

**Dräger**

# Atlan A100 (XL), A300 (XL), A350 (XL)

Anesthesia workstation

Software 2.1n



## Instructions for use

### WARNING

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

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# 1

## Information about this document

### 1.1

#### Typographical conventions

- Text** Bold, italicized text indicates labels on the device and screen text.
1. Numbers with a period indicate the individual steps within a process sequence. The numbering for each new process sequence starts once more at number 1.
    - a. Lower-case letters with a period indicate secondary steps. The lettering for each new higher-level step starts once more with the letter a.
    - This bullet point indicates individual steps without any specific order.
    - This triangle in safety instructions and precautionary statements indicates the options for avoiding danger.
  - (1) Numbers in parentheses refer to elements in illustrations.
  - 1** Numbers in illustrations denote elements referred to in the text.
  - Dashes indicate listings.
  - > The greater-than symbol indicates the navigation path in a dialog.
-  This symbol indicates information that will facilitate the use of the product.

### 1.2

#### Use of terms

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

### 1.3

#### Illustrations

Illustrations of products and screen content in this document may differ from the actual products depending on configuration and design.

### 1.4

#### Main devices and options

All available main devices and options are described in this document. Observe the equipment that is applicable for the present device. For further information see: "Main devices and options", page 37.

## 1.5 Trademarks

### 1.5.1 Trademarks owned by Dräger

Trademark
Atlan®
AutoFlow®
Infinity®
D-Vapor®
Drägersorb®
MEDIBUS®
ServiceConnect®
WaterLock®

The following web page provides a list of the countries in which the trademarks are registered: [www.draeger.com/trademarks](http://www.draeger.com/trademarks)

### 1.5.2 Trademarks owned by third-party manufacturers

Trademark	Trademark owner
Selectatec®	Datex-Ohmeda

## 2

# Safety-related information

### 2.1

## Intended use

This device is intended for use in anesthetizing adults, pediatric patients, and neonates. The device can be used for mechanical ventilation, manual ventilation, pressure-supported spontaneous breathing, and spontaneous breathing.

The device is equipped with the following basic functions:

- Ventilation monitoring
- Inspiratory O<sub>2</sub> measurement
- Device monitoring
- Anesthetic gas receiving system

The following options are additionally available:

- Patient-gas measurement module for O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic gases
- O<sub>2</sub> insufflation

Anesthesia is achieved through a mixture of pure oxygen and Air (medical compressed air) or pure oxygen and nitrous oxide, with the addition of volatile anesthetic agents.

Ventilation is accomplished on the patient through a laryngeal mask, a breathing mask, or an endotracheal tube.

The integrated breathing system can be used with partial rebreathing (low-flow or minimum-flow).

A non-rebreathing system, such as the Bain, Mapleson, Kuhn, or Waters system, may be used at the external fresh-gas outlet.

### 2.2

## Indications

The device is specified for inhalational anesthesia and/or patient ventilation in accordance with the intended use during surgical or diagnostic interventions.

### 2.3

## Contraindications

The device has no product-specific contraindications.

It is the responsibility of the user to select the appropriate treatment for the patient's underlying disease. The patient's condition must be continually monitored for any potential changes.

The safety information must be observed for patients suspected of malignant hyperthermia, patients with ketoacidosis, and patients who are under the influence of alcohol. Observe the following information: "Therapy with known pre-existing conditions", page 139.

 The device administers medical gases such as O<sub>2</sub>, N<sub>2</sub>O, Air (medical compressed air), and volatile anesthetic agents (halothane, enflurane, isoflurane, sevoflurane, desflurane). For contraindications to the applied medical gases, strictly follow the instructions for use of the medical gases.

## 2.4

### Application-specific safety aspects in general anesthesia

The anesthesia workstation may only be used by persons who are familiar with the medical procedures of general anesthesia and anesthesia ventilation.

Users of this device must be aware of the clinical risks and side effects of general anesthesia and anesthesia ventilation.

Users must have particular knowledge of the following effects, side effects, and complications and be in a position to respond to these appropriately:

- Respiratory problems, including those involving various artificial airways (e.g., obstruction, dislocation)
- Side effects of mechanical ventilation, including oxygen therapy (e.g., pulmonary complications, cardiovascular depression)
- Interindividual and intraindividual variability in the effect and potential side effects of the anesthetic agents administered, depending on:
  - Dosage
  - Underlying and accompanying diseases
  - General condition of the patient
  - Demographic and other patient-specific factors

## 2.5

### Environments of use

The device is designed for use in rooms in which therapeutic or diagnostic interventions can be performed under constant supervision of users. According to IEC 60601-1-2, use of the device is only permissible in health-care facilities with a class A electromagnetic environment.

Do **not** use the device in the following environments:

- Outside buildings
- On intensive care units
- During patient transport
- In vehicles, airplanes, helicopters, and on ships
- In areas where oxygen concentrations above 25 Vol% or combustible or explosive gas mixtures can occur.
- In rooms with magnetic field applications (e.g., magnetic resonance imaging)

## 2.6

### Essential performance features

Correct functioning of the essential performance features ensures that the product can be used in accordance with its intended use. The product has the following essential performance features:

#### General

- Supply of the anesthesia workstation with O<sub>2</sub>:  
If the O<sub>2</sub> supply (central gas 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<sub>2</sub>, an alarm is issued.

- Supply of an adequate anesthetic gas concentration to the patient:  
When the anesthetic gas is measured by means of an integrated patient-gas measurement module, an alarm will be generated if the anesthetic gas concentrations are too high.
- Monitoring of the airway pressure:  
Alarms are issued depending on the set alarm limits.

#### **Gas measurement**

- Breathing gas monitoring:
  - Inspiratory O<sub>2</sub> concentration FiO<sub>2</sub>
  - Inspiratory and expiratory measured values for O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic gas as well as automatic anesthetic agent identification (only with the patient-gas measurement module)The gas composition is measured with ISO accuracy.
- Monitoring of breathing gas concentrations:  
Alarms will be issued depending on the set alarm limits or if the gas measurement fails.

## **2.7 User group requirements**

The term "user group" describes the personnel responsible who have been assigned by the operating organization to perform a particular task on a product.

### **2.7.1 Duties of the operating organization**

The operating organization must ensure the following:

- Every user group has the required qualifications (e.g., has undergone specialist training or acquired specialist knowledge through experience).
- Every user group has been trained to perform the task.
- Every user group has read and understood the relevant chapters in this document.

### **2.7.2 User groups**

#### **Clinical users**

This user group operates the product in accordance with the intended use.

Users have medical specialist knowledge in the field of anesthesia. Users have knowledge of device monitoring and perioperative care.

#### **Reprocessing personnel**

This user group carries out the necessary activities to reprocess the product.

Reprocessing personnel has specialist knowledge in the reprocessing of medical devices.

#### **Service personnel**

This user group installs the product and performs the service activities.

Service personnel has specialist knowledge in electrical and mechanical engineering and experience in the servicing of medical devices.

Where product specific knowledge or tools are required, the service activities must be performed by specialized service personnel. The specialized service personnel was trained by Dräger for these service activities on this product.

## 2.8 Information on safety instructions and precautionary statements

Safety instructions and precautionary statements warn of risks and give instructions for the safe use of the product. Failure to observe them may lead to personal injury or property damage.

### 2.8.1 Safety instructions

This document contains sections with safety instructions which warn of risks. The type of risk and the consequences of non-compliance are described in each safety instruction.

### 2.8.2 Precautionary statements

Precautionary statements relate to action steps and warn of risks that may arise when performing the action steps. Precautionary statements precede the action steps.

The following warning signs and signal words indicate precautionary statements and differentiate the possible consequences of non-compliance.

Warning sign	Signal word	Consequences of non-compliance
	WARNING	May result in death or serious injury.
	CAUTION	May result in moderate or minor injury.
	NOTICE	May result in property damage.

## 2.9 Safety instructions

### 2.9.1 Instructions for use

Personal injury and property damage may arise if this product is used contrary to the information in these instructions for use.

- ▶ Follow these instructions for use.
- ▶ Only use this product in accordance with its intended use.
- ▶ Keep these instructions for use in an accessible location. Make sure that the instructions for use are compatible with the device software.
- ▶ Follow the instructions for use of all the products that are used with this product.

These instructions for use do not provide any information on the following:

- Risks that are obvious to the user
- Consequences of foreseeable misuse of the product
- Possible negative effects on patients with one or more diseases

## 2.9.2

### Symbols and product labels

Failure to observe symbols and product labels may result in personal injury and property damage.

- Observe the symbols and product labels.

## 2.9.3

### Monitoring the patient's condition

Monitoring of a patient's condition can range from direct observation to electronic monitoring by means of medical devices. The patient may be put at risk if his or her condition is not adequately monitored.

- Monitor the patient's condition by suitable means and at appropriate intervals.

N<sub>2</sub>O, O<sub>2</sub>, CO<sub>2</sub> and, where necessary, anesthetic gases must be monitored when patients are ventilated. If no monitoring is available or the sensors are not ready for operation, the patient will not be adequately monitored and may be put at risk.

- Provide for suitable monitoring of O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic gases in accordance with ISO 80601-2-55.
- Provide for suitable substitute monitoring in the event of a fault.

If substitute monitoring is used, the integrated monitoring may still draw in ambient air. This may result in lower gas concentrations in the breathing gas than the set values. As a result, the patient could be put at risk.

- Monitor the patient's condition by suitable means and at appropriate intervals.
- Increase the fresh-gas flow if necessary.

## 2.9.4

### Accessories and components

#### Compatible accessories

The use of faulty or incompatible accessories may compromise the functional integrity of the product. Personal injury and property damage may occur as a consequence.

- Use only compatible accessories. The accessories that are compatible with this product are listed in the list of accessories supplied with the product.
- Use only accessories that are in good working order.

### Instructions for use for accessories

If accessories or connected devices are used contrary to the information in the associated instructions for use, this may lead to user errors, incorrect use, or incorrect reprocessing. Personal injury and property damage may occur as a consequence.

- ▶ Follow the instructions for use for all accessories, e.g.:
  - Water traps
  - Flow sensors
  - CLIC adapter
  - CLIC absorber
  - Soda lime
  - Breathing hoses
  - Masks
  - Filter
  - Bronchial suction
  - Vaporizer
  - Manual resuscitator
  - AGSS terminal unit

## 2.9.5

### Color codes and labels

#### Arrangement and display of gases

In some countries, the arrangement and display of the gases on the gas mixer and on the screen may deviate from the illustrations shown in this document.

- ▶ Always pay attention to the respective color codes and labels.

## 2.9.6

### Device

#### Penetrating liquid

Penetrating liquid may cause the following:

- Damage to the device
- Electric shock
- Device malfunctions

Personal injury and property damage may occur as a consequence.

- ▶ Ensure that no liquid, e.g., disinfectant, penetrates the device.
- ▶ Do not place any containers containing liquids above or on the device.
- ▶ Do not transport infusion bags or other containers with liquids with the device.
- ▶ If the device was exposed to moisture or liquids during transport, wipe it/them off after transport. Before connecting the device to the power supply, ensure sufficient drying time.
- ▶ Only use the device on level surfaces without inclination.

### **Housing**

Under the housing, there are live electrical components, which may cause an electric shock.

- The housing may only be opened by user groups that are assigned to the specific activity.

### **2.9.7**

### **Service**

If service activities are not performed regularly or properly, malfunctions may occur that can result in personal injury and property damage.

- Perform the service in accordance with the chapter "Service".

### **2.9.8**

### **Reprocessing**

Reusable products must be reprocessed, otherwise there is an increased risk of infection.

- Reprocess the device and the reusable products prior to their first use and each further use.
- Perform the reprocessing in accordance with the reprocessing instructions supplied with the product.

Incorrect reprocessing can lead to cross-infection.

- Clean and disinfect the workstation in accordance with the infection prevention policy of the health-care facility.
- Observe the reprocessing intervals and the reprocessing instructions supplied with the device.

### **2.9.9**

### **Modifications to the product**

Modifications to the product may lead to malfunctions and unforeseen risks. This may result in injury to the patient or the user or in property damage.

- Do not modify this product.

### **2.9.10**

### **Electromagnetic compatibility (EMC)**

Medical electrical equipment is subject to special precautionary measures concerning electromagnetic compatibility. During installation and before initial operation, follow the information in section: "EMC declaration" (page 299).

### **Electrostatic discharge**

Measures to protect from electrostatic discharge must be adhered to when handling components carrying the ESD warning symbol. Otherwise, malfunctions may occur which could put the patient at risk.

To prevent malfunctions, observe the following measures and train the relevant personnel:

- ▶ Observe the ESD protective measures, e.g.:
  - Wear antistatic clothes and shoes.
  - Use gloves that are electrically insulating and antistatic.
  - When establishing connections, touch a potential equalization pin.
- ▶ Observe the requirements for the electromagnetic environment. Observe the following section: "Electromagnetic environment" (page 299).

### **Electromagnetic disturbances**

Wireless communication devices (e.g., cellular phones) and medical electrical equipment (e.g., defibrillators, electrosurgical devices) emit electromagnetic radiation. When such devices are operated too close to this device or its cables, the functional integrity of this device may be compromised by electromagnetic disturbances. As a result, the patient could be put at risk.

- ▶ Maintain a distance of at least 0.3 m (1.0 ft) between this device and wireless communication devices, to ensure that the essential performance of this device is fulfilled.
- ▶ Maintain an adequate distance between this device and other medical electrical equipment.

Magnetic fields can adversely affect the functional integrity of the medical device and thus put the patient or user at risk.

- ▶ Do not use the medical device in rooms where devices for magnetic field applications are used (e.g., magnetic resonance imaging).

The medical device meets the applicable limit values for electromagnetic fields. The functioning of pacemakers can nevertheless be impaired by emissions.

- ▶ All wearers of pacemakers should maintain a distance of at least 25 cm (10 in) between pacemaker and medical device.

## **2.9.11**

### **Network security**

#### **Data interfaces**

The prohibited use of data interfaces can lead to new dangers.

- ▶ Only establish connections with data interfaces if permission has been granted by the IT representatives and device owners of the health-care facility appointed by the operating organization.
- ▶ Observe the following information: "IT networks and cybersecurity", page 301.

Unauthorized access to the device can impair the device function.

- ▶ The LAN interface may only be used by specialized service personnel. Authentication and a secure connection protocol are required. The data is transmitted in encrypted form.

## Structure of a network

The use of the data interfaces establishes a network with the connected device and, if necessary, also with other devices. This may place the data security and functional reliability at risk. Personal injury and property damage may occur as a consequence.

- Before activating an interface, the operating organization must assess the data security and functional security risks.

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 connecting the device to the network or changing the network, the IT representatives and the device owner at the health-care facility must ensure the following:

- The risks must be identified, analyzed, and assessed.
- Appropriate actions must be taken.

## Functional impairment of the device

If, in the event of an error, the startup screen shows that the device is not suitable for clinical use (***Not for clinical use***), the device may no longer be used.

- Turn off the device. Contact specialized service personnel.

Unauthorized access to the device can impair the device function.

- The operating organization must ensure that external service providers for Dräger devices adequately protect their service assets (e.g., service software, installation files) against unauthorized access or manipulation. Protection is provided, for example, by encrypting hard disks or physically protecting computers with service software.
- The operating organization must ensure that the remote service running on a server-based service infrastructure (e.g., SCG) accepts only authenticated remote desktop connections from other computers.

## Security events

Security events may require immediate action or cause messages in the corresponding logs of the device. These security events may result in risks to patients, users and third parties.

The following provides examples of possible security events:

- Failed authentication events
- Software installation events
- Configuration events
- Network anomalies
- Inform the health-care facility's IT representatives or the device owner.
- Observe the following information: "Security events", page 307.

## **2.10 Further information**

### **2.10.1 Use of Infinity ID components**

Ownership or purchase of a medical device with RFID technology only includes the right to use the medical device and RFID technology in conjunction with products approved by Dräger and in strict compliance with these instructions for use. No intellectual property rights or any rights to the use of the medical device or RFID technology are hereby granted, either explicitly or implicitly, which are contrary to the above-mentioned conditions.

### **2.10.2 Mandatory reporting of incidents**

Serious incidents with this product must be reported to Dräger and the responsible authorities.

### **2.10.3 Training**

Training for users is available via the Dräger organization responsible (see [www.draeger.com](http://www.draeger.com)).

