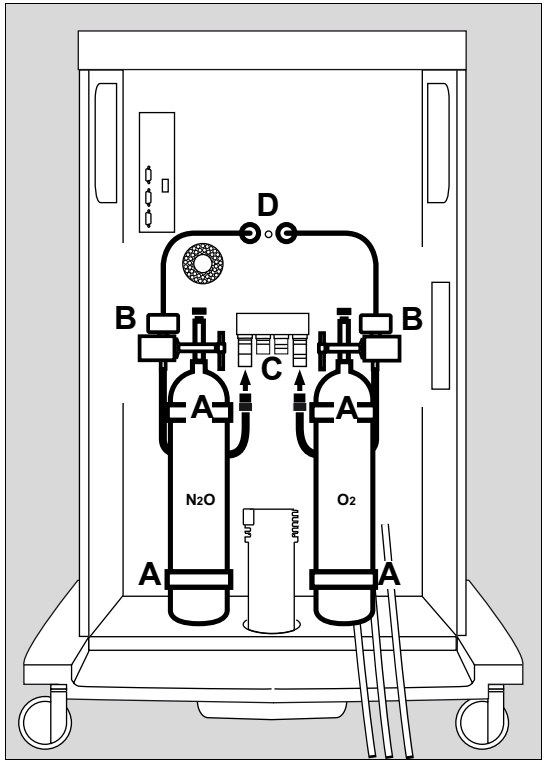
**CAUTION**

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.

On the rear of the device:




**1** Place full cylinders in the cylinder holders (A) and secure them with straps.
With the "Operation without nitrous oxide" option, connection of an $N_2O$ backup gas cylinder is not possible.

**2** Fit 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 $N_2O$ gas inlets to prevent $N_2O$ being connected by mistake. These sealing caps may only be removed by DrägerService. Before the device is used again with nitrous oxide, it must undergo a complete inspection 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 $O_2$ cylinders

**WARNING**

**Risk of explosion**

**If the $O_2$ cylinder valves or $O_2$ pressure reducing adapters is handled with oily or greasy fingers/hands, the risk of explosion is eminent.**

**Do not oil or grease the $O_2$ cylinder valves or $O_2$ 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**

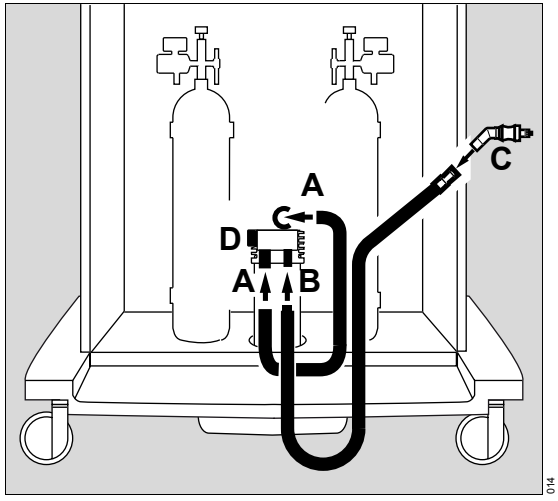
**Risk of supply failure**

**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

According to the particular requirements for anesthesia workstations, the use of an anesthetic gas scavenging system is required.




1. Connect the gray transfer hose (A) to the nozzles on the Primus *Infinity Empowered* 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 operation indicator of the terminal unit is green.
6. The AGS is functioning when the float in the flow tube is between the two marks.

Observe the instructions for use included with 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.

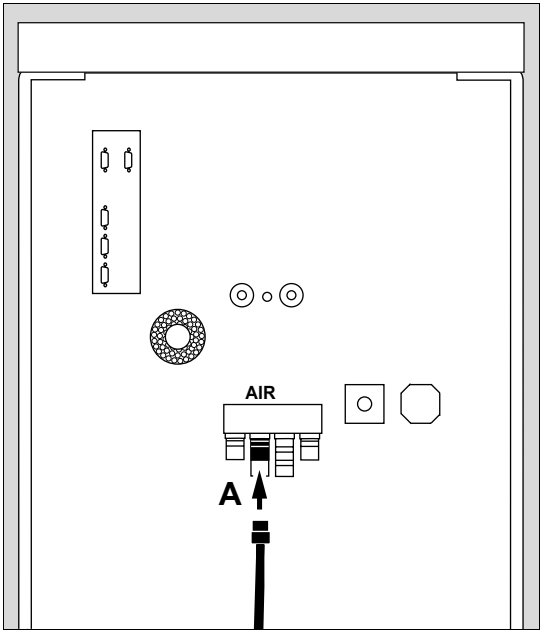
**NOTE**

If the anesthesia machine is operating on an incline exceeding 5°, 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 *Infinity Empowered*.

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 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.**

**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.**

**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**

Primus *Infinity Empowered* (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**

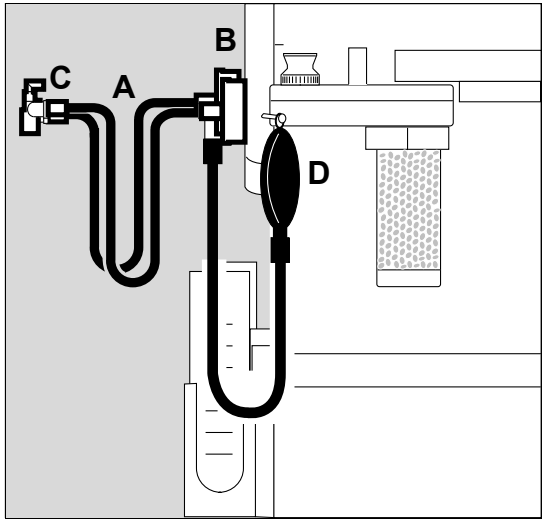
Only use original sample line – other lines may change the technical data of the device.

**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) |
| **Filters** | 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.**

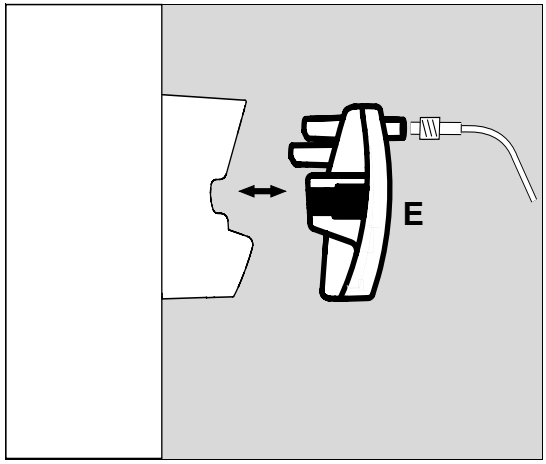
**Make sure that all breathing hoses are correctly connected to the breathing system.**

**2** Connect each breathing hose (A) to the inspiratory port and expiratory port, optionally with microbial filter (B).

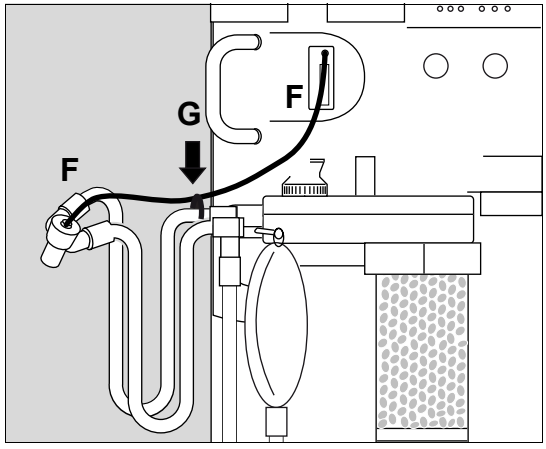
**3** Connect both breathing hoses to the Y-piece (C).

**4** Connect breathing bag (D) to breathing bag hose.

**5** Attach the breathing bag hose to the bag elbow and hang the breathing bag on the hook.



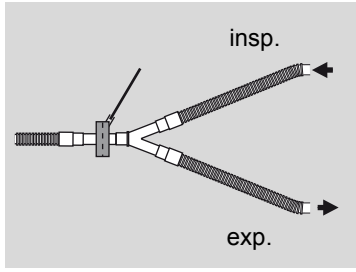
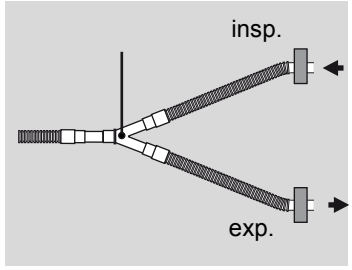
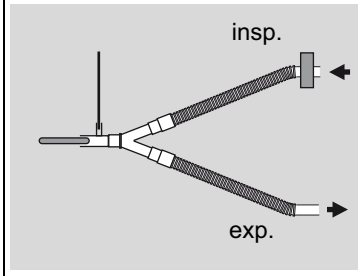

**6** Fit the water trap (E).

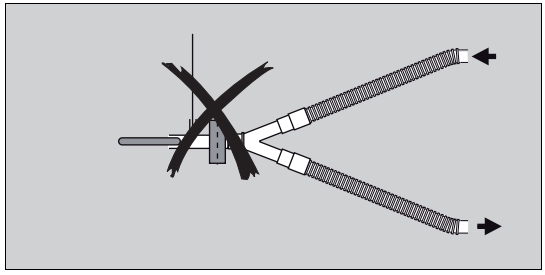



**7** Connect the sample line (F) to the connector on the Y-piece and to the water trap.

**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***

<table>
<tr><th>Adults</th><th>Pediatric patients</th><th>Neonates</th></tr>
<tr><td colspan="2">A filter or an HME filter between the Y-piece and patient, connector for sample line on the filter or HME filter:<br>  <br><br>Or<br>One filter each on the inspiratory port and expiratory port, connector for sample line on the Y-piece:<br>  <br></td><td>One filter on the inspiratory port, connector for sample line as close as possible to the patient:<br>  <br><br>Side connectors for connecting the sample line support the $CO_2$ measurement and help to flush the dead space in the Y-piece and tube adapter.</td></tr>
</table>




**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 $CO_2$, 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 ($cmH_2O$) 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):

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

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

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).

**Using the Infinity ID hose system**

When connecting a new Infinity ID hose system to Primus *Infinity Empowered*, the device can automatically detect the breathing hoses and is able to monitor the correct assembly of the hose system.

If this function for Infinity ID hoses should not be used it can be disabled in the Standby configuration, see page 173.

The function for the transfer of ventilation settings (TVS) needs to be enabled or disabled separately by DrägerService and in the Standby configuration, see page 45.

Every time a new Infinity ID hose system is connected to the Primus *Infinity Empowered* the compliance and leakage values stored on the hose can be transferred and stored in the Primus *Infinity Empowered*. When the next self test or leakage test is performed, the values can be replaced by the determined values.

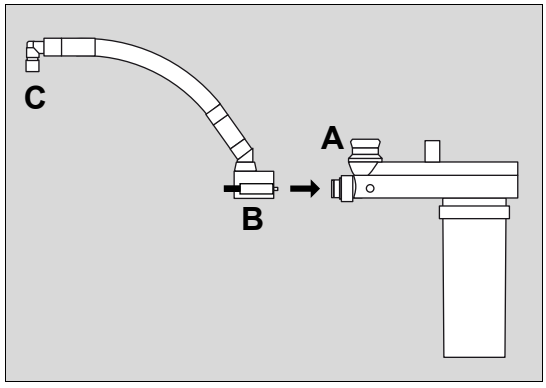
**Patient’s age**

When ventilating, in particular neonates and children, it is important to set the patient age properly. Depending on the patients' age setting, the MAC and xMAC algorithms, the trigger sensitivity, and the sensitivity of the flow measurement adapt automatically.

* 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.




**Positioning the flexible arm and 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° elbow (C) to the end of the flexible arm.
4. Attach the breathing bag to the other end of the elbow.

## Park holder for vaporizer units (optional)

**CAUTION**

Risk of ambient environment contamination and patient injury

The parked vaporizer may be mistakenly opened if the parking holder is positioned immediately 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.

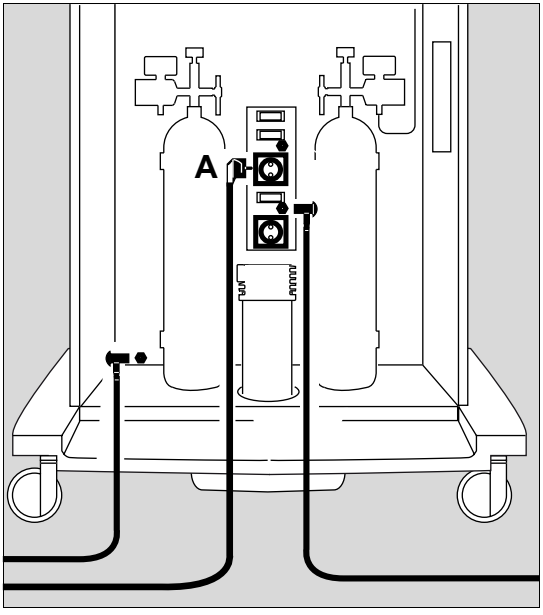
# Connecting the electrical connections

## Connecting auxiliary devices

The Primus *Infinity Empowered* has two auxiliary outlets on the rear of the machine. Each outlet is rated 3 amps and protected by safety fuses.

There is also a dedicated auxiliary power outlet for a Desflurane vaporizer on the side of the machine, above the vaporizer mount (see item V on page 20). This outlet is protected by safety fuses.

In addition there is a 4 amp automatic circuit breaker for the outlet for a Desflurane vaporizer.




**1** Connect to auxiliary outlets (A) at the back of the workstation.

**2** Install the Desflurane vaporizer in its mount and connect it to the outlet on the side of the machine, see page 79.

**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 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 instead.**

**The system must fulfill the requirements for medical electrical equipment in accordance with the relevant standards, see the chapter "Technical Data", page 270.**

## Establishing potential equalization

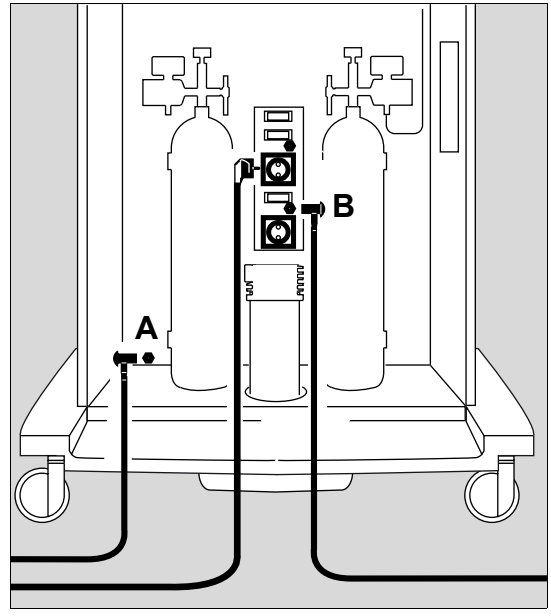
e.g., for intracardiac or intracranial surgery.

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:

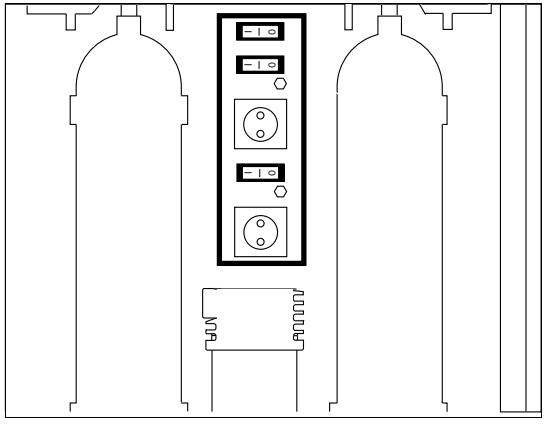
100 to 240 V

- 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 *Infinity Empowered* can be quickly interrupted if there is a device failure.

## Fuses for auxiliary outlets




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.

# Getting started

## Device check

Prerequisites:

The device has been prepared and assembled ready for operation (see "Assembly" on page 229).

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.**

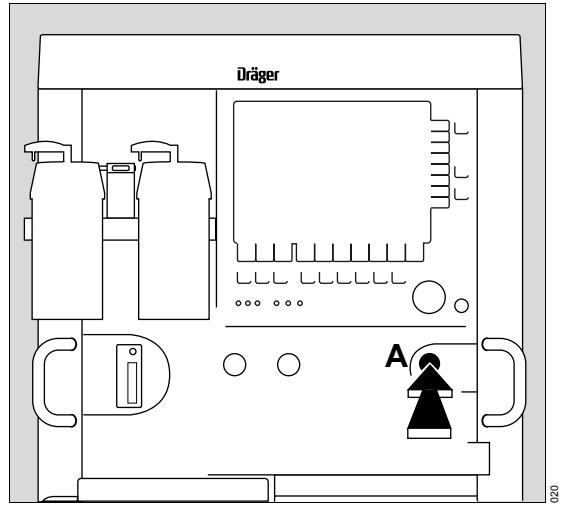
**CAUTION**

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 *Infinity Empowered*: press the system power switch ■○ ⊙▬ (A), an acoustic tone sounds.

After approx. 15 seconds all LEDs and the loudspeaker are tested by Primus *Infinity Empowered*.

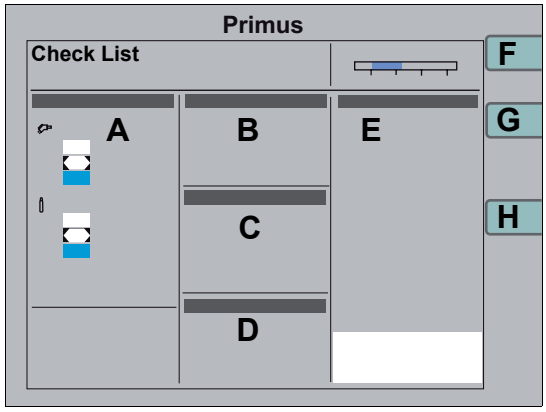
**NOTE**

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

The initial screen appears after about 20 seconds. Primus *Infinity Empowered* 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***
- ***$O_2$ Flush functional?***
- ***Safety $O_2$ control functional?***

**B** ***Vaporizers***
- ***Correctly locked in positon?***
- ***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 $O_2$ flow control.***

- Check the components as instructed in the ***Check List*** on the screen and as described on the following pages 83 to 94.

**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 89.

**WARNING**

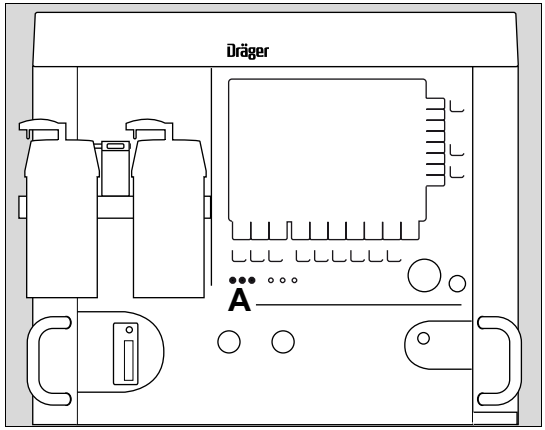
**Risk of device failure and/or patient injury**

**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.**

* Only without configured CLIC absorber.

## 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.

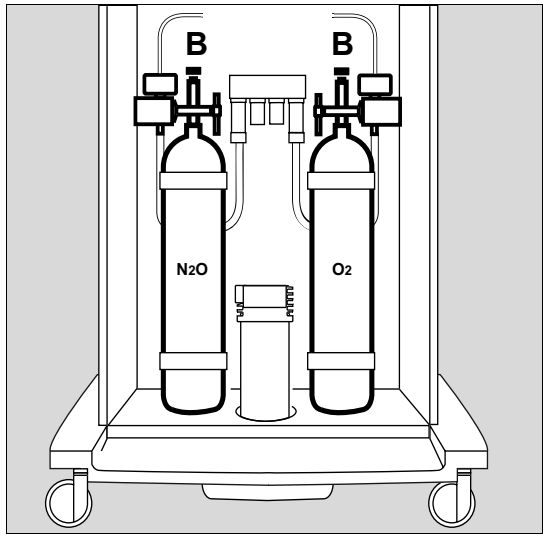
## Reserve gas cylinders

**CAUTION**

Risk of supply failure

If valves are open during operation on central supply, there is a risk of gas being withdrawn from the reserve gas gylinders.

Close cylinder valves whenever the central supply is sufficient.




See also the instructions for use of the pressure reducers used, e.g., Silverline.

**1** Slowly open the cylinder valves (B).

LEDs light up green when $O_2$ pressure is over 20 kPa x 100 and $N_2O$ 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 175. Only these gas supplies will then be checked during the self test and an alarm issued in the event of a fault dur-

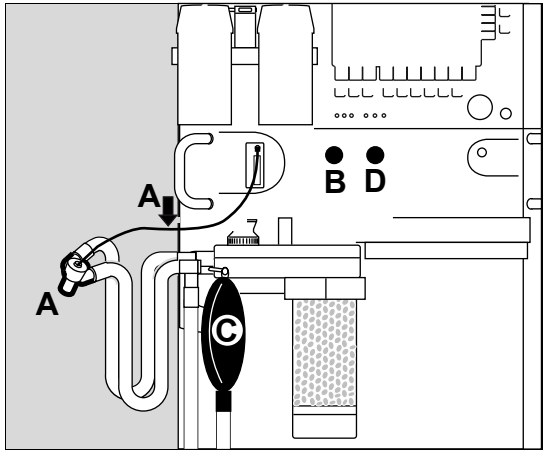
* See page 266 for precise details on cylinder pressures.

ing normal operation. The central $O_2$ supply and the $O_2$ 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.

$O_2$ must be connected for the following self test.

## $O_2$-Flush




1 Close the Y-piece = plug (A) firmly onto the cone.

2 Press the ***O2+*** button (B).

3 Breathing bag (C) inflates with an audible flow.

## $O_2$ emergency delivery

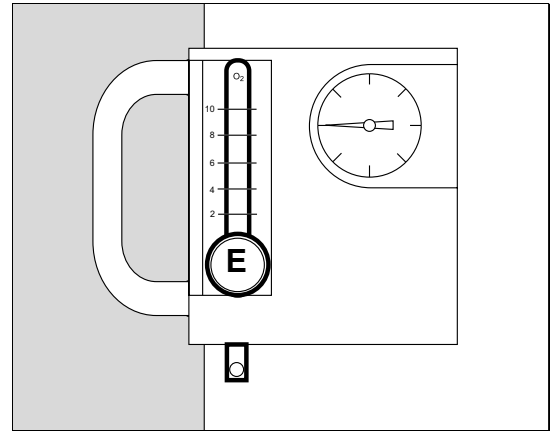
1 Close the Y-piece = plug (A) firmly onto the cone.

2 Press the safety knob (D) for the $O_2$ 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 $O_2$ emergency delivery and press it inwards.

## Auxiliary oxygen flow tube (optional)




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

**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.**

**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 scavenging system) are tight so that oxygen leaks cannot endanger the user or the patient.**

**CAUTION**

Risk of inadequate pressure monitoring

The optional auxiliary outlets are not pressure monitored.

Pressure monitoring must be ensured by the connected device.

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

- Turn the flow knob (E) clockwise until it can no longer be turned.

Only then the oxygen flow is completely off.

## Emergency resuscitator

Example: Dräger Resutator 2000

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

Note the instructions for use.

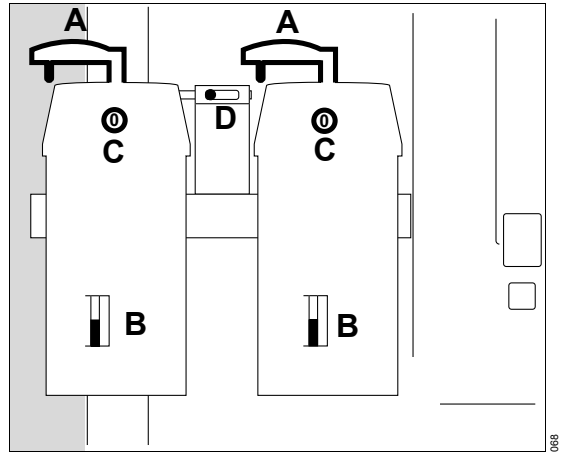
## Vaporizers

**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 vaporizers used must conform to the ISO 8835-4 or ISO 80601-2-13 standard. If the internal patient-gas measurement module fails, an independent gas measurement system conforming to 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 glasses (B) and ensure an adequate filling level.

**3** Ensure that the control dial is set to ***0*** and button (C) is 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** Control dial 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.

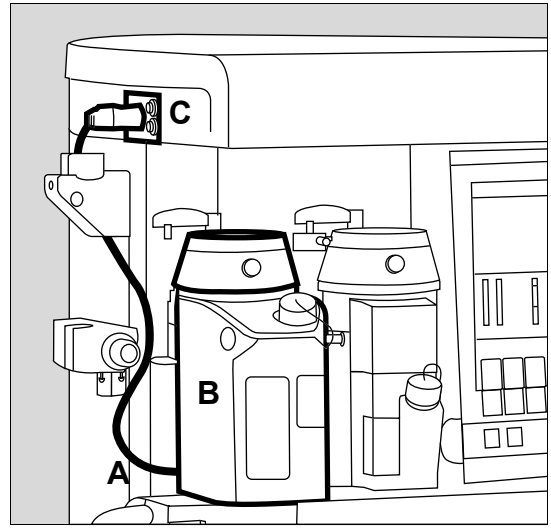
**6** Turn both handwheels to ***0*** positions.

**After filling or changing the vaporizer:**

- Perform leak test, see page 123.

**Connecting the Dräger Desflurane vaporizer**

The Dräger Desflurane vaporizer D-Vapor can be connected to the auxiliary outlet in the top shelf by using a short cable.




**1** Route the short 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 (C).

**WARNING**

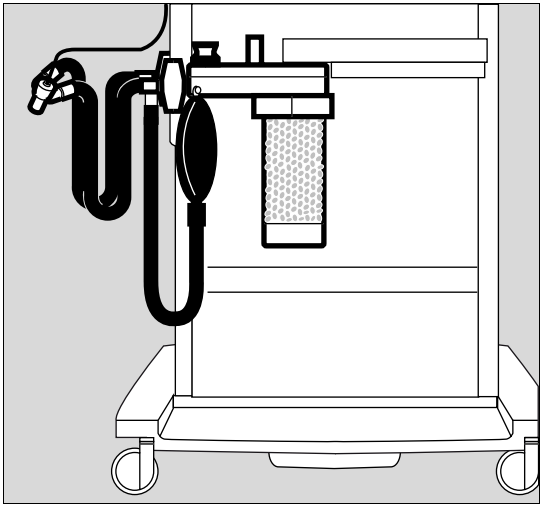
**Risk of patient injury**

**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-Vapor 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.

**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.**

- Fresh soda lime, without discoloration is used. For information on how to change the soda lime, see "Changing soda lime" on page 121, "Removing the absorber" on page 218 and "Filling and fitting the absorber" on page 230.

**Soda lime depletion**

When using the Infinity ID CLIC absorber, Primus *Infinity Empowered* automatically detects if the Infinity ID CLIC absorber is in a locked position and calculates the amount of $CO_2$ already absorbed.

In the ***Standby Conf.*** menu, see page 173, the maximum number of use days can be set for the CLIC absorber based on, e.g., clinical hygiene guidelines. The soda lime consumption is monitored in proportion to the $CO_2$ absorption capacity set in the ***Standby Conf.*** menu. The use days and the calculated soda lime consumption are then available on the ***Check List***, during the ***Self Test,*** and on the ***Self Test Results*** page. This allows conclusions about the remaining availability, e.g., during the reprocessing of the device.

When the time remaining for use is 0 days or the remaining absorbent capacity is less than 20 %, the component will be marked conditionally functional during the ***Self Test*** and an alarm will be generated in ***Standby***.

**CAUTION**

Risk of high inspiratory $CO_2$ levels

If the soda lime has been used for an extended period of time, inspiratory $CO_2$ levels may increase. Infinity ID functionality should not be solely relied upon for soda lime exchange intervals.

Check the soda lime regularly for discoloration, especially if the inspiratory $CO_2$ level rises unexpectedly.

If a Infinity ID CLIC absorber already used on another machine is mounted, this functionality is not available.

**NOTE**

If during operation the absorber is for any reason no longer able to be identified by the anesthesia machine, an alarm condition will be generated. If confirmed, this alarm condition will no longer be displayed.

For Primus *Infinity Empowered* not configured with an automatic detection for the Infinity ID CLIC absorber, the date and time indicating when the soda lime was changed can only be logged by pressing the soft key ***soda lime changed*** on the ***Check List*** or the ***self test results*** 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.

The Infinity ID functionality for the Infinity ID CLIC absorber can be enabled and disabled by DrägerService. The factory default is enabled.

**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 $CO_2$ absorption,**
- **increased heat build-up in the absorber and thus, an increased breathing gas temperature,**
- **formation of CO,**
- **absorption and/or decomposition of the volatile anesthetic agent.**

**These reactions could pose a danger to the patient.**

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

**NOTE**

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

For diaphragm location and disassembly instruction see page 220.

**CAUTION**

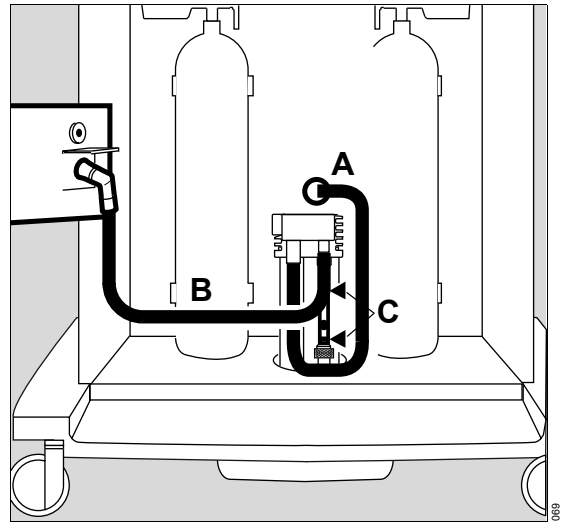
Risk of device failure

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.

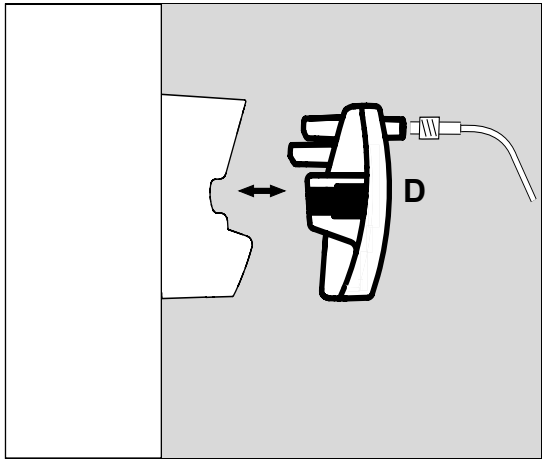
Note the instructions for use of the Drägersorb 800 Plus or Drägersorb FREE soda lime.

## 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



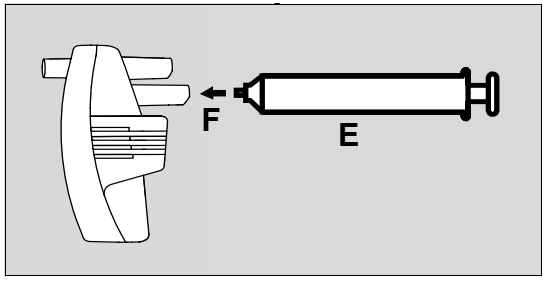

Two water traps are available for the Primus *Infinity Empowered*: the WaterLock 2 and the Infinity ID WaterLock 2. Only the Infinity ID water trap has the Infinity ID label and the integrated tag on the back.

For more details about the water traps see also the instructions for use of the water traps.

- 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** Plug an empty syringe (E) (minimum volume: 20 mL) without a cannula into the blue socket (F).

**3** Extract water, remove syringe and dispose of full syringe as infectious hospital waste.

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

## Dealing with the water trap exchange interval for the Infinity ID water trap

To avoid damage to the gas measuring system, water traps must be replaced at regular intervals. The expiration date of Infinity ID water traps is automatically calculated based on the date of first use. The date of first use of a new water trap is set when switching from standby to a ventilation mode. When the expiration date is reached and the water trap must be replaced an alarm is displayed (only shown in ***Standby***).

**CAUTION**

Risk of gas measurement failure

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.

Infinity ID functionality should not be solely relied upon for water trap exchange intervals, especially if e.g. low-flow anesthesia is often applied.

**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

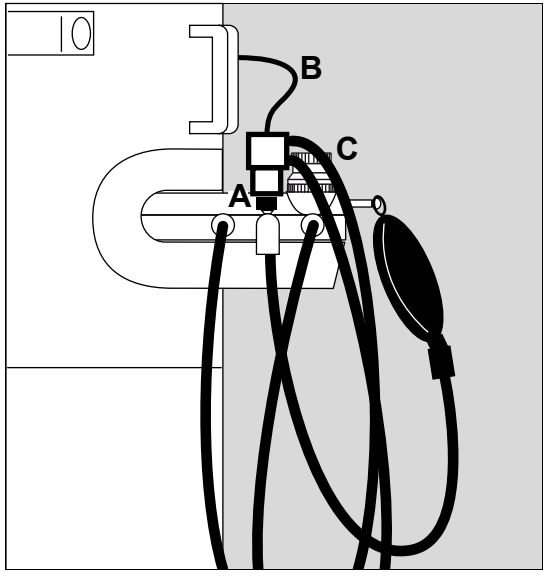
Aerosols can damage the diaphragm and the measurement system.

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 243 for additional information on using the water trap.

The Infinity ID function for the Infinity ID WaterLock 2 can be enabled and disabled by DrägerService. The factory default is enabled.

## Preparing Primus *Infinity Empowered* for the self test




1 Fit the Y-piece (A) securely on to the circuit plug.

2 Make sure the sample line (B) is connected to the Y-piece and to the water trap.

3 Set the APL valve (C) to position ***Man*** and to 30 hPa ($cmH_2O$).

**Notes on the use of bacterial/viral filters, endotracheal tubes, Y-pieces, breathing hoses, soda lime and other accessories for breathing systems**

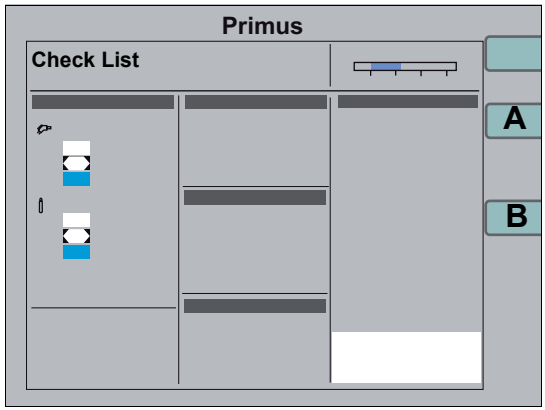
**WARNING**

**Risk of patient injury**

**When using additional components in the breathing system or configurations which deviate from the standard hose system, the inspiratory and expiratory breathing resistances can be increased to values which exceed the standard requirements.**

**If configurations of this kind are used, the user must pay special attention to the measured values.**

## Self test




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

- Start the self test by pressing the ***Start self test*** key (A) or by pressing the rotary knob.