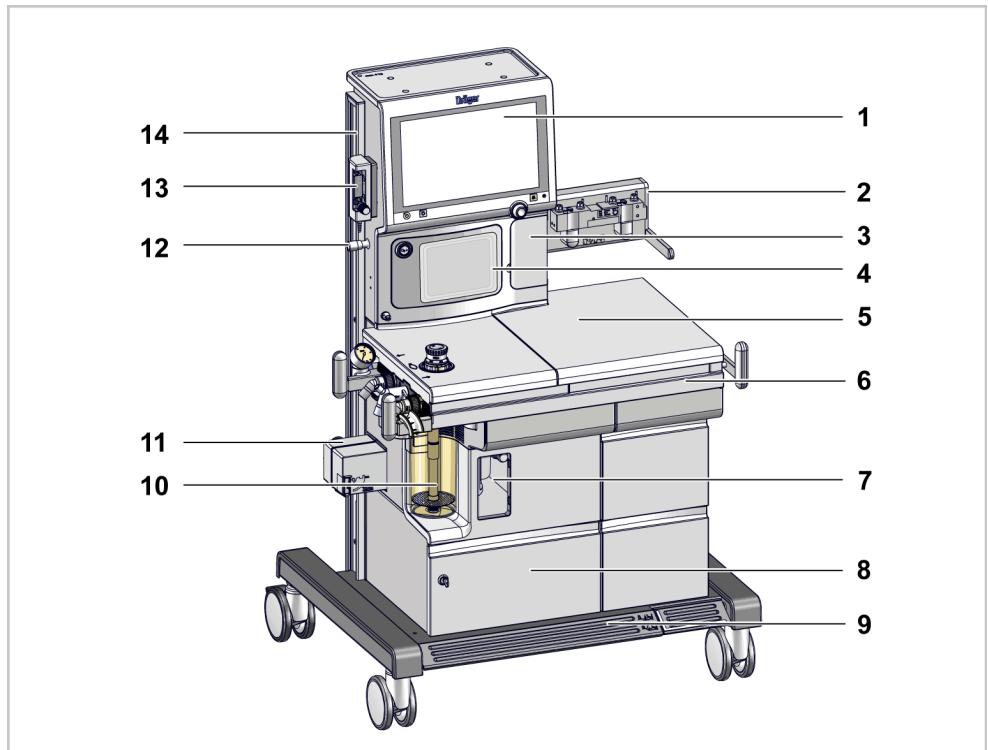
### 3 Overview

#### 3.1 Hardware

Some equipment items and device functions are available as an option. Not all equipment is available worldwide for all main devices.

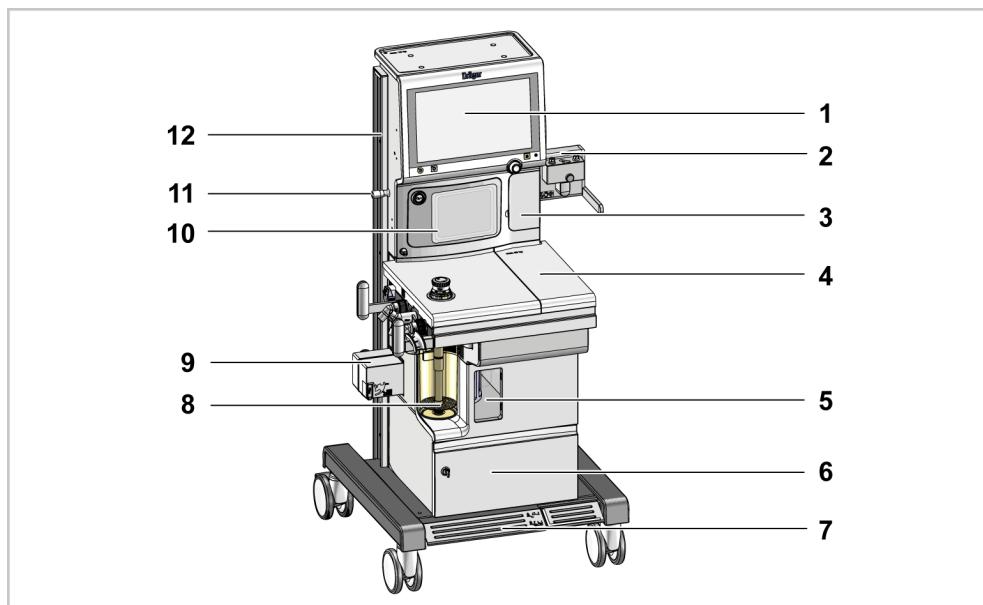
##### 3.1.1 Front

###### 3.1.1.1 Large version (XL)



No.	Designation	Description
1	Screen	Enables user inputs by touchscreen and rotary knob.
2	Plug-in connectors for vaporizers	Enable the connection of 1 or 2 vaporizers.
3	Backup manual switch (behind the flap)	Used to switch to backup manual mode in the event of malfunctions of the device.
4	Gas mixing unit	Produces a gas mixture from the selected gases (e.g., O <sub>2</sub> and Air).
5	Work surface	Used for storage.
6	Pull-out writing tray	Provides additional work surface.
7	Viewing window for piston ventilator	Allows visual checking of the movement of the piston ventilator.
8	Lockable drawer	Provides additional storage space.
9	Trolley with castors and cable deflectors	Used for moving the device. The central brake locks the two front castors.

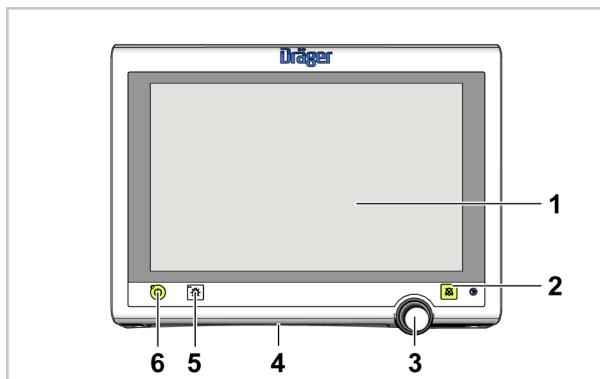
No.	Designation	Description
10	CO <sub>2</sub> absorber	Absorbs CO <sub>2</sub> from the patient's expiratory gas.
11	Anesthetic gas receiving system	Used for scavenging excess anesthetic gas and breathing gas. Used to reduce the anesthetic gas concentration released into the environment by the anesthesia machine and to scavenge the sample gases from an external anesthetic gas monitor.
12	External fresh-gas outlet	Gas outlet for a mixture of fresh gas and anesthetic gas which is fed to a non-rebreathing system.
13	External O <sub>2</sub> flowmeter	Supplies oxygen for O <sub>2</sub> insufflation.
14	Rail	Used for fastening additional components.

**3.1.1.2****Compact version**

No.	Designation	Description
1	Screen	Enables user inputs by touchscreen and rotary knob.
2	Plug-in connectors for vaporizers	Enable the connection of 1 or 2 vaporizers.
3	Backup manual switch (behind the flap)	Used to switch to backup manual mode in the event of malfunctions of the device.
4	Work surface	Used for storage.
5	Viewing window for piston ventilator	Allows visual checking of the movement of the piston ventilator.
6	Lockable drawer	Provides additional storage space.
7	Trolley with castors and cable deflectors	Used for moving the device. The central brake locks the two front castors.

No.	Designation	Description
8	CO <sub>2</sub> absorber	Absorbs CO <sub>2</sub> from the patient's expiratory gas.
9	Anesthetic gas receiving system	Used for scavenging excess anesthetic gas and breathing gas. Used to reduce the anesthetic gas concentration released into the environment by the anesthesia machine and to scavenge the sample gases from an external anesthetic gas monitor.
10	Gas mixing unit	Produces a gas mixture from the selected gases (e.g., O <sub>2</sub> and Air).
11	External fresh-gas outlet	Gas outlet for a mixture of fresh gas and anesthetic gas which is fed to a non-rebreathing system.
12	Rail	Used for fastening additional components.

### 3.1.2 Screen



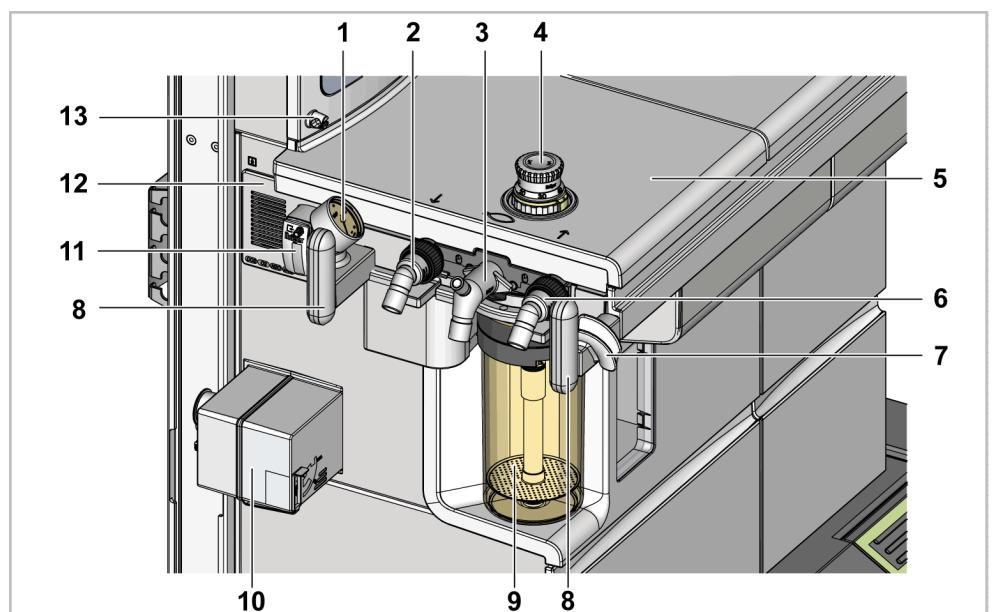
36441

No.	Designation	Description
1	Touchscreen	Calls up functions or dialogs when touched.
2	Alarm silence key	Suppresses the alarm tones of all active alarms for 2 minutes.
3	Rotary knob	Used for selecting, adjusting, and confirming settings. Lights up in color in certain situations.
4	Working light	Illuminates the work surface.
5	key	Turns the working light on or off. Dims the illuminance in 3 steps (dark, medium, and bright).
6	key	Turns the device on or off.

### 3.1.3 Breathing system and other components

#### 3.1.3.1 Overview

The following illustration shows the device and the breathing system.



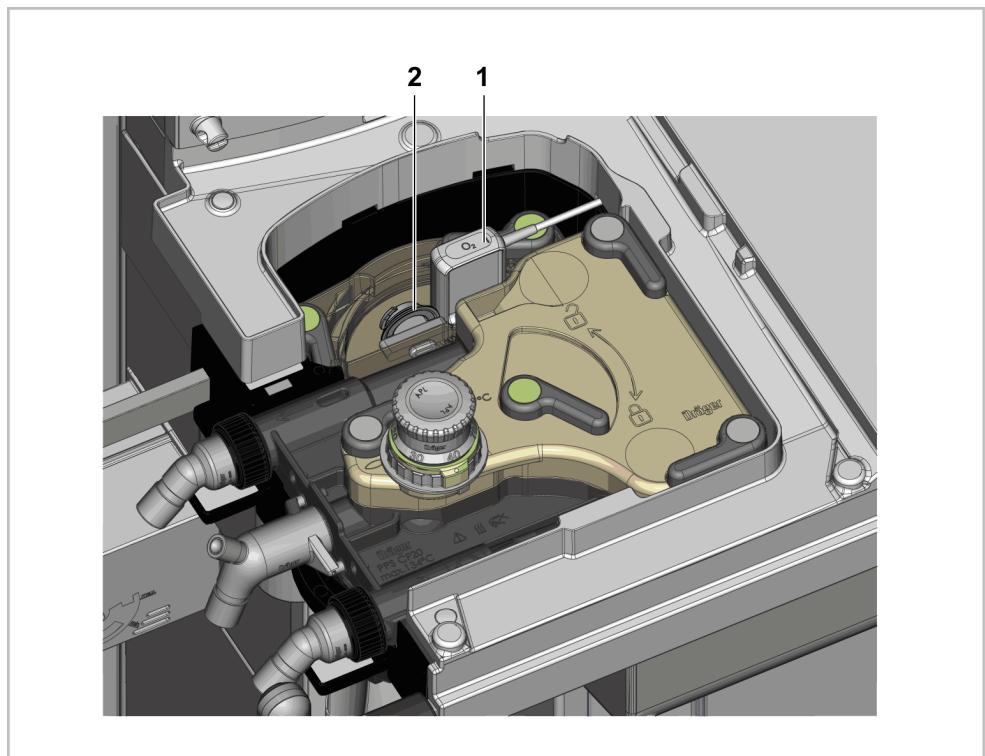
No.	Designation	Description
1	Airway pressure gauge	Mechanically measures the airway pressure and displays it on an analog indicator.
2	Inspiratory port	Used to connect the inspiratory hose to the device.
3	Bag elbow with circuit plug	Used to connect the breathing bag hose. The circuit plug is used to seal the Y-piece during an automatic test.
4	APL valve	In the <b>Man/Spon</b> mode: Limits the maximum airway pressure to the set value (during manual ventilation: <b>Man</b> ) or enables spontaneous breathing when set to <b>Spong</b> .
5	Breathing system cover	Protects the breathing system underneath and provides climate control for the breathing system.
6	Expiratory port	Used to connect the expiratory hose to the device.
7	Holder	Used for parking the breathing bag hose.
8	Handles	Used for positioning the device and for stowing used breathing hoses.
9	CO <sub>2</sub> absorber	Absorbs CO <sub>2</sub> from the patient's expiratory gas.

No.	Designation	Description
10	Anesthetic gas receiving system	Used for scavenging excess anesthetic gas and breathing gas, to reduce the anesthetic gas concentration released into the environment by the anesthesia machine, and to scavenge the sample gases from an external anesthetic gas monitor.
11	Water trap with connection for sample line <sup>1)</sup>	Collects condensed water which forms in the sample line. Protects the patient monitor and the patient-gas measurement module against water, bacteria and viruses.
12	Patient-gas measurement module <sup>1)</sup>	Measures and monitors various gas concentrations in the breathing gas (O <sub>2</sub> , CO <sub>2</sub> , N <sub>2</sub> O, and anesthetic gases).
13	Guide clip	Used to securely lay the O <sub>2</sub> insufflation hose.

1) Only for devices with integrated PGM.

### 3.1.3.2 Equipment with integrated O<sub>2</sub> monitoring

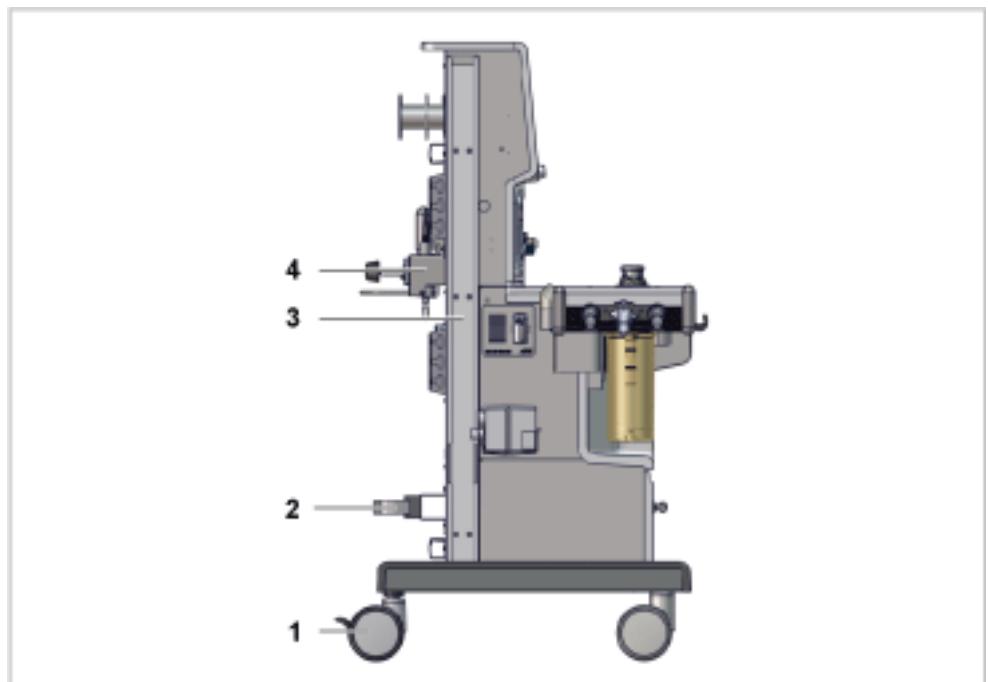
The following illustration shows the device without its breathing system cover and illustrates the position of the O<sub>2</sub> sensor.



No.	Designation	Description
1	O <sub>2</sub> sensor	Measures the inspiratory O <sub>2</sub> concentration in the breathing gas.
2	Sealing cap	Seals the O <sub>2</sub> sensor port during calibration of the O <sub>2</sub> sensor.