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

- Press the ***cancel test*** key (B), and proceed as specified in "Emergency start" on page 89. The self test can be canceled up to ten consecutive times.

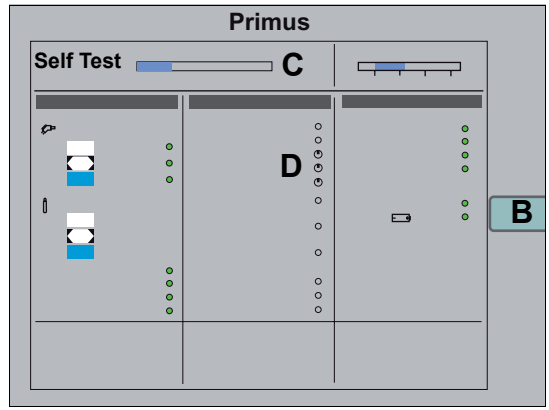
**WARNING**

**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 *Infinity Empowered* 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 self 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 $O_2$ 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 *Infinity Empowered* 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/cm$H_2O$).

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

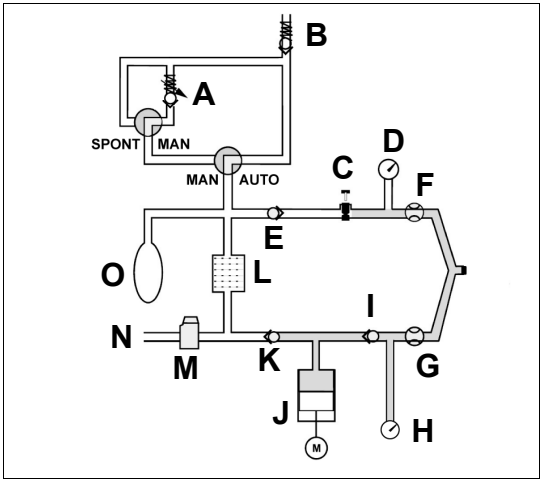
## Leakage

Leaks are tested in the mechanical subsystem and in the complete system (see gas flow 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** Mechanical pressure gauge (optional)

**I** Insp. valve

**J** Piston pump ventilator

**K** Fresh-gas decoupling valve

**L** $CO_2$ absorber

**M** Vaporizer

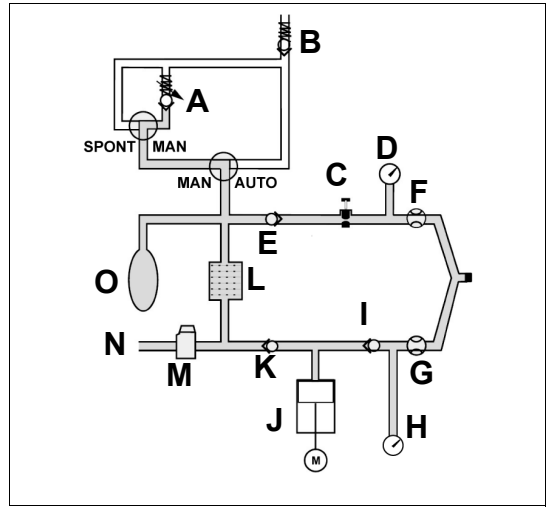
**N** Fresh gas

**O** 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 *Infinity Empowered* 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 123.

Possible causes of leaks include, e.g.:

– $CO_2$ 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 ($cmH_2O$)
– 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
– $O_2$ sensor not (or not correctly) connected (for electrochemical $O_2$ 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 occluding the Y-piece is 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.

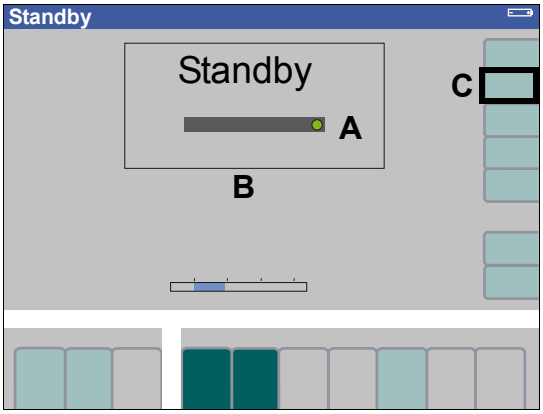
**NOTE**

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 *Infinity Empowered* switches to ***Standby***.




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

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

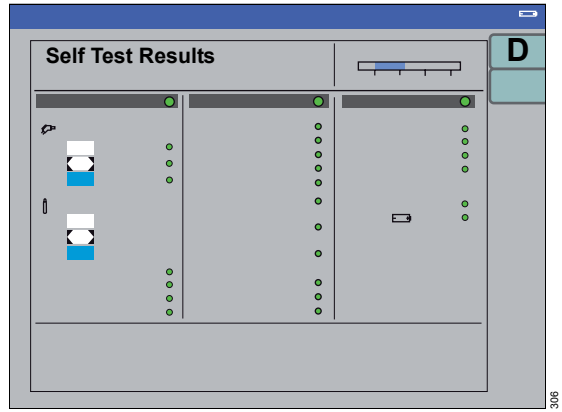
Dräger recommends that a full self test is carried out before the start of therapy, after restarting the device, and at least once every 24 hours. If the last self test was more than 24 hours ago, the text below the status display (A) is highlighted in yellow.

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.

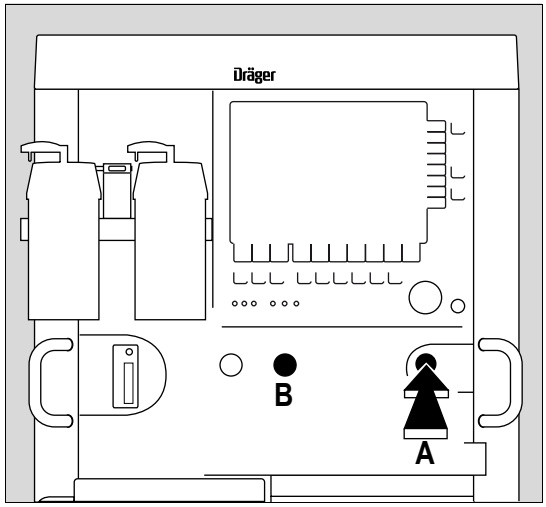
The ***Self Test Results*** screen contains the ***soda lime changed*** (D) key.




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 ***Self Test Results*** screen.

This key is only available if the Infinity ID functionality has not been enabled by DrägerService. If the Infinity ID functionality for the Infinity CLIC absorber is enabled, the soda lime change can automatically be detected by the Primus *Infinity Empowered* and can be stored in the self test results.

## Emergency start




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

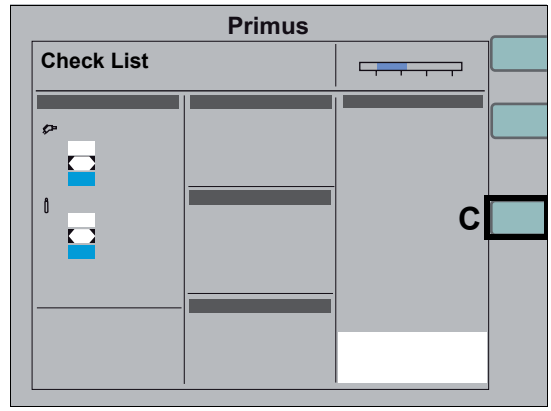
1 Switch on the workstation (A).

2 Check that both vaporizers are closed.

3 Set the safety knob (B) of the $O_2$ emergency delivery to the required $O_2$ 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 during this phase. Spontaneous breathing can continue.

Primus *Infinity Empowered* is ready for operation about 1 minute after initiating. The $O_2$ 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 247 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 *Infinity Empowered* 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 *Infinity Empowered*:

**1** Set the safety knob for $O_2$ emergency delivery to ***0*** and press it inwards.

**2** Select the fresh-gas setting and ventilation mode, see "Operation" on page 91.

# Operation

# 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 therapy-related data from Infinity ID breathing circuits

Primus *Infinity Empowered* supports automatic configuration of the workplace by transfer of therapy-related data via Infinity ID breathing circuits from and to other devices supporting this functionality. Transfer of the following data is supported:

– Ventilation settings and ventilation therapy data

– Fresh-gas settings

– Alarm limits

– Patient data

**NOTE**

When connecting an Infinity ID breathing circuit to the breathing system, no inspiratory or expiratory microbial filters should be used.

### Ventilation Settings

Ventilation settings are automatically transferred. Ventilation mode settings, which are different from those offered in Primus *Infinity Empowered*, are automatically transferred into that mode offering the most similar respiratory support.

| **Data received from breathing circuit Ventilation mode**[1)] | | **Resulting mode Primus *Infinity Empowered*** |
|---|---|---|
| Mandatory ventilation | Volume-controlled ventilation | ***Volume Mode*** |
| | Volume guaranteed | ***Volume AF*** [2)], otherwise ***Volume Mode*** |
| | Pressure controlled | ***Pressure Mode*** |
| Synchronized Intermittend Mandatory Ventilation<br>Assisted ventilation<br>Mandatory Minute Volume Ventilation | Volume-controlled ventilation | ***Volume Mode***, ***Trigger*** ON |
| | Volume guaranteed | ***Volume AF*** [2)], otherwise ***Volume Mode***, ***Trigger*** ON |
| | Pressure controlled | ***Pressure Mode***, ***Trigger*** ON |
| Continuous positive airway pressure | | ***Press. Support CPAP*** [2)], otherwise ***Man.Spont.*** mode |
| Continuous positive airway pressure with Pressure Support (except proportional pressure support) | | ***Press. Support CPAP*** [2)], otherwise ***Pressure Mode*** |
| Independent Lung Ventilation | | ignored completely |
| Continuous Flow | | ***Ext. Outlet*** mode [2)], otherwise ***Man.Spont.*** mode |
| External Fresh Gas | | ***Ext. Outlet*** mode [2)], otherwise ***Man.Spont.*** mode |
| Man./Spont. | | ***Man.Spont.*** mode |

1) Nomenclature may vary dependent on device.
2) If a ventilation mode software option has not been activated, a substitute mode will be selected.

If Pressure Support (exception: Proportional Pressure Support) has been activated in order to support the patient's spontaneous breathing efforts, Primus *Infinity Empowered* will also take this setting, as long as the software option has been activated. Volume Mode AutoFlow (***Volume AF***) will be transferred into ***Volume Mode***, if the software option is not activated.

**Fresh-gas settings**

Data for fresh-gas settings from devices without rebreathing systems, will not be transferred to the Primus *Infinity Empowered*.

**Alarm limits and alarm activation**

The numerical values are taken as is, for the following alarm limits:

– minute volume high and low
– airway pressure high and low
– inspiratory $O_2$ concentration high and inspiratory $O_2$ concentration low

Whether or not these alarm limits will be valid, depends on how Primus *Infinity Empowered* has been configured.

**NOTE**

If during operation the breathing hoses are for any reason no longer able to be identified by the anesthesia machine, an alarm condition will be generated; if confirmed, this alarm condition will no longer be displayed.

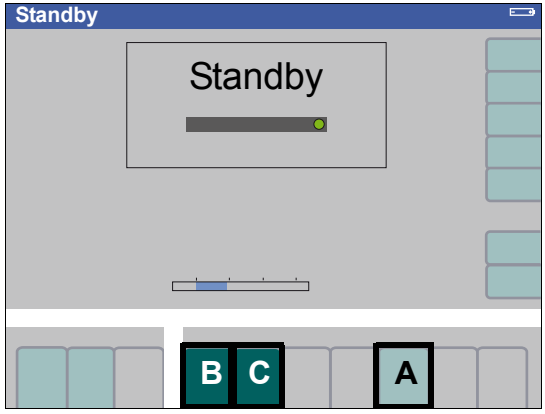
#### Patient data

Patient age is transferred as is; for transfer of data from another Primus *Infinity Empowered*, the ideal body weight is transferred as is, otherwise it is calculated according to patient height and patient category (adult, pediatric, or neonate) or age.

## 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 *Infinity Empowered* is switched on. They can be changed and set as required for the specific hospital concerned, see "Configuring the default settings" on page 166.




- 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 $SpO_2$ 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 ***VT*** and frequency ***freq.*** as well as the alarm limits for the expiratory minute volume ***MV*** during operation.

1 Press the soft key ***weight*** (C).

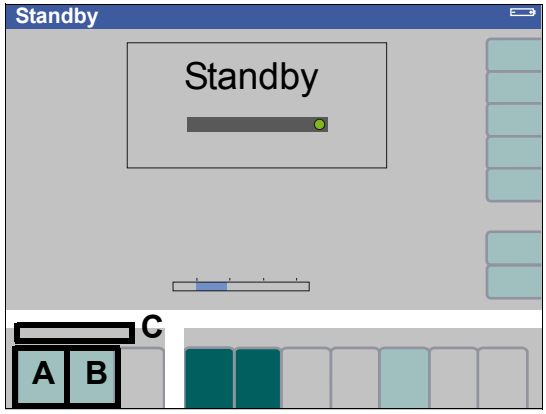
2 Set and confirm the weight using the rotary knob.

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

**Setting ranges and factory settings**

| Parameter | Setting ranges | Factory setting |
|---|---|---|
| ***age*** | <1 to 120 years | 40 |
| ***weight*** | 1 to 120 kg<br>(1 to 240 lbs) | – – |

## Setting fresh-gas concentrations




**1** $O_2$ concentration ***$O_2$ %*** (A)

**2** Fresh-gas flow ***flow L/min*** (B).

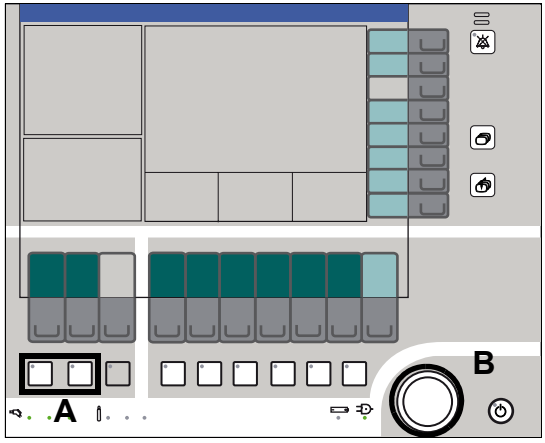
The fresh-gas settings can be changed before selecting a ventilation mode. Fresh gas does not flow in the ***Standby*** mode (soft keys = light green).

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).

**Setting ranges and factory settings**

| Fresh-gas parameters | Setting ranges | Factory setting |
|---|---|---|
| Carrier gas | ***Air*** or ***$N_2O$*** | ***AIR*** |
| ***$O_2$***<br>[%] | 21 to 100 for carrier gas Air<br>25 to 100 for carrier gas $N_2O$ | 100 |
| Fresh-gas ***flow***<br>[L/min] | 0.2 to 18 | 2 |

## Selecting the carrier gas

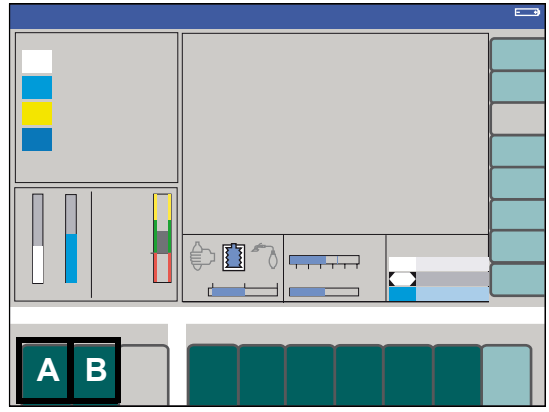



1 Press the hard key ***N2O*** or ***Air*** (A).
The green LED in the key flashes.

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.

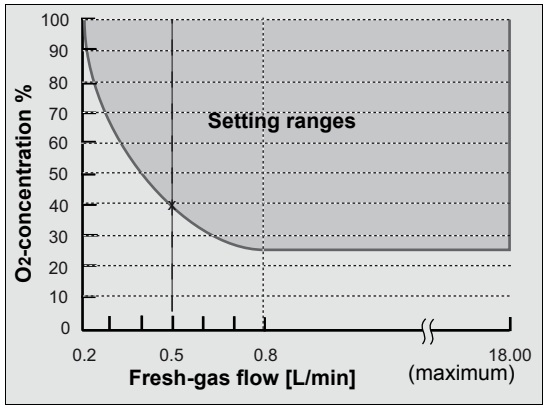
**CAUTION**

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.

To avoid this risk, use a suitable soda lime such as, e.g., Drägersorb Free, or set higher fresh-gas flows. Always use the patient-gas measurement module of the anesthesia machine.

## SORC (Sensitive Oxygen Ratio Controller)




Primus *Infinity Empowered* is fitted with an electronic $O_2$ minimum delivery system to avoid hypoxic gas mixtures when ***$N_2O$*** is selected as carrier gas. For fresh-gas flows greater than 0.8 L/min, the minimum $O_2$ concentration is limited to 25 %.

At fresh-gas flows below 0.8 L/min, the $O_2$ concentration is automatically increased to a value corresponding to an $O_2$ flow of 200 mL/min. If this control mechanism is activated, the $O_2$ % 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 ***$N_2O$*** as carrier gas.

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

## Fresh gas failure detection

During operation, Primus *Infinity Empowered* 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.**

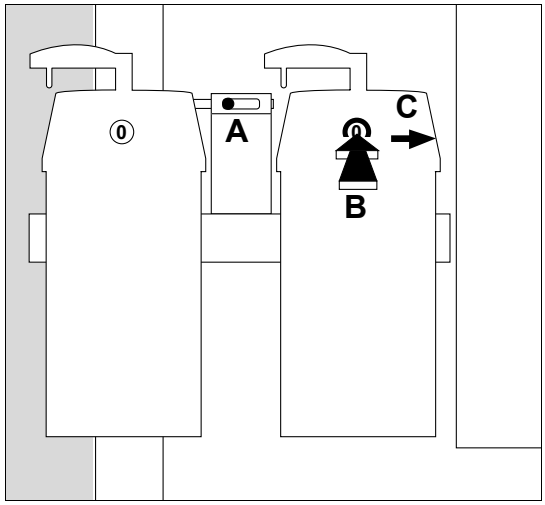
**Carefully monitor the gas mixture and, if necessary, use IV anesthetics.**

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***:

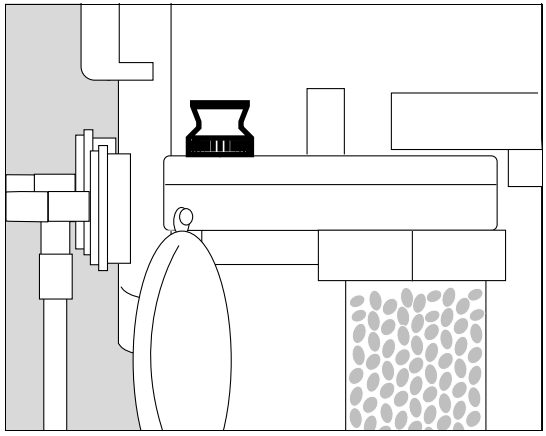
**2** Press ***0*** key (B), engage handwheel at ***0***. Wait 5 seconds for pressure to equalize.

**3** Press ***0*** key and turn handwheel (C) counterclockwise to set the required anesthetic gas concentration.

# Ventilation

## Pressure control valve APL

### Man.Spont. ventilation mode



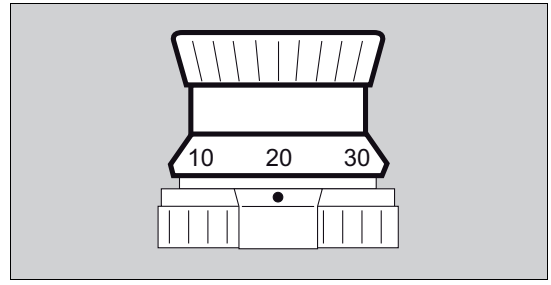

On the pressure control valve APL, you can select between manual ventilation ***Man.*** and spontaneous breathing ***Spont.***

**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



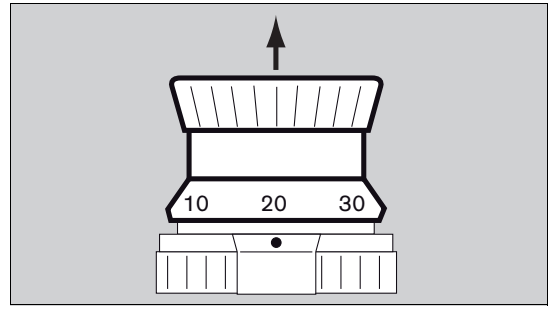

- Adjust the APL valve to the desired maximum airway pressure.

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.

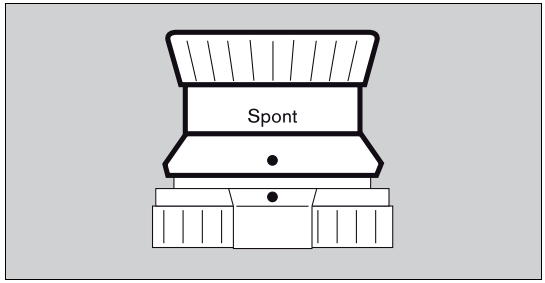
Even in automatic ventilation, the APL valve must be adjusted to a pressure that is safe for the patient!

### Quick release




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

### Spontaneous breathing

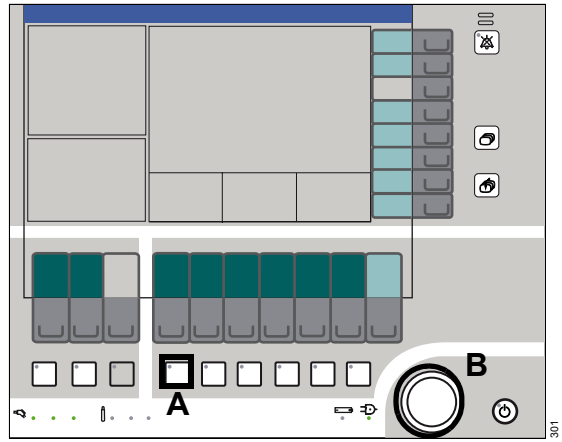



- Turn the APL valve counterclockwise as far as it will go.

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

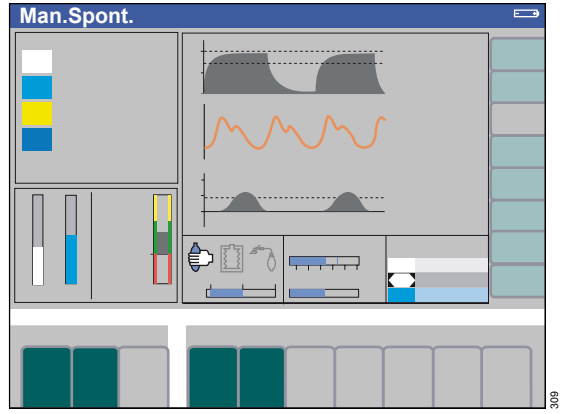
The pressure limitation is canceled, the valve is open for free spontaneous breathing.

## 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).

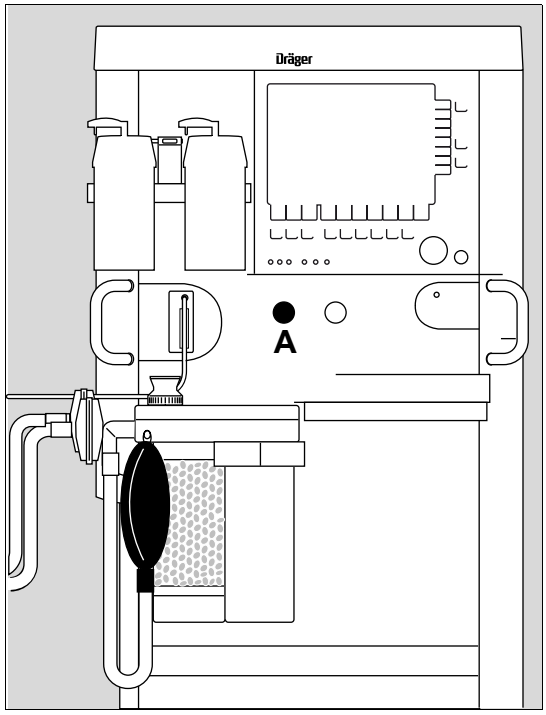



Certain alarms are disabled automatically in the ***Man.Spont.*** ventilation mode in order to avoid artifacts.

See page 132 for a list of alarms which are active in the ***Man.Spont.*** mode.

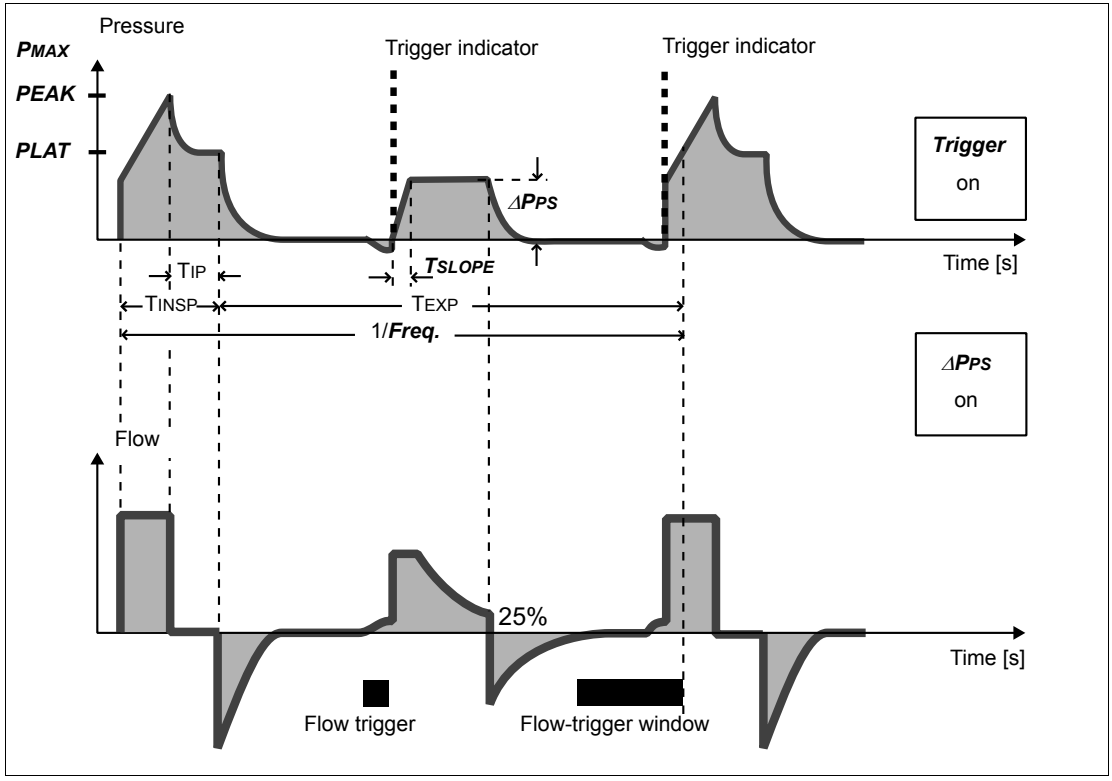
## $O_2$-Flush

For flushing and rapidly filling the breathing system and breathing bag with $O_2$ while bypassing the vaporizer.




- Press the ***$O_2$+*** (A) button. $O_2$ flows into the breathing system without anesthetic agent as long as the button is held down.

## Volume Mode



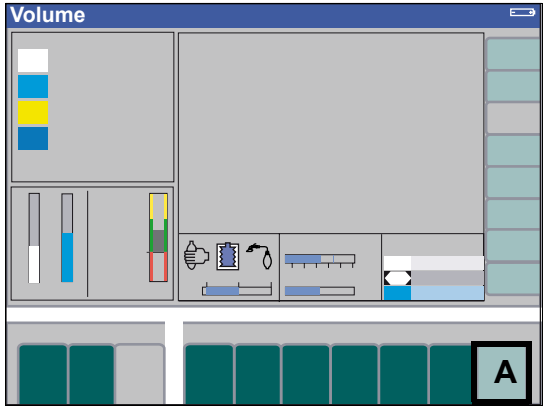

Volume-controlled ventilation mode with fixed mandatory tidal volume ***VT*** and frequency ***freq.*** (formerly IPPV), as well as with optional activation of synchronization (formerly SIMV(VC)) and adjustable pressure support for spontaneous breathing (formerly SIMV(VC)+PS, optional).

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

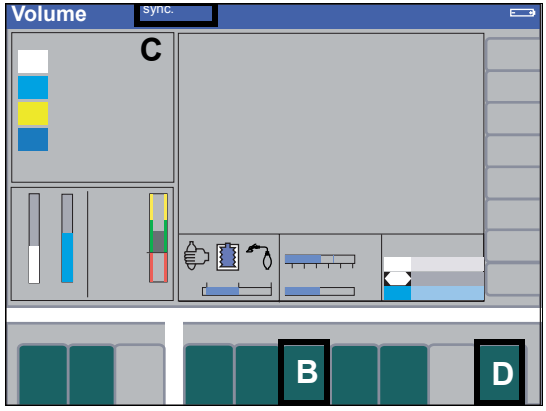
### Synchronized volume-controlled ventilation

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., ***TINSP*** 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 in the pressure waveform and in the flow waveform by a continuous vertical black line (trigger indicator). The active window for the breath triggered by the patient corresponds to the last 25 % of the applicable expiratory time.

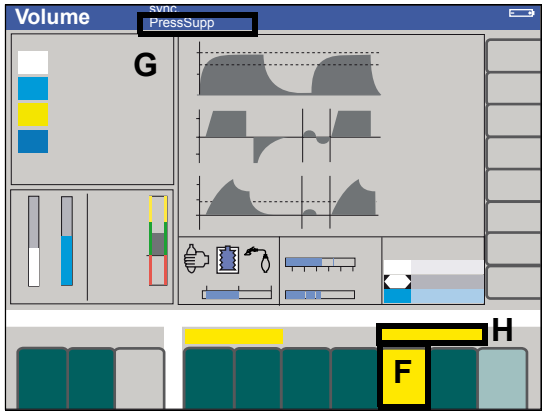
**NOTE**

A triggered ***VT*** 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***.

In the case of continuous and strong patient activity, it is possible that the mandatory ventilation coincides with the pressure-supported breaths of the patient, resulting in an increased tidal volume ***VT***.

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).

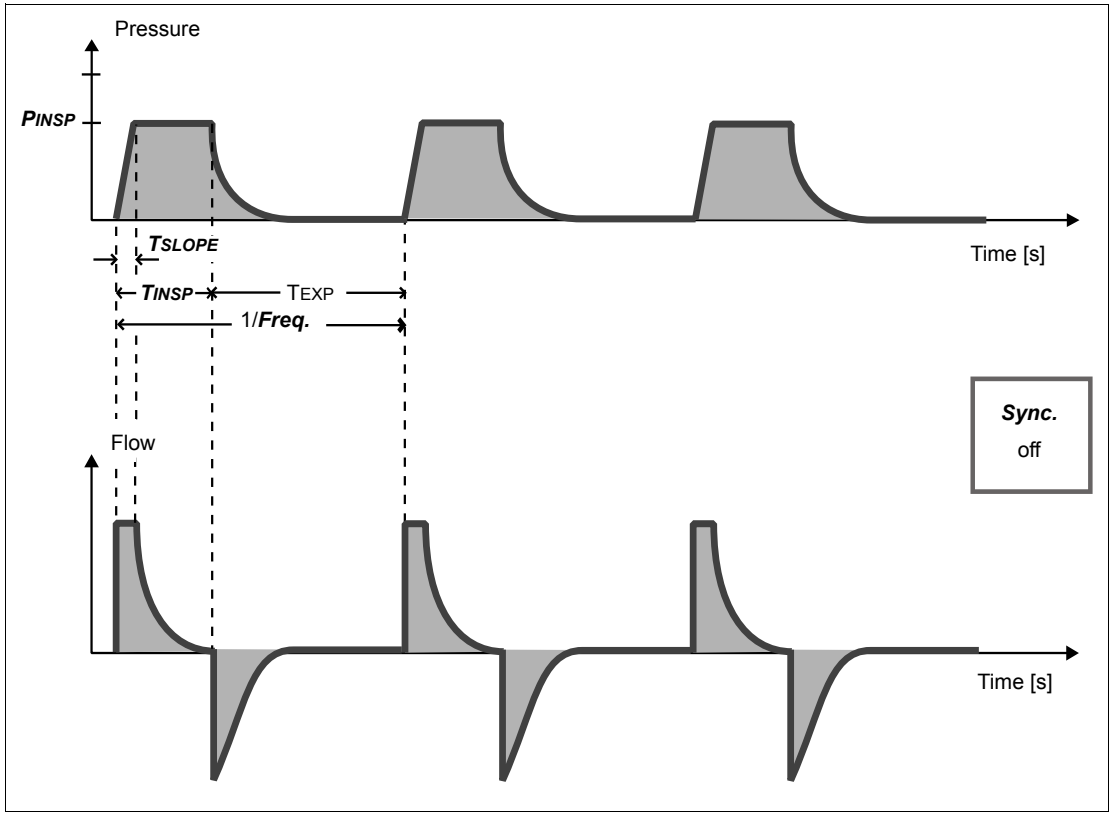
### Setting ranges and factory settings

| Ventilation parameters | Setting ranges | Factory setting[1)] |
|---|---|---|
| Pressure limitation<br>***PMAX***<br>[hPa (cmH2O)] | 10 to 70<br>min. ***PEEP*** +10 | 40 |
| tidal volume<br>***VT***<br>[mL] | 20 to 1400[2)] | 600 |
| Frequency<br>***freq.***[3) 4)]<br>[1/min] | 3 to 100 | 12 |
| Inspiratory time<br>***TINSP***[4)]<br>[sec.] | 0.2 to 6.7 | 1.7 |
| Insp. pause time: Insp. time<br>***TIP:TINSP***<br>[%] | 0 to 60 | 10 |
| ***PEEP***<br>[hPa (cmH2O)] | 0 to 20<br>max. ***PMAX*** –10 | 0 |
| Trigger sensitivity<br>***Trigger***<br>[L/min] | ***OFF***,<br>0.3 to 15 | 3.0<br>(***Pressure Support***)<br>***OFF***<br>(***Volume Mode***/ ***Pressure Mode***) |

| **Ventilation parameters** | **Setting ranges** | **Factory setting**[1)] |
|---|---|---|
| Pressure Support<br>***ΔPPS***[5)]<br>[hPa (cmH2O)] | ***OFF***,<br>3 to 50<br><br>max. ***PMAX*** – ***PEEP*** | 5<br>(***Pressure Support***)<br>***OFF***<br>(***Volume Mode***/ ***Pressure Mode***) |
| Rise time<br>***TSLOPE***<br>[sec.] | 0.0 to 2.0 | 0.0 |
| ***age***<br>[years] | <1 to 120 | 40 |
| ***weight***<br>[kg]<br>[lbs] | <br>1 to 120<br>1 to 240 | <br>– – |

1) The default values can be set specifically for the hospital concerned, see page 166.
2) Optionally 5 to 1400 mL.
3) Depending on the configuration, the inspiratory time ***TINSP*** can be automatically changed together with adjustment of the frequency so that the resultant ratio of inspiration to expiration I:E remains constant. Only applies if trigger = ***OFF***, see "Ventilator and gas delivery" on page 175.
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 ***VT*** 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 ***VT*** is delivered in a pressure controlled ventilation mode. The inspiratory pressure automatically adapts to the set tidal volume, limited by a maximum pressure ***PMAX***. When ventilation with ***Volume AF*** is started, the first mandatory breath is volume-controlled in order to identify the necessary pressure level, if it is not known from a previous ventilation mode.

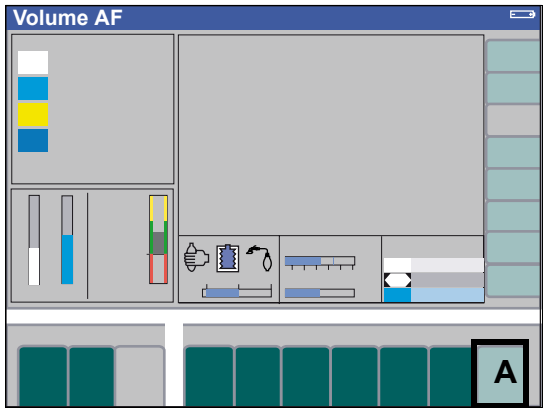
Primus *Infinity Empowered* automatically adapts the inspiratory pressure to the changing lung condition in steps of max. ±3 mbar per breathing cycle.

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 inspiratory pressure for the following breath will be reduced to 75 % of the target pressure, but limited to a maximum of 15 mbar above ***PEEP***.

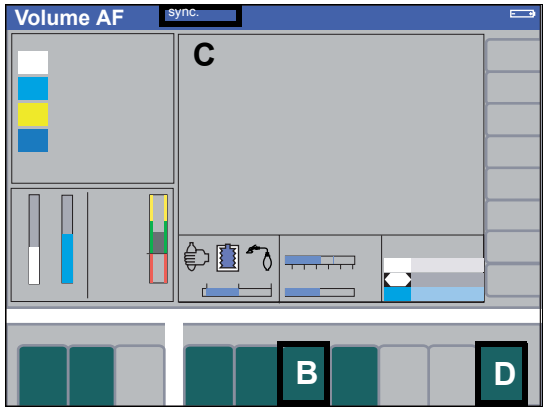
Some settable values are limited or mutually exclusive so that specific combinations of therapy settings are not possible, e.g., ***TINSP*** 6.9 s at ***Freq.*** 100/min

### 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*** (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.

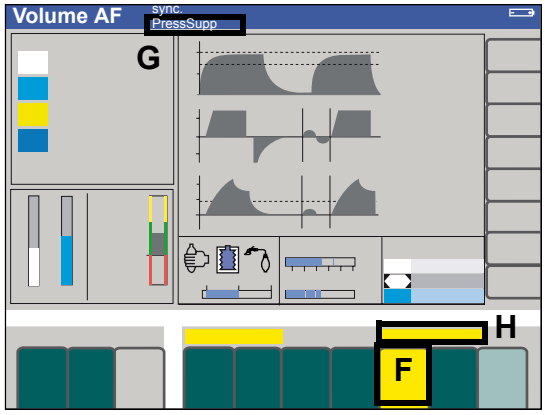
A mandatory breath triggered by the patient is represented in the pressure curve and in the flow curve by a continuous vertical black line (trigger indicator). The active window for the breath triggered by the patient corresponds to the last 25 % of the applicable expiratory time.

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*** (D) 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 ***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 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***.

In case of a continuous and strong patient activity, it is possible that the mandatory ventilation coincides with the pressure supported patient breaths, resulting in an increased tidal volume ***VT***.

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).

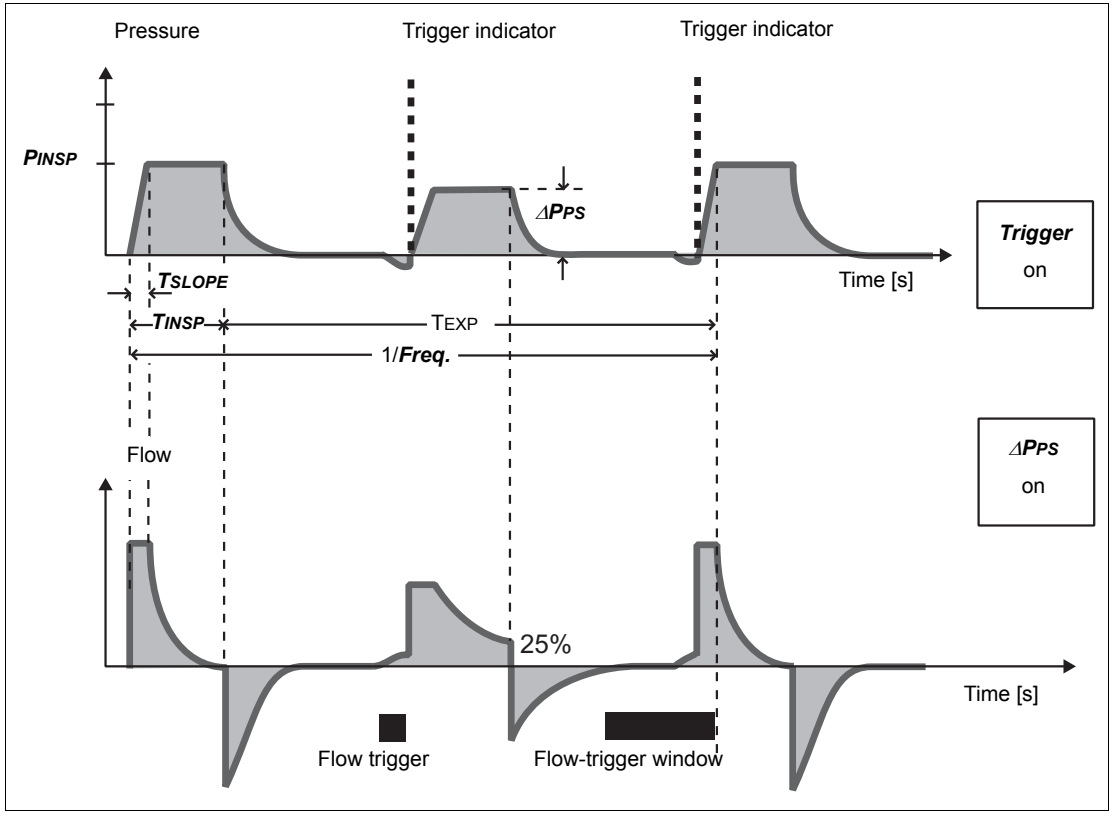
### Setting ranges and factory settings

| Ventilation parameters | Setting ranges | Factory setting[1)] |
|---|---|---|
| Pressure limitation<br>***PMAX***<br>[hPa (cmH2O)] | 10 to 70<br>min. ***PEEP*** +10 | 40 |
| tidal volume<br>***VT***<br>[mL] | 20 to 1400[2)] | 600 |
| Frequency<br>***freq.***[3) 4)]<br>[1/min] | 3 to 100 | 12 |
| Inspiratory time<br>***TINSP***[4)]<br>[sec.] | 0.2 to 6.7 | 1.7 |
| ***PEEP***<br>[hPa (cmH2O)] | 0 to 20 | 0 |
| Trigger sensitivity<br>***Trigger***<br>[L/min] | ***OFF***,<br>0.3 to 15 | 3.0<br>(***Pressure Support***)<br>***OFF***<br>(***Volume AF***) |
| Pressure Support<br>***ΔPPS***[5)]<br>[hPa (cmH2O)] | ***OFF***,<br>0 to 50<br><br>max. ***PMAX*** – ***PEEP*** | 5<br>(***Pressure Support***)<br>***OFF***<br>(***Volume AF***) |

| **Ventilation parameters** | **Setting ranges** | **Factory setting[1)]** |
|---|---|---|
| Rise time<br>***TSLOPE***<br>[sec.] | 0.0 to 2.0 | 0.0 |
| ***age***<br>[years] | <1 to 120 | 40 |
| ***weight*** | | |
| [kg] | 1 to 120 | – – |
| [lbs] | 1 to 240 | |

1) The default values can be set specifically for the hospital concerned, see page 166.
2) Optionally 5 to 1400 mL.
3) Depending on the configuration, the inspiratory time ***TINSP*** can be automatically changed together with adjustment of the frequency so that the resultant ratio of inspiration to expiration I:E remains constant. Only applies if trigger = ***OFF***, see "Ventilator and gas delivery" on page 175.
4) The resultant ratio of inspiration to expiration I:E is also displayed in parallel.
5) Optional

## Pressure Mode ventilation mode




***Pressure*** is a pressure-controlled ventilation mode with fixed pressure limitation ***PINSP*** 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).

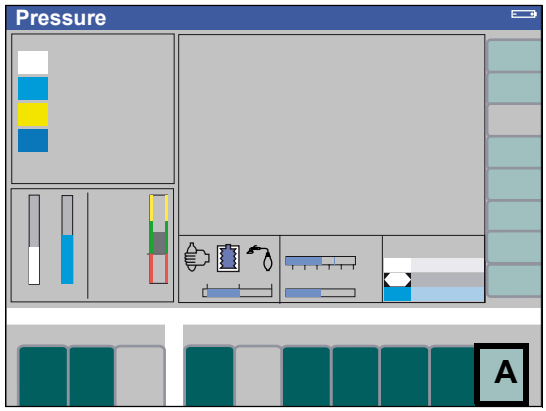
A continuous pressure is applied to the patient during the inspiratory time ***TINSP***. The rate at which the pressure curve rises is pre-set via the rise time ***TS-LOPE***. Synchronization and pressure support are controlled by the sensitivity of the flow trigger and the level of ***ΔPPS***. The maximum 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.

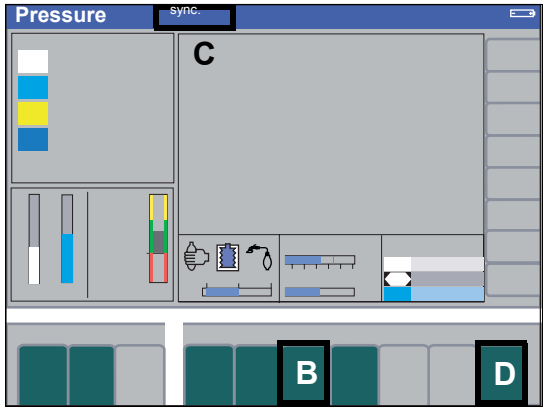
Some settable values are limited or mutually exclusive so that specific combinations of therapy settings are not possible, e.g., ***TINSP*** 6.9 s at ***Freq.*** 100/min

### 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.

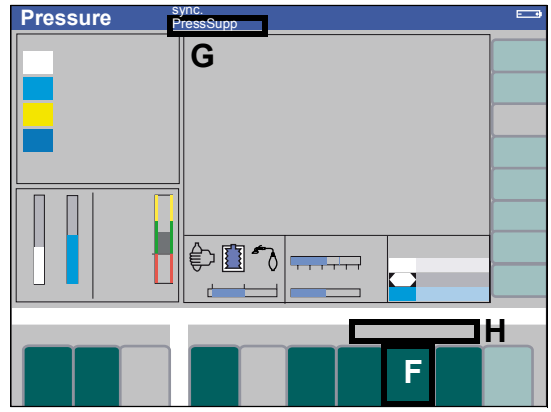
3 Set and confirm the trigger sensitivity with the rotary knob. When finally confirmed, the indication ***sync.*** in the status area (C) of the ventilation mode lights up steadily instead of flashing.

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 indicator). 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***.

In case of a continuous and strong patient activity, it is possible that the mandatory ventilation coincides with the pressure supported patient breaths, resulting in an increased tidal volume ***VT***.

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).

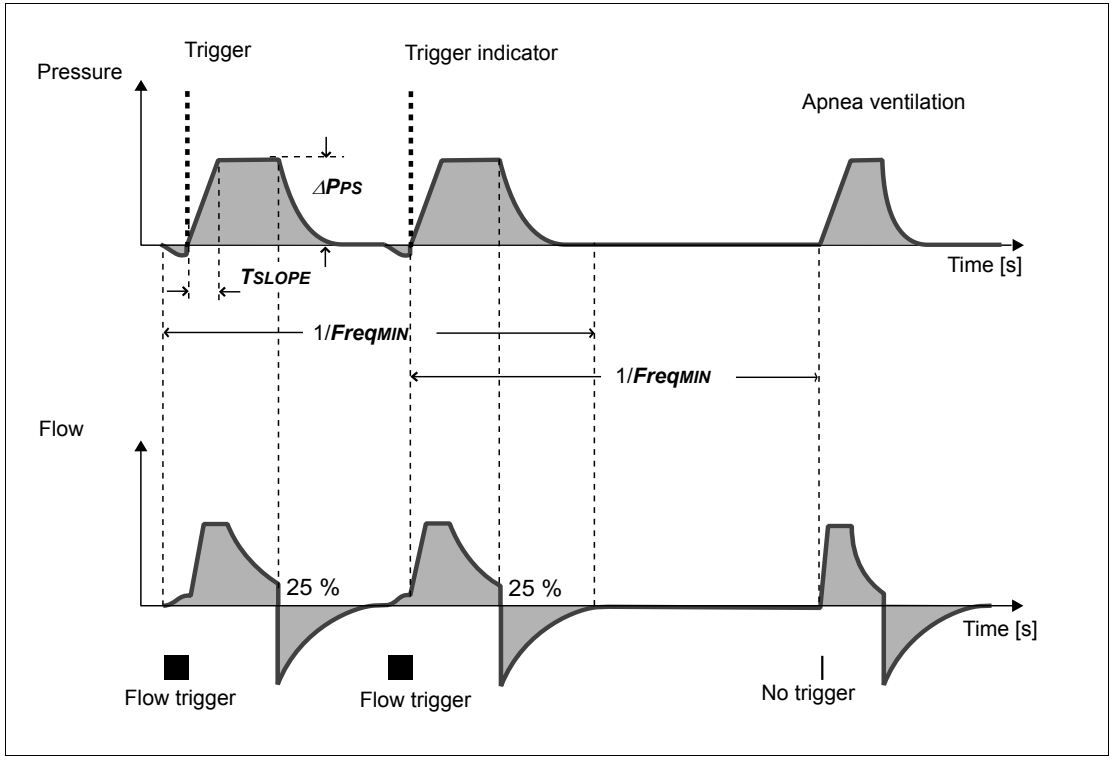
**Setting ranges and factory settings**

| **Ventilation parameters** | **Setting ranges** | **Factory setting[1)]** |
|---|---|---|
| Pressure limitation<br>***PINSP***<br>[hPa (cm$H_2O$)] | 5 to 70<br>min. ***PEEP*** +5 | 15 |
| Frequency<br>***freq.*** [2) 3)]<br>[1/min] | 3 to 100 | 12 |
| Inspiratory time<br>***TINSP*** [3)]<br>[sec.] | 0.2 to 6.7 | 1.7 |
| Insp. pause time: Insp. time<br>***TIP:TINSP*** [%] | 0 to 60 | 10 |
| ***PEEP*** [4)]<br>[hPa (cm$H_2O$)] | 0 to 20<br>max. ***PINSP*** –5 | 0 |
| Trigger sensitivity<br>***Trigger***<br>[L/min] | ***OFF***,<br>0.3 to 15 | 3.0<br>(***Pressure Support***)<br>***OFF***<br>(***Volume Mode***/ ***Pressure Mode***) |

| **Ventilation parameters** | **Setting ranges** | **Factory setting[1)]** |
|---|---|---|
| Pressure support ***ΔPPS*** [5)] [hPa (cmH2O)] | ***OFF***,<br>3 to 50<br><br>max. ***PMAX*** – ***PEEP*** | 5<br>(***Pressure Support***)<br>***OFF***<br>(***Volume Mode***/ ***Pressure Mode***) |
| Rise time<br>***TSLOPE***<br>[sec.] | 0.0 to 2.0 | 0.0 |
| ***age*** [years] | <1 to 120 | 40 |
| ***weight***<br>[kg]<br>[lbs] | <br>1 to 120<br>1 to 240 | <br>– – |

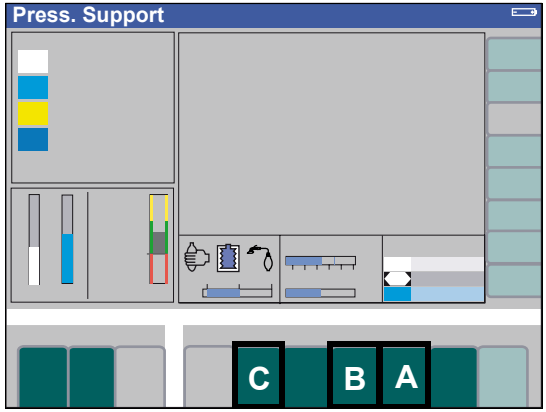
1) The default values can be set specifically for the hospital concerned, see page 166.
2) Depending on the configuration, the inspiratory time ***TINSP*** can be automatically changed together with adjustment of the frequency so that the resultant ratio of inspiration to expiration I:E remains constant. Only applies if trigger = ***OFF***, see "Ventilator and gas delivery" on page 175.
3) The resultant ratio of inspiration to expiration I:E is also displayed in parallel.
4) Depending on the configuration, the pressure limit value ***PINSP*** can also be changed automatically when the ***PEEP*** value is changed. See "Starting the preset ventilation mode" on page 116 and "Ventilator and gas delivery" on page 175.
5) Optional

## Pressure Support Mode (optional)




***Press. Support*** is a pressure-supported ventilation mode for patients with spontaneous breathing. Synchronization and pressure support of 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 ***Freq*MIN** (C). The ventilator is automatically triggered by ***Freq*MIN** 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 ***Freq*MIN** (***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 pressure support ***ΔPPS*** is set to ≤2 [hPa (cmH2O)].

At the same time, the minimum frequency ***Freq*MIN** is set to ***OFF*** and the rise time ***T*SLOPE** is set to 0.0. Apnea ventilation with minimum frequency is not appicable in the ***CPAP*** mode.

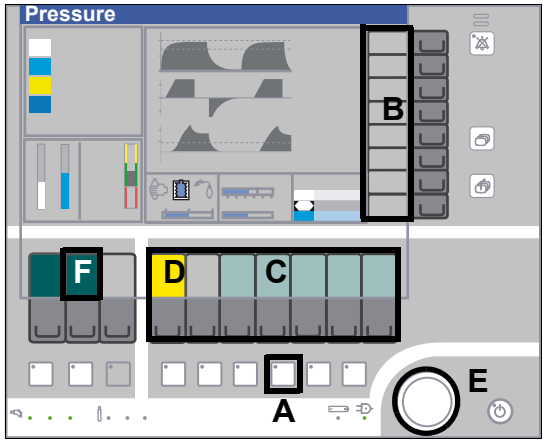
### Setting ranges and factory settings

| Ventilation parameters | Setting ranges | Factory setting[1)] |
|---|---|---|
| Minimum frequency[2)]<br>***Freq*MIN**<br>[1/min] | ***OFF***, 3 to 20<br><br>***OFF*** (***CPAP***) | 3 |
| ***PEEP***<br>[hPa (cmH2O)] | 0 to 20 | 0 |
| Trigger sensitivity<br>***Trigger***<br>[L/min] | 0.3 to 15 | 3.0 |
| Pressure Support ***ΔPPS***<br>[hPa (cmH2O)] | >2 to 50<br><br>0 to 2<br>(***CPAP***) | 5 |
| Rise time<br>***T*SLOPE**<br>[sec.] | 0.0 to 2.0<br><br>0.0<br>(***CPAP***) | 0.0 |
| ***age***<br>[years] | <1 to 120 | 40 |
| ***weight***<br>[kg]<br>[lbs] | <br>1 to 120<br>1 to 240 | <br>– – |

1) The default values can be set specifically for the hospital concerned, see page 166.
2) The inspiratory time is limited by adjustment of ***Freq*MIN** to yield a maximum ratio of 1:1 for I:E, thus ensuring an adequate expiratory time.

## Presetting the ventilation mode

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




**1** Press the ***Press. Mode*** key (A); 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 gray, indicating they 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. After 10 seconds an audible tone sequence of 5 seconds is issued.

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

### Starting the preset ventilation mode

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

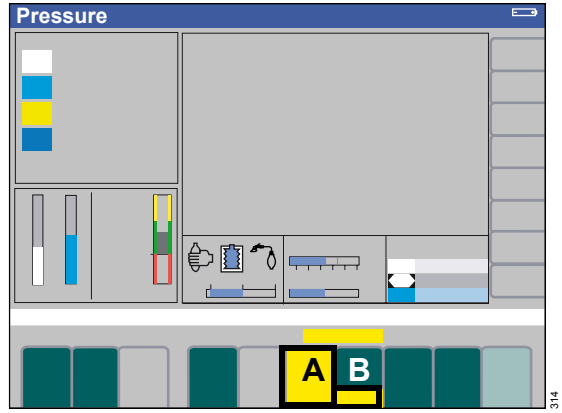
Fresh-gas flows, as indicated by the rotating symbol in the soft key ***flow L/min*** (F).

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 ***TINSP*** can be automatically changed together with adjustment of the frequency in volume or pressure-controlled ventilation without synchronization, so that the resultant ratio of inspiration to expiration I:E remains constant, see page 176.




For dependent setting of the change in ***TINSP***:

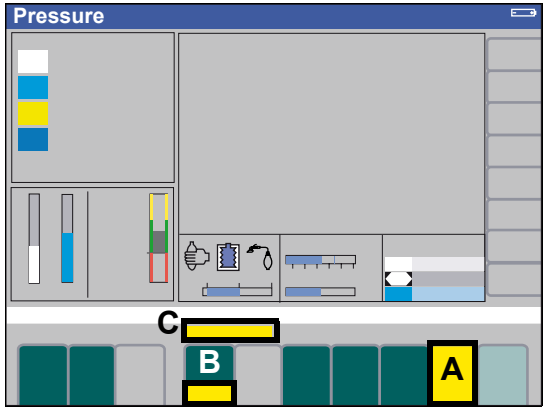
**1** Press the ***Freq.*** (frequency) softkey (A); the key lights up yellow.

**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 176.




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.

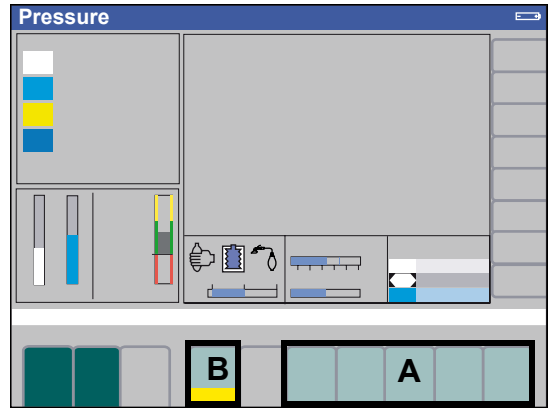
If configured, the lower alarm limit for the airway pressure ***PAW*** ▼ (C) will be automatically changed when the ***PEEP*** value is changed.

## 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 calculated based on 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*** or ***Trigger*** were set to ***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***, ***ΔPPS***, 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: Make sure that the breathing bag is adequately filled.
– Increased condensation: Possible impairment of the flow measurement and increased water accumulation in the upper diaphragm of the ventilator. Check the upper diaphragm on a daily basis and empty if necessary.
– Difference between $O_2$ setting and inspiratory $O_2$ concentration: The $O_2$ 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

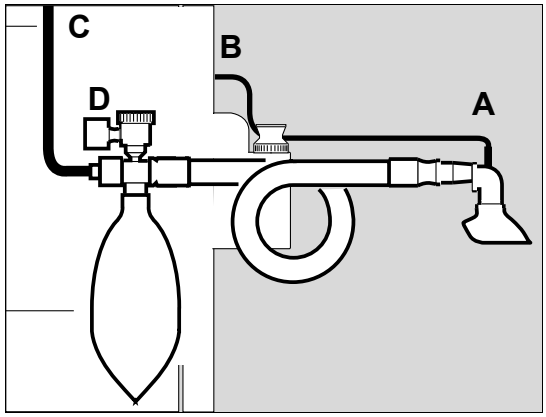
**(only with optional external fresh-gas outlet)**

**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 a non-rebreathing system if the flow is insufficient.**

Example: Bain system

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




To monitor $O_2$, $CO_2$ and anesthetic gases:

1 Connect the sample line to the Luer Lock connector of the elbow (A) and to the water trap (B) at the front of the device.

For mask manifolds without sample line connector:

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

or:

- If applicable, use the Luer Lock connector on a filter.

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

3 To dispose of the exhaled gas, connect the non-rebreathing system connector (D) to the Y-piece.

4 Follow the instructions for use included with the Bain system.

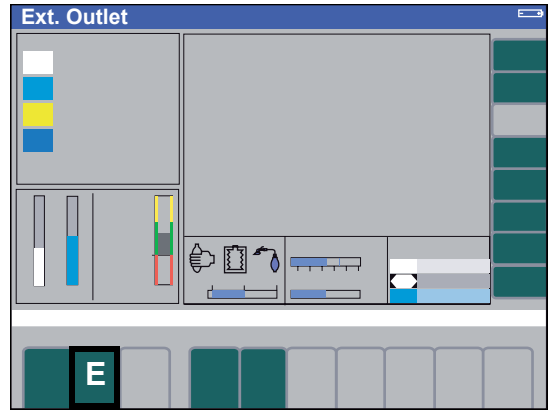
Divert fresh gas to the external outlet; start ***Ext. Outlet*** mode:

- 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 $O_2$-flush or $O_2$ emergency delivery.

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




- 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 132.

**CAUTION**

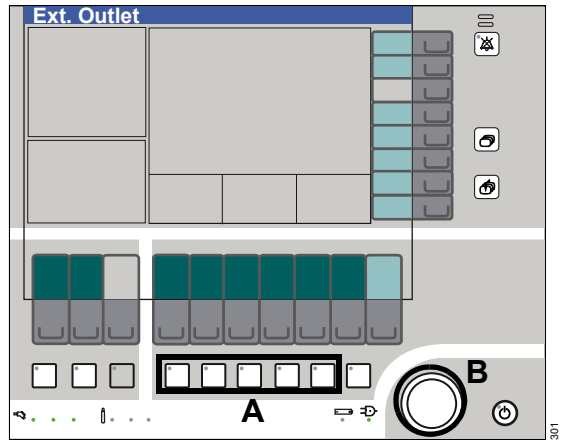
Risk of increased ambient gas concentration

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 *Infinity Empowered*. For this purpose, connect the AGS 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 *Infinity Empowered* is restored directly in this way.

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

- Reconnect the sample line to the Y-piece.

# Changing patients

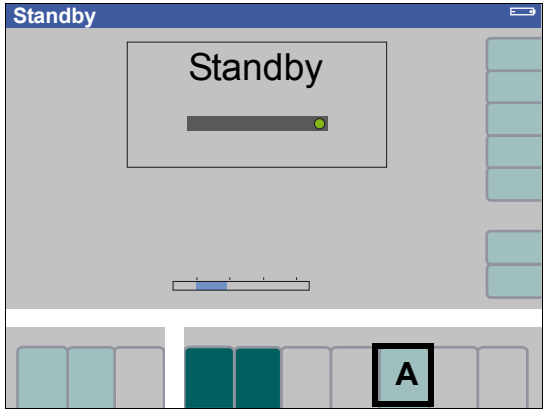
To switch Primus *Infinity Empowered* into ***Standby***:

- 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.

Therapy-related data stored on an Infinity ID breathing circuit will be deleted one minute after changing to the ***Standby*** mode and thus are no more available for further transfer.




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

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

– the soda lime in the absorber has changed color.

  Dräger recommends the use of Drägersorb 800 Plus or Drägersorb FREE. The color change indicates that the $CO_2$ absorbent can no longer absorb $CO_2$ (Drägersorb 800 Plus and Drägersorb FREE change from white to violet).

– the inspiratory $CO_2$ concentration ***in$CO_2$*** exceeds the alarm limit.

– the time limit for usage has been reached.

– the Infinity ID CLIC absorber has reached its user-set depletion limit.

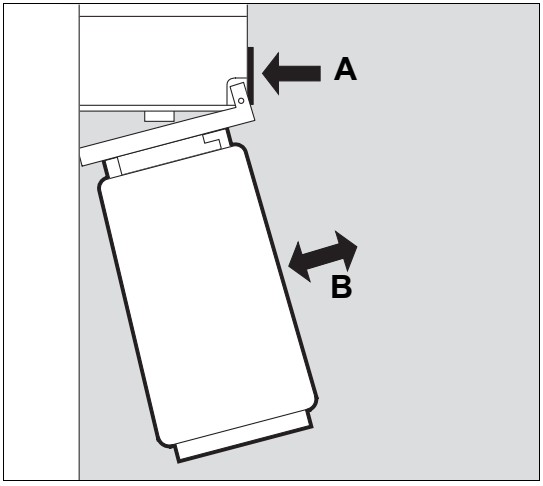
## Disposable absorber Drägersorb CLIC

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

**NOTE**

The disposable $CO_2$ absorber must be clicked into place before Primus *Infinity Empowered* is switched on. This ensures that the absorber is included in the leak and compliance test of 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 Drägersorb CLIC absorber for information on disposal.

### 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) and

**4** Push the absorber into the machine (B) until it engages.

**WARNING**

**Risk of increased inspiratory $CO_2$ concentrations**

**When the absorber is swung out, no $CO_2$ is absorbed.**

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

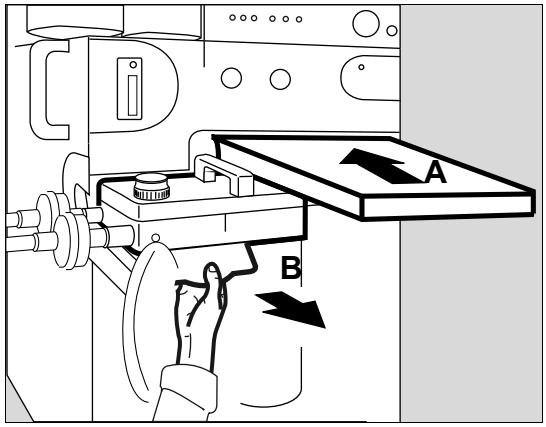
If the Infinity ID CLIC absorber has been configured in ***Standard Conf.*** (see "Soda lime depletion" on page 80), the new absorber will be automatically detected by Primus *Infinity Empowered*.

If the Infinity ID CLIC absorber was not configured:

- Reset the soda lime change log to current date by pressing the soft key ***soda lime changed***, see page 88.

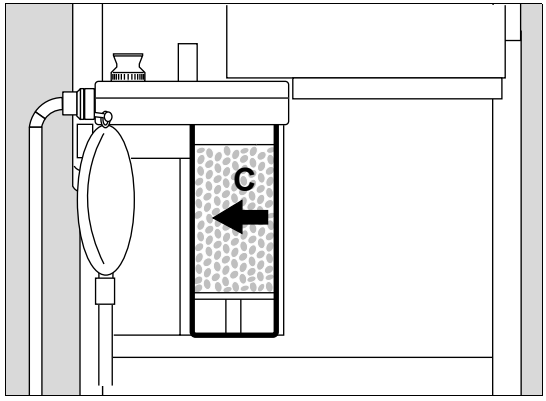
## Reusable absorber

- 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).




3 Turn the absorber counterclockwise (C) and pull it down and off.

4 Empty out the used soda lime and dispose of in accordance with the instructions for use of the soda lime.

5 Fill the absorber to the upper mark with fresh soda lime.

6 Fit the absorber into the breathing system from below and turn it clockwise as far as it will go.

7 Slide the ventilator drawer in until it clicks into place.

8 Pull the writing table out.

9 Reset the soda lime change log to current date by pressing the soft key ***soda lime changed*** *, see page 88.

## 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.**

**WARNING**

**Risk of misleading measured values**

**Changing the breathing hoses, vaporizer, or soda lime can modify the calculated leak and compliance values of the anesthesia machine and influence the therapy settings.**

**Carry out a leak test after the breathing hoses, vaporizers, or soda lime has been replaced.**

**WARNING**

**Risk of incorrect volume application**

**If Infinity ID breathing hoses are used, the compliance of the ID breathing hoses can be transferred from the breathing hoses to the anesthesia machine. Unlike the usual case in which leak and compliance values are derived from the system or leak test, exact determined values will not be available.**

**Pay special attention to compliance and leak values during operation.**

* Only without configured CLIC absorber.

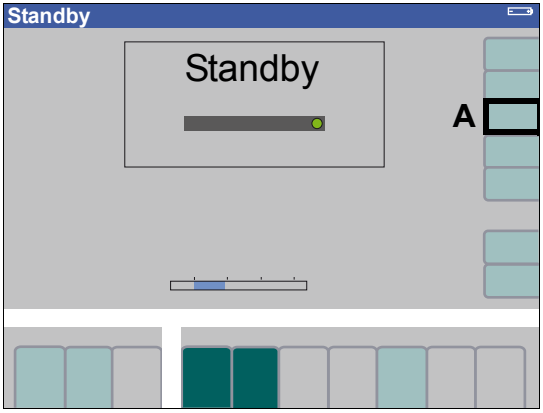
Note that when an Infinity ID breathing hose is connected without a leakage test or self test being performed, the leakage value is set invalid (– –) and the compliance stored on the Infinity ID hose is transferred and stored in the test results. The compliance label changes to ***compliance (ID)***. The status of the leakage value and compliance value remain valid. Both values are replaced after a leakage test by the determined values.

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.***

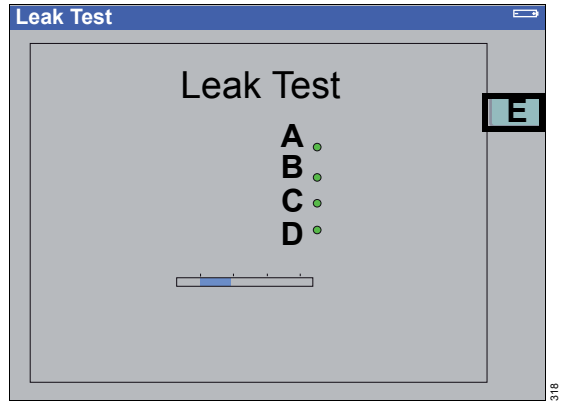
5 Push the rotary knob.

Primus *Infinity Empowered* 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 *Infinity Empowered* 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 85.

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 *Infinity Empowered* 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 *Infinity Empowered*:

- Push the system power switch in completely.

Primus *Infinity Empowered* is equipped with a power-down delay.

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

This message is displayed:

***Please wait while device shuts down. Make sure that the $O_2$ 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 *Infinity Empowered* 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 *Infinity Empowered* 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 220.

## Switch off the anesthetic gas scavenging system AGS

- Disconnect the anesthetic gas scavenging hose.