### 3.1.4

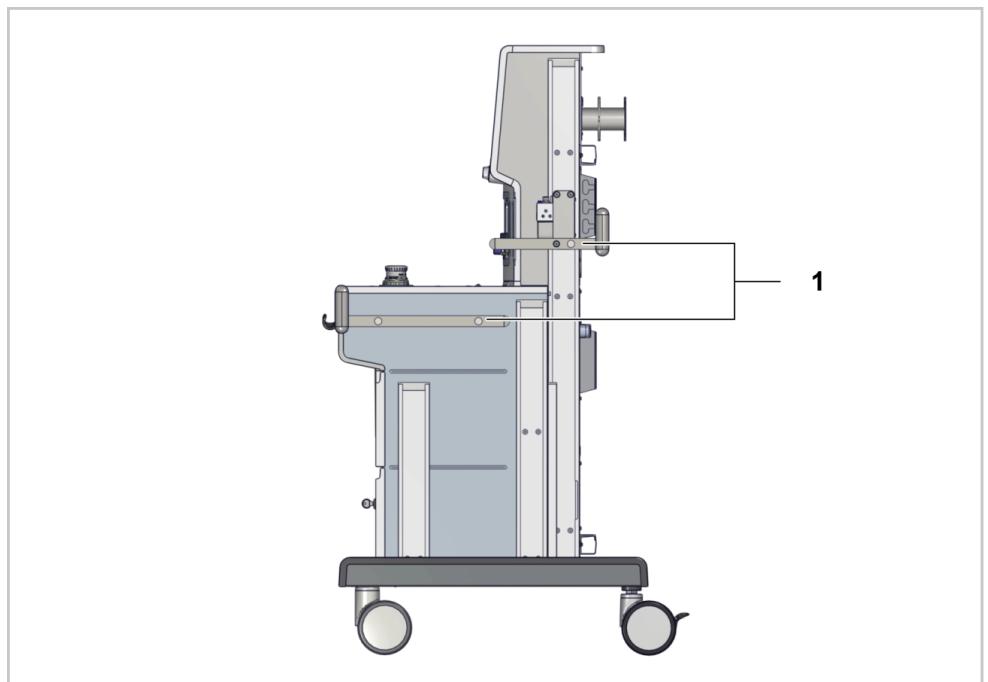
### Side view from left



No.	Designation	Description
1	Castor brake	For locking the castors with an individual wheel brake.
2	Gas cylinder holder	Secures the gas cylinders.
3	Rail	Used for fastening additional components.
4	Hanger yoke system	Enables the connection of gas cylinders with a pin-index connector.

### 3.1.5

### Side view from right

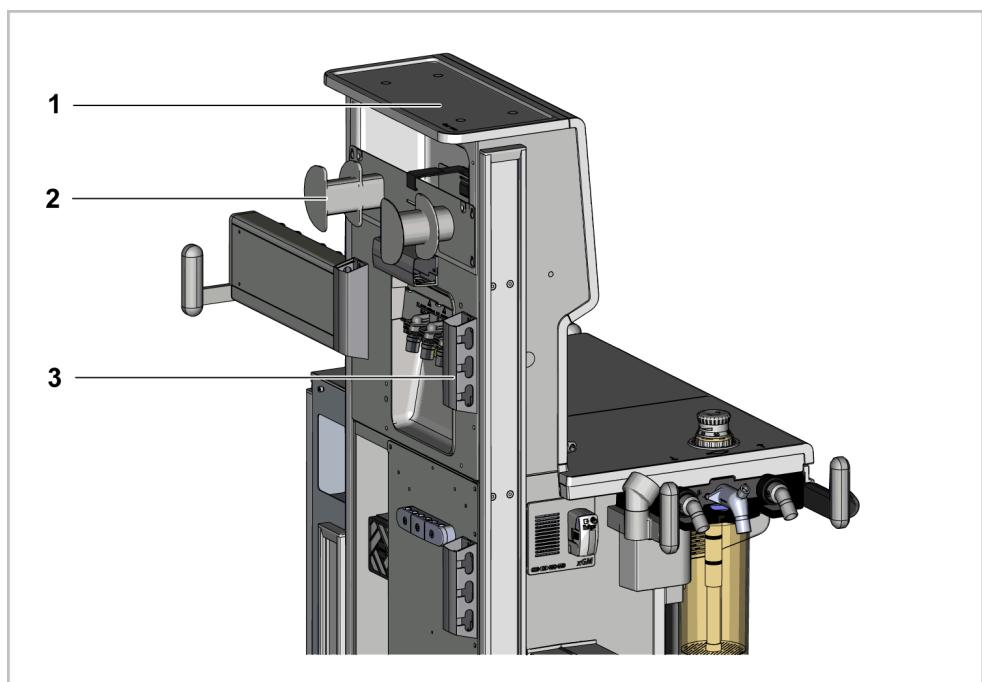


No.	Designation	Description
1	Standard rail with handle	Allows the device to be maneuvered during intrahospital transport and also the attachment of accessories.

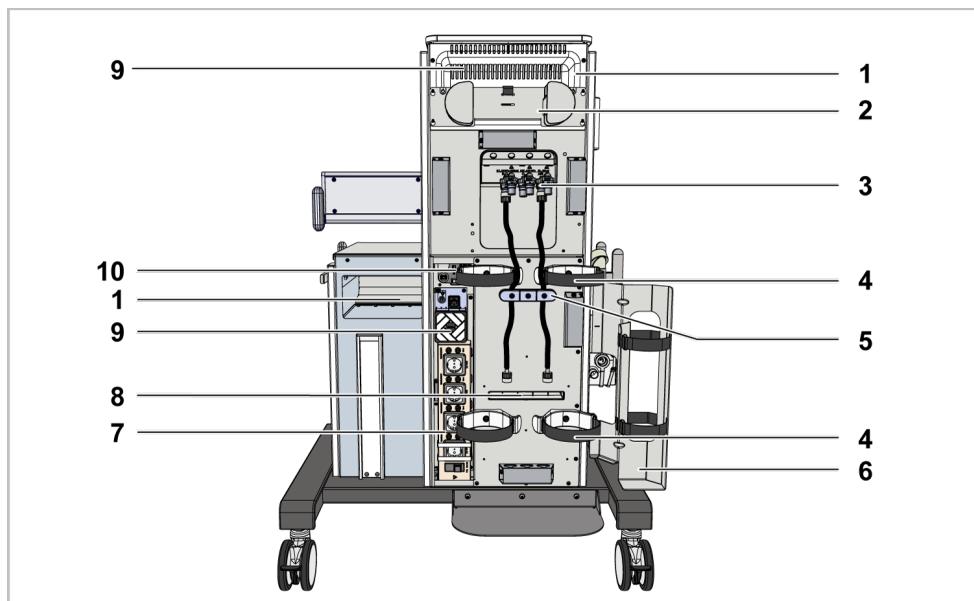
### 3.1.6

### Device column

The illustration shows the left side of the device.



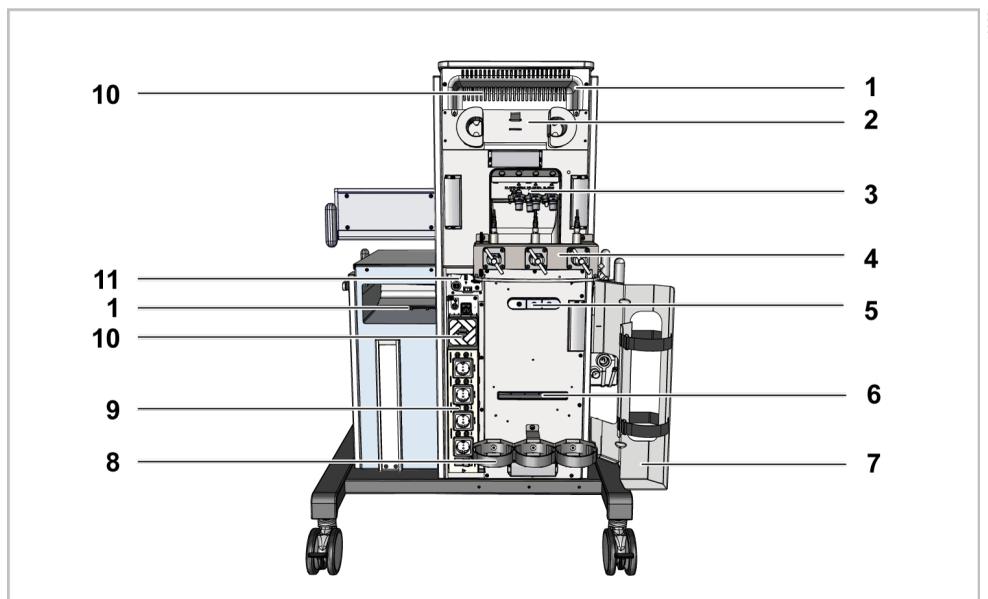
No.	Designation	Description
1	Column cover	Depending on the version, allows a patient monitor or other workplace components to be mounted.
2	Holder for hoses and cables	Used for storing and winding up central supply hoses and cables.
3	Cable holder with cable channels	For passing hoses and cables through.

**3.1.7****Rear****3.1.7.1****Equipment with screw connections for standing gas cylinders**

No.	Designation	Description
1	Storage compartment	Can be used as storage space.
2	Holder for hoses and cables	Used for storing and winding up central supply hoses and cables.
3	Gas supply block	Provides connectors for gases from the central gas supply system and for gas cylinders.
4	Gas cylinder holder	Secures the gas cylinders.
5	Strain relief for compressed gas hoses	Protects the compressed gas hoses from loosening inadvertently.
6	Gas cylinder park holder	Can hold an additional gas cylinder.
7	Auxiliary power sockets	Allow other devices to be connected.
8	Vent	Discharges warmed air from the device into the environment.
9	Ventilation slot	Feeds ambient air to the device for ventilation.
10	Connectors	Provides connectors for power cable, potential equalization, and interfaces. Used for data exchange between external devices, additional components, and networks.

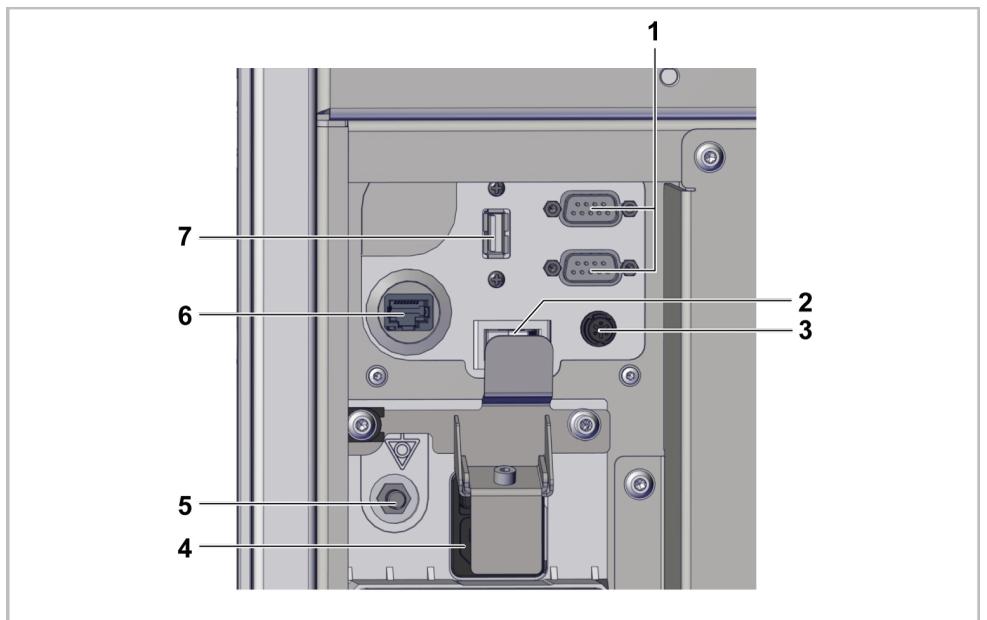
## 3.1.7.2

## Equipment with pin-index connector for suspended gas cylinders



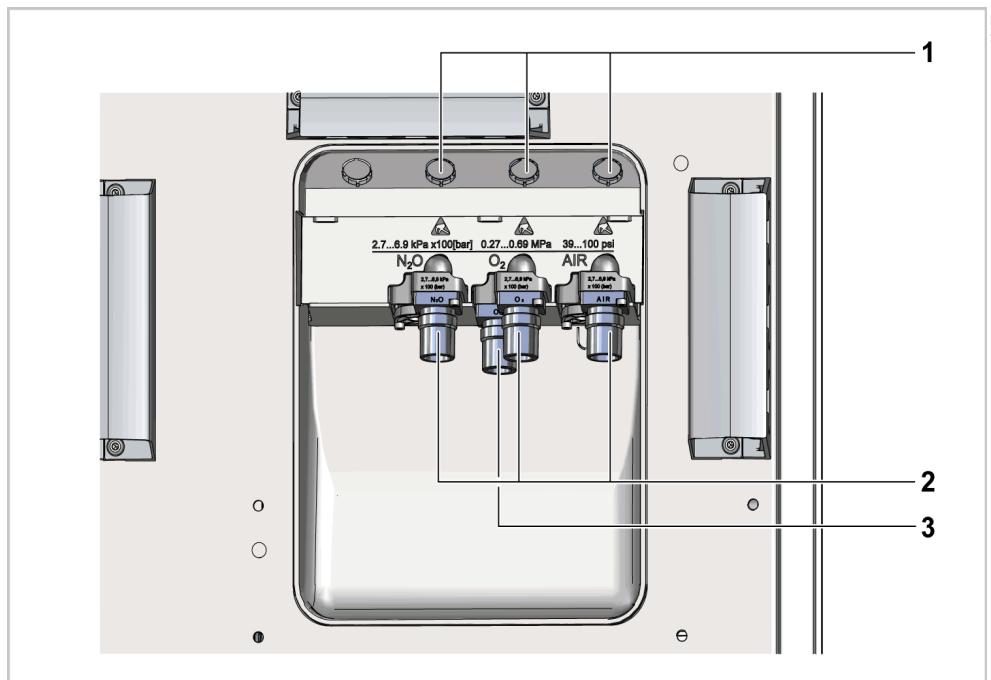
No.	Designation	Description
1	Storage compartment	Can be used as storage space.
2	Holder for hoses and cables	Used for storing and winding up central supply hoses and cables.
3	Gas supply block	Provides connectors for gases from the central gas supply system and for gas cylinders.
4	Hanger yoke system	Enables the connection of gas cylinders with a pin-index connector.
5	Strain relief for compressed gas hoses	Protects the compressed gas hoses from loosening inadvertently.
6	Vent	Discharges warmed air from the device into the environment.
7	Gas cylinder park holder	Can hold an additional gas cylinder.
8	Gas cylinder holder	Secures the gas cylinders.
9	Auxiliary power sockets	Allow other devices to be connected.
10	Ventilation slot	Feeds ambient air to the device for ventilation.
11	Connectors	Provides connectors for power cable, potential equalization, and interfaces. Used for data exchange between external devices, additional components, and networks.

### 3.1.8 Connectors



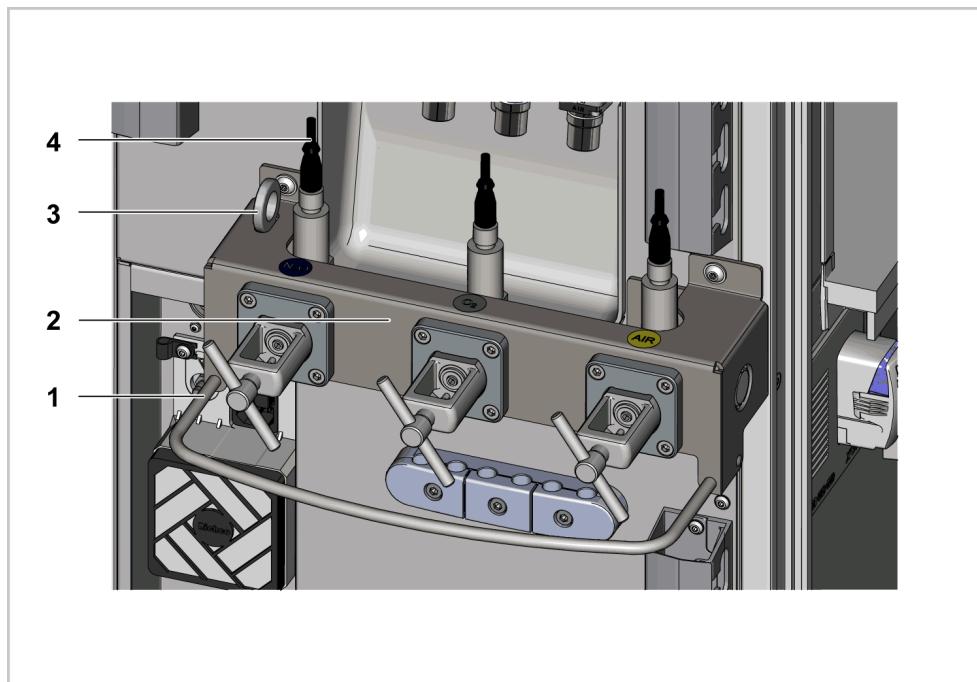
No.	Designation	Description
1	Serial port (COM 1 and COM 2)	This serial port (RS232) supports the MEDIBUS.X protocol for data exchange between the anesthesia machine and external devices.
2	Main switch	Turns the device off and minimizes the current consumption when the power plug is pulled out. To be used when the device is to be disconnected from the power supply for longer than 2 weeks and during service activities.
3	Connector for workplace light	Used for connecting an external workplace light.
4	Power inlet (connector for power cable)	Used to connect the device to the mains power supply.
5	Potential equalization pin	Used for connecting a potential equalization cable. This will minimize differences in electrical potential.
6	Network port	Enables data transfer within an IT network.
7	USB port	Used to transfer data to a USB mass storage device.