## When Primus *Infinity Empowered* is not in use

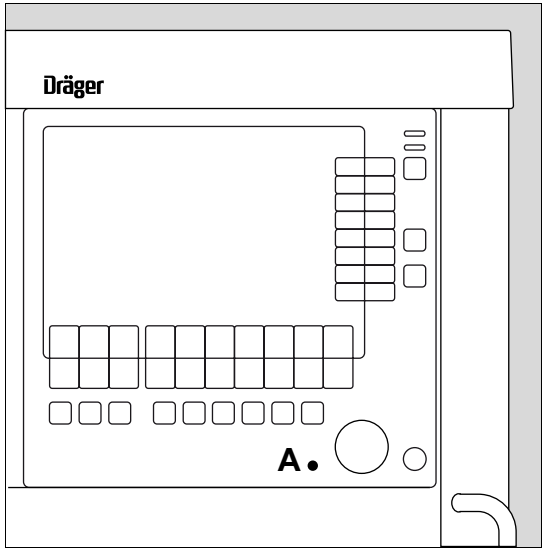
**WARNING**
**Risk of battery failure**

**Allowing the battery to run low can damage it.**

**It must be charged at least every four weeks.**

If Primus *Infinity Empowered* is not used for an extended period:

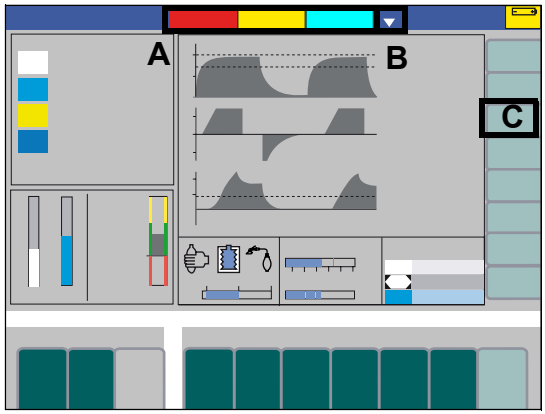
- Unplug the medical gas hoses from the terminal units of the central gas supply.
- Close the cylinder valves on the reserve gas cylinders.
- Leave the device permanently connected to the electricity supply.




The green LED (A) lights up.

# Alarms

## Alarm displays



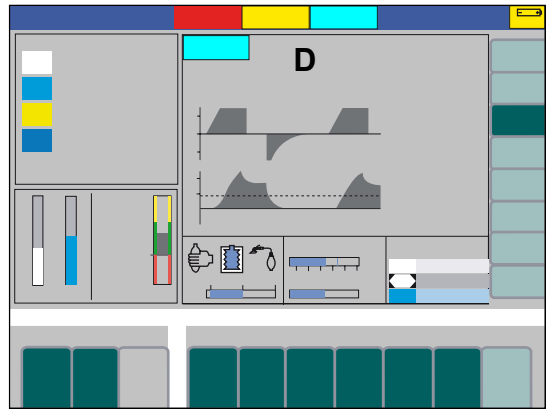

Alarm messages are displayed in the alarm field (A) in order of priority.

All displayed alarms are sorted according to the three classes defined on page 129. 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 194. 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 more 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.

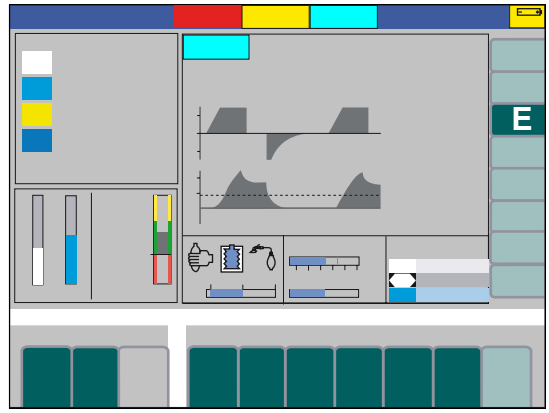
When this soft key is pressed, the upper curve display (D) is replaced by up to six additional alarm fields for 15 seconds.




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.

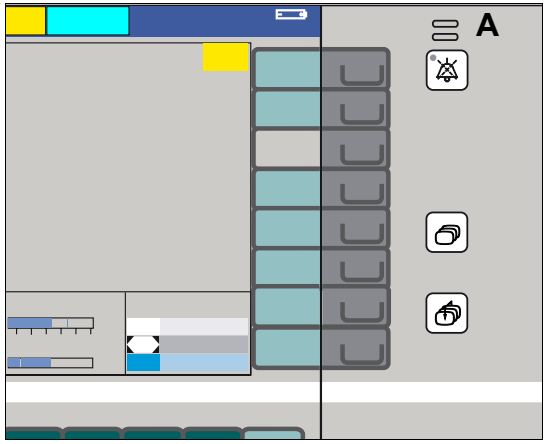
The alarm tone sequence accompanying a displayed alarm message with the highest priority will always be sounded at least once completely. The alarm tone sequences of alarm messages with lower priorities will not sound if a higher priority alarm is activated, i.e. the tone sequence thereof will sound.

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.



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 *Infinity Empowered*, 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.

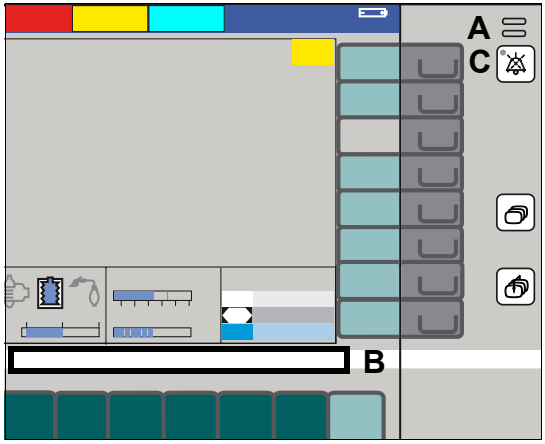
---

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

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

*** The third tone is one octave lower.

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




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

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).

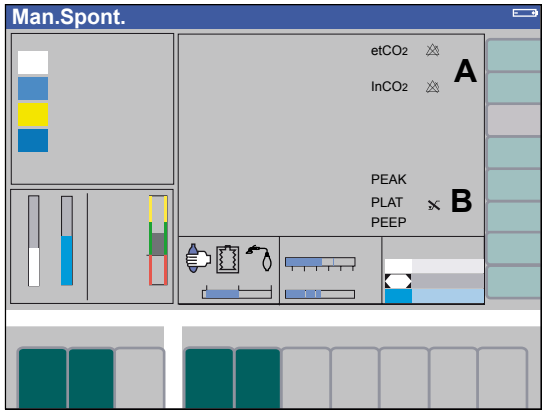
Refer to the chapter "Alarm – Cause – Remedy" on page 194 for a list of alarm messages.

### 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.

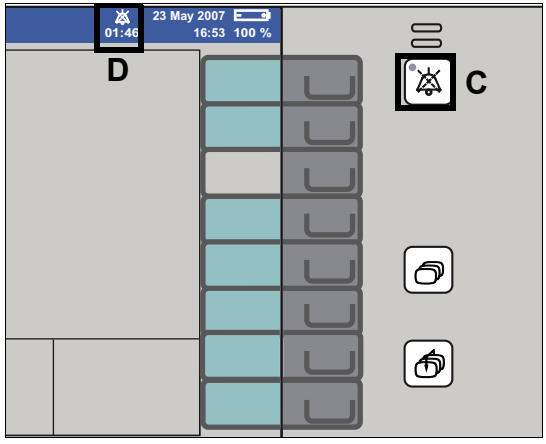
If all the alarms connected to a measurement function have been disabled, the measured value will be marked with the symbol (A).

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 $CO_2$ breathing phase has not yet been detected for the parameters $O_2$, $N_2O$, MV, or inspiratory and expiratory $CO_2$, or, respectively, a valid pulse signal for $SpO_2$. As soon as a breathing phase has been detected or valid pulse signals are available for $SpO_2$, 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 *Infinity Empowered* 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 setting for ***Freq.***/***Freq$_{MIN}$*** is <6 1/min, the apnea alarms will be suppressed for 30 seconds. In all other cases, they 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 166.**

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

| Mode / Alarm | *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) | – – |
| ***PAW*** ↑ | ON | ON | ON | ON | 40 |
| [hPa (cmH2O)] ↓ | ON | ON | OFF | ON | 8 |
| ***APNEA PRESSURE*** | ON | OFF | OFF | OFF | 8 |
| ***APNEA FLOW*** | ON | ON | OFF | OFF | - - - |
| ***APNEA CO2*** | ON | ON | ON2) | ON2) | - - - |

1) In ***Standby***, these alarms can be configured ON or OFF 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 triggered 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 $CO_2$ alarms are active after at least 15/30 seconds depending on the set frequency/***FreqMIN***.

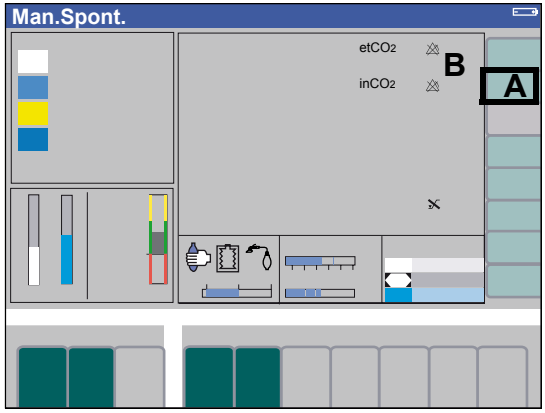
All apnea and limit-based $O_2$, $CO_2$, $N_2O$, and agent alarms are only active if a breath has already been detected (AutoWakeUp).

# Enabling/disabling $CO_2$ alarms

The alarm limits for in$CO_2$, et$CO_2$, and $CO_2$ apnea monitoring can be disabled via the soft key ***$CO_2$ alrm ON ->off***. This key is effective in the following operating modes:

– ***Man.Spont.***
– ***Monitoring***
– ***Ext. Outlet***

### Disabling $CO_2$ alarms




- Press the soft key ***$CO_2$ alrm ON ->off*** (A).

The symbol appears beside the measured values for the end-expiratory and inspiratory $CO_2$ concentration (B).

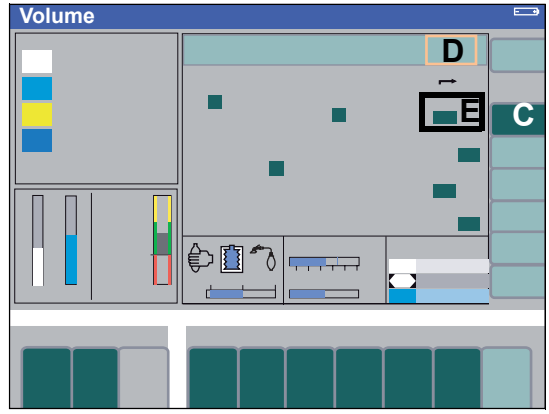
### Enabling the $CO_2$ alarms

- Press the soft key ***$CO_2$ alrm OFF ->on*** (A) again.

Disabled $CO_2$ alarms are enabled automatically when changing to another ventilation mode.

The alarms for ***etCO2*** and ***inCO2*** 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 171.




**$CO_2$ alarms can also be enabled and disabled globally for 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 ***$CO_2$*** (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 et$CO_2$ 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 ***HLM mode***:

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

– $CO_2$ apnea and pressure apnea alarms are inactive.

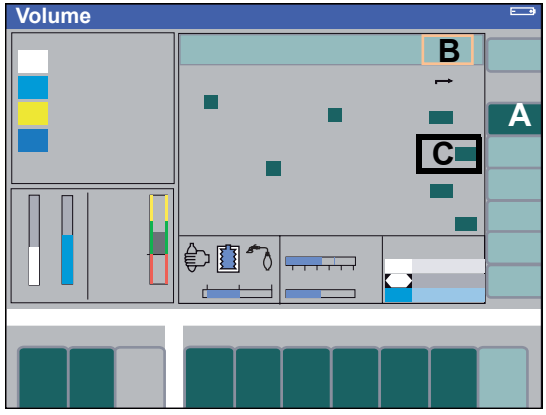
– $SpO_2$ monitoring alarms are inactive.

– The ***MAC LOW?*** alarm is inactive.

– MV alarms and flow apnea monitoring can be configured (see page 171).

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

## Enabling/disabling HLM mode



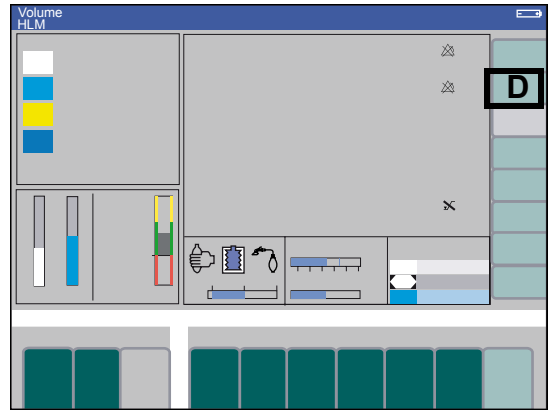

To activate/deactivate ***HLM mode*** in an active ventilation mode:

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 $CO_2$ apnea and pressure apnea alarms, but $SpO_2$ measurement (optional) is only reactivated when pulse signals have been detected again.

Deactivating the HLM mode has no effect on the ***on*** or ***off*** status of $SpO_2$ measurement; the last status set is retained.

### 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.

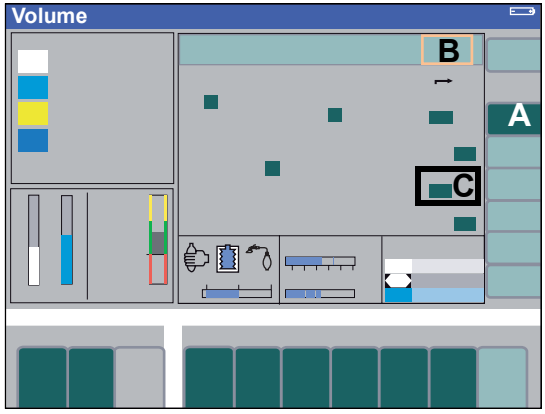
Special attention is required.

In the standby configuration, MV alarms and flow apnea alarms can be configured to be inactive in HLM mode (see page 171). 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 $SpO_2$ 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 $SpO_2$ monitoring parameter is disabled.

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

$SpO_2$ alarms can also be enabled and disabled during operation, see page 180.

**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.

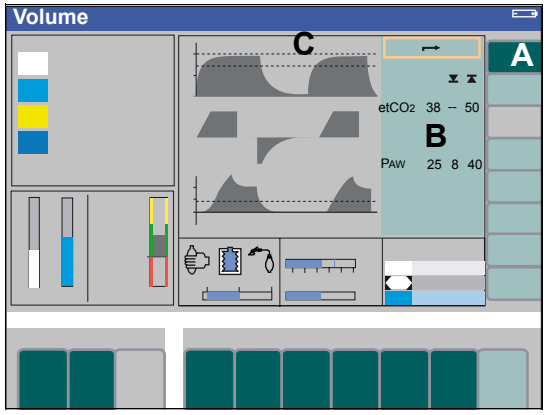
**3** Select and confirm the line ***$SpO_2$*** (C) via the rotary knob.

**4** Select and confirm ***on*** or ***off*** via the rotary knob.

Suppressed alarm limits are identified by the symbol  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 166 or adjusted individually for the patient concerned.

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

To call up alarm limits during operation:

- Press the soft key ***alarm limits*** (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 ($cmH_2O$)) and the lower alarm limit (8 hPa ($cmH_2O$)) are assigned to the measured value ***PAW*** (25 hPa ($cmH_2O$)).

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 ⟶ 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 171.

#### Setting ranges of the alarm limits during operation

| Alarm | Setting ranges |
|---|---|
| ***SpO2*** ↑ | 51 to 99; – – |
| [%] ↓ | 50 to 98 |
| ***Pulse*** ↑ | 21 to 250 |
| [1/min] ↓ | 20 to 249 |
| ***etCO2*** ↑ | 1 to 75 |
| [mmHg] ↓ | 0 to 74 |
| ***inCO2*** ↑ | 1 to 10 |
| [mmHg] | |
| ***MV*** ↑ | 0.1 to 20.0 |
| [L/min] ↓ | 0 to 19.9 |
| ***inO2*** ↑ | 19 to 99; – – |
| [Vol%] ↓ | 18 to 98 |
| ***inHal*** ↑ | 0.1 to 8.4 |
| [Vol%] ↓ | 0 to 8.3 |
| ***inIso*** ↑ | 0.1 to 8.4 |
| [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 ($cmH_2O$)] | 0 to 35 |

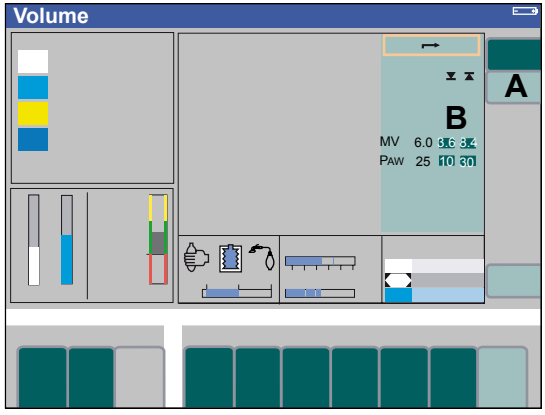
To exit the ***alarm limits*** menu:

- Place the cursor on ⟶ and confirm with rotary knob.

or

- Press the key.

## Adapting alarm limits




When ventilation settings have been made, Primus *Infinity Empowered* 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 ***auto-set limits*** soft key (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 *Infinity Empowered* 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 *Infinity Empowered* calculates the values internally with much greater accuracy.

The new alarm limits for ***PAW*** are calculated by Primus *Infinity Empowered* on the basis of the mean values for ***PEAK***, ***PLAT***, and ***PEEP*** over the last four mechanical breaths. Spontaneous breaths by the patient and triggered pressure support breaths 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 ($cmH_2O$)] | ***PEAK*** +5 or ***PLAT*** +10, the greater value applies |
| ***PAW*** lower alarm limit [hPa ($cmH_2O$)] | 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 171.

To restore all default alarm limits:

- see "Operation" on page 92.

## Setting the alarm tone

The volume of the alarm tone can be set in the configuration menu, see page 167.

## 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 *Infinity Empowered* when in ***Standby***.

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

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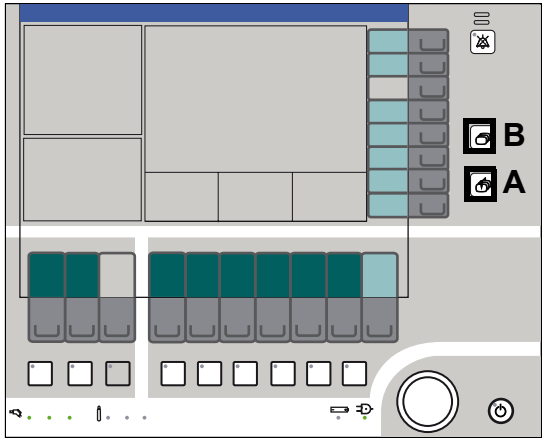
# Monitoring

## Selecting the standard screen

The standard screen is automatically displayed whenever a ventilation mode is selected.



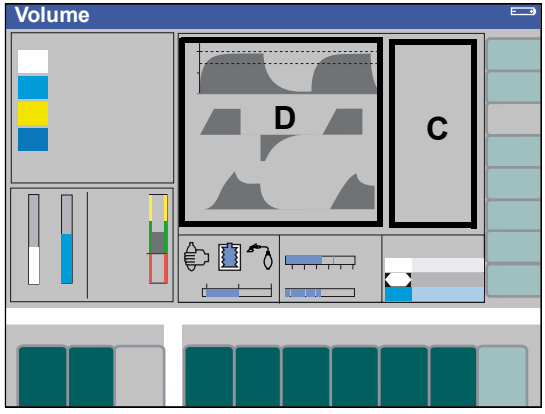

This screen can always be selected during operation:

- By pressing the key (B),

or

- By pressing the key (A) repeatedly.

Display (example):

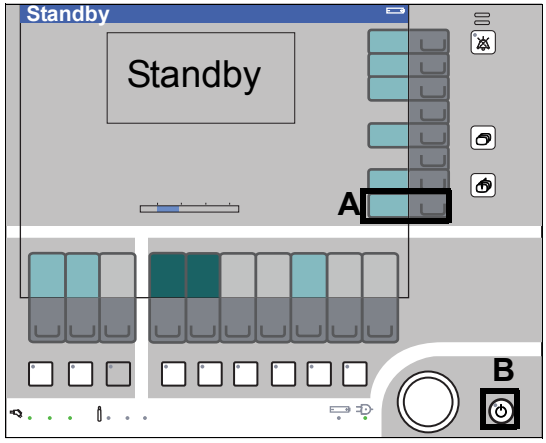



The most important parameters are grouped together on the right (C) and left sides of the screen.

The three curves are displayed in the middle (D) (for other standard screens, see page 156).

## Monitoring mode

***Monitoring*** can be activated in ***Standby***, for instance for exclusive measurement of the $SpO_2$ value. Fresh-gas is not delivered.




To start the monitoring mode:

- Press the ***Monitor. Mode*** soft key (A)

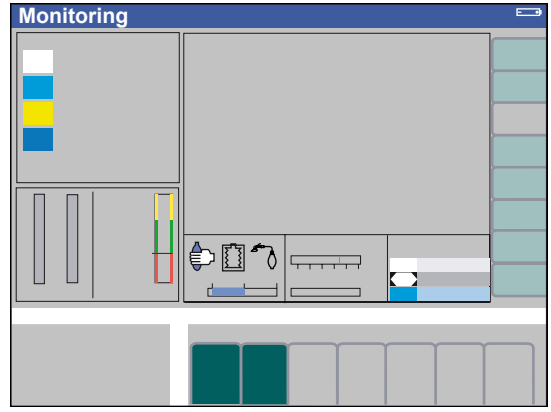
or

- Press the key (B).

To return to ***Standby***:

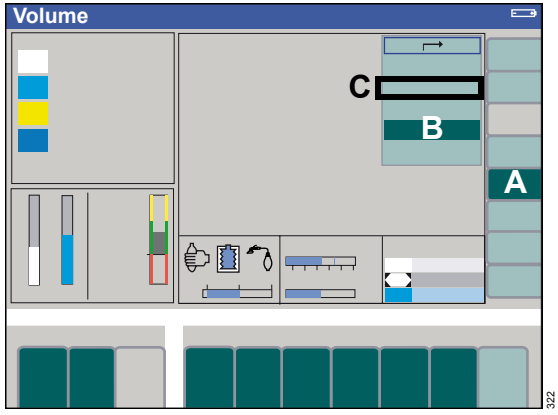
- Press the key (B) again and confirm via the rotary knob.

Display (example):




All alarms are active in the monitoring mode compared to the ventilation mode ***Man.Spont.***, see page 132.

## Screen layout




Using the ***Screen Layout*** key (A), it is possible to select between three different screen views. The currently selected screen layout (B) is highlighted by a dark green background.

The screen layout can be changed via the ***Screen config.*** menu item (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 170.

# Displayed parameters

## $CO_2$ concentration

– Curve display
The color of the curve can be configured by DrägerService.

– Numerical display

***etCO2*** : End-tidal $CO_2$ concentration

***inCO2*** : Inspiratory $CO_2$ concentration

– Trend curve for $CO_2$

## $O_2$ concentration

– Curve display

– Numerical display

***inO2*** : Inspiratory $O_2$ concentration

***ΔO2*** : Difference between inspiratory and expiratory $O_2$ concentration

– Trend curve for $O_2$

## 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 (***PAW***)

– Numerical display

***PEAK*** : Peak pressure

***PLAT*** : Plateau pressure

***PEEP*** : Positive end-expiratory pressure

***PMEAN*** : Mean pressure

(only on the data screen)

– Bar graph

## $SpO_2$ concentration (optional)

– Plethysmogram

– Numerical display

***SpO2*** : Functional $O_2$ saturation of the blood

♥ : Pulse rate

– Trend curve for $SpO_2$ and pulse

## Flow and volume

– Curve display flow (insp./exp.)

– Numerical display

***MV*** : Expiratory minute volume

***VT*** : tidal volume

***VTINSP*** : Measured inspiratory tidal volume

***ΔVT*** : Difference between inspiratory and expiratory tidal volume

***MVSPON*** : Spontaneously breathed expiratory minute volume

| | | |
|---|---|---|
| ***MV*MAND** | : | Mandatory breathed expiratory minute volume |
| ***Freq.*** | : | Respiratory rate |
| ***MV*LEAK** (only on the data screen) | : | Difference between inspiratory and expiratory minute volume |
| ***C*PAT** | : | Patient lung compliance<br>Determined from ***PLAT*** and expiratory ***V*T**.<br>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.<br>(only on the data screen) |

**WARNING**

**Risk of insufficient ventilation**

**The displayed spontaneous minute volume (*MV*SPON) 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, *MV*SPON 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 *MV*SPON.**

– Trend curve for ***MV*** and ***C*PAT**

## 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 ***O*2** and ***N*2*O*** or ***Air***.

## Indicators for the active ventilation source

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

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

: Automatic (controlled) ventilation

## 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***.

* see page 151 for a detailed description

** see page 152 for a detailed description

## Loops (optional)*

Graphical display for the following measured and calculated values:

– ***PAW-V*** loop

– ***V-Flow*** loop

## 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***.

* see page 153 for a detailed description
** see page 154 for a detailed description

# Gas measurement

The concentration of $O_2$, $CO_2$ and the anesthetic agents $N_2O$, halothane, enflurane, isoflurane, desflurane and sevoflurane are measured.

The gas concentrations are measured by the sidestream procedure. This results in a delayed indication of the real-time values compared 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 chapter "Technical data", page 261).

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.

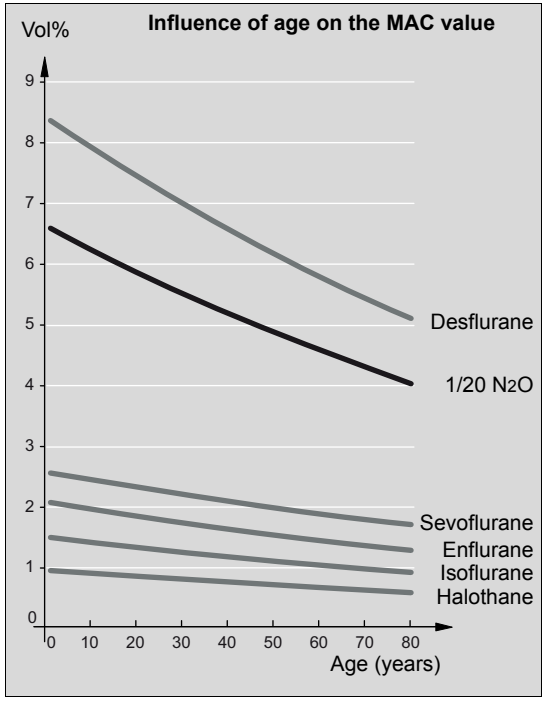
| | **1 MAC corresponds to:** (in 100 % $O_2$) |
|---|---|
| Halothane | 0.77 Vol% |
| Enflurane | 1.7 Vol% |
| Isoflurane | 1.15 Vol% |
| Desflurane | 6.0 Vol% |
| Sevoflurane | 2.10 Vol% |
| $N_2O$ | 105 Vol% |

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 *Infinity Empowered* 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.

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




Primus *Infinity Empowered* 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 *Infinity Empowered* 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.

$$xMAC = \frac{\text{exp. conc. agent}_1}{MAC_{\text{age-corrected agent}_1}} + \frac{\text{exp. conc. agent}_2}{MAC_{\text{age-corrected agent}_2}} + \frac{\text{exp. conc. } N_2O}{MAC_{\text{age-corrected } N_2O}}$$

**Example:**

exp. Sev. = 1.5 Vol%; exp. $N_2O$ = 60 %;
age = 10 years

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

$MAC_{\text{age-corrected}}$ of $N_2O$: 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 *Infinity Empowered* 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 2 anesthetic agents may lead to a temporary failure of the measured $O_2$ value.

**WARNING**

**Risk of patient injury**

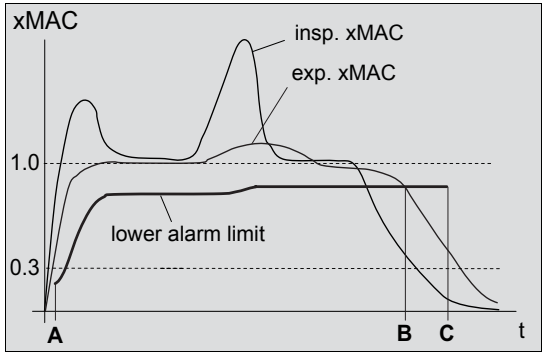
**If the anesthetic agent displayed does not match the label of the anesthetic vaporizer being applied (open), make sure the vaporizer is filled correctly.**

* 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 *Infinity Empowered* provides an alarm management system for the xMAC level which is automatically activated when the expiratory xMAC reaches about 0.3.




After activation (A), the alarm limit adapts to the level of the anesthetic agents used. It adapts only to increasing xMAC values. Primus *Infinity Empowered* generates an advisory message **MAC low** as soon as the expiratory xMAC value falls below the alarm limit (B).

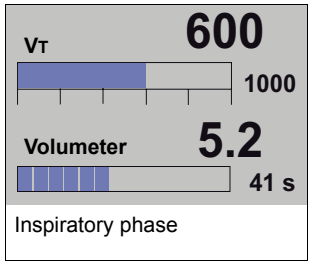
Without confirmation, the priority is automatically set to "Caution" after 30 seconds. When the alarm message is present, the alarm limit menu can open automatically with the confirmation field for the **MAC low OK?** alarm already preselected. The user can now confirm the alarm message by pressing the rotary knob.

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

# Using the volumeter function

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

## Upper bar graph



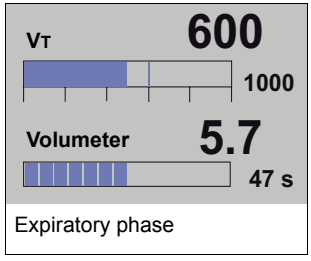

Displays the current inspiratory and expiratory tidal volume ***VT***, with an additional numerical indication of the expiratory tidal volume.

The bar graph follows the inspiratory and expiratory tidal volume ***VT***.

The tidal volume delivered at the end of inspiration is represented by a bar.

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

## Lower bar graph



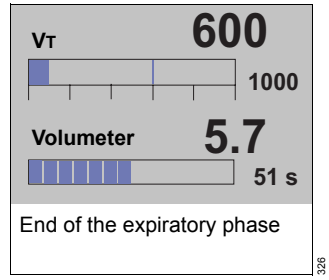

***Volumeter*** (minute volume measurement).

Numerical indication of the expiratory minute volume.

The scales of the bar graphs can be configured during operation and in ***Standby***, see page 168.

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

## Starting the volumeter

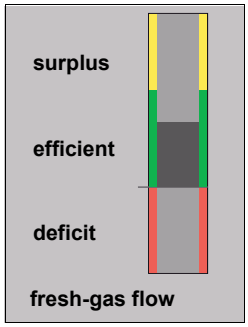



- Push the rotary knob.

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

The individual breaths are indicated by units in the bar graph. The volumeter stops automatically after 60 seconds. The measured values are displayed for 4 minutes and then deleted.

## Econometer (optional)



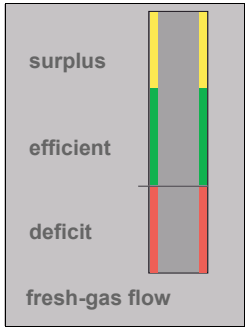

The bar graph indicates the qualitative utilization of the ***fresh-gas flow***. If the fresh-gas delivery is more than 1 L/min above the gas consumption, the econometer will indicate ***surplus***. Below this level, utilization of the fresh gas is considered ***efficient***. If less fresh gas is delivered 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,

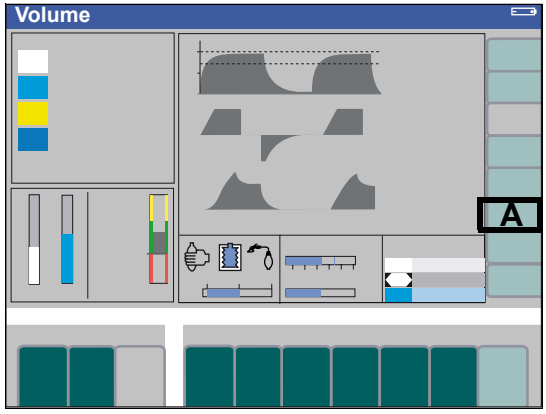
– leakage, and

– the $CO_2$ volume absorbed.

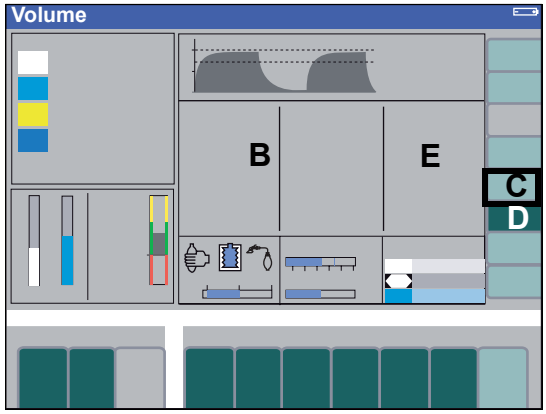



If data for calculation are not available, the legend appears in gray and the bar graph is not active.

## 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, an inverted display is also available. To change the display setting, contact service personnel.

See page 168 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:

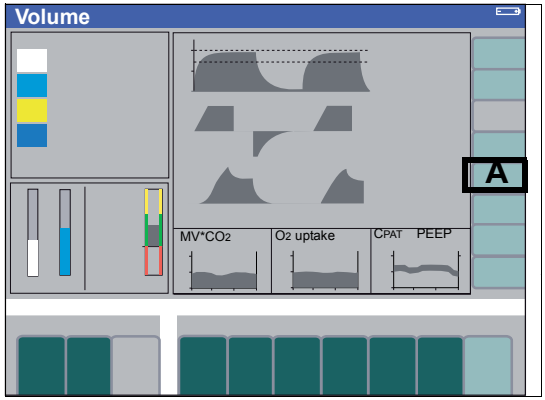
– when changing to ***Standby*** mode or

– 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 three different mini trends available that can be displayed below the waveform area:

– MV*CO2

– O2 uptake

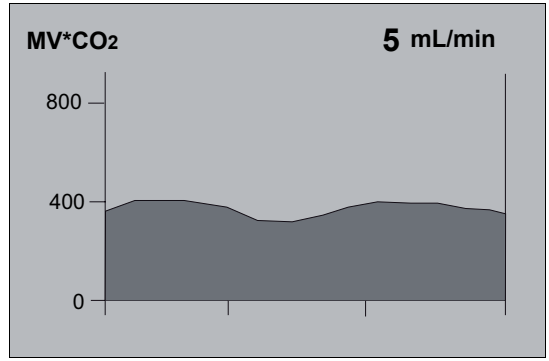
– CPAT/PEEP

To configure a mini trend:

- Press the ***Screen Layout*** softkey (A).

Select a parameter module and select the corresponding mini trend.

### Mini trend for *MV*CO2*




This mini trend displays the expiratory minute volume in combination with expiratory CO2 concentration over 15 minutes.

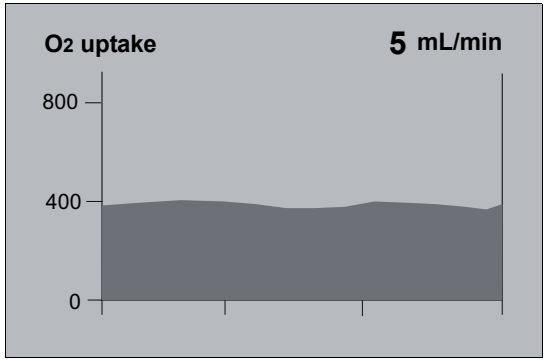
The current value of ***MV*CO2*** is displayed as numeric value above the mini trend.

The parameter ***MV*CO2*** indicates the CO2 volume that is expired by the patient.

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

| ***VT*** **mL** | ***MV*CO2*** |
|---|---|
| 50 | 50 |
| 150 | 150 |
| 500 | 500 |
| 1000 | 1000 |

## Mini trend for $O_2$ uptake

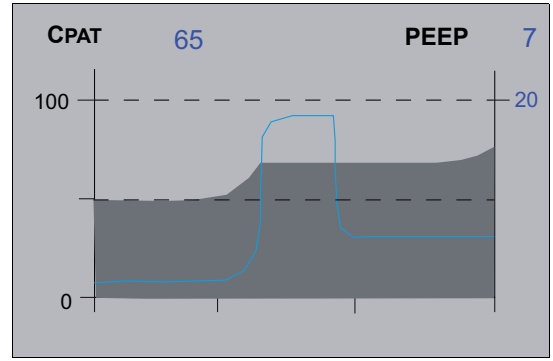



This mini trend displays the difference between the inspiratory and the expiratory oxygen concentration over 15 minutes.

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.

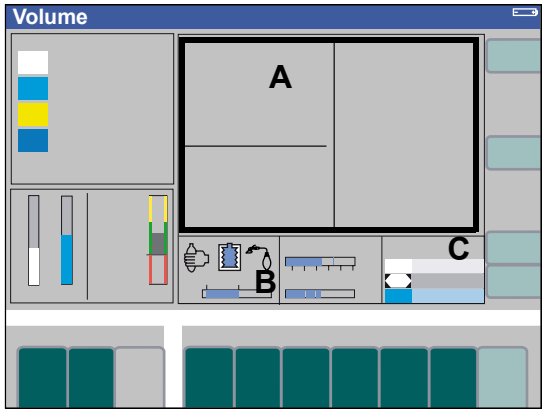
The scaling for ***CPAT*** depends on the expiratory tidal volume ***VT*** and is automatically adjusted.

| ***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.

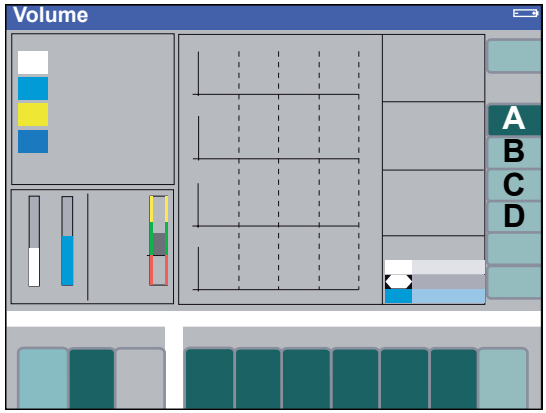
The bar graph at the bottom of the screen shows the current ventilation pressure ***PAW*** (B).

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*** reserve 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)

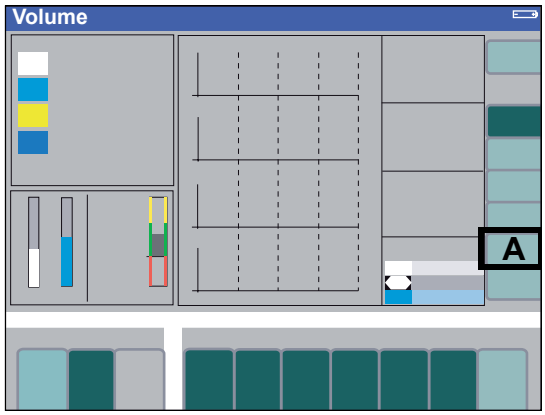
The ***SpO2 pulse*** soft key does not appear if the SpO2 measuring function is not available.

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:

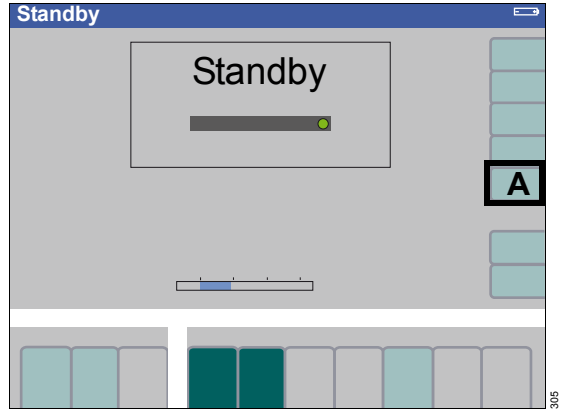
- Press the soft key ***total trend*** (A). The complete trend is displayed on the screen again.

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***.

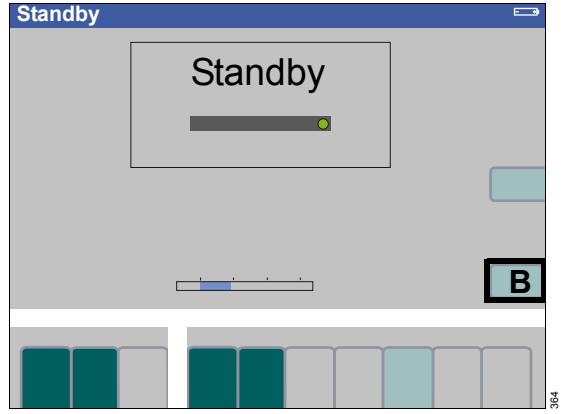
Graphic trend, mini trends (optional) and logbook are deleted simultaneously!




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).

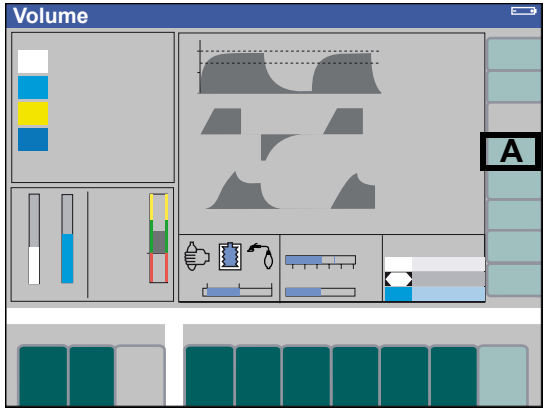
## Selecting the logbook

For recording ventilation modes, measured values and primary anesthetic agent to facilitate compilation of the anesthetic record.

Primus *Infinity Empowered* 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.

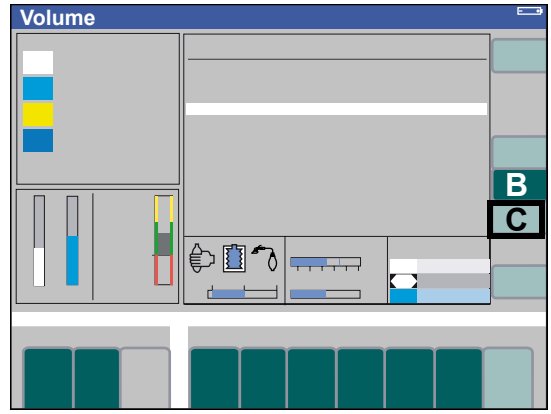
The trigger criteria for entries can be configured, see "Interfaces/logbook" on page 169 and "The logbook entries menu (E) contains the following sub-menus:" on page 181.

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 $SpO_2$ and pulse.



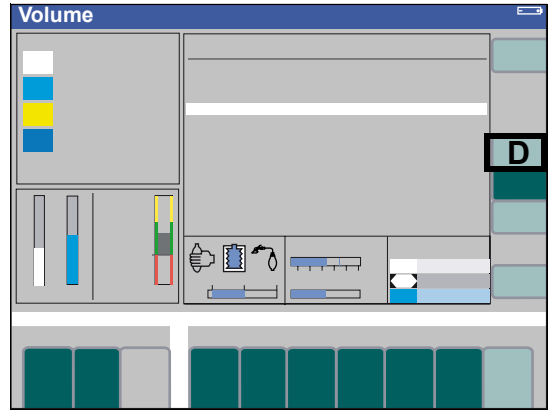

- Press the soft key ***logbook*** (A).

***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

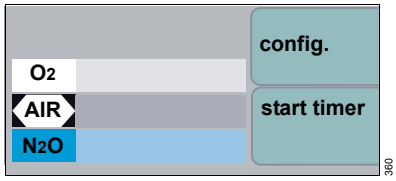
- Press the key.

### To delete the logbook

Logbook and trend memory are deleted simultaneously!

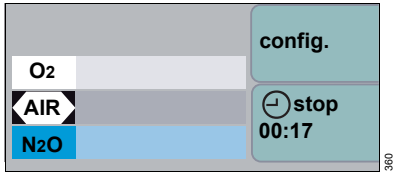
The logbook will be maintained even after switching off the Primus *Infinity Empowered* completely. It can only be deleted by using the ***delete trend*** functionality in ***Standby,*** see page 158.

## Using the timer function




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

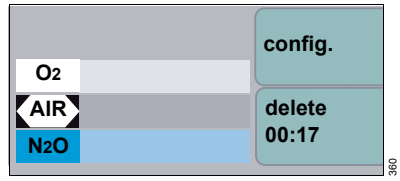
- Press the soft key ***start timer*** in any operating mode.




To stop the timer:

- Press the soft key ***stop***.

The measured time is displayed.

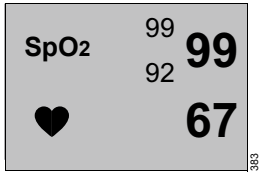



To reset the timer to "00:00":

- 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 *Infinity Empowered* 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.

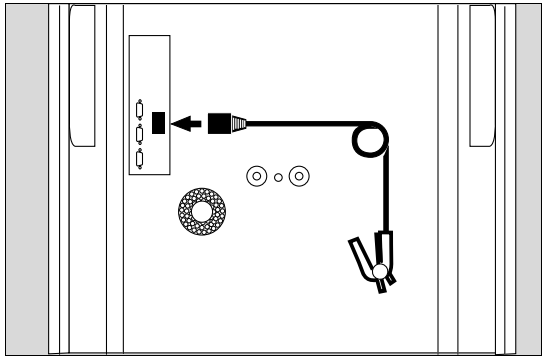
Note the instructions for use of the sensors.

- 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 will assist when 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

Avoid positioning the sensor 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 $SpO_2$ 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 $SpO_2$ 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 $SpO_2$ measurement.

– The adhesive straps must not be stretched unduly.

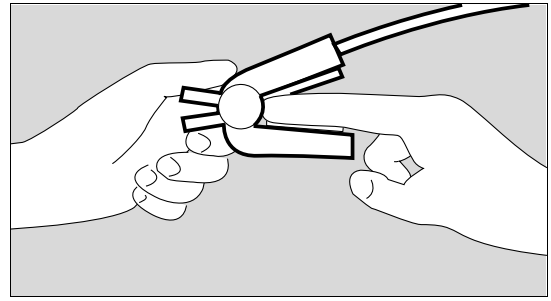
– Never use two adhesive straps as this can lead to venous pulsation. The pulse signal might fail.

– 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

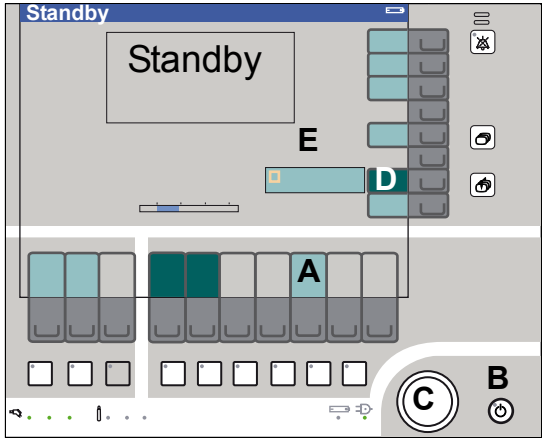
If simulators are used as calibrators, the $SpO_2$ module may produce incorrect data.

Simulators must not be used as a calibrator.

# Configuration

## 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).

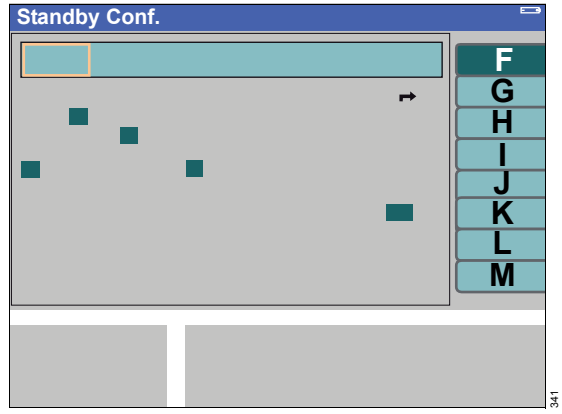
**2** Press the soft key ***default config.*** (D).

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:

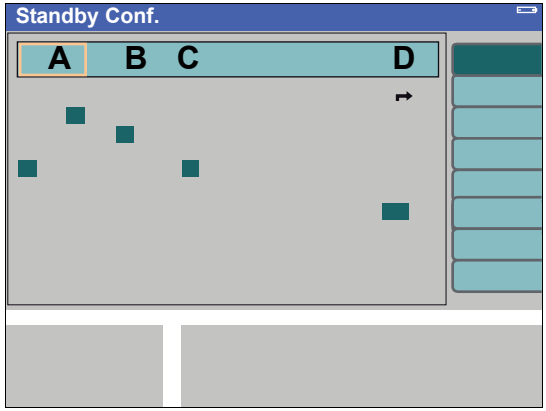
– ***basic settings audible signals*** (F)
– ***parameters*** (G)
– ***interfaces logbook*** (H)
– ***screen layout*** (I)
– ***alarm limits*** (J)
– ***ventilator and gas delivery*** (K)
– ***system information*** (L)

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 alarm ***NO $O_2$ DELIVERY*** is always announced at the maximum volume.

Primus *Infinity Empowered* 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.

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 0

**D** ***date/time language***

– ***date/time***
month, year
hours : minutes

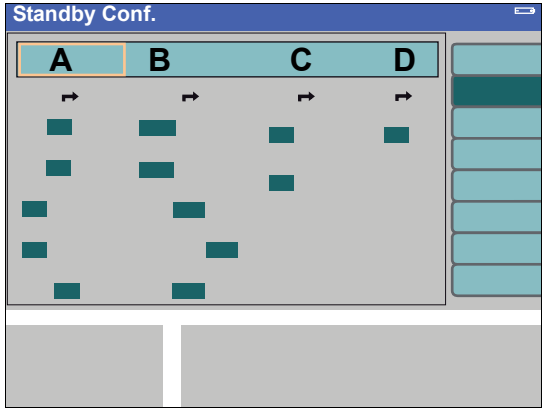
– ***time format***
Factory setting 24 h

– ***language***
of the display texts
Factory setting English (GB)

* Only in connection with breathing sound module.

## Parameters

The menu ***parameters*** contains the following submenus:




**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.
<1 year: 50 mL,
1 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, cmH2O | 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 147 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 ensure 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.

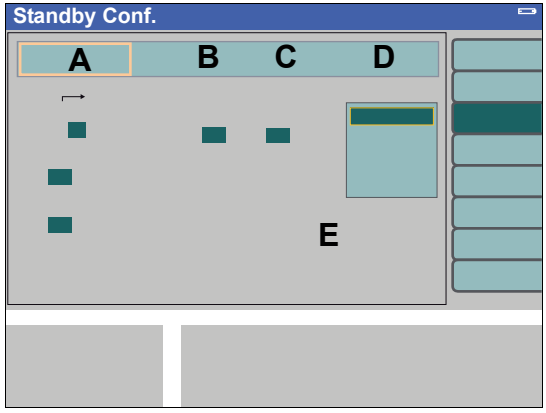
**D** ***Optional parameters***

| Parameter | Factory setting |
|---|---|
| ***SpO2***: yes/no | Automatic setting<br>Option available: yes<br>Option not available: no |

For a detailed description of SpO2 monitoring, see page 160.

## 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<br>Entries are made after a fixed time interval in minutes. | 5 min |
| ***warning alarms***: yes/no<br>Entries are made when a warning is issued. | yes |
| ***caution alarms***: yes/no<br>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***

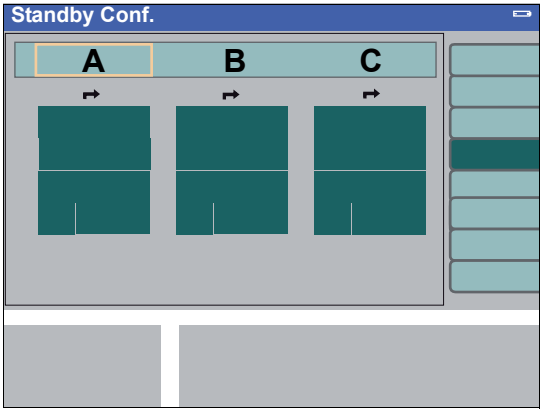
These values cannot be configured; this is information only.

The logbook stores up to 600 entries. If the logbook is full and new entries are to be stored, the logbook deletes the oldest entries.

When the Primus *Infinity Empowered* is switched off, all logbook entries are saved and are available upon the next start-up of the Primus *Infinity Empowered*.

## Screen layout

The ***screen layout*** menu contains three default layouts for the home screen:




**A** ***Layout 1***

**B** ***Layout 2***

**C** ***Layout 3***

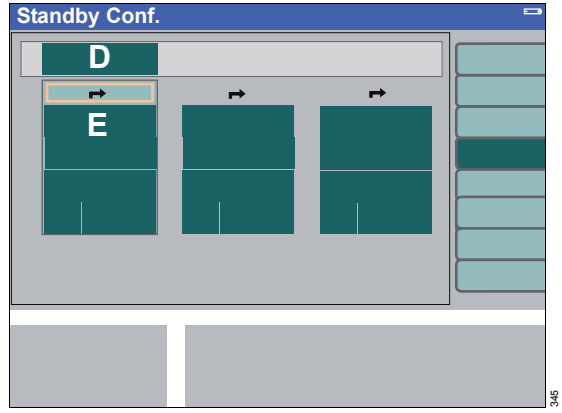
The layouts comprising the following elements can be freely configured:

– 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 | | |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ | | | $CO_2$ | | | $CO_2$ | | |
| flow / MV | | | $O_2$ | | | agent | | |
| PAW | | | PAW | | | PAW | | |
| vent. | $V_T$ Vol | Gas supply | vent. | $V_T$ Vol | MV | vent. | $V_T$ Vol | MV |

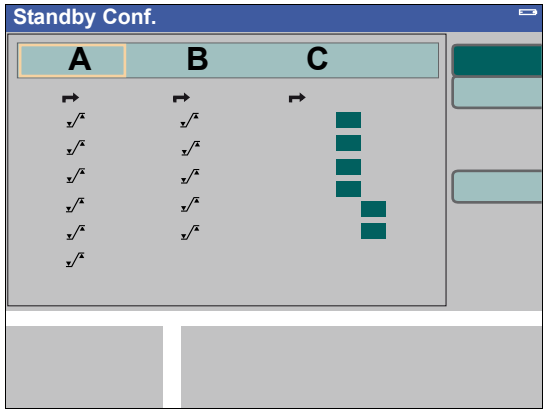
**CAUTION**

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*** ↑ | 81 to 99; – –[1)] | – – |
| [%] ↓ | 80 to 98 | 92 |
| ***Pulse*** ↑ | 21 to 250 | 120 |
| [1/min] ↓ | 20 to 249 | 50 |
| ***inO2*** ↑ | 19 to 99; – – | – – |
| [Vol%] ↓ | 18 to 98 | 20 |
| ***etCO2*** ↑ | 1 to 75 | 50 |
| [mmHg] ↓ | 0 to 74 | – – |
| ***inCO2*** ↓ | 1 to 10 | 5 |
| [mmHg] | | |
| ***MV*** ↑ | 0.1 to 20.0 | 12.0 |
| [L/min] ↓ | 0 to 19.9 | 3.0 |
| ***PAW*** ↑ | 5 to 99 | 40 |
| [hPa (cmH2O)] ↓ | 0 to 35 | 8 |

1) – –: The corresponding alarm limit is disabled.

**B** ***Default limits, anesthetic agents***

| Alarm | Setting ranges | Factory setting |
|---|---|---|
| ***inHal*** ↑ | 0.1 to 8.4 | 1.5 |
| [Vol%] ↓ | 0 to 8.3 | – –[1)] |
| ***inIso*** ↑ | 0.1 to 8.4 | 2.3 |
| [Vol%] ↓ | 0 to 8.3 | – – |

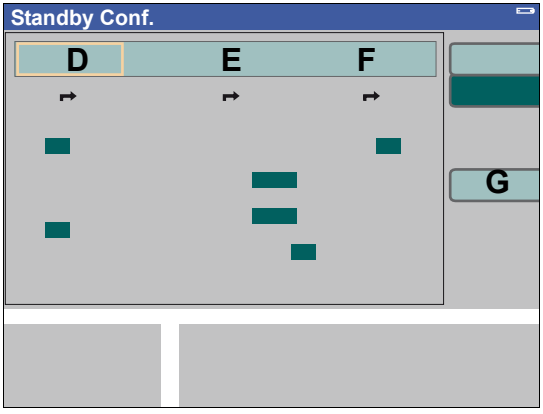
| Alarm | Setting ranges | Factory setting |
|---|---|---|
| ***inEnf*** ↑ | 0.1 to 9.9 | 3.4 |
| [Vol%] ↓ | 0 to 9.8 | – – |
| ***inSev*** ↑ | 0 to 9.9 | 4.2 |
| [Vol%] ↓ | 0 to 9.8 | – – |
| ***inDes*** ↑ | 0.1 to 21.9 | 12.0 |
| [Vol%] ↓ | 0 to 21.8 | – – |

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 |

The alarms issued when switching to the ***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 185.




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) presets 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***

– ***$O_2$ cylinder low alarm active at:***
Determine the pressure at which the warning ***$O_2$ CYLIND. LOW*** is to be issued. This menu item only appears if the $O_2$ cylinder has been configured as gas supply, see page 175.
Factory setting 30 kPa x 100

– ***soda lime depletion limit*** *
The absorption capacity of a $CO_2$ absorber depends largely on the conditions under which it is operated. Conditions are e.g. flow levels, gas temperatures, humidity in the absorber, periods of rest between cases, and the time of replacement. User practices, e.g., set fresh-gas flow, ventilation settings, patient categories entered, and device behavior have the biggest influence on these conditions. Primus *Infinity Empowered* has been designed for optimized use of the absorber.
The total capacity of an unused CLIC absorber is set by the ***soda lime depletion limit***. The capacity is entered in absorption units and can be adjusted if necessary, to reflect the individual clinical routines described above. Decrease setting, if the remaining capacity shown is too large and the alarm does not occur although the soda lime in the absorber changes color or the inspiratory $CO_2$ concentration ***in$CO_2$*** exceeds the alarm limit.
Factory setting **– –**.

– ***soda lime time limit***
Determines the period of use of the soda lime. As soon as the interval has expired the advisory message ***SODA LIME DEPLETED?*** will be issued.
Factory setting 7 days.

– ***ID ventilation circuit used***
Select whether Infinity ID ventilation circuits are used or not.
When ***yes*** is set:
Primus *Infinity Empowered* automatically detects the Infinity ID breathing hoses and checks the following:
- correct hoses used
- assembly complete and hoses connected to the correct port
- shelf life of hoses.
In case of a deviation a respective alarm message is issued.
When ***no*** is set:
The connected hose system is not checked. The stored value for compliance is transferred, see page 124, the value for leakage is set to "**– –**".
Factory setting ***yes.***

– ***Flexible bag arm present?***
When ***yes*** is set:
Primus *Infinity Empowered* does not check for the Infinity ID breathing bag hose.
When ***no*** is set:
Primus *Infinity Empowered* checks for the Infinity ID breathing bag hose.
Factory setting ***no***

**F** ***Other settings***

| **Therapy-related alarm limits** | **Factory setting** |
|---|---|
| ***open limit menu if alarms occur?***: yes/no<br>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<br>If set to "no", this enables a cascade for the alarm ***APNEA VENTILATION***, see page 198. | no |
| ***immediate alarm upon apnea? (patients <6 years)***: yes/no<br>Further information, see page 172. | no |

* Only available if the Infinity ID functionality for the Infinity ID CLIC absorber has been activated by DrägerService.

***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 181).

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<br>(after 65 seconds in ***Man.Spont.***, in ***Monitoring*** mode, and in ***Ext. Outlet*** mode) |

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 ***Freq$_{MIN}$*** set to less than 6/minute or ***OFF***.

**Further information on setting alarm limits**

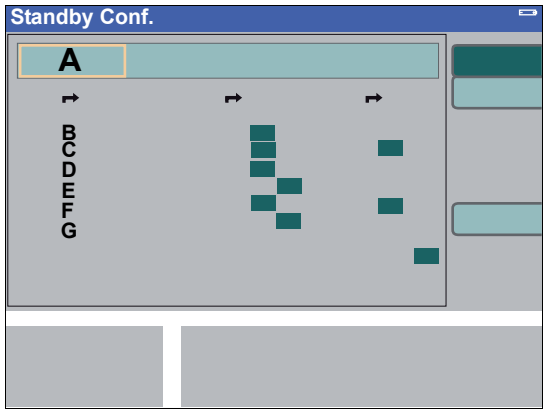
**NOTE**
The new default alarm limits are effective whenever the workstation is switched on and after selecting ***restore default settings*** in ***Standby***.

Certain alarms are automatically turned off in ***Man.Spont.***, ***Monitoring***, and ***Ext. Outlet***, see table on page 132.

## 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.

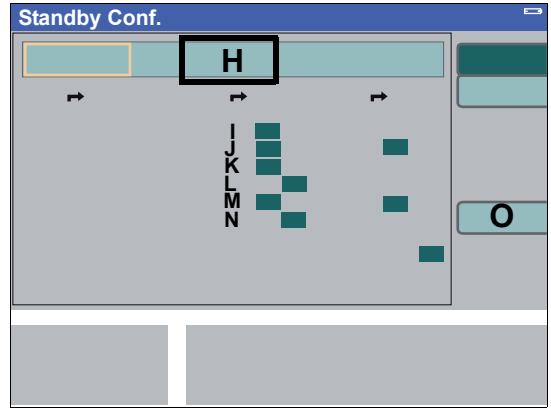
If the trigger has been pre-set to ***OFF*** in ***Volume Mode***, ***Volume AF Mode*** or ***Pressure Mode***, the value configured under pressure support will automatically be adopted when synchronization is activated during operation. The same also applies with regard to adopting the value for ***ΔPPS*** 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 |

**NOTE**

Only the gas supply defined as being present in the configuration will be included in the self test.

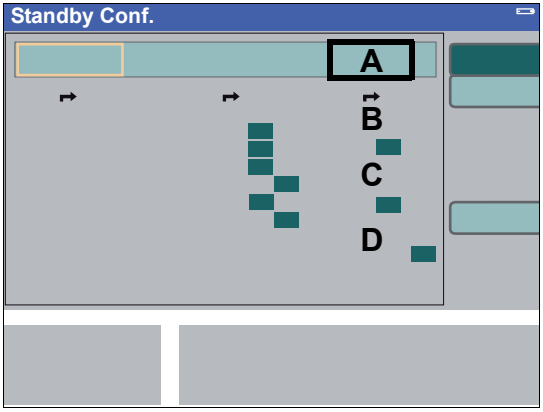
**WARNING**
**Risk of device failure**

**The anesthesia machine does not operate without at least one oxygen supply.**

**Either the central $O_2$ supply or the $O_2$ cylinder supply must be configured for the $O_2$ supply.**

- Press ***exit*** (O), to exit the menu.

### Menu for Ventilator default settings




**A** ***ventilator default settings***

– ***transfer of presettings from ID ventilation circuit***: (B) ***yes***/***no****
When ***yes*** is set:
The function transfer of ventilation settings is activated.
When ***no*** is set:
The function transfer of ventilation settings is deactivated.
Factory setting: ***no***

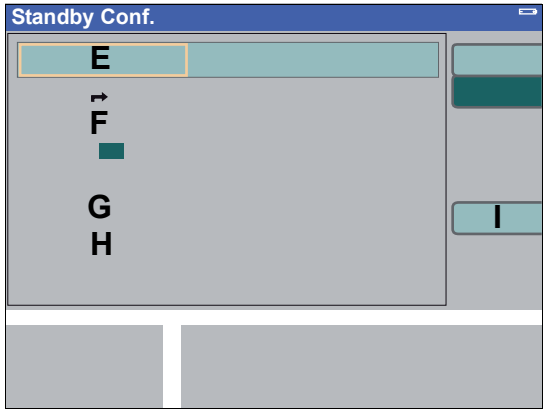
– ***PINSP changes with PEEP:*** (B) ***yes***/***no***
When ***yes*** is set:
Changes in the set ***PEEP*** parameter automatically change the parameter value ***PINSP*** so that the difference between ***PEEP*** and ***PINSP*** remains constant.
When ***no*** is set:
Parameter value ***PINSP*** remains unaffected by changes in the ventilation parameter ***PEEP***.
Factory setting: ***yes***

– ***TINSP changes with freq. if synchronization is off:*** (C) ***yes***/***no***
When ***yes*** is set:
***TINSP*** is automatically adjusted when the frequency is changed, so that the ratio of inspiration to expiration I:E remains constant. This only applies if synchronization has not been set.
When ***no*** is set:
***TINSP*** remains independent of the change in frequency and the ratio of inspiration to expiration I:E changes accordingly.
Factory setting: ***yes***

– ***PAW low alarm limit changes with PEEP:*** (D)
When ***yes*** is set:
The low alarm limit for airway pressure (***PAW***) will be automatically changed when the ***PEEP*** value is changed.
When ***no*** is set:
The low alarm limit for airway pressure (***PAW***) will be unaffected by changes in the ***PEEP*** value.
In ***Pressure Mode***, the lower ***PAW*** alarm limit will not exceed ***PINSP*** –2. This also applies to changes to ***PINSP***.
In ***Press. Support*** (optional), ***PEEP*** + ***ΔPPS*** –2 will not be exceeded. This is also valid for changes to ***ΔPPS***.
Factory setting: ***yes***

* Only available when the transfer of ventilation settings for Infinity ID breathing hoses has been activated by DrägerService.

The following parameters can be set in the menu ***ventilator and gas delivery*** > ***weight related settings*** > ***body weight related ventilator settings***:




**E** ***body weight related ventilator settings***

– ***VT and freq. presetting related to ideal body weight:*** (F)
If the settings for ***VT*** and ***freq.*** are to be referred to the patient's body weight, the initial value for ***VT*** can be selected in accordance with the Radford nomogram.
Factory setting: ***yes***

– ***preset configuration:*** (G)

- Select, edit, and confirm the ***VT*** to be changed via the rotary knob.
The settings for ***VT*** are interpolated for weights between the four predetermined classes.

| **weight (*ideal BW*) [kg]** | ***VT* [mL]** | | ***Freq.*** |
|---|---|---|---|
| | **Setting ranges** | **Factory settings** | **[1/min]** |
| 2 | 10 to 25 | 15 | 35 |
| 15 | 60 to 150 | 110 | 26 |
| 65 | 300 to 500 | 450 | 13 |
| 100 | 550 to 800 | 700 | 10 |

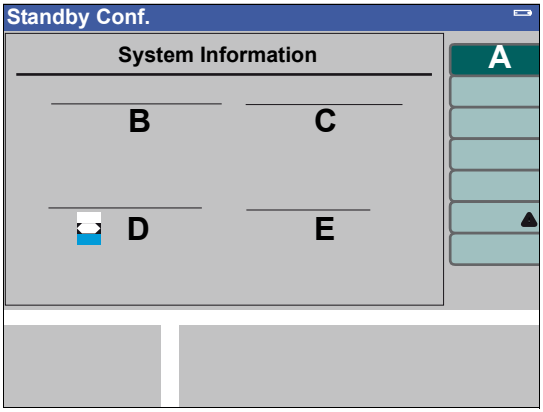
– ***restore factory default presets*** (H).

- 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.

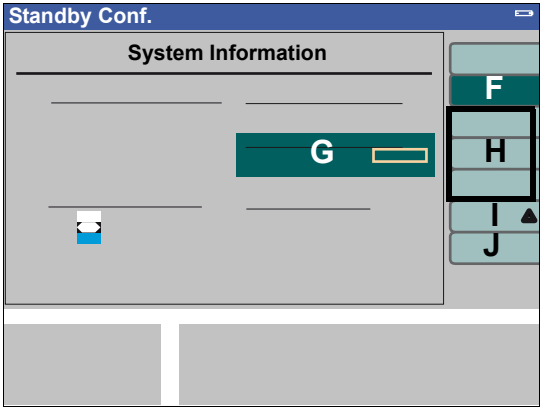
# System information




**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 178 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**

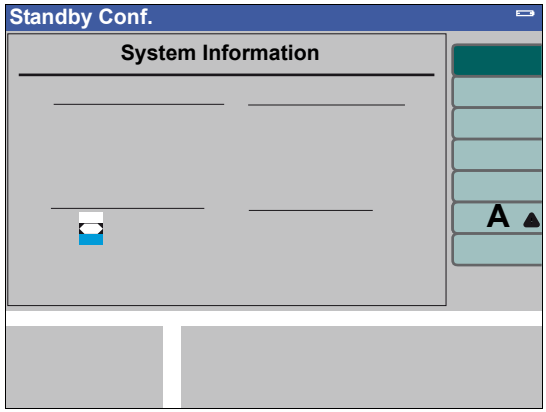
**Risk of patient injury**

**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*** ⚠ (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.***

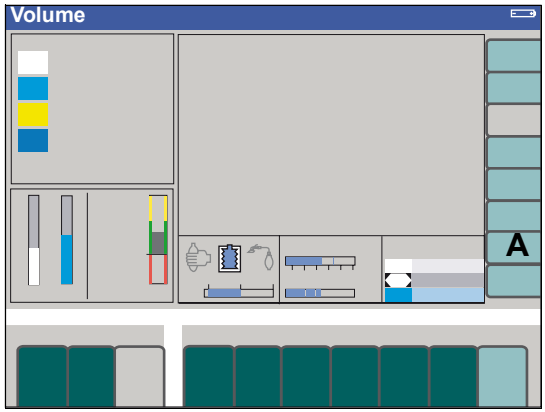
**3** Connect the Remote Service Link to the COM 1 interface.

The service data of Primus *Infinity Empowered* can now be transferred. For further operation, see instructions for use for the Remote Service Link.

After exiting ***remote service***

**4** Switch off Primus *Infinity Empowered*.

## Configuration during operation




During operation, certain monitoring functions can be selected or changed via configuration menus.