## 3.1.9

**Gas inlets**

No.	Designation	Description
1	Connectors for pressure measuring lines for gas cylinders	Used for connecting the pressure measuring lines of the pressure reducers on the gas cylinders.
2	Connectors for central gas supply system	Enable the device to be supplied with gases from the central supply.
3	Connectors for gas cylinders	Enable the device to be supplied with gases from the gas cylinders.

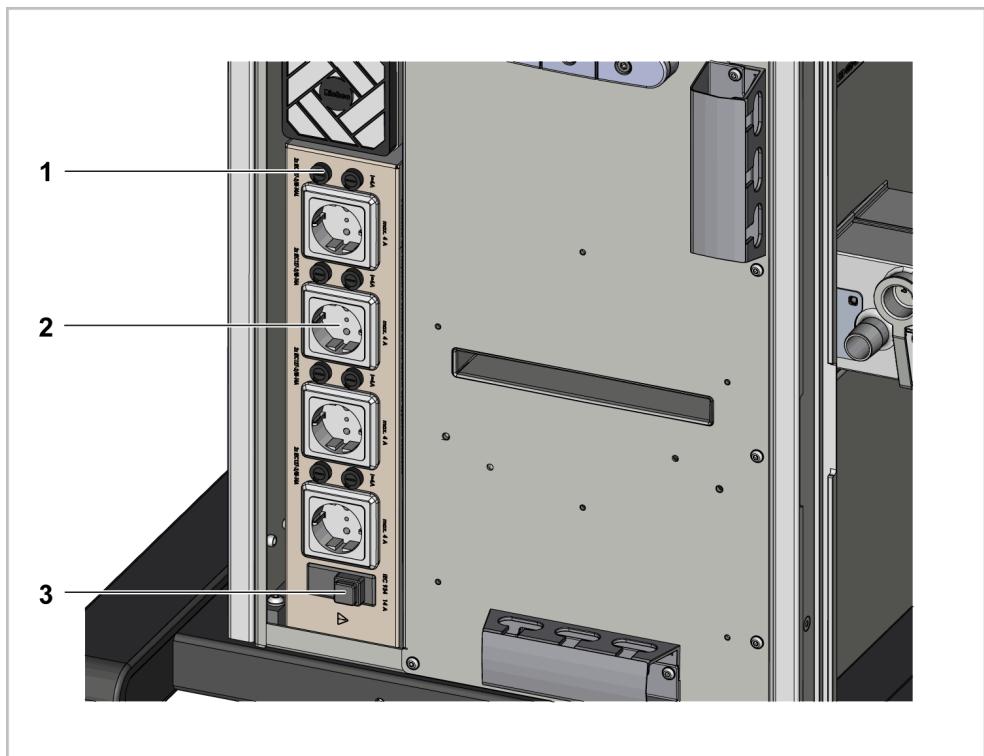
### 3.1.10 Hanger yokes with pin-index connection



No.	Designation	Description
1	Protection bar	Protects the connectors for the gas cylinders from damage.
2	Hanger yoke system with three pin-index connectors	Enables the connection of gas cylinders with a pin-index connector.
3	Wrench	For opening and closing the gas cylinder valves.
4	Connecting cable	Enables electronic gas pressure measurement.

### 3.1.11

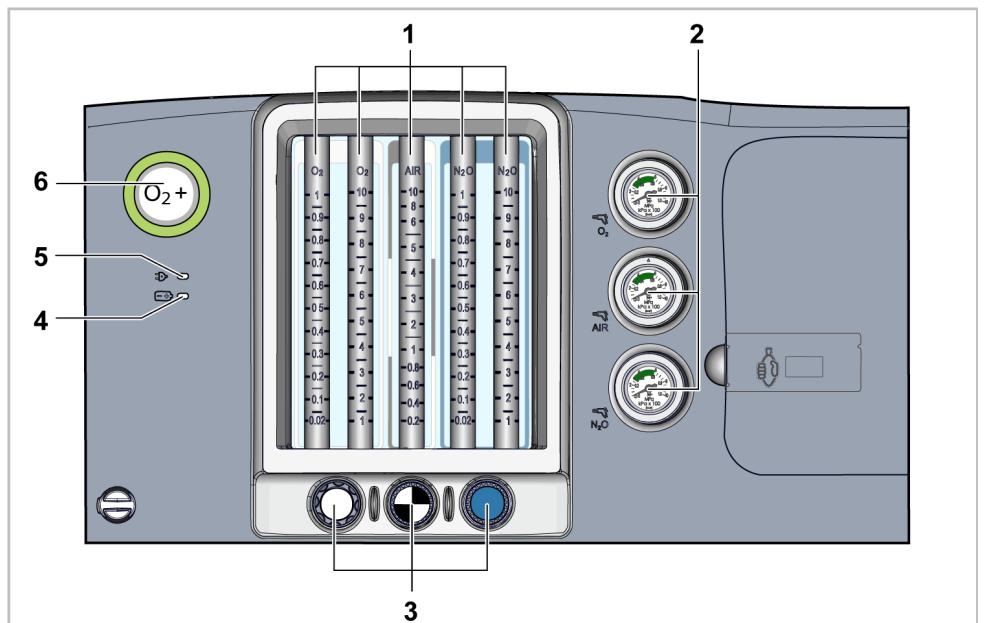
### Auxiliary power sockets

**No. Designation**

- 1 Fuses, 2 each per power socket
- 2 Auxiliary power sockets, 4 pcs.
- 3 Main fuse

### 3.1.12 Gas mixing unit

#### 3.1.12.1 Gas mixing unit (mechanically controlled with flow tubes)



##### No. Designation

- |   |  |
|---|--|
| 1 | Flow tubes (O <sub>2</sub> , Air, N <sub>2</sub> O or O <sub>2</sub> , Air) for display of the set flow            |
| 2 | Pressure gauge for gas supply (O <sub>2</sub> , Air, N <sub>2</sub> O or O <sub>2</sub> , Air) from central supply |
| 3 | Flow control valves (O <sub>2</sub> , Air, N <sub>2</sub> O or O <sub>2</sub> , Air)                               |
| 4 | Display for power supply from internal battery   |
| 5 | Display for mains power supply   |
| 6 | O <sub>2</sub> + key (O <sub>2</sub> flush)  |

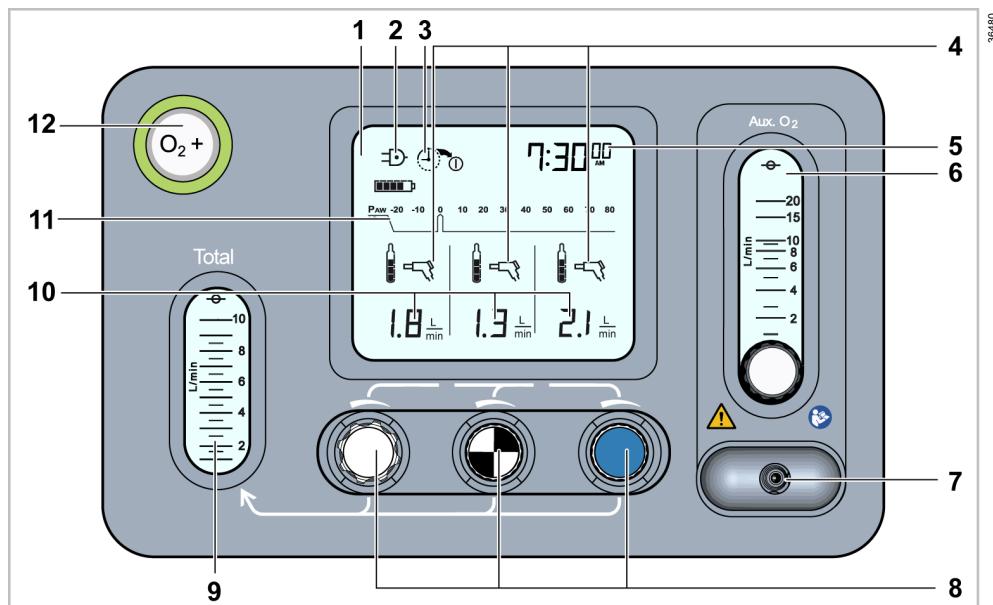
The explanation of the symbols can be found on page 330.

#### Displays for power supply

	LED lit green	LED lit orange	LED not lit
LED for the internal battery	Battery charge is higher than approx. 90 %.	Battery charge is lower than 90 %. The battery is being charged if the LED for mains voltage is lit green.	The internal battery is faulty or discharged or the device has been switched off with the main switch.
LED for mains voltage	Mains voltage is present.	---	The device is disconnected from the mains voltage or the power supply unit is faulty.

## 3.1.12.2

## Gas mixing unit (mechanically controlled with electronic flow measurement)



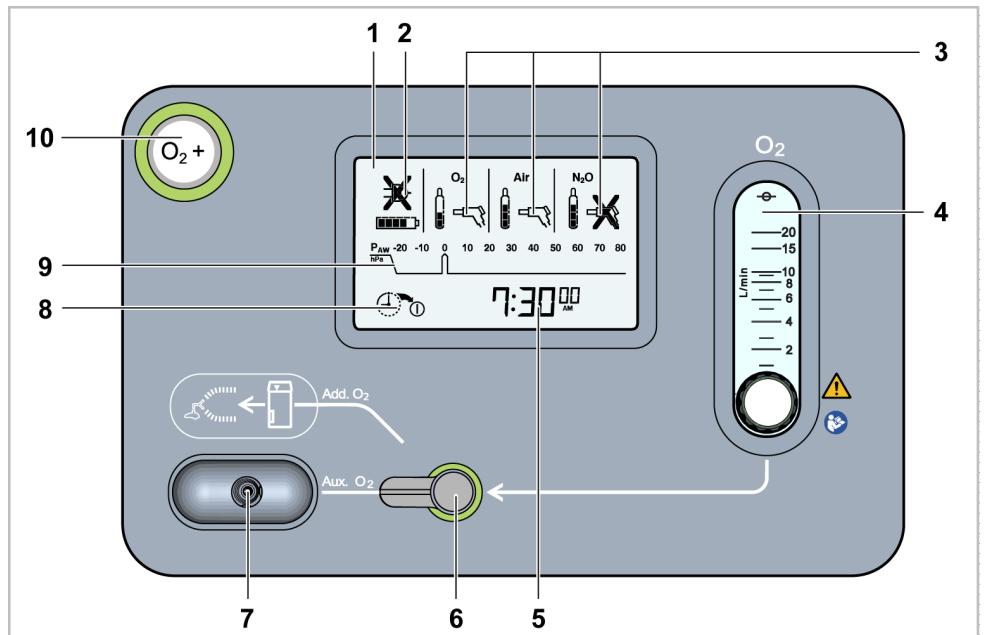
## No. Designation

- 1 Status display
- 2 Symbols for mains power supply and power supply from internal battery
- 3 Symbol for programmed Auto On
- 4 Symbols for gas supply (O<sub>2</sub>, Air, N<sub>2</sub>O or O<sub>2</sub>, Air) from central supply and gas cylinders
- 5 Current time or time for Auto On
- 6 O<sub>2</sub> flowmeter (for O<sub>2</sub> insufflation **Aux. O<sub>2</sub>**)
- 7 Outlet for O<sub>2</sub> insufflation, e.g., for nasal cannula
- 8 Flow control valves (O<sub>2</sub>, Air, N<sub>2</sub>O or O<sub>2</sub>, Air)
- 9 Total flow tube
- 10 Display of the set fresh-gas flows
- 11 Display of airway pressure in the internal breathing system, see page 22
- 12 O<sub>2</sub>+ key (O<sub>2</sub> flush)

The explanation of the symbols can be found on page 330.

## 3.1.12.3

## Gas mixing unit (electronically controlled)



## No. Designation

- |    |  |
|----|--|
| 1  | Status display   |
| 2  | Symbols for mains power supply and power supply from internal battery  |
| 3  | Symbols for gas supply (O <sub>2</sub> , Air, N <sub>2</sub> O or O <sub>2</sub> , Air) from central supply and gas cylinders  |
| 4  | O <sub>2</sub> flowmeter (for O <sub>2</sub> insufflation <b>Aux. O<sub>2</sub></b> and emergency O <sub>2</sub> delivery <b>Add. O<sub>2</sub></b> )                |
| 5  | Current time or time for Auto On   |
| 6  | O <sub>2</sub> switch (for switching between O <sub>2</sub> insufflation <b>Aux. O<sub>2</sub></b> and emergency O <sub>2</sub> delivery <b>Add. O<sub>2</sub></b> ) |
| 7  | Outlet for O <sub>2</sub> insufflation, e.g., for nasal cannula  |
| 8  | Symbol for programmed Auto On  |
| 9  | Display of airway pressure in the internal breathing system, see page 22   |
| 10 | <b>O<sub>2</sub>+</b> key (O <sub>2</sub> flush)   |

The explanation of the symbols can be found on page 330.

## 3.2

# Functional scope

### 3.2.1

## Main devices and options

Some equipment items and device functions are available as an option. Not all equipment is available worldwide for all main devices.

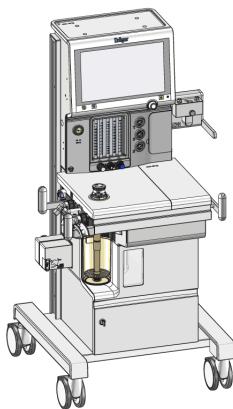
The device is intended for use with the options and accessories listed in the associated list of accessories.

#### 3.2.1.1

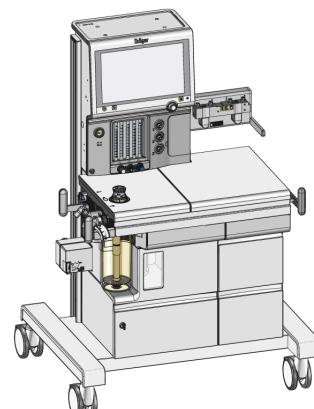
### Main devices

The available main devices with the associated designations are listed in the following tables:

**A100**



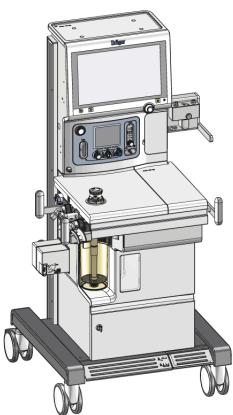
**A100 XL**



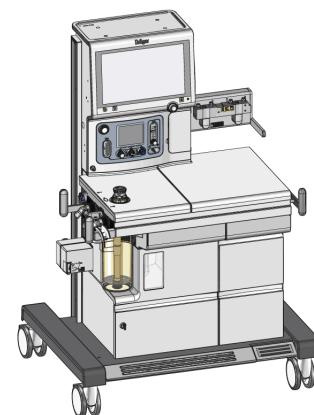
- Mechanically controlled gas mixer
- Flow tubes
- Compact trolley

- Mechanically controlled gas mixer
- Flow tubes
- Large trolley

**A300**

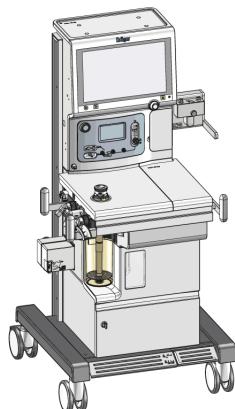
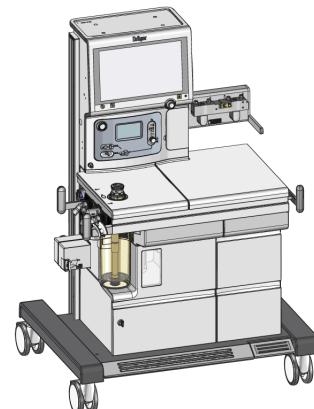


**A300 XL**



- Mechanically controlled gas mixer with status display
- Electronic fresh gas flow measurement
- Compact trolley

- Mechanically controlled gas mixer with status display
- Electronic fresh gas flow measurement
- Large trolley

**A350****A350 XL**

- Electronically controlled gas mixer with status display
- Electronic fresh gas flow measurement
- Compact trolley
- Electronically controlled gas mixer with status display
- Electronic fresh gas flow measurement
- Large trolley

#### **Indication of availability**

The available equipment for the main devices is shown in the tables below and is identified as follows:

<b>Indicator</b>	<b>Meaning</b>
●	The main device has this equipment.
○	The equipment is available as an option.
---	The equipment is not available.