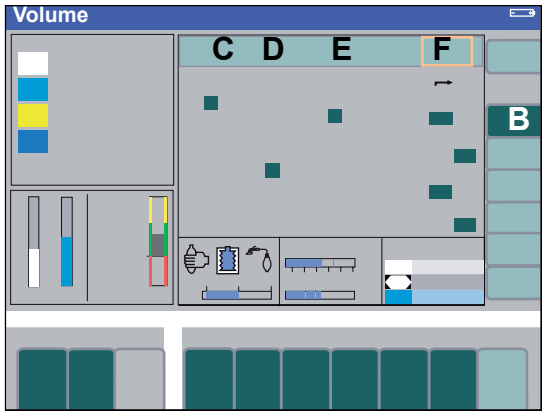
The settings made here remain valid until the workstation is switched off.

On the standard screen or data screen:

- Press the ***config.*** soft key (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 (<75 dB(A))

**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 alarm ***NO $O_2$ DELIVERY*** is always announced at the maximum volume.

Primus *Infinity Empowered* 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.

* Only in connection with breathing sound module.

**E** ***pulse volume*** (optional)

0 = off
to
9 = maximum volume

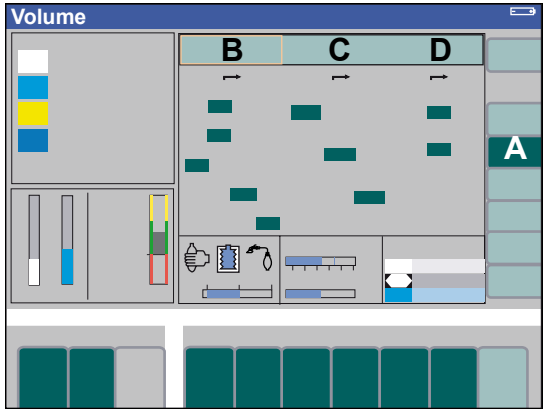
**F** ***alarms on/off***

$CO_2$ and $SpO_2$ alarms (optional) and HLM mode, see page 135, 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 174).

The ***paramet. settings*** (A) menu contains the following sub-menus:




**B** ***Scaling amplitude***

– ***$CO_2$, $P_{AW}$, flow, $O_2$***
The setting is made automatically or by selecting a pre-set scale.
***auto***: Automatic adjustment to the next higher or lower scale after two passes if the scaling frame is exceeded.

– ***tidal volume***
***auto***: A suitable scaling is selected automatically in accordance with the set age.
<1 year: 50 mL,
1 to 2 years: 150 mL,
>2 to 10 years: 500 mL,
>10 years: 1000 mL.

**C** ***Units***

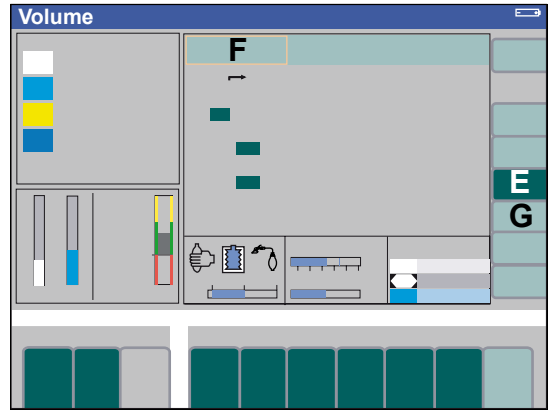
– ***$CO_2$***: mmHg, Vol%, kPa
– ***$P_{AW}$***: hPa, mbar, $cmH_2O$
– ***agents***: Vol%, kPa

**D** ***agent monitoring***

– ***MAC display***
(See page 147 for a detailed description of the MAC definition and calculation.)

– ***Related to age***

The ***logbook entries*** menu (E) contains the following sub-menus:




**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.

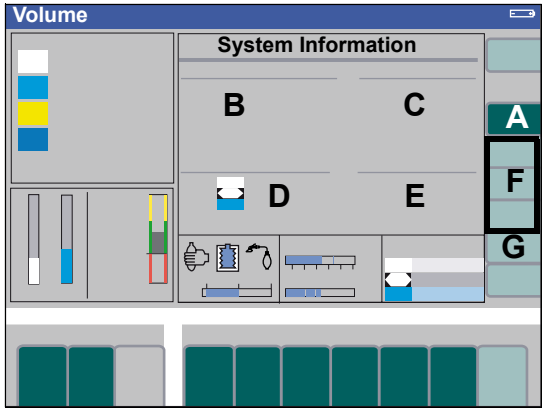
– ***Caution***
Entries are made when a caution message is issued.

### Displaying system information

- Press the softkey ***system info*** (G) to enter the system information.

For more information about the system information screen, see page 178.

**A** ***general info***




This screen contains information on

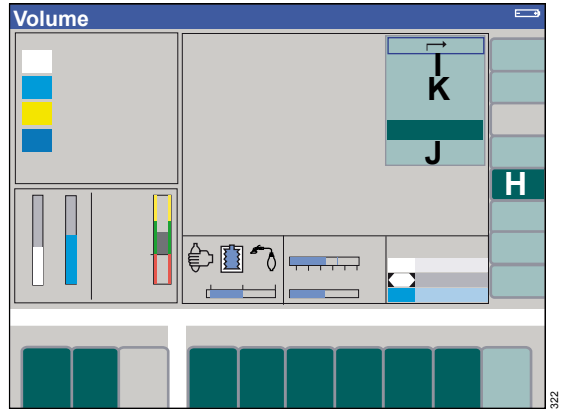
- ***Software versions*** of the individual components (B)
- Enabled ***Software Options*** (C)
- ***Gas Consumption*** and sampling rate of the patient gas module (D)
- ***Operating Hours*** of individual components (E)

**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 ***screen layout*** softkey (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 desired 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 170.

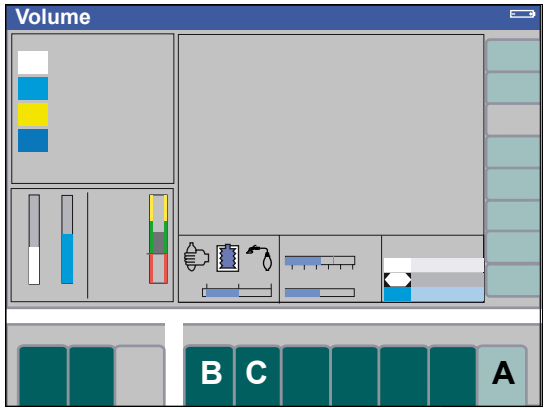
The active screen layout can be changed via the ***screen layout*** menu item (K).

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***.

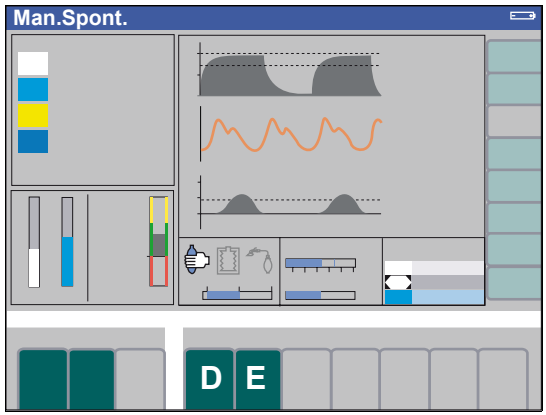
In automatic ventilation modes:




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.

The keys can be accessed directly in the ***Man.Spont.***, ***Ext. Outlet***, and ***Monitoring*** mode.




- Select the soft key ***age*** (D) or ***weight*** (E) to change and confirm with rotary knob.

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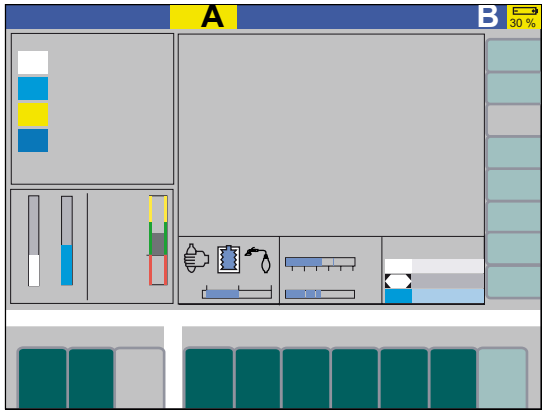
# Remedying faults

## Power failure

Primus *Infinity Empowered* 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) and the remaining battery capacity in percent (B) are displayed on the screen.

Example:

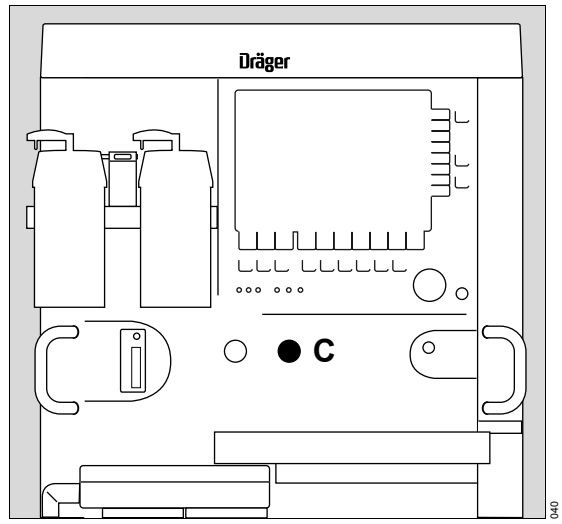
**30 %**

If the battery is almost empty, the message ***BATTERY LOW*** is displayed.

Primus *Infinity Empowered* permits manual ventilation with 100 % $O_2$ 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.

When the power supply is re-established, the anesthesia machine behaves as described in "Ventilator and fresh gas delivery failure" on page 191; see also the alarm message ***GAS + VENT. FAIL*** on page 200. To continue operation for emergency situations, switch the anesthesia machine off and then on again and refer to page 89 of these instructions for use.




**1** Check vaporizer setting,

**2** Press the safety knob (C) for $O_2$ emergency delivery to unlock it and set it to the required $O_2$ flow.
Range: 0 to 12 L/min. This $O_2$ flows through the vaporizer.

**3** Ensure adequate substitution monitoring.

**WARNING**

**Risk of patient injury**

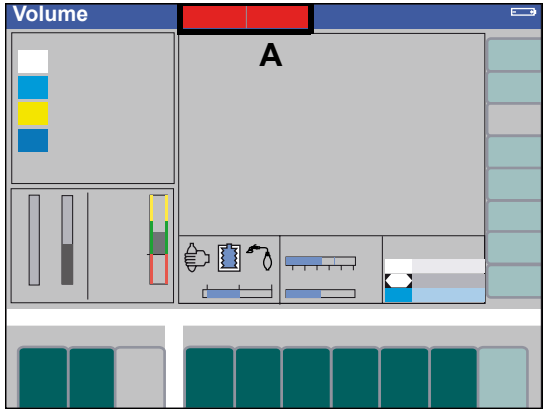
**If all power supplies fail, the screen display will be dark and automatic ventilation will cease.**

**The patient must be ventilated manually!**

**NOTE**

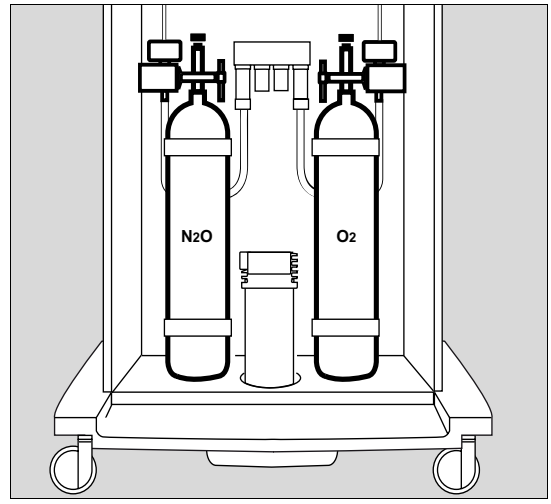
If a D-Vapor is in use and a power failure occurs, refer to the instructions for use of the D-Vapor for a description of system behavior in a power fail situation.

## Gas failure




Primus *Infinity Empowered* displays a corresponding message (A) if the gas supply fails:

***NO $O_2$ DELIVERY***, ***NO AIR DELIVERY***, or ***NO $N_2O$ 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 *Infinity Empowered* then delivers air or $O_2$ instead of the set gas mixture:

– Primus *Infinity Empowered* delivers 100 % Air if $O_2$ has failed.

– Primus *Infinity Empowered* delivers 100 % $O_2$ if $N_2O$ has failed.

– Primus *Infinity Empowered* delivers 100 % $O_2$ if Air has failed.

The fresh-gas flow (L/min) remains constant.

**CAUTION**

Risk of patient injury

Primus *Infinity Empowered* delivers 100 % $O_2$ if ***AIR*** or ***$N_2O$*** has failed.

Note the contra-indications for 100 % $O_2$.

Fresh-gas delivery remains operational even following a gas failure. This means that ***AIR*** or 100 % $O_2$ can be set as carrier gas if ***$N_2O$*** fails.

If the central gas supply for $O_2$ 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, where necessary, use intravenous anesthetic agents.**

**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**

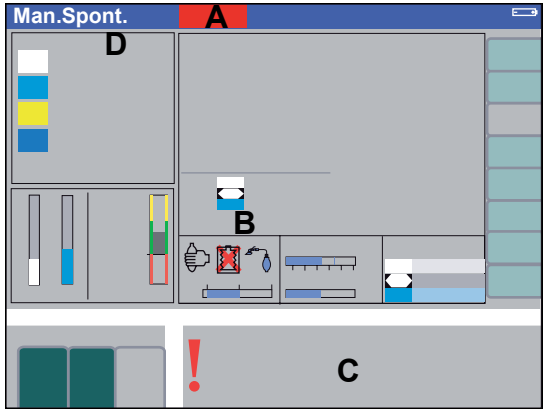
Risk of supply failure

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. Manual ventilation available only.*** (C)

Primus *Infinity Empowered* 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**

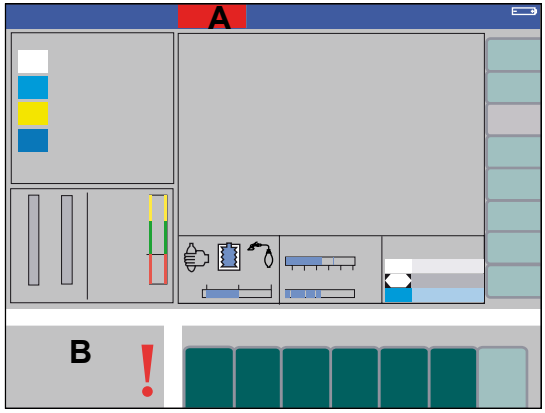
**Risk of patient injury**

**If pressure and volume monitoring fails, the patient cannot be adequately monitored.**

**Ensure adequate substitute 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 $O_2$ control valve and set a sufficient flow.*** (B)

1 Check vaporizer setting.

2 Set the safety knob of the $O_2$ emergency delivery to the required flow. Range: 0 to 12 L/min. This flow streams through the vaporizer.

**WARNING**

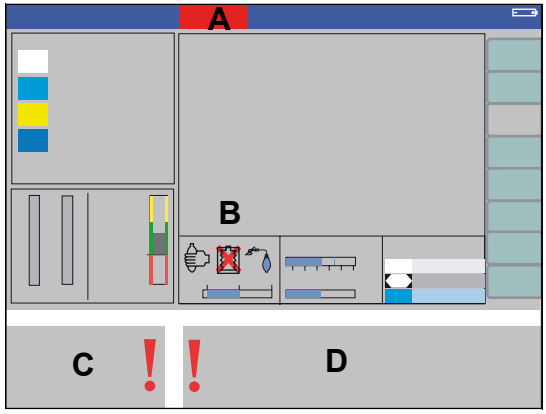
**Risk of patient injury**

**If the fresh-gas delivery fails, the anesthesia machine automatically discontinues the fresh-gas flow.**

**An $O_2$ flow must be delivered to the patient. Check vaporizer setting, Set $O_2$ 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 $O_2$ control valve and set a sufficient flow.*** (C)

***Ventilator failure. Manual ventilation available only.*** (D)

Primus *Infinity Empowered* automatically switches to the ***Monitoring*** mode.

1. Check vaporizer setting.
2. Set the safety knob of the $O_2$ 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 $O_2$ flow must be delivered to the patient and the patient must be ventilated manually. Check the vaporizer setting, open the Safety $O_2$ 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 substitute monitoring!**

## Gas measurement failure

- Ensure adequate substitute monitoring!

## Screen error

If the screen display fails:

**1** Switch off Primus *Infinity Empowered*.

**2** Set the oxygen flow to the desired value with the $O_2$ emergency delivery.

**3** Check vaporizer setting.

**4** The patient must be ventilated manually.

**5** Ensure adequate substitution monitoring.

## User interface failure

If the soft keys or the rotary knob are not operational:

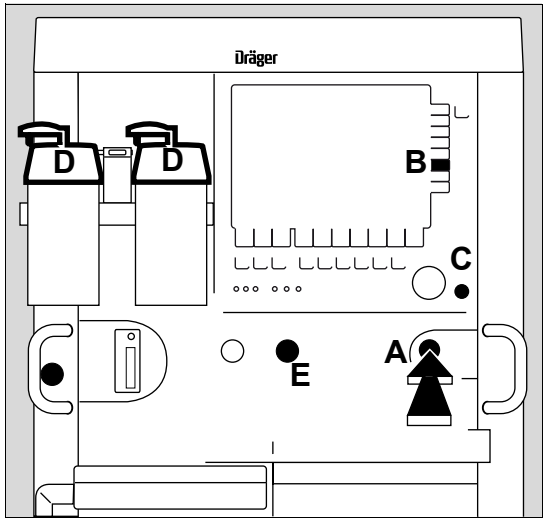
**1** Select the ***Monitoring*** mode, see page 143.

**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 *Infinity Empowered* 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 143.

**If the system has failed completely:**

- Switch Primus *Infinity Empowered* off (A).

**In both cases, to ensure alternative delivery of 100 % $O_2$ and anesthetic agent:**

1 Check the vaporizer setting (D).

2 Press the safety knob (E) to unlock it and turn it to set the 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 *Infinity Empowered* 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. For these alarms the lower priority is shown following the "/" (if a dash (–) is shown, it means that alarm can be canceled).

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 128) are written in parentheses, e.g. (23 / 31), in the table below.

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note<br>(7) | ***2 MIXED AGENTS*** | A second anesthetic agent has been detected. | Wait for the transition phase to end after changing anesthetic agents.<br>Check vaporizer fill level.<br>Flush system if necessary.<br>Check fresh-gas settings. |
| Caution<br>(15) | ***3 MIXED AGENTS*** | A mixture of more than two anesthetic agents has been detected, see page 149. | Check vaporizer fill level.<br>Flush system if necessary.<br>Check fresh-gas settings.<br>Wait for transition phase to end. |
| Note<br>(1) | ***AGENT SENSOR FAIL***<br>(in ***Standby*** only) | Anesthetic gas measurement system has failed. | Use external gas measuring system.<br>Call DrägerService. |
| Note/<br>–<br>(8/–) | ***AIR CYLIND. CONNECT.?*** * | Pressure sensor for reserve gas cylinder not connected. | Check pressure sensor connection. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution/ Note<br>(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.<br>Use the central gas supply. |
| Caution<br>(24)<br>Warning<br>(31) | ***APNEA*** | Priority in accordance with maximum priority of the individual alarms.<br>Breathing/ventilation has stopped (detected by pressure, volume, and $CO_2$ monitoring). | **Patient must immediately be ventilated manually!**<br>Check patient's spontaneous breathing ability.<br>Check ventilation setting.<br>Check fresh-gas setting.<br>Make sure everything is connected.<br>Check hose system and tube! |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note<br>(10) | ***APNEA $CO_2$*** | Apnea alarms are graded in time:<br>In automatic ventilation modes:<br>Caution = 0 to 30 sec.<br>Warning = >30 sec.<br>In ventilation modes ***Man.Spont.***, ***Pressure Support***, ***Ext. Outlet***:<br>Note = 0 to 30 sec.<br>Caution = 31 to 60 sec.<br>Warning = >60 sec. | |
| | | Sample line not connected. | Check sample line. |
| Caution<br>(24)<br>Warning<br>(31) | | No spontaneous breathing. | **Patient must immediately be ventilated manually!**<br>Check patient's spontaneous breathing ability.<br>Make sure everything is connected.<br>Check hose system and tube. |
| | | Breathing/ventilation has stopped. | **Patient must immediately be ventilated manually!**<br>Check ventilation setting. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution/ (see page 174)<br>Note (see page 181)<br>(10)<br>Caution<br>(24)<br>= 0 to 30 sec. | ***APNEA FLOW*** | Breathing/ventilation has stopped. | **Patient must immediately be ventilated manually!** |
| Warning<br>(31)<br>>30 sec. | | | Check patient's spontaneous breathing ability. |
| | | | Check ventilation setting. |
| | | Insufficient fresh gas supply. | Check fresh-gas setting. |
| | | Tube kinked.<br>Leak in hose system. | Check hose system and tube. |
| Caution<br>(24)<br>= 0 to 30 sec. | ***APNEA PRESSURE*** | Breathing/ventilation has stopped | **Patient must immediately be ventilated manually!** |
| Warning (see page 174)<br>(31)<br>≥0<br>or<br>>30 sec. | | Insufficient fresh gas supply. | Check fresh-gas setting. |
| | | Leak or blockage in tube or hose system. | Check hose system, tube, and microbial filter. |
| | | Patient not connected. | Connect patient correctly. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution/ Note (see page 174) (11/9) | ***APNEA VENTILATION*** * | No spontaneous breathing efforts by the patient during the ***Pressure Support*** mode. | Check the patient's trigger capability.<br>Set an adequate trigger. |
| Caution (13) Note (7) | ***BATTERY LOW*** | The battery capacity (Note = 10 to 20 %; Caution = <10 %) of the uninterruptible power supply is almost exhausted. | Connect to mains power.<br>Check patient's condition!<br>Prepare manual ventilation with 100 % $O_2$. |
| Warning (26) | ***BREATH. SYS. TEMP. HIGH*** | Temperature of the breathing system is too high. | Check breathing system and breathing gas temperature.<br>Call DrägerService. |
| Warning/ Caution (31/15) | ***CHECK VENTILATOR ASSEMBLY*** | If the Caution ***APNEA PRESSURE*** and ***APNEA FLOW*** also occur, the priority changes from Caution to Warning.<br>Breathing system installed incorrectly or incompletely.<br>Breathing system is defective. | Check whether upper diaphragm is correctly installed.<br>Use another breathing system. |
| Note (7) | ***CIRCLE LEAK*** | Leak in patient circle system. | Check tube, hoses, and filter. |
| Note (1) | ***$CO_2$ SENSOR FAIL*** (in ***Standby*** only) | $CO_2$ patient-gas measurement module failed. | Use external gas measuring system.<br>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 *Infinity Empowered* and the on-line equipment. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Warning<br>(31) | ***CONTINUOUS PRESSURE*** | The breathing pressure exceeds the set limit for more than 15 seconds. | Check ventilation and/or spontaneous breathing of the patient.<br>Check breathing hoses, breathing system, and gas scavenging system for correct functionality.<br>Check alarm limit for correct setting. |
| Caution<br>(18) | ***ET $CO_2$ HIGH*** | The upper alarm limit for the end-expiratory $CO_2$ concentration has been exceeded for at least two breaths. | Check ventilation. |
| Caution<br>(18) | ***ET $CO_2$ 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<br>(8) | ***EXP. FLOW SENSOR FAIL***<br>(in ***Standby*** only) | Expiratory flow sensor has failed. | Replace flow sensor, see page 220. |
| Note<br>(6) | ***FAN FAIL*** | Fan for evacuating gases inside the device is defective. | Workstation must be switched off!<br>A defective fan together with an internal leak may cause higher $O_2$ concentrations inside the workstation. Risk of fire<br>Call DrägerService. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution<br>(16)<br>Warning<br>(31) | ***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.<br>Check anesthetic gas scavenging system. |
| | | Leakage | Repair leak. |
| Warning/<br>Note<br>(30/10) | ***FRESH GAS EXTERN OK?*** * | Fault when switching over to the external fresh-gas outlet. | Check fresh-gas flow at external outlet.<br>Switch external fresh-gas outlet on and off several times.<br>If breathing bag of the non-rebreathing system does not fill, switch to internal breathing system.<br>Use operational outlet.<br>Call DrägerService. |
| Warning/<br>Note<br>(30/10) | ***GAS + VENT. FAIL*** * | Fresh-gas mixer and ventilator are no longer operational. | **Patient must immediately be ventilated manually!**<br>Check vaporizer setting.<br>Set the safety knob for $O_2$ emergency delivery to the required $O_2$ flow, between 0 and 12 L/min.<br>Call DrägerService. |
| Warning/<br>Note<br>(29/10) | ***GAS MIXER FAIL*** * | Fresh-gas mixer is no longer operational. | Check vaporizer setting.<br>Set the safety knob for $O_2$ emergency delivery to the required $O_2$ flow, between 0 and 12 L/min.<br>Make sure the fresh gas flows into the breathing circle used (breathing system or ext. fresh-gas outlet).<br>Call DrägerService. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note<br>(1) | ***GAS SENSOR FAIL***<br>(in ***Standby*** only) | Complete gas measurement system failure. | Use external gas measuring system.<br>Call DrägerService. |
| Note<br>(7) | ***HOSE EXPIRED***<br>(Only available if ***ID ventilation circuit used*** has been activated in the default configuration.) | Breathing hose shelf life has been expired. | Exchange breathing hoses. |
| Caution/<br>–<br>(11/–) | ***HOSE MISMATCH **** | Breathing hoses are not connected to the correct breathing system port. | Check breathing hose connection for mismatch. |
| | | Wrong hose type connected to a breathing system port. | Check type of breathing hoses. |
| | | Unknown hose or accessory connected. | Remove unknown accessories.<br>Check whether breathing system is correctly installed. |
| Note<br>(7) | ***ID FUNCTIONS FAIL***<br>(Not available if the Infinity ID function has been completely deactivated by DrägerService.) | Infinity ID functions not available, because of a device failure. | Call DrägerService. |
| Note<br>(7) | ***ID HOSE MISSING***<br>(Only available if ***ID ventilation circuit used*** is activated in the default configuration.) | No or not all Infinity ID breathing hoses are detected. | Connect all Infinity ID breathing hoses correctly. |
| Caution/<br>–<br>(11/–) | ***INCOMP. HOSE **** | Breathing hoses and other accessories, which are connected, are not intended to be used with Primus *Infinity Empowered*. | Exchange breathing hoses. Use only compatible accessories with Primus *Infinity Empowered*. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution/ Note<br>(14/10) | ***INCORRECT FG FLOW **** | Set fresh-gas flow cannot be delivered. | Check vaporizer setting.<br>Make sure the emergency $O_2$ delivery is closed.<br>Set fresh-gas flow to between 3 and 10 L/min. |
| Caution<br>(11) | ***INSP. $CO_2$ HIGH*** | Soda lime in circle system exhausted. | Increase the fresh-gas flow.<br>Replace soda lime. |
| | | Leak or fault in breathing system. | Replace breathing system! |
| | | High respiratory rates.<br>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<br>(8) | ***INSP. FLOW SENSOR FAIL*** | Insp. flow sensor is defective. | Replace flow sensor, see page 220. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution<br>Warning<br>Note | ***INSP. HAL. HIGH***<br>***INSP. ISO. HIGH***<br>***INSP. ENF. HIGH***<br>***INSP. DES. HIGH***<br>***INSP. SEV. HIGH*** | Caution (24) =<br>insp. MAC value >3 MAC for >180 seconds.<br>Warning (31) =<br>insp. MAC value >5 MAC<br>Warning (31) =<br>insp. MAC value >3 MAC and exp. MAC value >2.5 MAC for >30 seconds. | |
| | | Insp. anesthetic gas concentration exceeds 5 MAC. | Check the vaporizer and fresh-gas settings. |
| | | Insp. anesthetic gas concentration exceeds 3 MAC for more than 180 seconds. | |
| | | Insp. anesthetic gas concentration exceeds 3 MAC and exp. 2.5 MAC for more than 30 seconds. | |
| | | Note (10) =<br>Insp. gas concentration > upper alarm limit for 0 to 30 seconds.<br>(preliminary information for the user)<br>Caution (24) =<br>Insp. gas concentration > upper alarm limit for 31 to 180 seconds.<br>Warning (31) =<br>Insp. gas concentration > upper alarm limit for >180 seconds. | |
| | | Inspiratory anesthetic gas concentration 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 inspiratory 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. $N_2O$ HIGH*** | Inspiratory $N_2O$ concentration exceeds the upper alarm limit of 82 %. | Check $N_2O$ concentration in the fresh-gas flow. Flush. |
| Caution (12) | ***INSP. $O_2$ HIGH*** | Inspiratory $O_2$ concentration exceeds the upper alarm limit. | Check $O_2$ concentration in the fresh-gas flow. |
| Warning (31) | ***INSP. $O_2$ LOW*** | Inspiratory $O_2$ concentration is below the lower alarm limit. | Check $O_2$ concentration and fresh-gas setting. |
| | | | Check for leakages in breathing system. |
| | | | Check $O_2$ supply. |
| Warning/ Note (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<br>(10) | ***LOW AIR SUPPLY*** | Compressed air supply has failed. | Open optional Air reserve gas cylinder.<br>Check central gas supply, see page 187. |
| | | The central 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<br>(10) | ***LOW $N_2O$ SUPPLY*** | $N_2O$ supply has failed. | Open $N_2O$ reserve gas cylinder.<br>Check central gas supply, see page 187. |
| | | Probe for the central gas supply not plugged in or $N_2O$ hose kinked. | Check connection to central gas supply. |
| | | $N_2O$ cylinder empty or closed. | Connect a full $N_2O$ cylinder or open the cylinder valve. |
| Caution<br>(11) | ***LOW $O_2$ SUPPLY*** | $O_2$ supply has failed. | Open $O_2$ reserve gas cylinder.<br>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 187. |
| | | $O_2$ cylinder empty or closed. | Connect a full $O_2$ cylinder or open the cylinder valve. |
| Caution/ Note<br>(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<br>(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<br>(22) | ***MINUTE VOL. LOW*** | Lower alarm limit for the minute volume has been fallen short of. | Check breathing system.<br>Check ventilation setting. |
| | | | Correct the trigger level if necessary when using the ***Pressure Support*** mode. |
| | | | Check the patient's trigger capability. |
| | | Tube sealed/kinked. | Check tube. |
| | | Leakage | Check tube, hoses, filters, bellows, absorber. |
| | | Reduced tidal volume through pressure limitation. | Correct ventilation settings. |
| | | Fresh-gas flow is insufficient. | Increase the fresh-gas flow. |
| Note/<br>–<br>(8/–) | ***$N_2O$ CYLIND. CONNECT.?*** * | Pressure sensor for reserve gas cylinder not connected. | Check pressure sensor connection. |
| Warning/<br>Note<br>(25/7) | ***$N_2O$ CYLIND. EMPTY*** * | $N_2O$ reserve gas cylinder empty or closed and<br>central $N_2O$ supply not available or not connected. | Use a new $N_2O$ reserve gas cylinder or open the cylinder valve.<br>Use the central gas supply. |
| Note<br>(1) | ***$N_2O$ SENSOR FAIL***<br>(in ***Standby*** only) | $N_2O$ gas measurement system has failed. | Use external gas measuring system.<br>Call DrägerService. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Warning/ Note (25/10) | ***NO AIR DELIVERY*** * | Compressed air supply has failed. | Open optional Air reserve gas cylinder.<br>Check central gas supply, see page 187. |
| | | 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 $N_2O$ DELIVERY**** | $N_2O$ supply has failed. | Open $N_2O$ reserve gas cylinder.<br>Check central gas supply, see page 187. |
| | | Probe for the central gas supply not plugged in or $N_2O$ hose kinked. | Check connection to central gas supply. |
| | | $N_2O$ cylinder empty or closed. | Connect a full $N_2O$ cylinder or open the cylinder valve. |
| Warning (31) | ***NO $O_2$ DELIVERY*** | $O_2$ supply has failed. | Open $O_2$ reserve gas cylinder.<br>Check central gas supply, see page 187. |
| | | 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 $SpO_2$ PULSE*** | No pulse signal detected with the $SpO_2$ measurement for approx. 10 seconds. | Check patient's condition!<br>Check application of $SpO_2$ sensor. |
| | | NiBP measurement on the same arm. | Measure blood pressure on the other arm. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note/<br>–<br>(8/–) | ***O2 CYLIND. CONNECT.?**** | Pressure sensor for reserve gas cylinder not connected. | Check pressure sensor connection. |
| Warning/<br>Note<br>(28/7) | ***O2 CYLIND. EMPTY**** | O2 reserve gas cylinder empty or closed and central O2 supply not available or not connected. | Use a new O2 reserve gas cylinder or open the cylinder valve.<br>Use the central gas supply. |
| Note<br>(10) | ***O2 CYLIND. LOW*** | Pressure has dropped below the pressure limit set for the O2 cylinder. | Use a new O2 reserve gas cylinder.<br>Use the central gas supply. |
| Caution<br>(11) | ***O2 SENSOR FAIL***<br>(in ***Standby*** only) | O2 sensor is spent or defective. | Replace O2 sensor, see page 244. |
| | | | Ensure adequate substitution monitoring.<br>Call DrägerService. |
| Caution<br>(14) | ***PEEP HIGH*** | Exp. pressure 5 hPa (cmH2O) above PEEP for two breaths | In automatic ventilation modes: Check the set ventilation parameters.<br>Check the anesthetic gas scavenging line. |
| | | Exp. pressure 5 hPa (cmH2O) above PEEP in the ***Pressure Support*** mode for more than 30 seconds. | |
| Caution<br>(12) | ***PINSP NOT ATTAINED*** | The inspiratory pressure set in Pressure Mode is not achieved. | Check set ventilation parameters, repair leak if necessary. |
| | | Fresh gas shortage. | Check fresh-gas setting. |
| Caution/<br>Note<br>(12/7) | ***POWER FAIL**** | Power failure. | Restore central gas supply.<br>Observe battery capacity.<br>Prepare manual ventilation. |
| | | Short-circuit in one of the units connected to an auxiliary outlet. | Unplug appliance connector from auxiliary outlet.<br>Restore central gas supply. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note (1) | ***POWER SPLY. ERROR*** | Internal fault in the power supply. | Call DrägerService.<br>Operation of the workstation can continue for the time being. |
| Note (8) | ***PRESSURE ERROR*** (in ***Standby*** only) | Pressure sensor is defective. | Perform self test.<br>Call DrägerService. |
| 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.<br>Call DrägerService. |
| | | Anesthetic gas scavenging system is defective. | Check anesthetic gas scavenging system.<br>Call DrägerService. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note<br>(10) | ***PRESSURE RELIEF*** | Internal pressure relief valve opened due to high system pressure.<br>(***Standby***, ***Monitoring***, ***Man.Spont.***) | Check APL valve settings.<br>Check fresh-gas settings. |
| Caution<br>(21) | ***PULSE RATE HIGH*** | Upper alarm limit for pulse has been exceeded. | Check patient's condition!<br>Correct alarm limit if necessary. |
| Warning<br>(31) | ***PULSE RATE LOW*** | Pulse below lower alarm limit. | Check patient's condition!<br>Check ventilation. |
| Caution<br>(18) | ***SAFETY $O_2$ OPEN*** | $O_2$ emergency delivery is open. | Close $O_2$ emergency supply. |
| Caution/<br>–<br>(14/–) | ***SETTING CANCELLED**** | The last settings have not been accepted on account of temporary errors. | Repeat settings.<br>Alarm can be canceled by pressing  . |
| Note<br>(7) | ***SODA LIME DEPLETED?***<br>(in ***Standby*** only) | Soda lime of Infinity ID CLIC Absorber in circle system exhausted.<br>(Only available if this functionality is activated by DrägerService.) | Check soda lime, if necessary replace soda lime. |
| | | Time limit for usage reached. | |
| | | Shelf life of Infinity ID CLIC Absorber expired.<br>(Only available if this functionality is activated by DrägerService.) | |
| Caution<br>–<br>(11/–) | ***SODA LIME DISCONN.**** | Infinity ID CLIC Absorber not correctly connected. | Check and connect Infinity ID CLIC Absorber. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Note (1) | ***SPEAKER FAIL*** | Speaker is defective. | No alarm tone.<br>Call DrägerService. |
| Note (1) | ***SpO2 FAIL*** (in ***Standby*** only) | SpO2 measurement system has failed. | Use external measuring system.<br>Call DrägerService. |
| Caution (21) | ***SpO2 HIGH*** | Upper alarm limit for oxygen saturation has been exceeded. | Check ventilation. |
| Warning (31) | ***SpO2 LOW*** | Lower alarm limit for oxygen saturation has been fallen short of. | Check ventilation.<br>Check application of SpO2 sensor.<br>Check O2 concentration of fresh-gas flow. |
| Note (10) | ***SpO2 SENS. DISCONNECT*** | SpO2 sensor not connected. | Check sensor connection. |
| Warning/ Note (28/10) | ***VENTILATOR FAIL*** * | Ventilator is no longer operational. | **Patient must immediately be ventilated manually!**<br>Adequate substitute monitoring must be ensured if pressure and volume monitoring has failed.<br>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.<br>The ambient air may become contaminated with anesthetic agents! |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| Caution<br>(12) | ***VOLUME NOT ATTAINED*** | Set volume is not delivered. | Remove leak.<br>Correct pressure limitation or inspiratory time if necessary. Check fresh-gas flow setting. |
| | | | Check fresh-gas flow setting. |
| Note<br>(7) | ***WATER TRAP EXPIRED***<br>(This alarm is only available if this functionality is activated by DrägerService.) | Service life of Infinity ID water trap for gas analyzer expired. | Exchange water trap. |
| Note<br>(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.<br>Ensure adequate substitute monitoring!<br>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 substitute monitoring!<br>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 171. |
| | **symbol next to measured values** | All alarms for the measured values concerned have been temporarily disabled.<br>The alarm system is waiting for automatic measurement wake-up (AutoWakeUp). | Connect sample line.<br>Connect $SpO_2$ Sensor.<br>Connect patient.<br>For more details see page 130. |

| Priority | Message | Cause | Remedy |
|---|---|---|---|
| | **symbol next to measured values** | The apnea alarm for the measured value concerned has been disabled.<br><br>Some apnea alarms are disabled automatically in some ventilation modes. For more details see page 132. | For more details see page 132. |
| | **, , 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 171. |
| | **Grayed out measured values** | The specified accuracy cannot be maintained. | |
| | **Grayed out values** | The set value differs from the delivered value. | |

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# Cleaning, disinfection and sterilization

# Disassembly

**Disconnecting from the mains**

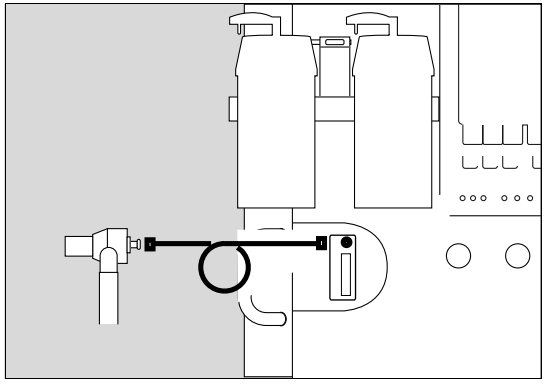
**1** Shut down the device and all additional devices.

**2** Remove the mains plug.

## Observe before disassembly

- Switch off the device and accessory devices and remove their mains plugs.

## Removing the sample line




- Unscrew the sample line from the Y-piece and the water trap on the front of the unit.

**CAUTION**

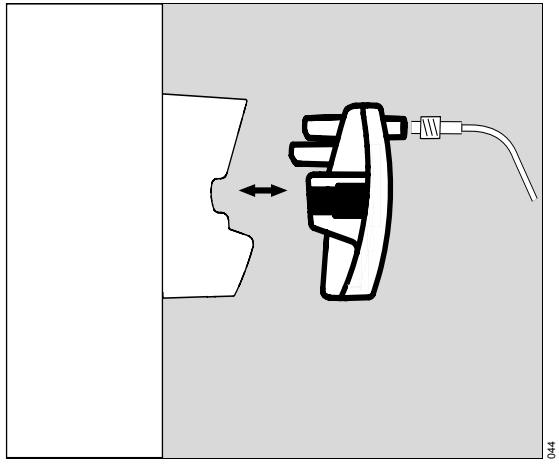
Risk of gas measurement failure and device failure

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 82.

**WARNING**

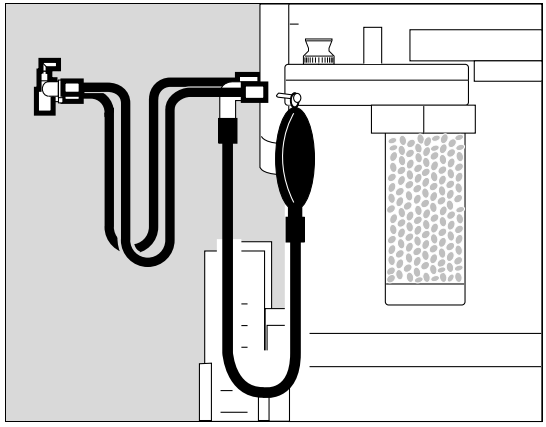
**Risk of gas measurement failure and device failure**

**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.**

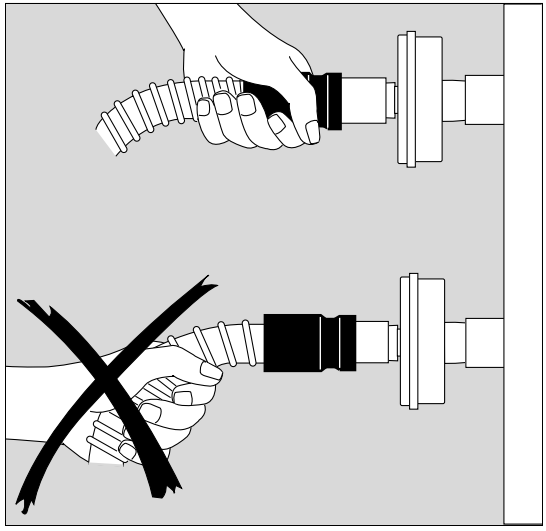
**The water trap must be replaced after a service life of four weeks.**

When disposing of old water traps, follow the corresponding instructions for use for the WaterLock water trap or the Infinity ID WaterLock 2 and comply with the hospital's hygiene requirements.

## Removing the patient system




**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.

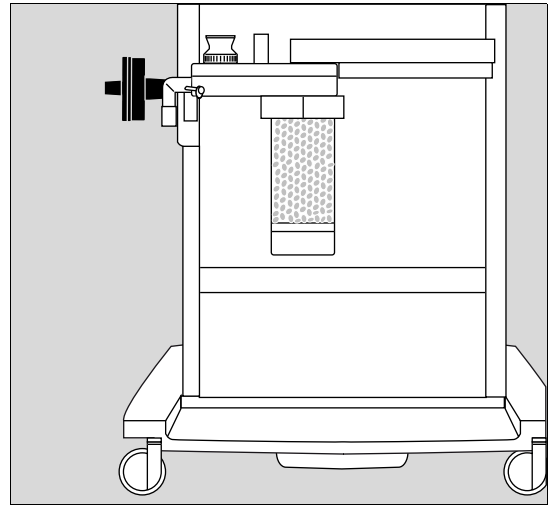
**CAUTION**

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)

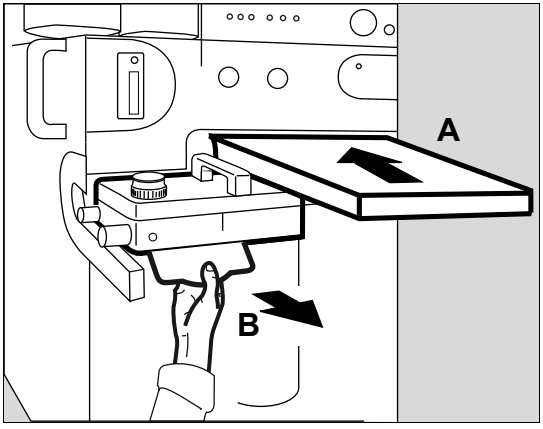


On the sleeve of the microbial filter:

**1** Pull the filter off the nozzle.

**2** Prepare the microbial filter for conditioning according to the corresponding instructions for use.

## Removing the ventilator module

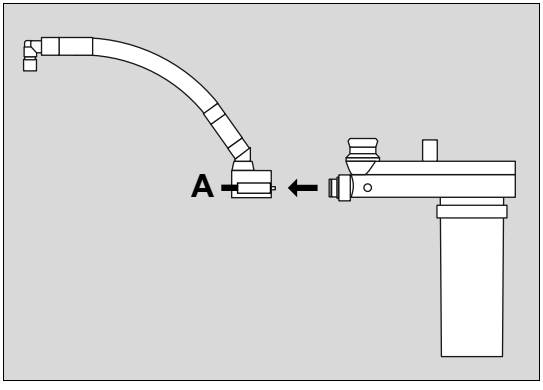



**1** Slide the writing table (A) inwards.

**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.



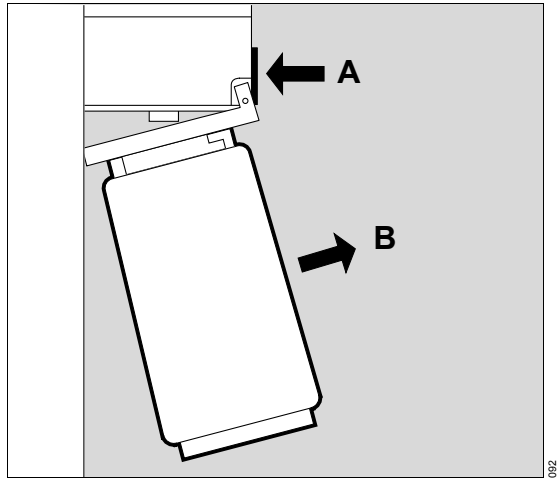

**2** Unscrew the knurled screws (A) on the socket of the arm.

**3** Disconnect the arm from the breathing system.

## Removing the absorber

The disposable absorber Drägersorb CLIC or a reusable absorber can be used.

**Disposable absorber Drägersorb CLIC**

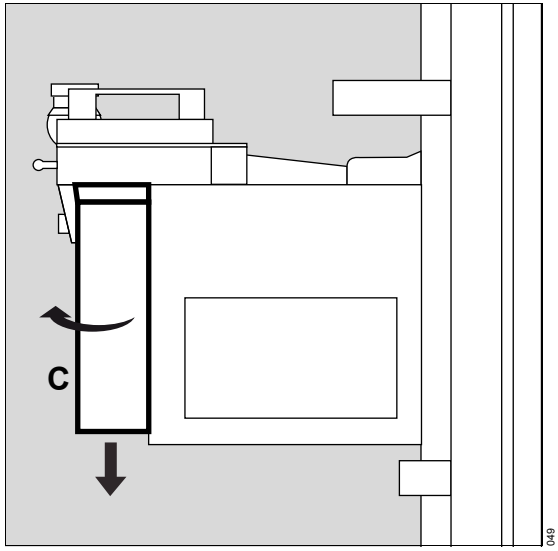



**1** Press the button (A); the mounting swings open.

**2** Slide the disposable absorber off the mounting (B).

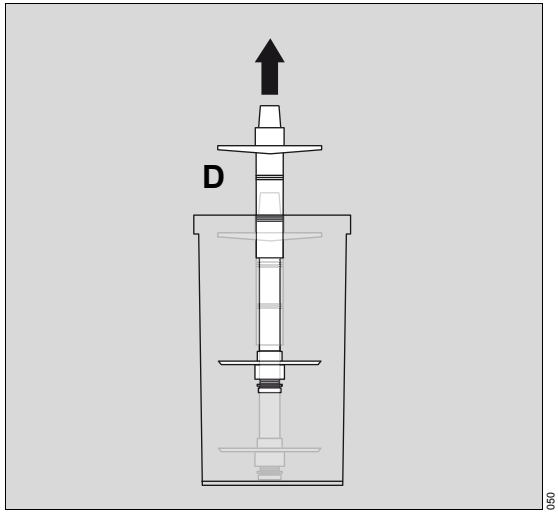
Note the Drägersorb CLIC instructions for use.

**Reusable absorber**




**1** Turn the absorber counterclockwise and pull it down (C).

**2** Empty out the soda lime in accordance with the instructions for use of the absorber, see page 123.



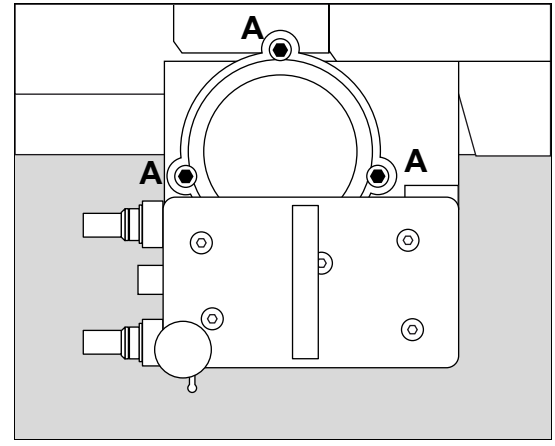

**3** Remove the insert from the absorber (D). The inner and outer sealing rings remain on the absorber insert.

**4** Prepare the absorber for conditioning in a cleaning and disinfecting machine.

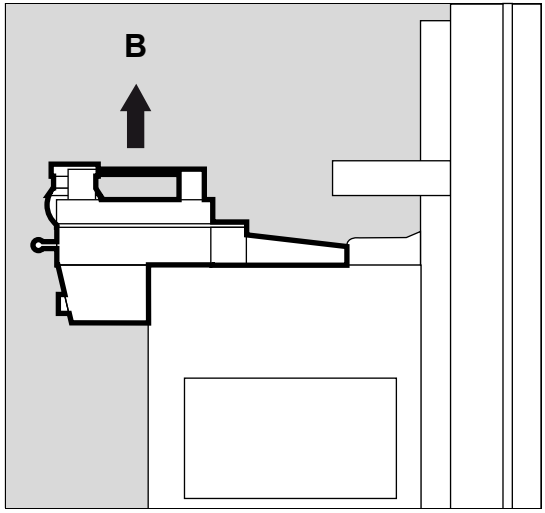
## Removing the breathing system

**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.

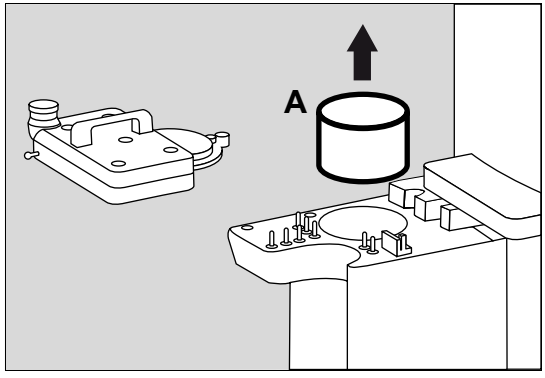



**1** Loosen the three sealing screws (A) on the ventilator a quarter turn counterclockwise using the key supplied.




**2** Pull the breathing system up (B) and out by the handle.

## Removing the ventilator diaphragm



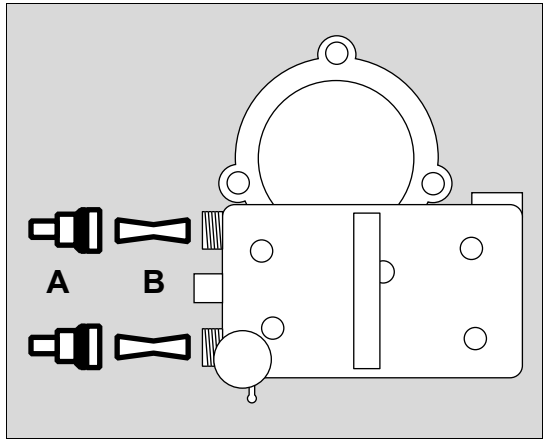

- Remove the upper diaphragm (A) and prepare it for conditioning in a cleaning and disinfecting machine.

**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.

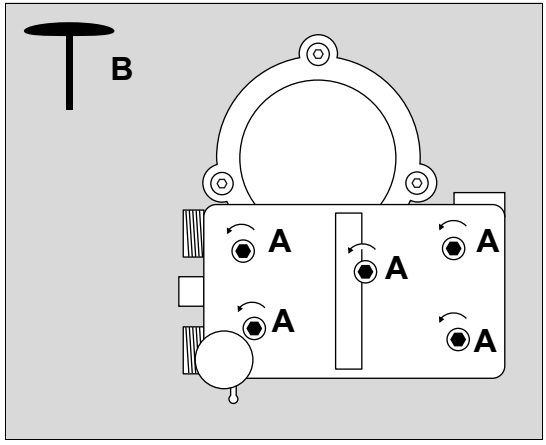
**CAUTION**

Risk of flow measurement failure

Sterilizing the Spirolog flow sensors in high-temperature steam will damage them and cause the flow measurement to fail.

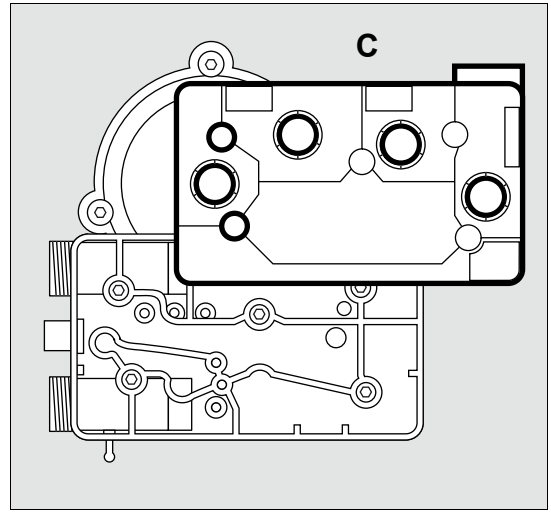
Disinfect and clean the flow sensor as described in the instructions for use of the Spirolog and SpiroLife flow sensors.

## Opening the breathing system




**1** Loosen the five sealing screws (A) a quarter turn counterclockwise using the key (B) supplied.

**2** Remove the cover.

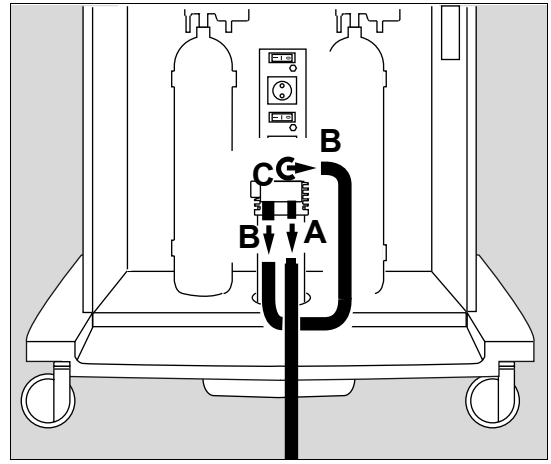



**3** Lift off the metal valve plate (C).

**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



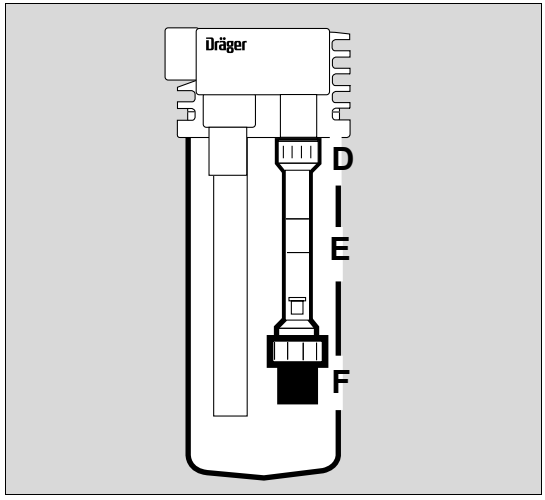
1 Remove the scavenging hose (A) from the AGS system on the back of Primus *Infinity Empowered*.

2 Remove the gray transfer hose (B).

3 Remove the anesthetic gas scavenging system (C).

4 Prepare the individual parts for reprocessing in a cleaning and disinfecting machine (washing machine).
Flow tubes must not be placed in the washer!

5 Remove the container for buffer volume.




6 Unscrew the union nut (D).

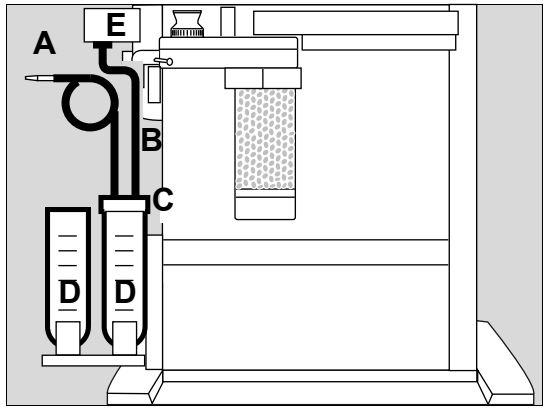
7 Unscrew the flow tube (E).

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 237.

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.

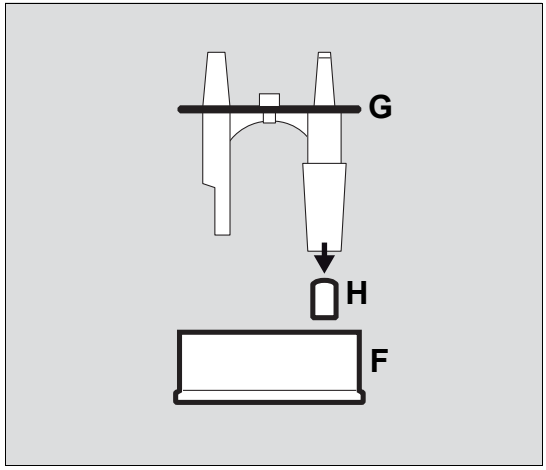
2 Grip the silicone sleeve (C) of the bottle cap (see details below) and pull it off.

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 237.)




**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:

– Uncricital 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 *Infinity Empowered* 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. | | |
| Anesthetic gas receiving system AGS | 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 reprocessed** | **Recommended reprocessing intervals** | **Precleaning** | **Machine cleaning and disinfection** | **Manual** | | **Sterilization** |
|---|---|---|---|---|---|---|
| | | | | **Cleaning** | **Disinfection** | |
| Primus *Infinity Empowered* 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 | | | | no | 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. | | | | | |
| Anesthetic gas receiving system AGS | 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

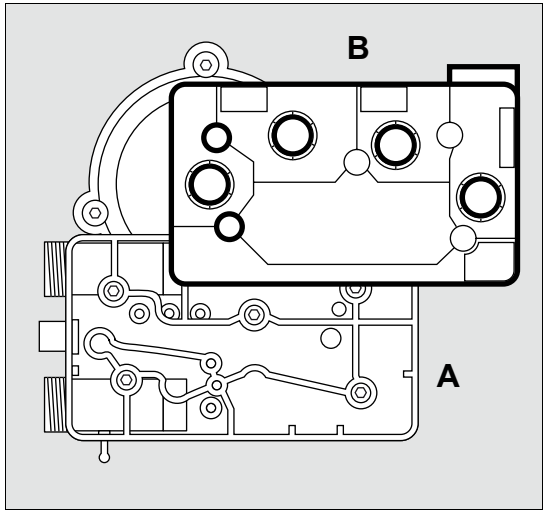
## Visual inspection

- 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

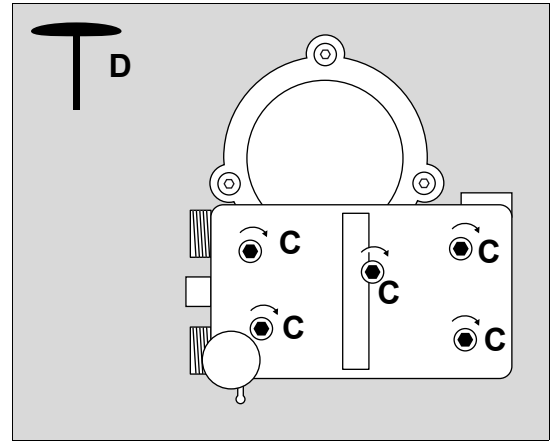
**NOTE**

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.

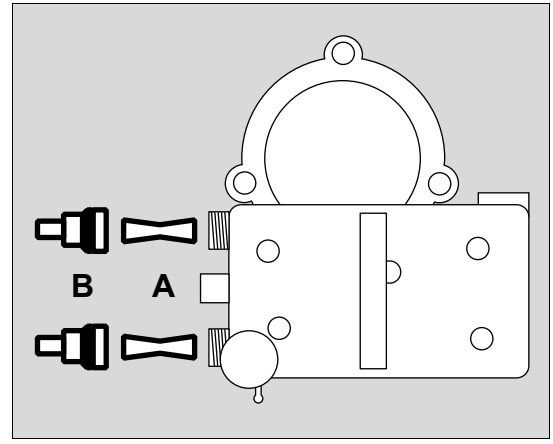
**2** Fit the metal valve plate (B) onto the bottom section.




**3** Tightly fit the cover.

**4** Tighten all five sealing screws (C) a quarter turn clockwise using the key (D) supplied.

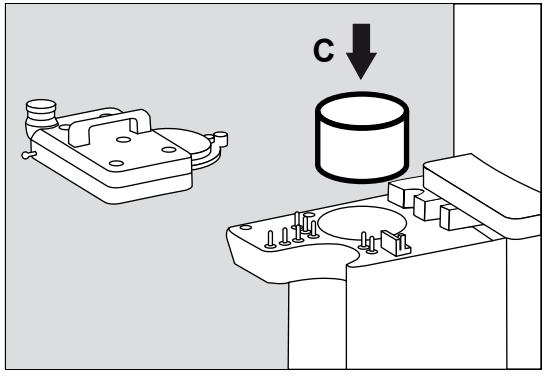
## Inserting the flow sensors



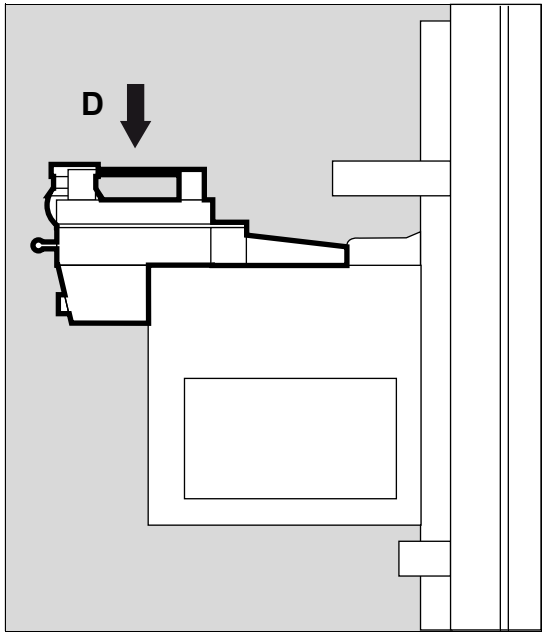

**1** Insert the flow sensors (A) with the electric connection in the slot.

**2** Push in the expiratory and inspiratory ports (B), with the nose of the port in the slot.

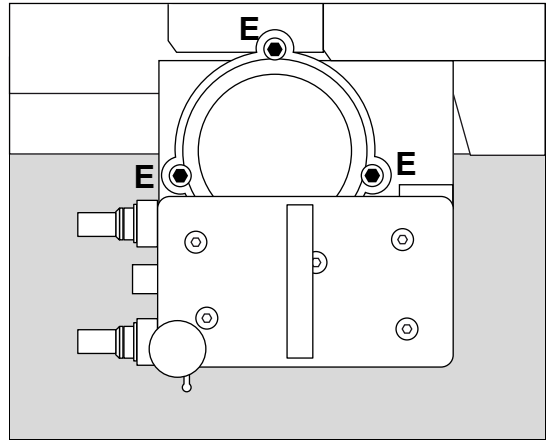
**3** Tighten the knurled nut by hand.




**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

The disposable absorber Drägersorb CLIC or a reusable absorber can be used.

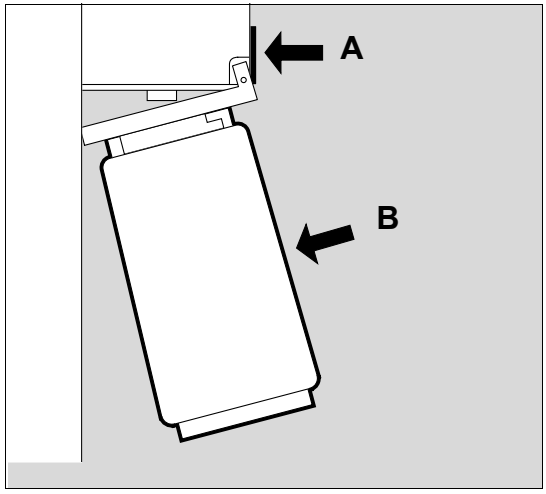
### Disposable absorber Drägersorb CLIC

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

**NOTE**

The disposable absorber must be clicked into place before Primus *Infinity Empowered* is switched on. This ensures that the absorber is included in the leak and compliance test of the machine.

To click the absorber into place:




**1** Press the button (A); the mounting swings open.

**2** Before fitting, shake the disposable absorber, e.g., by turning it upside down several times in order to loosen up the soda lime.

**3** Remove the seal from the new disposable absorber.

**4** Slide the new disposable absorber into the mount (B) and

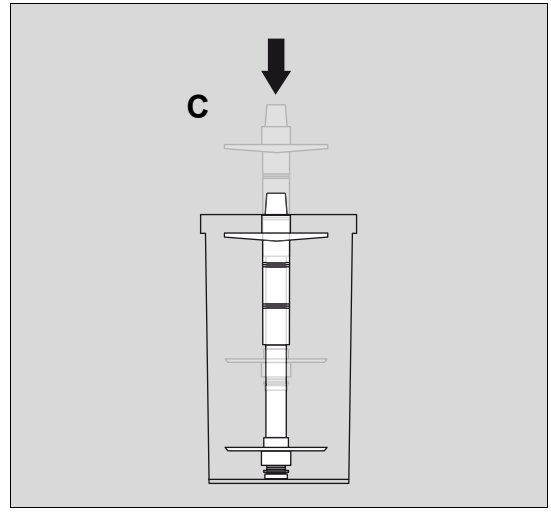
**5** Push the absorber into the machine until it engages.

If the Infinity ID CLIC absorber has been configured in ***Standard Conf.*** (see "Soda lime depletion" on page 80), the new absorber will be automatically detected by Primus *Infinity Empowered*.*

If the Infinity ID CLIC absorber was not configured

**6** Reset the soda lime change log to current date by pressing the soft key ***soda lime changed***, see page 88.

**Reusable absorber**




**7** Push the insert fully into the absorber (C).

**8** 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.**

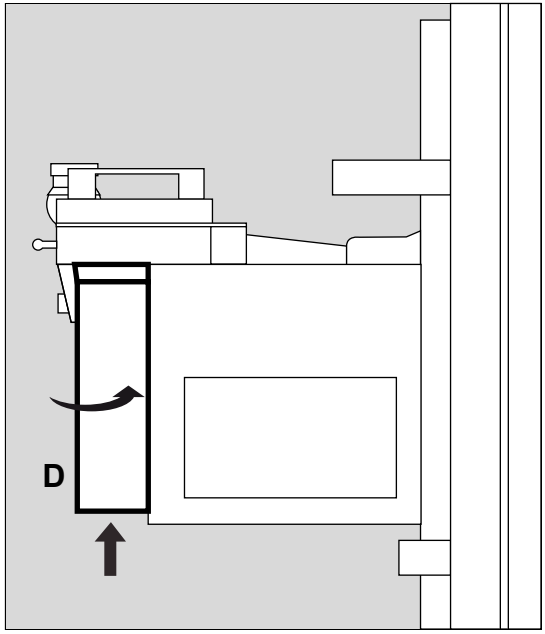
Recommendation:

Only use Drägersorb 800 Plus or Drägersorb FREE!

**NOTE**

Do not use powdered lime, as a higher dust load can impair the functionality of Primus *Infinity Empowered*.

* Function not available at present.




**9** Insert the absorber in the breathing system from below (D) and turn clockwise as far as possible. The disposable Drägersorb CLIC absorber can also be used instead of the reusable absorber described here. (See the Drägersorb CLIC instructions for use.)

If the breathing system is not to be used within the next 24 hours:

- Only fill with the soda lime immediately before use!
- If no Infinity ID CLIC absorber is used, reset the soda lime change log to current date by pressing the soft key ***soda lime changed***, see page 88.

**WARNING**

**Risk of patient injury**

**The soda lime loses moisture. Generally, if the moisture level falls below a minimum set point, undesirable reactions occur, independent of the type of lime and the volatile anesthetic agent being used:**

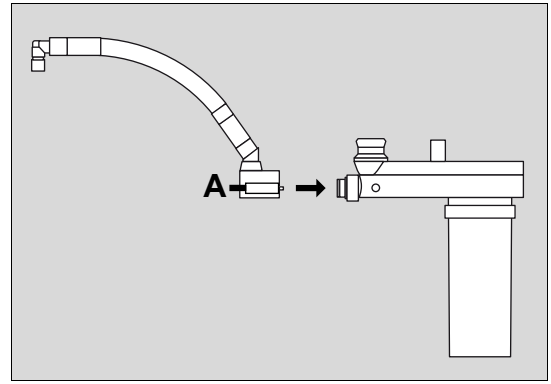
- **reduced $CO_2$ absorption,**
- **increased heat build-up in the absorber and thus, an increased breathing gas temperature,**
- **formation of CO,**
- **absorption and/or decomposition of the inhalation anesthetic.**

**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.

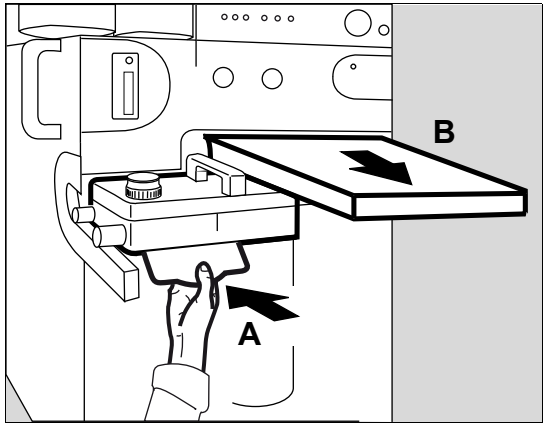
## Installing the flexible arm (optional) and breathing bag




**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

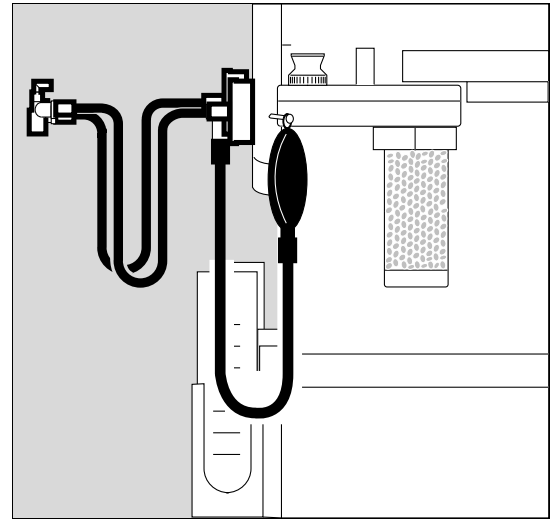



**1** Slowly push in the ventilator module (A) until it engages.

**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 patient system




**1** Fit the microbial filters (optional) on the inspiratory and/or expiratory port of the breathing system until they audibly engage.