	<b>Main device</b>			
	<b>A100 (XL)</b>	<b>A300 (XL)</b>	<b>A350 (XL)</b>	
<b>Mechanically controlled gas mixer with flow tubes</b>	●	---	---	
– The fresh-gas delivery is adjusted by means of manually operated flow control valves.				
– The individual fresh-gas flows are measured and displayed by means of the integrated conventional flow tubes.				
– Available as a 2-gas version (O <sub>2</sub> /Air) or 3-gas version (O <sub>2</sub> /Air/N <sub>2</sub> O)				

	Main device			
	A100 (XL)	A300 (XL)	A350 (XL)	
<b>Mechanically controlled gas mixer with electronic flow measurement</b>	---	●	---	
<ul style="list-style-type: none"> <li>- The fresh-gas delivery is adjusted by means of manually operated flow control valves.</li> <li>- With electronic flow measurement and display of the measured fresh-gas flows on the status display and screen</li> <li>- Available as a 2-gas version (O<sub>2</sub>/Air) or 3-gas version (O<sub>2</sub>/Air/N<sub>2</sub>O)</li> <li>- The leakage assistant provides additional support when searching for leaks</li> </ul>				
<b>Electrically controlled gas mixer</b>	---	---	●	
<ul style="list-style-type: none"> <li>- With electronic flow measurement</li> <li>- The fresh-gas delivery is adjusted using the screen with the aid of settable parameters for O<sub>2</sub> concentration in % and for fresh-gas flow in L/min.</li> <li>- Depending on the version (2-gas version or 3-gas version), Air or N<sub>2</sub>O can be selected as the carrier gas.</li> <li>- With O<sub>2</sub> flowmeter for O<sub>2</sub> insufflation</li> <li>- With integrated, mechanical emergency O<sub>2</sub> delivery <b>Add. O<sub>2</sub></b></li> <li>- The leakage assistant provides additional support when searching for leaks</li> </ul>				
<b>Compact version</b>	●	---	●	---
<ul style="list-style-type: none"> <li>- Version with small trolley</li> <li>- 1 large drawer</li> <li>- Plug-in connector for up to 2 vaporizers</li> </ul>	●	---	●	---
<b>Large version (XL)</b>	---	●	●	●
<ul style="list-style-type: none"> <li>- Version with large trolley</li> <li>- 1 large and 2 small drawers</li> <li>- Plug-in connector for up to 2 vaporizers</li> <li>- Plug-in connector for up to 3 vaporizers</li> </ul>	---	●	●	●

### Alternative equipment

The main devices are available with the following alternative equipment in each case:

- Gas monitoring
  - Integrated patient-gas measurement module  
Or
  - Integrated O<sub>2</sub> monitoring
- Anesthetic gas scavenging
  - Active anesthetic gas scavenging  
Or
  - Passive anesthetic gas scavenging
- Trolley
  - Trolley with central brake<sup>1)</sup>  
Or
  - Trolley with individual wheel brake

### Description of alternative equipment

Name	Description
<b>Gas monitoring</b>	
Integrated patient-gas measurement module	<ul style="list-style-type: none"> <li>– Measurement, monitoring, and display of the inspiratory and expiratory gas concentrations for O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic gases</li> <li>– Detection and indication of anesthetic gas mixtures</li> <li>– Display of the xMAC</li> <li>– Detection during the system test whether the connected O<sub>2</sub> supply actually delivers O<sub>2</sub>.</li> </ul>
Integrated O <sub>2</sub> monitoring	<ul style="list-style-type: none"> <li>– Measurement, monitoring, and display of the inspiratory O<sub>2</sub> concentration</li> <li>– The measurement is performed by the O<sub>2</sub> sensor integrated in the breathing system.</li> </ul>
<b>Anesthetic gas scavenging</b>	
Active anesthetic gas scavenging	<ul style="list-style-type: none"> <li>– Anesthetic gas scavenging with flow indicator for use with an active disposal system with a wall terminal unit</li> </ul>
Passive anesthetic gas scavenging	<ul style="list-style-type: none"> <li>– Anesthetic gas scavenging for gas disposal without an active disposal system</li> </ul>
<b>Trolley</b>	
Trolley with central brake	<ul style="list-style-type: none"> <li>– The central brake locks the two front castors.</li> <li>– Each of the two rear castors is equipped with a castor brake.</li> <li>– All castors are equipped with a cable deflector.</li> </ul>
Trolley with individual wheel brake	<ul style="list-style-type: none"> <li>– All four castors are equipped with a castor brake.</li> </ul>

1) Not available for A100 (XL)

### 3.2.1.2 Options

#### Indication of availability

The available equipment for the main devices is shown in the tables below and is identified as follows:

Indicator	Meaning
●	The main device has this equipment.
○	The equipment is available as an option.
---	The equipment is not available.

Hardware options	Main device			
	A100 (XL)	A300 (XL)	A350 (XL)	
External O <sub>2</sub> flowmeter for O <sub>2</sub> insufflation	○	○	---	
Integrated O <sub>2</sub> flowmeter for O <sub>2</sub> insufflation	---	○	●	
External fresh-gas outlet	○	○	○	
Gas cylinder connectors	○	○	○	
Hanger yoke system	○	○	○	
Gas cylinder holder	○	○	○	
Gas cylinder park holder	○	○	○	
Advanced Cylinder Support	---	○	○	
Support of Infinity ID accessories	---	○	○	
Breathing bag arm	○	○	○	
Airway pressure gauge	○	○	○	
Total flow tube	---	●	---	
Holder for hoses and cables	○	●	●	
Cable holder with cable channels	○	●	●	
Side folding table extension	○	○	○	
Pull-out writing tray	---	---	○	---
Pressure measuring lines for gas cylinders				
– Display of gas cylinder pressure	○	○	○	
– Alarm for empty gas cylinders	---	○	○	
Auxiliary power sockets	○	○	○	
Workplace light	○	○	○	

#### Description of hardware options

Name	Description
External O <sub>2</sub> flowmeter for O <sub>2</sub> insufflation	Supplies oxygen for O <sub>2</sub> insufflation
Integrated O <sub>2</sub> flowmeter for O <sub>2</sub> insufflation	Supplies oxygen for O <sub>2</sub> insufflation

Name	Description
External fresh-gas outlet	<ul style="list-style-type: none"> <li>– Allows use with external non-rebreathing systems, e.g.:           <ul style="list-style-type: none"> <li>– Mapleson</li> <li>– Kuhn</li> <li>– Bain</li> <li>– Magill</li> <li>– Waters</li> </ul> </li> </ul>
Gas cylinder connectors	Enable the device to be supplied with gases from the gas cylinders.
Hanger yoke system	Enables the connection of gas cylinders with a pin-index connector.
Gas cylinder holder	Used to fix the gas cylinders.
Gas cylinder park holder	Can hold an additional gas cylinder.
Advanced Cylinder Support	On devices that are equipped with Advanced Cylinder Support, the gas cylinder valves can also remain open during operation with the central supply.
Support of Infinity ID accessories	<p>Allows the use of Dräger Infinity ID accessories with the following functions:</p> <ul style="list-style-type: none"> <li>– Generates a message when the maximum period of use is exceeded for the breathing circuit, the water trap, the CO<sub>2</sub> absorber, and the flow sensors</li> <li>– Generates a message when the breathing circuit is incorrectly connected</li> <li>– Generates a message when the CO<sub>2</sub> absorber is not present or is not locked</li> </ul>
Breathing bag arm	Used to attach the breathing bag to the breathing system.
Airway pressure gauge	Mechanically measures the airway pressure and displays it on an analog indicator.
Total flow tube	Indicates the total fresh-gas flow.
Holder for hoses and cables	Used for storing and winding up central supply hoses and cables on the rear of the device.
Cable holder with cable channels	Used for routing hoses and cables on the rear of the device.
Side folding table extension	Used to extend the work surface.
Pull-out writing tray	Used to extend the work surface.
Pressure measuring lines for gas cylinders	<ul style="list-style-type: none"> <li>– Display of gas cylinder pressure</li> <li>– On correspondingly equipped devices, an alarm is issued when gas cylinders are empty.</li> </ul>
Auxiliary power sockets	Allow other devices to be connected.
Workplace light	Used for additional illumination of the work surface.

<b>Software options</b>	<b>Main device</b>		
	<b>A100 (XL)</b>	<b>A300 (XL)</b>	<b>A350 (XL)</b>
Volume-controlled ventilation (VC - CMV)	●	●	●
Pressure-controlled ventilation (PC)	○	●	●
Spontaneous breathing support (SIMV / PS)	○	---	---
Spontaneous breathing support (PSV)	○	---	---
Spontaneous breathing support (SIMV / PS, PSV)	---	○	○
AutoFlow (VC - AF)	○	○	○
Pause	---	●	●
Monitoring <sup>1)</sup>	○	○	○
Advanced trends	---	○	○
Advanced ventilation monitoring	---	○	○
Loops and trends	○	---	---
Advanced gas monitoring	---	○	○
Advanced neonatal support	---	○	○
Expert view	---	○	○
Lung recruitment	---	○	○
Auto On	---	○	○
SDC system integration	○	○	○
Leakage assistant	---	●	●

1) Only for devices with integrated PGM

#### Description of software options

<b>Name</b>	<b>Description</b>
Volume-controlled ventilation (VC - CMV)	Allows volume-controlled ventilation in VC - CMV mode. Can be extended by the following ventilation modes with software options for spontaneous breathing support: – VC - SIMV – VC - SIMV / PS
Pressure-controlled ventilation (PC)	Allows pressure-controlled ventilation in PC - CMV mode. Can be extended by the following ventilation modes with software options for spontaneous breathing support: – PC - SIMV – PC - SIMV / PS

Name	Description
Spontaneous breathing support (SIMV / PS)	<p>Allows synchronization with the patient's inspiratory effort.</p> <p>Can extend the existing ventilation modes by the following modes:</p> <ul style="list-style-type: none"> <li>– PC - SIMV</li> <li>– PC - SIMV / PS</li> <li>– VC - SIMV</li> <li>– VC - SIMV / PS</li> <li>– VC - SIMV / AutoFlow</li> <li>– VC - SIMV / PS / AutoFlow</li> </ul>
Spontaneous breathing support (PSV)	Allows assisted ventilation with pressure support in CPAP / PSV mode.
Spontaneous breathing support (SIMV / PS, PSV)	<p>Allows assisted ventilation with pressure support and, in controlled ventilation modes, synchronization with the patient's inspiratory effort.</p> <p>Can extend the existing ventilation modes by the following modes:</p> <ul style="list-style-type: none"> <li>– CPAP / PSV</li> <li>– PC - SIMV</li> <li>– PC - SIMV / PS</li> <li>– VC - SIMV</li> <li>– VC - SIMV / PS</li> <li>– VC - SIMV / AutoFlow</li> <li>– VC - SIMV / PS / AutoFlow</li> </ul>
AutoFlow (VC - AF)	<p>For volume-controlled, mandatory breaths with Auto-Flow, the set tidal volume is applied with the lowest required pressure.</p> <p>With switchable synchronization and settable pressure support (requires the "spontaneous breathing support" software option)</p>
Pause	Allows automated ventilation to be paused, for example, for short-term interruptions to a therapy.
Monitoring	Allows breathing gas measurement during spontaneous breathing without ventilation of the patient (only for devices with integrated PGM).
Advanced trends	<p>Includes the following functions:</p> <ul style="list-style-type: none"> <li>– Graphical trend of measured values</li> <li>– Mini-trends next to the waveforms</li> <li>– Export of trend data to USB mass storage device</li> </ul>

Name	Description
Advanced ventilation monitoring	<p>Includes the following functions:</p> <ul style="list-style-type: none"> <li>– Display of patient compliance with trend</li> <li>– Display of loops (Pressure-Volume and Flow-Volume)</li> <li>– Volumeter (bar graphic for monitoring the inspiratory and expiratory tidal volumes)</li> <li>– Display of the patient-triggered, mechanically supported minute volume compared with the mandatory minute volume</li> </ul>
Loops and trends	<ul style="list-style-type: none"> <li>– Graphical trend of measured values</li> <li>– Export of trend data to USB mass storage device</li> <li>– Display of patient compliance with trend</li> <li>– Display of loops (Pressure-Volume and Flow-Volume)</li> <li>– Volumeter (bar graphic for monitoring the inspiratory and expiratory tidal volumes)</li> </ul>
Advanced gas monitoring	<p>Includes the following functions:</p> <ul style="list-style-type: none"> <li>– Indicator for the efficiency of the fresh-gas setting and anesthetic agent consumption (econometer with trend and low-flow wizard)</li> <li>– Display of gas consumption</li> <li>– Display of anesthetic agent consumption and uptake</li> <li>– Display of MV×CO<sub>2</sub> with trend</li> <li>– Display of O<sub>2</sub> uptake with trend</li> </ul>
Advanced neonatal support	<p>Includes advanced ventilation functions and monitoring functions for the ventilation of neonates:</p> <ul style="list-style-type: none"> <li>– Minimum settable tidal volume of 5 mL</li> <li>– Higher sweep speed</li> </ul>
Expert view	<p>Optionally provides the following extensions:</p> <ul style="list-style-type: none"> <li>– 1 additional waveform</li> <li>– 1 additional row with parameter fields</li> </ul>
Lung recruitment	<p>Includes the following functions:</p> <ul style="list-style-type: none"> <li>– One-step recruitment</li> <li>– Multi-step recruitment</li> <li>– Reminder function: Displays a message during ventilation to remind the user to perform a lung recruitment maneuver.</li> <li>– Inspiration Hold, Expiration Hold: <ul style="list-style-type: none"> <li>– Extension of the breath.</li> <li>– Extension of the expiration and delay of the next breath.</li> </ul> </li> </ul>
Auto On	Allows the device to automatically switch on and the system test to be performed automatically so that the device is ready for operation at a defined time.

Name	Description
SDC system integration	In combination with the Connectivity Converter CC300, this allows operation of the device in an integrated system for exchange of information.
Leakage assistant	Provides additional support when searching for leaks

### 3.2.2

#### Ventilation drive

The device uses a piston drive as the ventilation drive and is equipped with compliance compensation and fresh-gas decoupling. For further information see: "Description of the ventilation drive", page 318.

### 3.2.3

#### Gas delivery

The device can deliver mixtures of medical gases to which anesthetic agent is added by means of a vaporizer.

##### Available gas mixtures

- O<sub>2</sub> and Air
- O<sub>2</sub> and N<sub>2</sub>O with 3-gas mixer

##### Usable anesthetic agents

- Sevoflurane
- Desflurane
- Isoflurane
- Halothane
- Enflurane

### 3.2.4

#### Ventilation modes

- Manual / Spontaneous
- VC - CMV / AutoFlow
- VC - SIMV / AutoFlow
- VC - SIMV / PS / AutoFlow
- VC - CMV
- VC - SIMV
- VC - SIMV / PS
- PC - CMV
- PC - SIMV
- PC - SIMV / PS
- CPAP / PSV

For a detailed description of the ventilation modes and the additional settings, see page 308.

### 3.2.5 Additional operation modes

#### Indication of availability

The available equipment for the main devices is shown in the tables below and is identified as follows:

Indicator	Meaning
●	The main device has this equipment.
○	The equipment is available as an option.
---	The equipment is not available.

Operation mode	Main device		
	A100 (XL)	A300 (XL)	A350 (XL)
External fresh-gas outlet	○	○	○
Pause	---	● <sup>1)</sup>	● <sup>1)</sup>
Monitoring <sup>2)</sup>	●	● <sup>3)</sup>	● <sup>3)</sup>
CBM mode	●	●	●

1) Pause must be activated in the system setup.

2) Only for devices with integrated PGM.

3) Pause must be deactivated in the system setup.

### 3.2.6 Monitoring functions

The device can monitor the following:

- Airway pressure
- Minute volume, tidal volume
- Inspiratory O<sub>2</sub> concentration
- Expiratory O<sub>2</sub> concentration (only available with the integrated patient-gas measurement module)
- Inspiratory and expiratory anesthetic gas concentrations (only available with the integrated patient-gas measurement module)
- Inspiratory and expiratory CO<sub>2</sub> concentrations (only available with the integrated patient-gas measurement module)
- Inspiratory and expiratory N<sub>2</sub>O concentrations (only available with the integrated patient-gas measurement module)
- Respiratory rate, apnea (derived from pressure, flow, and CO<sub>2</sub>)
- Occurrence of anesthetic gas mixtures (only available with the integrated patient-gas measurement module)
- Lack of fresh gas in the breathing system and the breathing circuit

### 3.2.7

#### Display on the screen

The device can display the following information on the integrated screen:

- Waveforms
- Graphical trends
- Numeric trends
- Loops
- Alarm logbook
- Logbook
- Numeric parameters
- Low-flow wizard
- Econometer

### 3.2.8

#### Logbook

The device can capture and store the following data, among other things:

- Measured values
- Set values and related changes
- Patient data
- Ventilation modes
- Events (e.g., alarms, reset alarms, switch-on time and switch-off time)
- Test results
- Gas consumption
- Anesthetic agent consumption

### 3.2.9

#### Gas supply

The device can be supplied with up to three medical gases:

Gas	Central supply	Gas cylinders
O <sub>2</sub>	Yes	Permanently mounted Dräger pressure reducer or Third-party manufacturer pressure reducer
Air	Yes	Permanently mounted Dräger pressure reducer or
N <sub>2</sub> O	Yes	Third-party manufacturer pressure reducer

### 3.2.10

#### Gas scavenging

The gas can be scavenged by means of the following procedures:

- Active anesthetic gas scavenging
- Passive anesthetic gas scavenging

Further information can be found on page 81.

### **3.2.11 Data exchange, interfaces**

#### **3.2.11.1 Serial port**

Two serial ports, COM 1 and COM 2, are provided for data transmission using the MEDIBUS.X communication protocol.

#### **3.2.11.2 USB port**

After a suitable USB flash drive is connected, the USB port enables, e.g., the following actions:

- Saving the screen contents as a screenshot.
- Saving and loading device configurations.
- Saving system test results or records as a text file.

Note the additional information on the specification of the USB port (see "Technical data", page 272).

#### **3.2.11.3 Network port**

If an appropriate service contract has been obtained, the Dräger Remote Service function can be executed.

The device can be connected to the ServiceConnect Gateway or a service laptop.

If the connected network offers an NTP service, the time on the device can be synchronized with the time on the NTP server.

For further information see: "IT networks and cybersecurity", page 301.

#### **3.2.11.4 Support of Infinity ID accessories**

- Replacement interval monitoring
- Anti-interchange security for breathing hoses

For further information see: "Support of Infinity ID accessories", page 326.

### 3.2.12 Safety functions

#### 3.2.12.1 Emergency O<sub>2</sub> delivery (electronically controlled gas mixer)

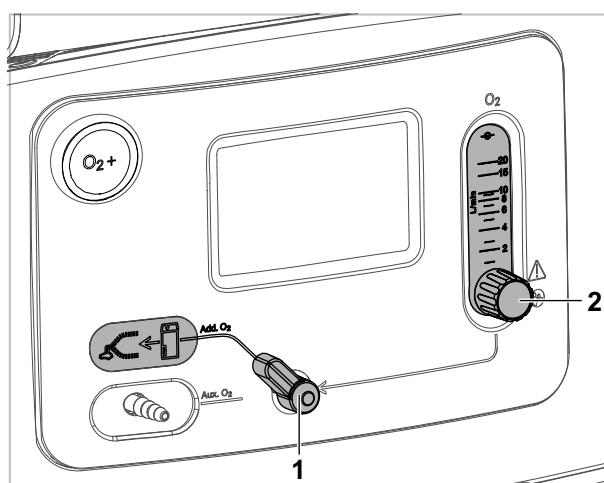
##### ⚠ CAUTION

##### Risk of increased anesthetic agent delivery

When the emergency O<sub>2</sub> delivery (**Add. O<sub>2</sub>**) is in use, anesthetic agent continues to be delivered into the breathing system in accordance with the vaporizer setting. When the emergency O<sub>2</sub> delivery is used during low-flow anesthesia or minimal-flow anesthesia, an increased quantity of anesthetic agent may enter the breathing system. This may lead to an increased anesthetic gas concentration.

- Carefully monitor the gas mixture.

1. Check the vaporizer setting.
2. Set the O<sub>2</sub> switch (1) upwards to the **Add. O<sub>2</sub>** position.



##### ⚠ WARNING

##### Risk of fire

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgical devices and laser surgical devices can cause fires.

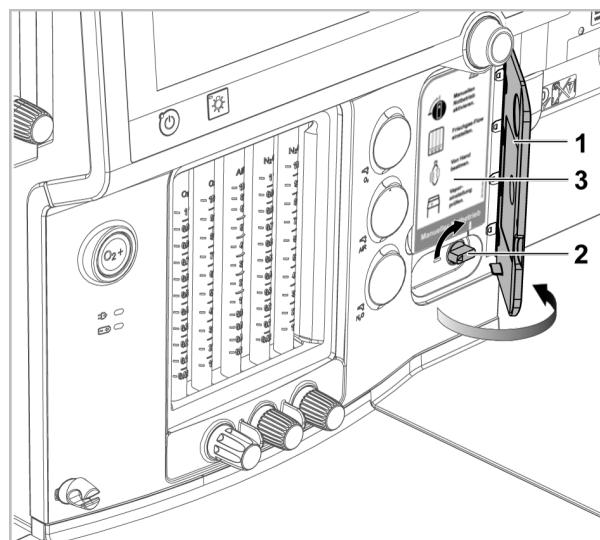
- If ignition sources are present, do not open the flow control valve on the O<sub>2</sub> flowmeter. Leave the flow control valve completely closed.
- 3. Open the flow control valve (2) on the O<sub>2</sub> flowmeter and set the desired flow. This O<sub>2</sub> flow flows through the vaporizer.

#### 3.2.12.2 Backup manual mode

In various technical fault situations, the backup manual mode enables a direct changeover to manual ventilation in order to continue the therapy. When the backup manual mode is activated, an acoustic and optical alarm signal is issued with high priority. The alarm is automatically downgraded to low priority after 20 seconds (see "Alarm delay, alarm escalation, and alarm deescalation", page 198).

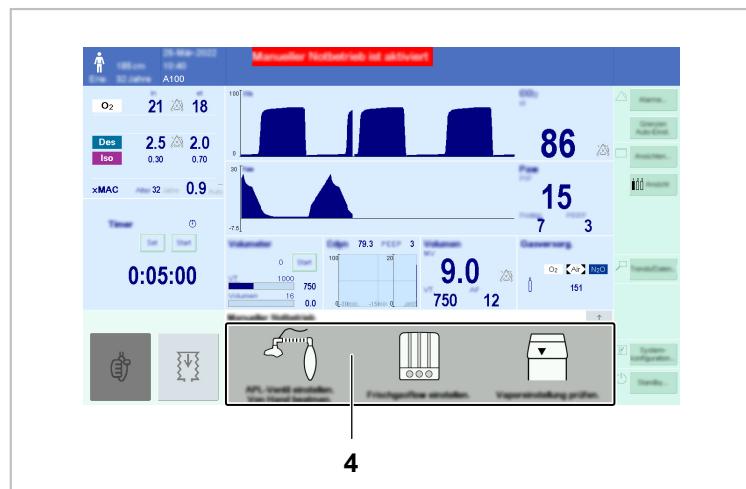
## Backup manual mode with a mechanically controlled gas mixer with flow tubes

1. Open the flap (1).



53297

2. Activate the backup manual switch (2). Follow the instructions on the product label (3) or the screen (4).

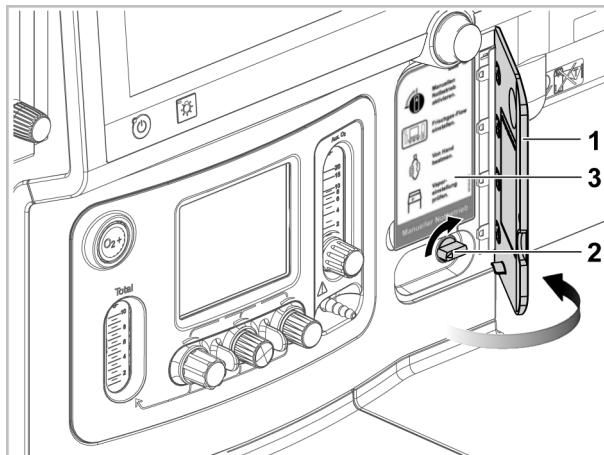


53590

3. Ventilate the patient manually.
  - a. During mechanical ventilation or in Man/Spon ventilation mode:  
Ventilate manually with the breathing bag.
  - b. When using the external fresh-gas outlet:  
Ventilate manually with the breathing bag on the non-rebreathing system.
4. Set the fresh-gas flow.
5. Check the vaporizer setting.

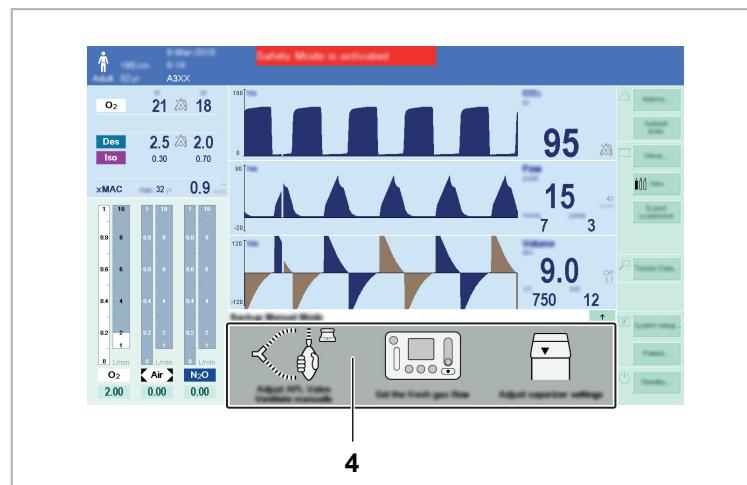
**Backup manual mode with a mechanically controlled gas mixer with electronic flow measurement**

1. Open the flap (1).



40877

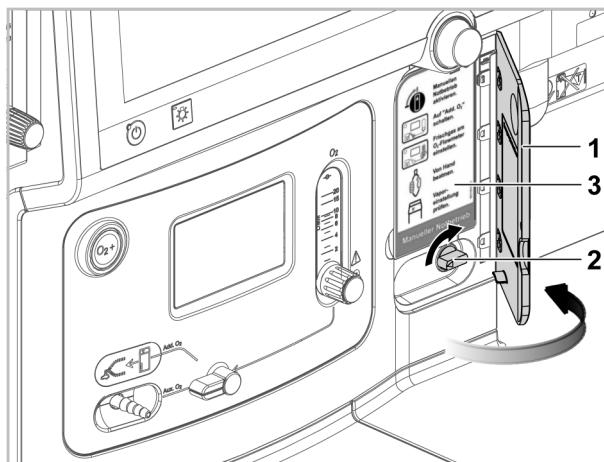
2. Activate the backup manual switch (2). Follow the instructions on the product label (3) or the screen (4).



3. Ventilate the patient manually.
  - a. During mechanical ventilation or in Man/Spon ventilation mode:  
Ventilate manually with the breathing bag.
  - b. When using the external fresh-gas outlet:  
Ventilate manually with the breathing bag on the non-rebreathing system.
4. Set the fresh-gas flow.
5. Check the vaporizer setting.

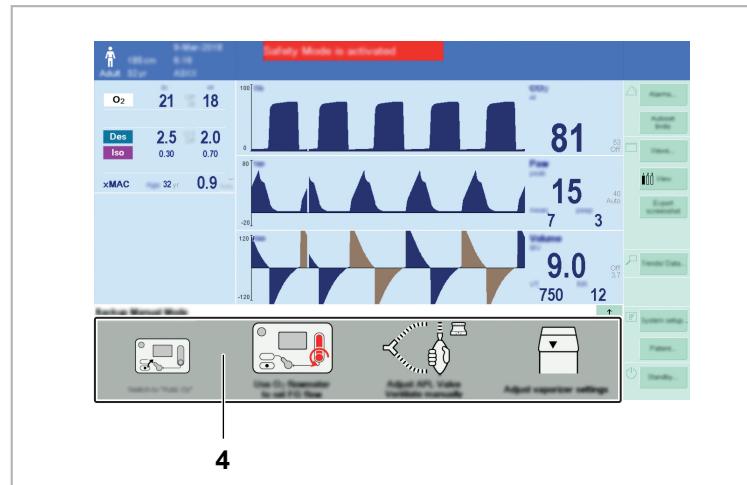
### Backup manual mode with an electronically controlled gas mixer

1. Open the flap (1).



40676

2. Activate the backup manual switch (2). Follow the instructions on the product label (3) or the screen (4).



47439

3. Set the O<sub>2</sub> switch to **Add. O<sub>2</sub>**.
4. Open the flow control valve on the emergency O<sub>2</sub> delivery and set an adequate O<sub>2</sub> flow. The set O<sub>2</sub> flow constitutes the total fresh-gas flow.
5. Ventilate the patient manually.
  - During mechanical ventilation or in Man/Spon ventilation mode:  
Ventilate manually with the breathing bag.
  - When using the external fresh-gas outlet:  
Ventilate manually with the breathing bag on the non-rebreathing system.
6. Check the vaporizer setting.

**3.2.12.3****Overview**

The following table gives an overview of the integrated safety functions which come into effect if problems occur during operation:

Fault	Safety function
Leakage	<p>Pressure regulation and PEEP compensation</p> <ul style="list-style-type: none"> <li>– In mechanical ventilation modes, the set PEEP is actively adjusted even in the case of small leaks.</li> <li>– In pressure-controlled modes, the pressure is controlled during the entire respiratory cycle.</li> </ul>
Mains power supply failure	<p>Uninterruptible power supply provided by internal battery</p> <ul style="list-style-type: none"> <li>– Device runtime in battery operation (see "Technical data", page 272)</li> <li>– Automatic deactivation of the breathing system warmer to increase battery runtime</li> </ul>
Mains power supply failure and battery discharged	<ul style="list-style-type: none"> <li>– Manual ventilation and spontaneous breathing are available</li> <li>– Emergency O<sub>2</sub> delivery (electronically controlled gas mixer)</li> <li>– Fresh-gas delivery (mechanically controlled gas mixers)</li> <li>– Delivery of anesthetic agents via connected vaporizers</li> </ul>
Failure of the central gas supply system	<ul style="list-style-type: none"> <li>– Use of the connected gas cylinders</li> </ul>
Complete failure of the gas supply	<ul style="list-style-type: none"> <li>– Mechanical ventilation with ambient air possible (the hose with the breathing bag will have to be removed for this)</li> <li>– No anesthetic agent delivery from the connected vaporizers possible; switch to intravenous anesthetic agent required</li> </ul>
Flow measurement failure	<ul style="list-style-type: none"> <li>– Mechanical ventilation can be continued.</li> <li>– Restrictions with regard to displayed measured values, measurement accuracies, and when triggering mandatory breaths are possible.</li> </ul>
Failure of fresh-gas delivery (electronically controlled gas mixer only)	<ul style="list-style-type: none"> <li>– Emergency O<sub>2</sub> delivery (see "Emergency O<sub>2</sub> delivery (electronically controlled gas mixer)", page 50)</li> <li>– Anesthetic agent delivery from connected vaporizers possible</li> <li>– All ventilation modes are available.</li> </ul> <p>Alternatively:</p> <ul style="list-style-type: none"> <li>– Backup manual mode</li> </ul>
Ventilator failure	<ul style="list-style-type: none"> <li>– Manual ventilation or spontaneous breathing possible</li> <li>– Fresh-gas delivery available</li> <li>– Anesthetic agent delivery from connected vaporizers possible</li> </ul> <p>Alternatively:</p> <ul style="list-style-type: none"> <li>– Backup manual mode</li> </ul>

Fault	Safety function
Screen fault (screen does not respond to operation or has failed)	If backup manual mode is activated: <ul style="list-style-type: none"><li>– Manual ventilation or spontaneous breathing possible</li><li>– Emergency O<sub>2</sub> delivery (electronically controlled gas mixer) or fresh-gas delivery (mechanically controlled gas mixers) available</li><li>– Anesthetic agent delivery from connected vaporizers possible</li></ul>
Complete device failure	If backup manual mode is activated: <ul style="list-style-type: none"><li>– Manual ventilation or spontaneous breathing possible</li><li>– Emergency O<sub>2</sub> delivery (electronically controlled gas mixer) or fresh-gas delivery (mechanically controlled gas mixers) available</li><li>– Anesthetic agent delivery from connected vaporizers possible</li></ul>

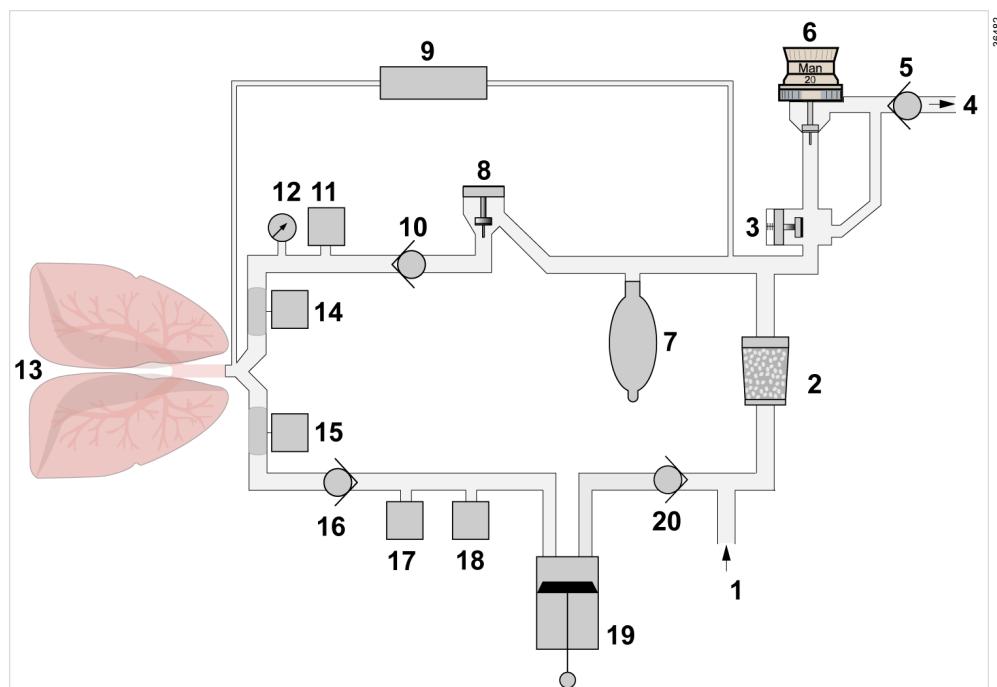
### 3.3

## Gas flow diagram

#### 3.3.1

### Breathing system and adjacent gas-carrying components

The following schematic illustration shows the breathing system and adjacent components in the gas flow of the breathing gas. Some of the components shown are available as an option or only with certain device equipment.