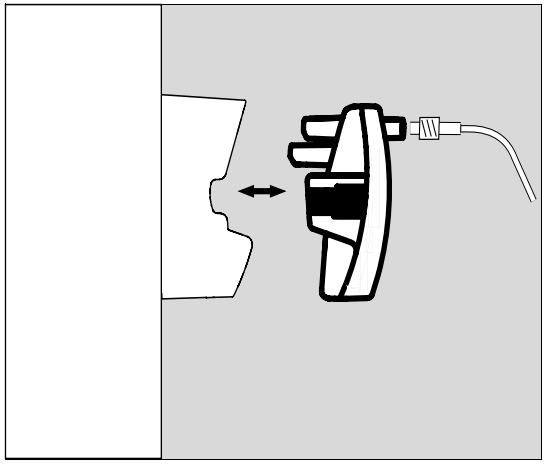
**2** Connect the various parts of the breathing circuit (breathing hoses, Y-piece, connector, and optional Y-piece filter) and hang the breathing bag on the hook.
See "Connecting the patient system" on page 63.

**WARNING**

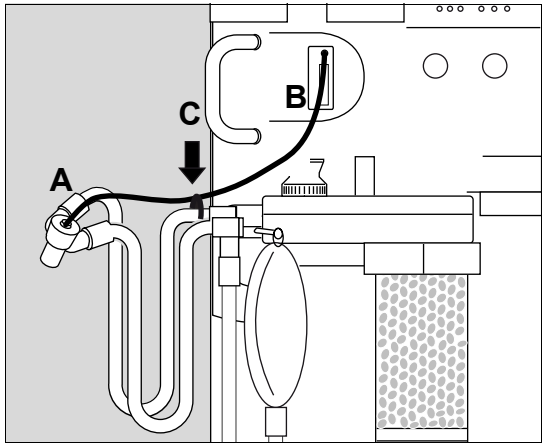
**Risk of burns**

**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**

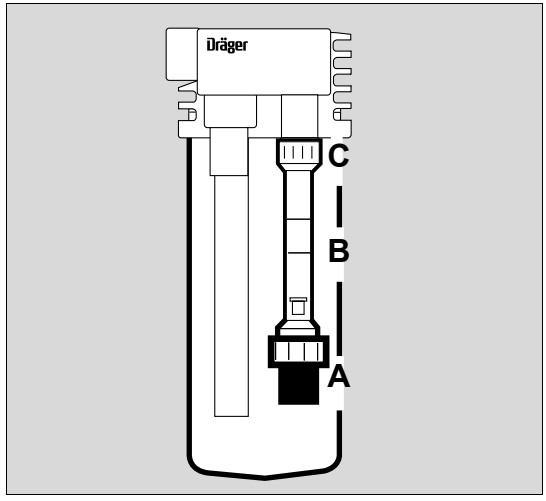
Primus *Infinity Empowered* (no accessories) is not made with natural rubber latex.

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

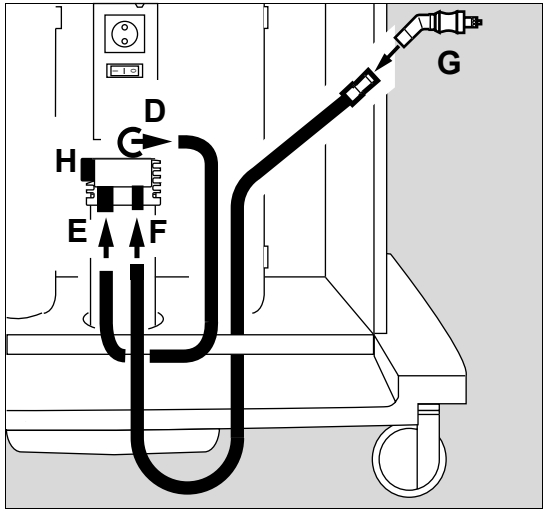



**1** Install the particle filter (A), tighten the union nut.

**2** Screw in the flow hose (B).

**3** Tighten the union nut (C).

**4** Refit the container for buffer volume.




**5** Connect the gray transfer hose to the scavenging nozzles (D) on the Primus *Infinity Empowered* and on the AGS (E).

**6** Connect the scavenging hose to the scavenging nozzle of the AGS (F).

**7** Connect the scavenging hose to the scavenging connector (G).

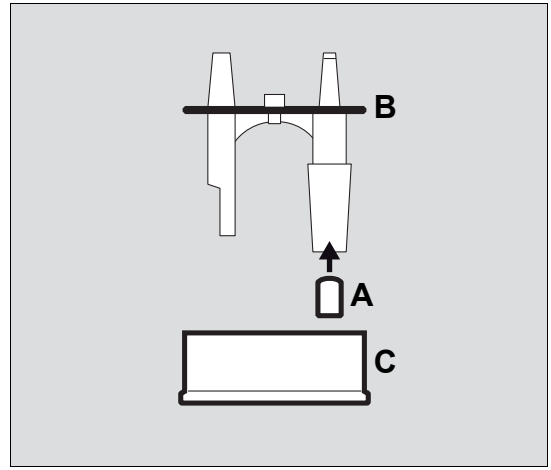
**8** Make sure the second port of the scavenging system (H) is sealed with the screw plug.

**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.

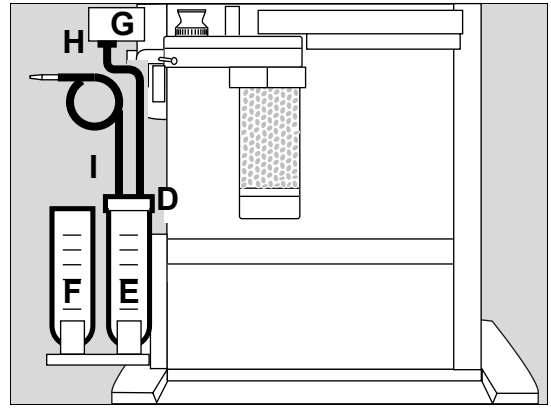
Note the instructions for use of the anesthetic gas scavenging system AGS.

## Connecting the secretion aspirator




**1** Press the overflow protection float (A) 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 sleeve (E) and the rinsing bottle in the outer sleeve (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 51.

**2** Check readiness for operation, see "Getting started" on page 73.

# Maintenance

## 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 and safety checks[1)] | Every 12 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 $O_2$ measurement.
- Check $CO_2$ 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.

**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.

**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 | Must be replaced after one year at most. | Replace | Users |

| Component | Interval | Measure | Personnel responsible |
|---|---|---|---|
| Water trap | If soiled or if the message ***WATER TRAP SAMPL. LINE?*** is displayed (assuming the sample line is free of blockages and is not kinked); at least every 4 weeks. | Replace | Users |
| $O_2$ sensor – fuel cell | Replace when calibration is no longer possible or when message ***$O_2$ 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 |

| Component | Interval | Measure | Personnel responsible |
|---|---|---|---|
| Man.Spont.-Automatic reversing diaphragm | Every 2 years | Replace | Service personnel |
| Bacterial/viral filter, patient gas module | Every 2 years | Replace | Service personnel |
| 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 unit + O-ring | Every 3 years | Replace | Service personnel |
| Lead gel battery in UPS | Every 3 years | Replace | Service personnel |
| | Or when message ***BATTERY 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.

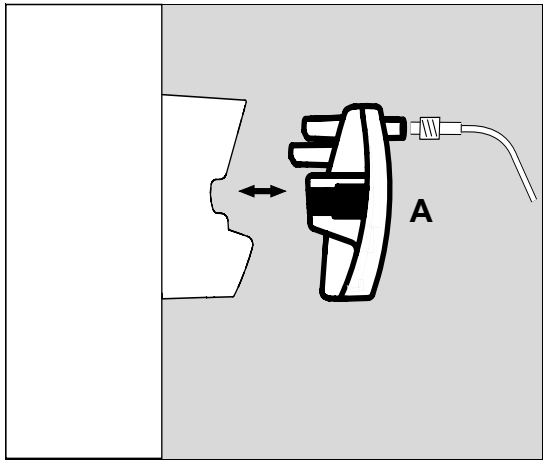
**WARNING**

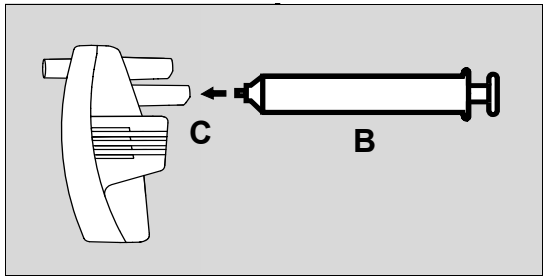
**Risk of gas measurement failure and device failure**

**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.**

## Emptying 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** Plug an empty syringe (B) (minimum volume: 20 mL) without a 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.

## 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.

For disposal of the old water trap follow the corresponding instructions for use of the water trap WaterLock and Infinity ID WaterLock 2 and comply with the hospital's hygiene requirements.

2 Push the new water trap into place until it engages.

## Replacing the $O_2$ sensor

The $O_2$ 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.

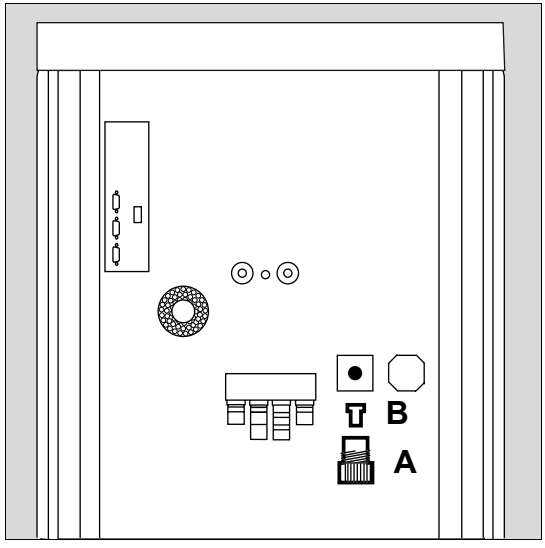
Replacement of $O_2$ sensors is not necessary in conjunction with consumption-free $O_2$ measurement (optional).

The $O_2$ sensor is located on the rear of the device.

It must be replaced if

– the message ***$O_2$ SENSOR FAIL*** is displayed or

– the sensor can no longer be calibrated.




Proceed as follows:

1 Loosen screw (A).

2 Remove the spent $O_2$ sensor (B) from the screw and insert the new $O_2$ sensor into the screw.

Screw the screw back into place.

- Dispose of the spent $O_2$ sensor, refer to the instructions for use.

# Disposal

## 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.

The following applies to the Federal Republic of Germany: end consumers are required under the Batteriegesetz [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

## General information

Units of measurement for pressure

1 hPa = 1 mbar = 1 $cmH_2O$

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 volume values 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) |
| | Battery charging: max. 35 °C (95 °F) |
| Humidity[1)] | 25 to 85 % (non-condensing) |
| 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

| | |
|---|---|
| **$O_2$ concentration** | 21 to 100 Vol% (for $N_2O$ 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)]<br>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.

| | |
|---|---|
| **$O_2$-Flush** | >35 L per minute<br>Standardized to ATPD conditions. |
| **$O_2$ safety flow** | 0 to 12 L per minute<br>Standardized to STPD conditions. |
| Accuracy | ±40 % or ±2 L per minute, the greater value applies |
| **Optional outlets** | For connecting $O_2$ flow meters and endotracheal suction.<br>Pressure corresponds to inlet pressure.<br>The outlets are not pressure monitored; this monitoring must be ensured by the connected device. |
| **Air outlet** | Maximum permitted flow: 70 L per minute<br>Standardized to STPD conditions. |
| **$O_2$ outlet** | Maximum permitted flow: 20 L per minute<br>Standardized to STPD conditions. |

## Ventilator

Electronically controlled, electrically driven piston ventilator, fresh gas decoupled

| | |
|---|---|
| Ventilation modes | ***Volume Mode***, ***Pressure Mode***, ***Volume AF Mode*** (optional), ***CPAP*** (optional) and ***Pressure Support*** (optional) |

**Settings**

**Pressure limitation *$P_{MAX}$***

| | |
|---|---|
| In ***Volume Mode*** and ***Volume AF Mode*** | (***PEEP*** +10) to 70 hPa [(***PEEP*** +10) to 70 $cmH_2O$] |
| Accuracy | ±10 % of set value or at least ±3 hPa (±3 $cmH_2O$) |

**Inspiration pressure *$P_{INSP}$***

| | |
|---|---|
| In ***Pressure Mode*** | (***PEEP*** +5) to 70 hPa [(***PEEP*** +5) to 70 $cmH_2O$] |
| Accuracy | ±10 % of set value or at least ±3 hPa (±3 $cmH_2O$) |

**tidal volume *VT* (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 ***FreqMIN*** | |
| 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 |

| | |
|---|---|
| ***TINSP*** | 0.2 to 6.7 seconds |
| Insp./Exp. ratio I:E | Derived from frequency and ***TINSP*** |
| | Range: max. 5:1 to 1:99 |
| Inspiratory pause ***TIP***:***TINSP*** | 0 to 60 % |
| Inspiratory flow | Derived from ***VT*** and ***TINSP*** |
| 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. PMAX –10 hPa)<br>[0 to 20 cmH2O (max. PMAX –10 cmH2O)] |
| In ***Pressure Mode*** and ***Pressure Support*** | 0 to 20 hPa (max. PINSP –5 hPa)<br>[0 to 20 cmH2O (max. PINSP –5 cmH2O)] |
| Accuracy | ±10 % of set value or ±2 hPa (±2 cmH2O), the greater value applies[1)] |

***ΔPPS***

| | |
|---|---|
| In ***Volume Mode***, ***Volume AF Mode*** and ***Pressure Mode*** | 3 to 50 hPa (max. ***PINSP***) [3 to 50 cmH2O (max. ***PINSP***)] |
| In ***Press. Support*** | 3 to 50 hPa (max. ***PINSP***) [3 to 50 cmH2O (max. ***PINSP***)]<br>0 to 2 hPa (0 to 2 cmH2O) = ***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/cmH2O) |
| During automatic ventilation | Typical 2.3 mL/hPa (2.3 mL/cmH2O) |

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/cm$H_2O$) |

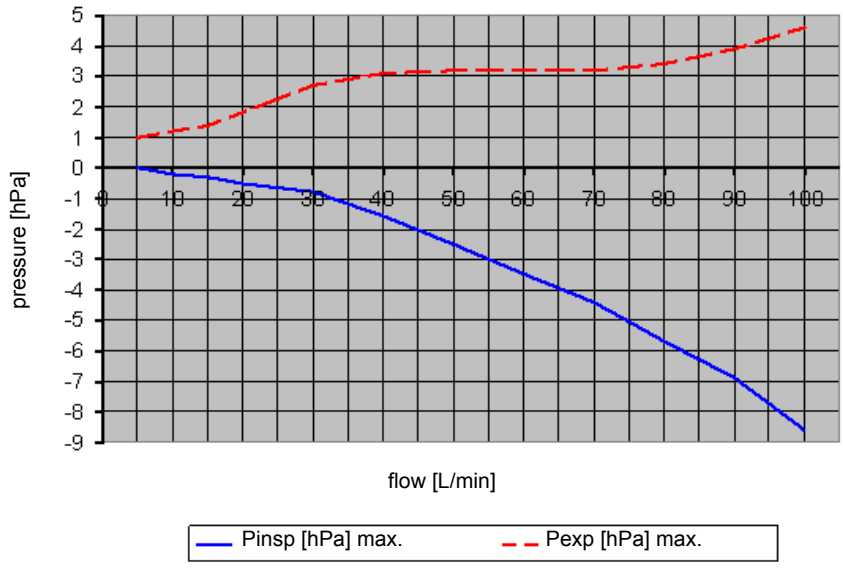
| | |
|---|---|
| **Total system leak** (as per ISO 8835-2) | <150 mL per minute at 30 hPa (30 cm$H_2O$) Standardized to BTPS conditions. |

**Pressure limitation valve APL**

| | |
|---|---|
| Setting ranges | 5 to 70 hPa (5 to 70 cm$H_2O$) |
| Accuracy, within a range of 5 to 15 L per minute | ±15 % of set value or ±3 hPa (±3 cm$H_2O$), the greater value applies |
| Pressure drop at 30 L per minute | 2.8 hPa (2.8 cm$H_2O$) (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 cm$H_2O$), with hose set for adults M30146 | –4.4 hPa (–4.4 cm$H_2O$) | 4.2 hPa (4.2 cm$H_2O$) |
| As per ISO 8835-2, dry, sole breathing system without patient hoses | –3.5 hPa (–3.5 cm$H_2O$) | 3.2 hPa (3.2 cm$H_2O$) |

**Pressure and flow characteristics of the breathing system without breathing hoses and filters (in accordance with ISO 8835-2 and ISO 80601-2-13)**

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| | |
|---|---|
| **Minimal Limited Pressure** (in accordance with ISO 8835-5 and ISO 80601-2-13) | –3 hPa (–3 $cmH_2O$) |

## **Fresh-gas outlet for non-rebreathing systems** (optional)

All values apply under STPD conditions:

| | |
|---|---|
| **Connection** | ∅ 22 mm ISO cone (male) with ∅ 15 mm ISO cone (female) |
| **Pressure limitation** | Max. 80 hPa (80 $cmH_2O$) at 18 L per minute |
| **Fresh-gas flow** | 0 and 0.2 to 18 L per minute (see fresh-gas delivery for tolerances) |

## **Flowmeter for oxygen delivery – auxiliary oxygen 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 $cmH_2O$) |
| Resolution of the displayed value | 0.1 hPa (0.1 $cmH_2O$) |
| Accuracy | ±4 % of the measured value or ±2 hPa (±2 $cmH_2O$), the greater value applies |

***PEEP*, *PEAK*, *PLAT*, *PMEAN***

| | |
|---|---|
| Measuring range | –20 to 99 hPa (–20 to 99 $cmH_2O$) |
| Resolution of the displayed value | 1 hPa (1 $cmH_2O$) |
| Accuracy | ±4 % of the measured value or ±2 hPa (±2 $cmH_2O$), the greater value applies |

**Respiratory pressure at the external fresh-gas outlet**

| | |
|---|---|
| Measuring range | –20 to 99 hPa (–20 to 99 $cmH_2O$) |
| Resolution of the measurement | 0.1 hPa (0.1 $cmH_2O$) |
| Accuracy | ±8 % of the measured value or ±3 hPa (±3 $cmH_2O$), the greater value applies |

***PEAK*, *PMEAN* at the external fresh-gas outlet**

| | |
|---|---|
| Measuring range | –20 to 99 hPa (–20 to 99 $cmH_2O$) |
| Resolution of the displayed value | 1 hPa (1 $cmH_2O$) |
| Accuracy | ±8 % of the measured value or ±3 hPa (±3 $cmH_2O$), 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), the greater value applies |

**Cylinder pressure**[1)]

| | |
|---|---|
| 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), the greater value applies |

**Pressure measurement** (optional)

**Respiratory pressure**

| | |
|---|---|
| Measuring range | –20 to 80 $cmH_2O$ |
| Resolution of the displayed value | 5 $cmH_2O$ |
| Accuracy at 60 L/min | ±5 % of measured value or ±2 $cmH_2O$, the greater value applies |

**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 *VT***

| | |
|---|---|
| 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 |

1) Valid for Silverline pressure reducers

**Delta *VT***

| | |
|---|---|
| Measuring range | 0 to 9999 mL |
| Resolution of the displayed value | 1 mL |
| Accuracy | ±16 % or ±10 mL, the greater value applies |

**Volume *VTINSP***

| | |
|---|---|
| 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 the measured value or ±0.1 L per minute, the greater value applies |

**Compliance *CPAT***

| | |
|---|---|
| Measuring range | 0 to 250 mL/hPa (0 to 250 mL/cm$H_2O$) |
| Resolution of the displayed value | 0.1 mL/hPa (0.1 mL/cm$H_2O$) |
| Accuracy | ±15 % of the measured value or ±0.5 mL/hPa (±0.5 mL/cm$H_2O$), 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 |

***$O_2$ 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*$CO_2$***

| | |
|---|---|
| Measuring range | 0 to 9999 mL per minute |
| Resolution of the displayed value | 1 mL per minute |
| Accuracy | ±20 % or ±20 mL/min; 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,<br>the lower value applies (6 to 100 per minute)<br>±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 $O_2$, $N_2O$, 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 $CO_2$ 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 $CO_2$ 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<br>±20 mL per minute | 200 mL per minute<br>±20 mL per minute |
| **Delay for sampling** (typical value; depends on sample line used) | Less than 4 seconds | Less than 4 seconds |
| **Response time $t_{10...90}$ $O_2$** | | |
| Gas measurement module using fuel cell (ambient temperature ≥20 °C) | Less than 650 ms | Less than 650 ms |
| Gas measuring module with consumption-free $O_2$ measuring | Not applicable | Less than 500 ms |
| **Response time $t_{10...90}$ $CO_2$** | Less than 500 ms | Less than 350 ms |
| **Response time $t_{10...90}$ anesthetic gas** | Less than 500 ms | Less than 500 ms |
| **Response time $t_{10...90}$ $N_2O$** | Less than 500 ms | Less than 500 ms |
| **$O_2$ measurement – electrochemical** (fuel cell) | | |
| **Measuring range** | 5 to 100 Vol% | |
| **Resolution of the measurement** | 0.1 Vol% | |
| **Resolution of the displayed value (for insp. $O_2$, exp. $O_2$)** | 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% | |

1) The respective value depends on the PGM used which is displayed on System Information page.

**$O_2$ measurement – paramagnetic** (consumption-free)

| | |
|---|---|
| **Measuring range** | 0 to 100 Vol% |
| **Resolution of the measurement** | 0.1 Vol% |
| **Resolution of the displayed value (for insp. $O_2$, exp. $O_2$)** | 1 Vol% |
| **Accuracy** | ±(2.5 Vol% +2.5 % rel.) |

**$CO_2$ measurement** (infrared spectrometry)

| | |
|---|---|
| **Measuring range** | 0 to 13.6 Vol%<br>0 to 13.6 kPa<br>0 to 102 mmHg<br>(at an ambient pressure of 1013 hPa / 760 mmHg) |
| **Resolution of the measurement** | 1 mmHg |
| **Resolution of the displayed value (for et$CO_2$, in$CO_2$)** | 1 mmHg |
| **Accuracy** | ±(0.43 Vol% +8 % rel.)<br>±(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[1)] | 0 to 20 Vol% |
| Resolution of the measurement | 0.1 Vol% |
| Resolution of the displayed value (for insp. and exp.) anesthetic gas) | 0.1 Vol% |
| Accuracy[1)] | ±(0.2 Vol% +15 % rel.) |

1) At respiratory rates up to 60 per minute and an insp./exp. ratio of 1:1.

| | |
|---|---|
| **Measuring range $N_2O$** | 0 to 100 Vol% |
| Resolution of the measurement | 0.1 Vol% |
| Resolution of the displayed value (for insp. and exp. $N_2O$) | 1 Vol% |
| Accuracy | ±(2 Vol% + 8 % rel.) |
| **MAC (xMAC)** | |
| Measuring range | 0 to 9.9 |
| Resolution of the displayed value | 0.1 |
| Accuracy | Derived value from gas measurement values |
| **Anesthetic agent detection** | Automatic |
| Primary agent | Min. 0.3 Vol% (typically 0.15 Vol%) |
| Secondary agent | At the latest: at 0.4 Vol%[1)], becomes primary agent if expiratory xMAC is more than 0.2 MAC above the former primary agent |
| **Cross sensitivity** | None referring to alcohol (<3000 ppm), acetone (<1000 ppm), methane, water vapor, NO, and CO |
| **Drift of measurement accuracy** | Compensated by cyclic zeroing. Zeroing is performed automatically and with ambient air. This means there is minimal change to the gas concentrations in the breathing circuit. |
| **Zeroing interval** | |
| Devices with $O_2$ sensor cells | 8 hours |
| Devices with paramagnetic $O_2$ measurement[2)] | 24 hours 2 hours |
| Maximum time until emptying of the water trap is necessary | 41 h (sample gas under BTPS conditions, at 23 °C ambient temperature) |

1) Exception: At a Desflurane concentration of more than 4 Vol% a mixture will be detected at the latest when the concentration of the second anesthetic gas increases to over 10 % of the Desflurane concentration.
2) The respective value depends on the PGM used which is displayed on System Information page.

**Consumption measurement**

| | |
|---|---|
| **Fresh-gas consumption per case** | 0 to 9999 L per gas ($O_2$, $N_2O$, AIR; only fresh gas applied by the gas mixer is taken into account) |
| Accuracy | ±10 % or ±1 L, the greater value applies |
| Resolution | 1 L |
| **Total anesthetic gas consumption per case (liquid)** | 0 to 3000 mL per agent (Halothane, Isoflurane, Enflurane, Sevoflurane, Desflurane) |
| Accuracy | Typically ±25 % or ±2 mL, the greater value applies |
| Resolution | 1 mL |
| **Agent consumption due to patient uptake per case (liquid)** | 0 to 3000 mL per agent (Halothane, Isoflurane, Enflurane, Sevoflurane, Desflurane) |
| Accuracy | Typically ±25 % or ±2 mL, the greater value applies |
| Resolution | 1 mL |
| **Soda lime consumption** | 0 to 1000 L (pure gas $CO_2$) |
| Accuracy | Typically ±30 % or ±15 L, the greater value applies |
| Resolution of limit setting | 10 L |

**$SpO_2$ measurement – light absorption** (optional)

The displayed plethysmogram is a relative indicator of the pulse amplitude. Its scale is not absolute and can only be used to judge the quality of the $SpO_2$ measurement.

| | |
|---|---|
| **Measuring range $SpO_2$** | 1 to 100 % |
| Resolution of the displayed value | 1 % |
| Accuracy | Depending on the sensor model, applies for DS-100 A |
| Adults | |
| Within a range of 70 to 100 % $SpO_2$ | ±3 % |
| Neonates | |
| Within a range of 70 to 100 % $SpO_2$ | ±4 % |

| | |
|---|---|
| **Actualization time** | Once per pulse |
| **Pulse rate** | 20 to 250 per minute |
| Resolution of the displayed value | 1 per minute |
| Accuracy | ±3 per minute |

**Sensors**

| | |
|---|---|
| Type | Nellcor sensors with OxiMax technology |
| Wavelengths | 660 nm (red)<br>920 nm (infrared) |
| Light energy | Infrared 1.5 to 4 mW<br>Standard red 0.8 to 3 mW |
| Acoustic pulse signal | A tone is generated for each pulse detected. The pitch of the tone is proportional to the oxygen saturation: increasing saturation raises the pitch. |
| Pitch of tone | The pitch of the tone is according to Nellcor specifications. |

## Interfaces

2 serial interfaces: COM 1 and COM 2

**COM 1 and COM 2**

| | |
|---|---|
| Protocol | MEDIBUS, MEDIBUS.X[1)] (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.

1) System alarm delay time = 600 ms (typical value).

| | |
|---|---|
| Pin assignment: | |
| 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 |
| **$SpO_2$** | For connecting an $SpO_2$ sensor |

## Operating data

| | |
|---|---|
| **Operating voltage** | 100 to 240 V~, 50/60 Hz, 12.8 A max. |

**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<br>Sealed, maintenance-free |
| 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<br>(to reach full power) | At least 10 hours |
| Charging power | Maximum 70 W |

**Auxiliary power outlets**

2 outlets with automatic circuit breakers rated at 3 A each;
1 connection for Desflurane vaporizer with two fuses rated 2 A each and one automatic circuit breaker rated 4 A

**Connection for optional halogen light**

12 V max. 20 W

**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<br>(39 psi to 100 psi) |
| Short-term peak inlet flows | approx. 55 L/min,<br>approx. 18 L/min, averaged over 10 s |
| Scavenging flow for anesthetic gas receiving 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 pore size <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:

| | |
|---|---|
| $Lp_{min}$ (Standby) | ≤35 dB(A) |
| $Lp_{max}$ ("Peak" during ventilation) | ≤46 dB(A) |
| Leq (5 cycles) | ≤42 dB(A) |

**Dimensions**[1] (W x H x D)

| | |
|---|---|
| Primus *Infinity Empowered* | 80 cm x 138 cm x 80 cm (31.5 in x 54.3 in x 31.5 in) |
| Primus *Infinity Empowered* ceiling/wall device | 64 cm x 103 cm x 54 cm (25.2 in x 40.6 in x 21.3 in) |
| Top shelf (W x D) | Max. 61 cm x max. 47 cm (max. 24.0 in x max. 18.5 in) |
| Top shelf (W x D) ceiling/wall device | Max. 61 cm x max. 26 cm (max. 24.0 in x max. 10.2 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) |

**Weight**[1] (ready for operation without vaporizers and reserve gas cylinders)

| | |
|---|---|
| Primus *Infinity Empowered* | 147 kg (324 lbs) |
| Primus *Infinity Empowered* ceiling/wall device | 118 kg (260.1 lbs) |
| Breathing system without soda lime | 4.4 kg (9.7 lbs) |

**weight**

| | |
|---|---|
| Nominal configuration<br>Floor unit:<br>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)) | Approx. 150 kg (331 lbs) |
| 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<br>Ceiling/wall device:<br>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)) | Approx. 120 kg (265 lbs) |
| 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) |

| | |
|---|---|
| **Screen** | Flat screen, color, TFT,<br>12.1" screen diagonal, 800 x 600 pixels |
| **Life span** | 10 years |

**Infinity ID wireless accessory detection system**

RFID as per ISO 15693

| | |
|---|---|
| Operating frequency | 13.56 MHz |
| Radio frequency transmitting power | 200 mW ±1 dB |

**Protection class**

| | |
|---|---|
| Workstation | I, as per IEC 60601-1 |
| IP class as per IEC 60529 | IPX0 |
| $SpO_2$ sensor<br>(breathing system nozzles) | Type BF  electrically isolated from protective conductor |

1) Deviations possible depending on the configuration.

| | |
|---|---|
| **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 devices | 10-134 |
| **GMDN code** | |
| Global Medical Device Nomenclature – global nomenclature for medical devices | 37710 |

## Use of latex

Primus *Infinity Empowered* is not made with natural rubber latex.

## Relevant standards

In addition to the standards listed here, ther medical device also complies with various other standards, e.g., standards concerning special national requirements.

| | |
|---|---|
| IEC 60601-1 2nd ed.<br>Medical electrical equipment | Part 1:<br>Requirements for safety |
| IEC 60601-1-2<br>Medical electrical equipment | Part 1-2:<br>General requirements for safety<br>Collateral standard: Electromagnetic compatibility; Requirements and tests |
| IEC 60601-1-8<br>Medical electrical equipment | Part 1-8:<br>General requirements for safety<br>Collateral standard: General requirements, tests and guidance for alarm systems in medical electrical systems |
| IEC 60601-2-13<br>Medical electrical equipment | Part 2-13:<br>Particular requirements for the safety of anaesthetic systems |
| ISO 8835-2<br>Systems for inhalational anaesthesia | Part 2:<br>Anaesthetic breathing systems |
| ISO 8835-3<br>Systems for inhalational anaesthesia | Part 3:<br>Transfer and receiving systems of active anaesthetic gas scavenging systems |
| ISO 8835-4 | Part 4:<br>Anaesthetic vapour delivery devices |
| ISO 8835-5<br>Systems for inhalational anaesthesia | Part 5:<br>Anaesthetic ventilators |
| ISO 9919<br>Medical electrical equipment | Particular requirements for basic safety and essential performance of pulse oximeter equipment for medical use |
| ISO 21647<br>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.<br>Medical electrical equipment | Part 1:<br>General requirements for basic safety and essential performance |
| IEC 60601-1-2<br>Medical electrical equipment | Part 1-2:<br>General requirements for safety<br>Collateral standard: Electromagnetic compatibility; Requirements and tests |

| | |
|---|---|
| IEC 60601-1-8 | Part 1-8:<br>General requirements for safety including essential performance characteristics<br>Collateral standard: Alarm systems; General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems |
| ISO 80601-2-13<br>Medical electrical equipment | Part 2-13:<br>Particular requirements for basic safety and essential performance of an anaesthetic workstation |
| ISO 80601-2-55 | Part 2-55:<br>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<br>Air discharge: ±8 kV | ±6 kV<br>±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<br>Longer input lines/ output lines: ±1 kV | ±2 kV<br>±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<br>Differential mode: ±1 kV | ±2 kV<br>±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<br>Dip 60 %, 5 periods<br>Dip 30 %, 25 periods<br>Dip >95 %, 5 seconds | >95 %, 0.5 periods<br>60 %, 5 periods<br>30 %, 25 periods<br>>95 %, 5 seconds | 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. |

| **Immunity against** | **IEC 60601-1-2 test level** | **Compliance level (medical device)** | **Electromagnetic environment** |
|---|---|---|---|
| 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 $P_{EIRP}$ to the medical device including its lines:<br>(1.84 m x $\sqrt{P_{EIRP}/W}$)[1)]<br>(6.04 ft x $\sqrt{P_{EIRP}/W}$)[1)] |
| RFcoupled into lines (IEC 61000-4-6) | 150 kHz to 80 MHz: 10 V inside ISM bands [2)]<br>150 kHz to 80 MHz: 3 V outside ISM bands [2)] | 10 V<br>3 V | Recommended minimum distance to portable and mobile radio frequency transmitters with transmission power $P_{EIRP}$ to the medical device including its lines:<br>(1.84 m x $\sqrt{P_{EIRP}/W}$)[1)]<br>(6.04 ft x $\sqrt{P_{EIRP}/W}$)[1)] |

1) For $P_{EIRP}$, 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.

| Max. 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., RS-232, 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:

– RS-232 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

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These instructions for use only apply to **Primus *Infinity Empowered* 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.

CE 0123
Directive 93/42/EEC
concerning Medical Products

CE 0678
Directive 1999/5/EC
concerning radio equipment and telecommunications terminal equipment


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Dräger reserves the right to make modifications to the device without prior notice.


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As of 2015-08:
Dräger Medical GmbH
changes to
**Drägerwerk AG & Co. KGaA**