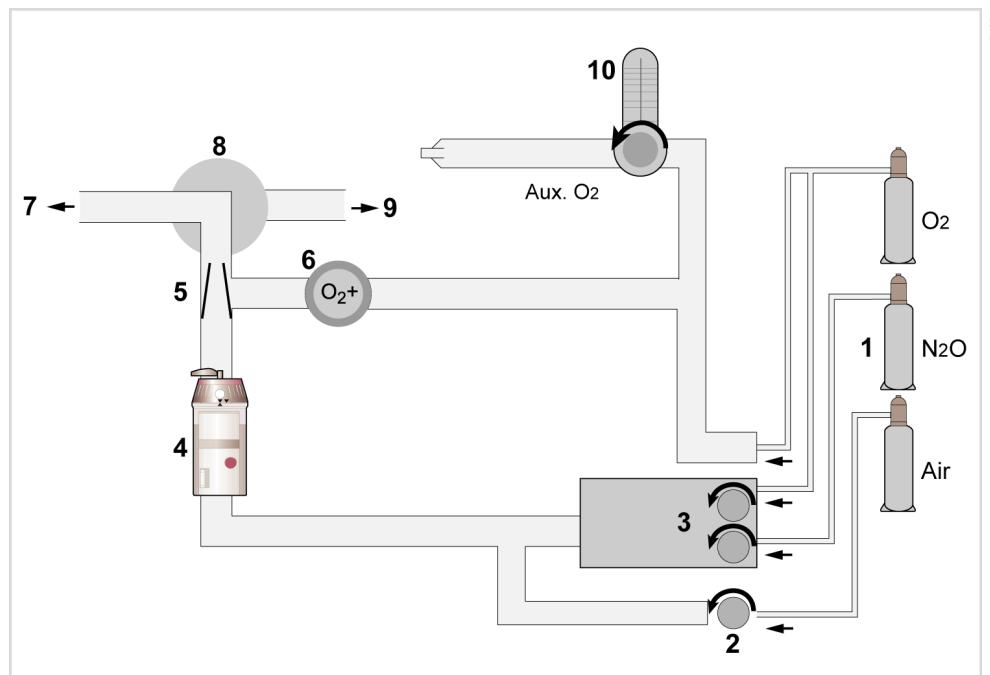
No.	Designation
1	Fresh gas ( $O_2$ , Air, $N_2O$ ) and anesthetic gas
2	$CO_2$ absorber
3	Changeover between mechanical ventilation and Manual / Spontaneous
4	Anesthetic gas receiving system
5	Anesthetic gas scavenging valve
6	APL valve
7	Breathing bag
8	PEEP/Pmax valve
9	Patient-gas measurement module
10	Expiratory valve
11	Expiratory pressure measurement
12	Airway pressure gauge
13	Patient
14	Expiratory flow sensor
15	Inspiratory flow sensor
16	Inspiratory valve
17	Inspiratory pressure measurement
18	Inspiratory $O_2$ sensor

**No. Designation**

- 19 Piston ventilator  
20 Fresh-gas decoupling valve

**3.3.2****Gas supply (mechanically controlled gas mixer with flow tubes)**

The following schematic illustration shows the gas mixer and adjacent components in the fresh-gas flow. Some of the components shown are available as an option or only with certain device equipment.

**No. Designation**

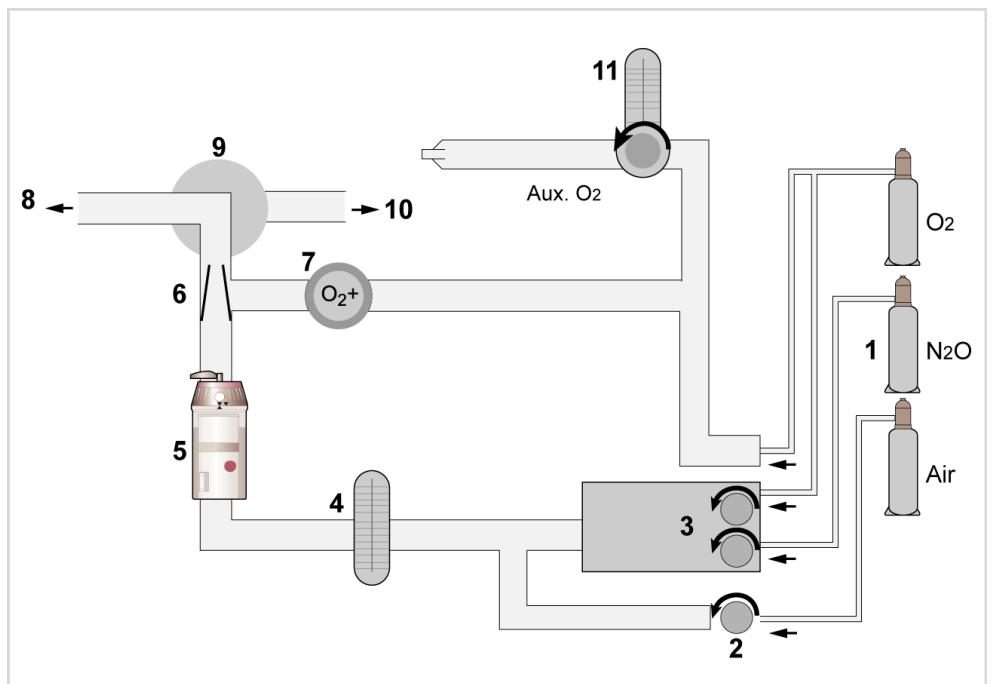
- 1 Gas supply (central supply or gas cylinders)  
2 Flow control valves  
3 Minimum O<sub>2</sub> delivery<sup>1)</sup>  
4 Vaporizer  
5 Ejector  
6 O<sub>2</sub> flush  
7 Breathing system  
8 Switch-over valve  
9 External fresh-gas outlet  
10 O<sub>2</sub> flowmeter

1) Only with 3-gas gas mixers

## 3.3.3

**Gas supply (mechanically controlled gas mixer with electronic flow measurement)**

The following schematic illustration shows the gas mixer and adjacent components in the fresh-gas flow. Some of the components shown are available as an option or only with certain device equipment.

**No. Designation**

1 Gas supply (central supply or gas cylinders)

2 Flow control valves

3 Minimum O<sub>2</sub> delivery<sup>1)</sup>

4 Total flow tube

5 Vaporizer

6 Ejector

7 O<sub>2</sub> flush

8 Breathing system

9 Switch-over valve

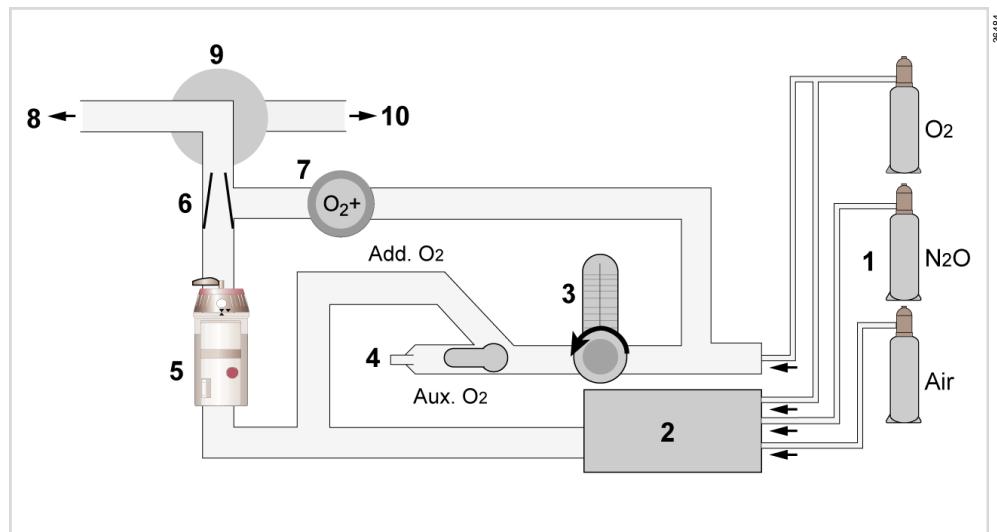
10 External fresh-gas outlet

11 O<sub>2</sub> flowmeter

1) Only with 3-gas gas mixers

### 3.3.4 Gas supply (electronically controlled gas mixer)

The following schematic illustration shows the gas mixer and adjacent components in the fresh-gas flow. Some of the components shown are available as an option or only with certain device equipment.



#### No. Designation

- |    |  |
|----|--|
| 1  | Gas supply (central supply or gas cylinders) |
| 2  | Gas mixer                                    |
| 3  | O <sub>2</sub> flowmeter                     |
| 4  | O <sub>2</sub> switch                        |
| 5  | Vaporizer                                    |
| 6  | Ejector                                      |
| 7  | O <sub>2</sub> flush                         |
| 8  | Breathing system                             |
| 9  | Switch-over valve                            |
| 10 | External fresh-gas outlet                    |

## 4 Assembly and preparation

### 4.1 Safety instructions

#### 4.1.1 Hoses, filters, cables, and breathing bags

Additional components or certain hose configurations may alter the values for leakage, compliance, and inspiratory and expiratory resistances and thus affect the therapy. Consequently, the patient may be put at risk, e.g., the tidal volume may deviate.

- ▶ When using configurations that deviate from a standard breathing circuit, the user must pay particular attention to the measured values.
- ▶ Perform a leakage test after replacing breathing hoses, particularly extendable hoses, vaporizers, soda lime, or other components.
- ▶ Perform a leakage test after changing the length of extendable hoses.
- ▶ Do not use extendable hoses to ventilate neonates.

As a result of leakage, ambient air may get into the breathing gas, breathing gas may escape, or contamination of the connected central supply may occur.

The patient or the user may be put at risk due to the following:

- Reduction of the depth of anesthesia
- Incorrect gas measurements
- The applied volume is less than the set volume.
- Accumulation of anesthetic gas in the ambient air
- Contamination of the supply gases
- The sample line is damaged.
- The CO<sub>2</sub> absorber is incorrectly locked in place.
- ▶ Connect the sample line correctly.
- ▶ Perform the leakage test before using the device. Rectify the leakage or reduce it to a minimum.
- ▶ If the central supply fails during operation, disconnect the hoses for the failed gas from the central supply.
- ▶ After mounting and replacing, make sure the CO<sub>2</sub> absorber is firmly locked into place.

Leakage in the inner hose of a coaxial breathing circuit may result in rebreathing CO<sub>2</sub> or inadequate gas exchange. The device can only detect such leakage if a separate test with a coaxial test adapter is performed.

- ▶ Check the inner hose for leakage. With Dräger hoses, use the appropriate test adapter. Next, perform a leakage test on the entire breathing circuit. Observe the following information: "Checking a coaxial breathing circuit for leaks with the leakage assistant", page 117.
- ▶ Monitor the measured gas concentrations during ventilation.

#### 4.1.2

### CO<sub>2</sub> absorber

#### Soda lime drying out

Moisture losses occur if fresh gas is continuously passed through the soda lime. If the moisture falls below the minimum level, the following adverse reactions occur regardless of the type of soda lime and inhalational anesthetic agent used:

- Reduced CO<sub>2</sub> absorption and consequently an increase in inspiratory CO<sub>2</sub> values
- Increased generation of heat in the CO<sub>2</sub> absorber and consequently increased breathing gas temperature
- Formation of carbon monoxide
- Absorption and/or degradation of the inhalational anesthetic agent
- ▶ Check the soda lime for color changes regularly and replace if necessary, especially if the inspiratory CO<sub>2</sub> value increases unexpectedly.
- ▶ Do not use unnecessarily high fresh-gas flows.
- ▶ Only use the O<sub>2</sub> flush when it is required.
- ▶ With electronically controlled gas mixer:  
Only use the emergency O<sub>2</sub> delivery when it is required.
- ▶ With mechanically controlled gas mixers:  
Do not leave the flow control valves open for an unnecessarily long period of time.
- ▶ Use a suitable soda lime such as Drägersorb Free. Do not use soda lime based on potassium hydroxide.

#### Chemical burns due to soda lime

Soda lime is caustic and is a strong irritant for eyes, skin, and airway.

- ▶ Handle the soda lime carefully and do not spill it.

#### 4.1.3

### Water trap and integrated patient-gas measurement module

Due to the technical characteristics of gas measurement, the measured gas values might be inaccurate at high respiratory rates and certain I:E ratios. As a result, the patient could be put at risk.

- ▶ Pay attention to the technical data for gas measurement.

Contaminants, aerosol propellants, damage, or overfilling of the water trap can impair gas measurement. This may result in inadequate ventilation and the patient may be put at risk.

- ▶ Check the water level in the water trap regularly and empty or replace the water trap if necessary.
- ▶ Do not use medication nebulizers.
- ▶ Follow the instructions for use of the water trap.
- ▶ A device equipped with an integrated patient-gas measurement module must always be operated with a water trap fitted to the patient-gas measurement module.

Silicone residues or aerosol residues in the water trap can get into the measuring cuvette. As a result, the measurement may be compromised or a fire could start, putting the user and patient at risk.

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

#### 4.1.4

## Electrical safety

### Ambient conditions

If the device is operated at ambient temperatures above 35 °C (95 °F), the battery cannot be charged properly. The power supply out of the battery may be limited. As a result, the patient could be put at risk.

- Do not expose the device to temperatures above 35 °C (95 °F) on a permanent basis.

### Mains power supply

If the device is connected to a power socket with incorrect mains voltage or a power socket without a protective ground, an electric shock may occur. Connecting the device to power socket strips can lead to an increased leakage current. This may result in an electric shock and the user and patient may be put at risk.

- Connect the device only to power sockets with correct mains voltage and a protective ground.
- Do not connect the device to power socket strips.

### Battery supply

If the battery is not sufficiently charged, it may not be possible to maintain operation for long enough if the mains power supply fails. As a result, the patient could be put at risk.

- Before first operation or after storage, charge the battery for at least 8 hours.
- Check the functional integrity of the battery by performing regular inspections.

### Auxiliary power sockets

The connection of devices to auxiliary power sockets can lead to an increased leakage current. If the protective ground conductor of one of these devices fails, the leakage current may rise above the permissible values. This may result in an electric shock or device failure and the patient and user may be put at risk.

- Do not connect additional power socket strips to the auxiliary power sockets on the device, but rather to separate power sockets on the wall.
- Have service personnel check the leakage current, especially if additional devices will be connected.
- If the permissible leakage current is exceeded, use separate power sockets on the wall instead of the auxiliary power sockets on the device.
- Do not connect high-frequency surgery equipment to the auxiliary power sockets.
- When making a connection, follow the manufacturer's instructions for all connected devices.

## Interfaces

Connecting devices to the data interfaces (serial ports and network ports) can lead to an increased leakage current. If the protective ground conductor of one of these devices fails, the patient leakage current may rise above the permissible values. This may result in an electric shock and the user and patient may be at risk.

- ▶ Only use USB devices that do not have their own power supply.
- ▶ Only connect devices or networks to a serial port, or to the network port, that have a maximum nominal voltage of 24 V DC and meet one of the following standards:
  - IEC 60950-1 / IEC 62368-1: Ungrounded SELV circuits
  - IEC 60601-1 (as of 2nd edition): Touchable secondary circuits
- ▶ Have service personnel check the leakage current, especially if additional devices will be connected.
- ▶ If the permissible value is exceeded, disconnect the devices from the serial ports.
- ▶ Do not touch the interface ports and the patient simultaneously.

### 4.1.5

## Explosion protection

### Flammable gases

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgery, laser surgery, and faulty cables or connectors can cause fires. As a result, user and patient could be put at risk.

- ▶ This device is not approved for use in areas where oxygen concentrations greater than 25 Vol%, combustible, or explosive gas mixtures are likely to occur.
- ▶ Maintain a distance of at least 200 mm (7.9 in) between electrical connections and components which conduct oxygen and nitrous oxide.
- ▶ Cables and connections must be sufficiently insulated and must not be damaged. Check cables for damage daily.
- ▶ Disconnect all oxygen feeds if oxygen leakage is suspected in the device or its vicinity (e.g., because a corresponding flowing noise can be heard). Do not operate the device, and contact service personnel.
- ▶ Keep ignition sources away from the device.

If a fire starts in the immediate vicinity of the patient, the device could also catch fire. Personal injury and property damage may occur as a consequence.

- ▶ Disconnect the oxygen-carrying connections from the device and the patient.
- ▶ Extinguish the fire and tend to the patient's medical needs.

### Flow sensors

Deposits that were not removed during reprocessing can damage the measuring wires in the flow sensor or cause a fire. As a result, user and patient could be put at risk.

- ▶ Check the flow sensor before insertion and at regular intervals afterwards for visible damage, soiling, and particles.
- ▶ Replace flow sensors when damaged, soiled, or not particlefree.

The flow sensor can ignite medications or other substances based on highly flammable substances. As a result, user and patient could be put at risk.

- ▶ Do not nebulize medications or other substances that are easily flammable or spray them into the device.
- ▶ Do not use substances containing alcohol.
- ▶ Do not allow flammable or explosive substances to enter the breathing system or the breathing circuit.
- ▶ Do not use cyclopropane or ether.

#### **Pressure reducers**

Pressure reducers have an internal pressure release valve. If a fault occurs, gas may escape into the ambient air. Personal injury or property damage may result as a consequence.

- ▶ Do not block or cover the pressure release valve.

### **4.1.6 Mechanical safety**

#### **Accessories**

If the weight of the accessories is unevenly distributed on the device or exceeds the permissible limits, the device may tip over. The end stops of the support arms in use must be functional, otherwise the arms may swing unchecked.

- ▶ Distribute the weight evenly.
- ▶ Pay attention to the maximum weight on each support arm.
- ▶ Check whether the additional counterweight in the lower section of the trolley is required (see "Compact version with counterweight", page 68).
- ▶ Check the functional integrity of the support arm end stops after the following activities:
  - After fitting accessories
  - After transporting the device

#### **Trapping of body parts**

Movable components or attached parts may cause crushing due to trapping. Pay special attention to edges, movable parts, and corners when working with the following components:

- ▶ Breathing system cover
- ▶ Drawers
- ▶ Folding table extension
- ▶ Pull-out writing tray
- ▶ Support arms for mounted devices
- ▶ Accessories such as gas cylinders, vaporizers, CLIC absorbers, and CLIC adapters

#### **Accidental movement of the trolley**

An unbraked device may accidentally move during operation. As a result, user and patient could be put at risk.

- ▶ To prevent this, actuate the castor brakes. Check the functional integrity of the brakes.

### Strangulation

Negligent placement of hoses, cables, and similar device components can put the patient at risk.

- Use particular caution when establishing connections to the patient.

### Transport

If the device collides with an obstacle during transport, the pressure reducers may be damaged. This may cause a fire. Take the following measures before transporting:

- Align the pressure reducers so that they are protected from collisions.
- Close the valves on the gas cylinders.
- If no gas cylinders are connected, fasten the pressure reducers with the hook-and-loop straps of the cylinder holders.

During transport, the device may tip over due to incorrect handling or carelessness. Personal injury or property damage may result as a consequence.

- Remove accessories mounted on the column cover before transport.
- When pushing the device, hold on to the standard rail with handle (right side of the device).
- The device may only be moved by persons who have the physical ability to do so.
- Always have the device moved by 2 persons for better maneuverability and when it is being transported over sloping surfaces.
- When the device is moved over inclines, around corners, or over thresholds (e.g., through doors or in elevators), make sure that it does not bump against anything.
- Do not pull the device over hoses, cables, or other obstacles lying on the floor.
- Do not operate either the central brake or any of the castor brakes while the device is being moved.
- Do not lean against the device.
- After transport, perform a visual inspection for damage.

## 4.1.7

### Color codes and labels

If the vaporizer is filled with the wrong anesthetic agent or if the filling level is too low, incorrect anesthetic gas concentrations or concentrations that are too low can occur as a result.

- Compare the color code and labeling on the vaporizer used with the anesthetic agent bottle and the anesthetic agent indicated on the screen.
- Observe the vaporizer filling level.

#### 4.1.8

#### Gas supply

All gas supplies (central supply, gas cylinders) must be correctly connected since otherwise the backup system (gas cylinders) will not be available if the gas supply fails. Other devices, e.g., a bronchial suction system, which are connected to the gas outlets of the device, will no longer be supplied with gas. As a result, the patient could be put at risk.

- ▶ Make sure that all compressed gas hoses are correctly connected to the rear side of the device.
- ▶ After connecting the gas supplies, ensure their functional integrity. Set the supply pressure from the gas cylinders in accordance with the specifications on the device.
- ▶ Even when the device is connected to the central supply, the gas cylinders should remain by the device with valves closed as backup.
- ▶ On devices that are equipped with Advanced Cylinder Support, the valves of the gas cylinders can remain open.
- ▶ Always monitor the gas supply to connected devices independently of the main device.

Devices connected to the gas supply may be damaged by inadequate gas quality. The use of non-medical gas can result in gas compositions that impair the functional integrity of the device.

- ▶ Use only medical gases.
- ▶ Follow the national and international standards regarding the use of medical gases.

Impermissible supply pressures or using oxygen with an insufficient purity can cause an incorrect gas composition. As a result, the patient could be put at risk.

- ▶ Check the supply pressures of the central supply and of the gas cylinders before operation.
- ▶ If O<sub>2</sub> is used, its purity must be at least 99.5 %.

The following effects can occur when using O<sub>2</sub> concentrators ("oxygen 93") and can put the patient at risk:

- Deviations between the set value and the actual value for fresh-gas flow and O<sub>2</sub> concentration in the fresh gas
- Inaccurate measured values for volume, anesthetic agent consumption, econometer, and low-flow wizard
- Accumulation of argon in low-flow operation and minimal-flow operation
- ▶ Do not use any O<sub>2</sub> concentrators.

A failure of the gas supply can result in a risk of patient injury. In the following cases, the availability of the gas cylinders cannot be monitored and the backup functionality may be put at risk:

- Instead of a Dräger pressure reducer, a pressure reducer without the required pressure sensor is used.
- A central supply hose is connected to the connector for the compressed gas cylinders.
- If monitoring of the gas cylinders is not available, suitable pressure monitoring conforming to ISO 80601-2-13 must be used. This will allow the user to read the cylinder pressures from the user's operating location.
- Do not connect central supply hoses to the connectors for gas cylinders.

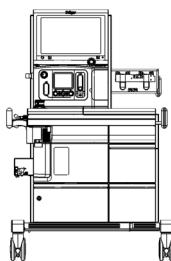
## 4.2

## Mounting of accessories

Information on the mounting of accessories is described in the assembly instructions.

### 4.2.1

#### Large version



The maximum total weight of the accessories is 45 kg (99 lb).

The weight is distributed as follows:

##### Column cover

The column cover may be loaded with a maximum of 15 kg (33 lb).

##### Left and right sides

Mounting position	Maximum weight	Additional restrictions
All accessories on a single arm	25 kg (55 lb)	Maximum arm length: 75 cm (29 in)
Accessories distributed over several arms on both sides	40 kg (88 lb)	Maximum arm length: 40 cm (16 in)
Accessories on both sides, distributed over 2 arms	15 kg (33 lb) per arm	Maximum arm length: First arm: 75 cm (29 in) Second arm: 40 cm (16 in)
Accessories that are not mounted on arms	See product label	Maximum distance to the device: 10 cm (4 in)

##### Rear

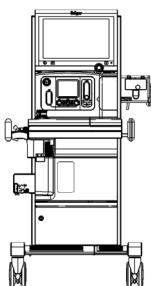
The rear may be loaded with a maximum of 40 kg (88 lb). In addition to the accessories, this must also take account of the weight of gas cylinders including the pressure reducers and the hanger yoke system.

##### Other components

Component	Maximum weight
Writing tray	20 kg (44 lb)
Standard rail	10 kg (22 lb)
Large drawer	3 kg (6.6 lb)
Small drawer	2 kg (4.4 lb)

## 4.2.2

### Compact version



The maximum total weight of the accessories is 30 kg (66 lb).

The weight is distributed as follows:

#### Column cover

The column cover may be loaded with a maximum of 15 kg (33 lb).

#### Left and right sides

Mounting position	Maximum weight	Additional restrictions
All accessories on a single arm	15 kg (33 lb)	Maximum arm length: Left side: 75 cm (29 in) Right side: 40 cm (16 in)
Accessories that are not mounted on arms	See product label	Maximum distance to the device: 10 cm (4 in)

#### Rear

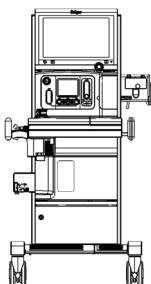
The rear may be loaded with a maximum of 40 kg (88 lb). In addition to the accessories, this must also take account of the weight of gas cylinders including the pressure reducers and the hanger yoke system.

#### Other components

Component	Maximum weight
Writing tray	20 kg (44 lb)
Standard rail	10 kg (22 lb)
Large drawer	3 kg (6.6 lb)

## 4.2.3

### Compact version with counterweight



There is a counterweight of 30 kg (66 lb) fitted in the lower section of the trolley. The maximum total weight of the accessories rises to 45 kg (99 lb) with this.

The weight is distributed as follows:

#### Column cover

The column cover may be loaded with a maximum of 15 kg (33 lb).

#### Left and right sides

Mounting position	Maximum weight	Additional restrictions
All accessories on a single arm	20 kg (44 lb)	Maximum arm length: 75 cm (29 in)
Accessories distributed over several arms on both sides	30 kg (66 lb)	Maximum arm length: 40 cm (16 in)
Accessories that are not mounted on arms	See product label	Maximum distance to the device: 10 cm (4 in)

#### Rear

The rear may be loaded with a maximum of 40 kg (88 lb). In addition to the accessories, this must also take account of the weight of gas cylinders including the pressure reducers and the hanger yoke system.

## Other components

Component	Maximum weight
Writing tray	20 kg (44 lb)
Standard rail	10 kg (22 lb)
Large drawer	3 kg (6.6 lb)

## 4.3 Before first operation

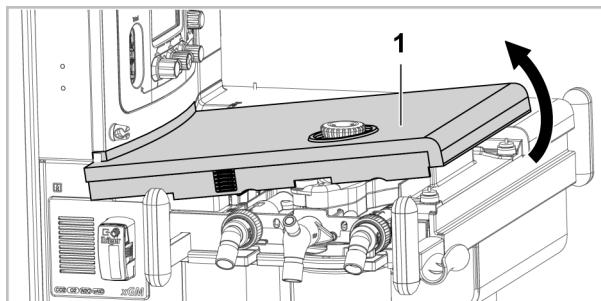
**i** The breathing system must be reprocessed before the device is operated for the first time. Perform the reprocessing in accordance with the reprocessing instructions supplied with the product.

### 4.3.1 Inserting the O<sub>2</sub> sensor cell

**i** Before inserting the O<sub>2</sub> sensor cell, make sure the date and time are correctly set on the device. Otherwise, there may be errors in the lifespan monitoring of the sensor cell.

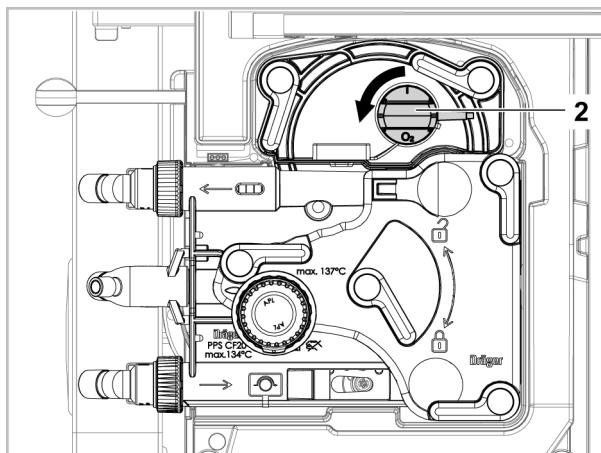
If the device is equipped with an O<sub>2</sub> sensor, an O<sub>2</sub> sensor cell must be inserted into the O<sub>2</sub> sensor.

1. Remove the breathing system cover (1).



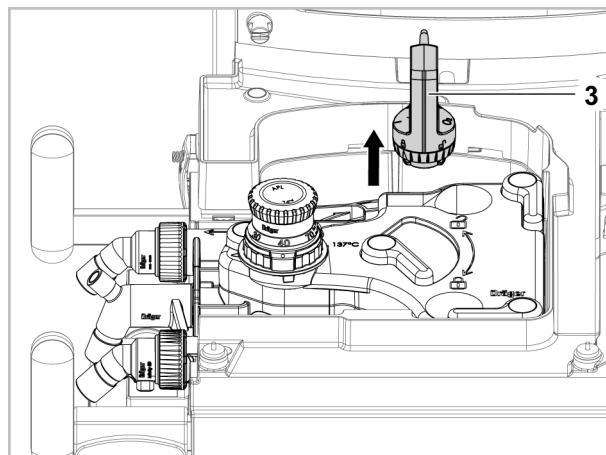
37062

2. Turn the O<sub>2</sub> sensor (2) counterclockwise.



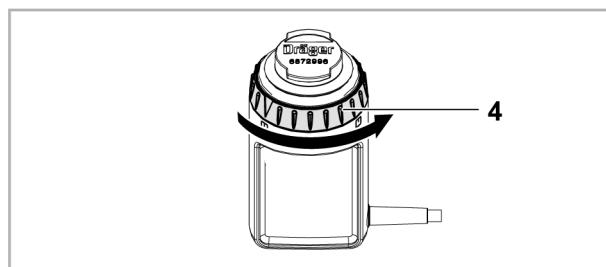
37079

3. Take out the O<sub>2</sub> sensor (3).



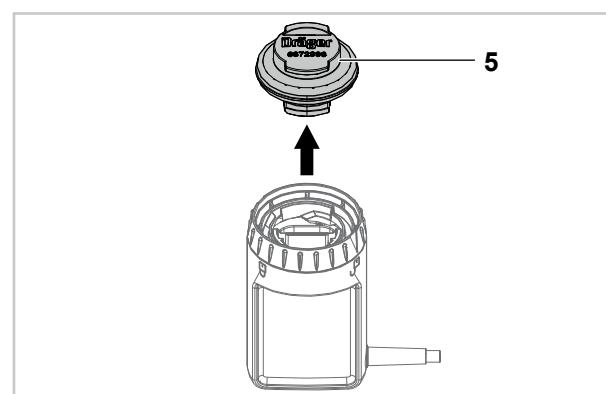
37080

4. Turn the knurled nut (4) approximately 90° counterclockwise.



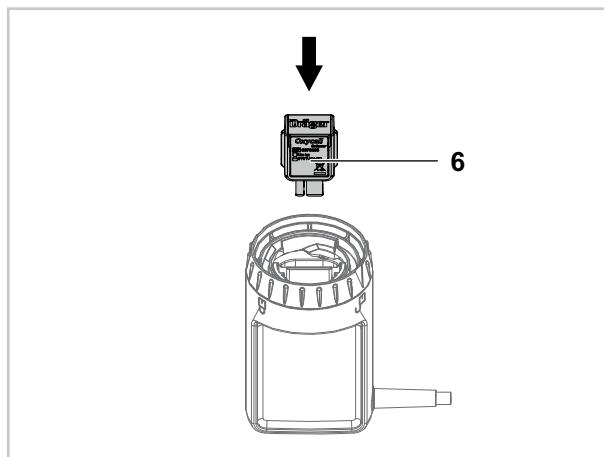
37172

5. Remove the sensor cap (5).



47466

6. Insert the new O<sub>2</sub> sensor cell (6) into the O<sub>2</sub> sensor.

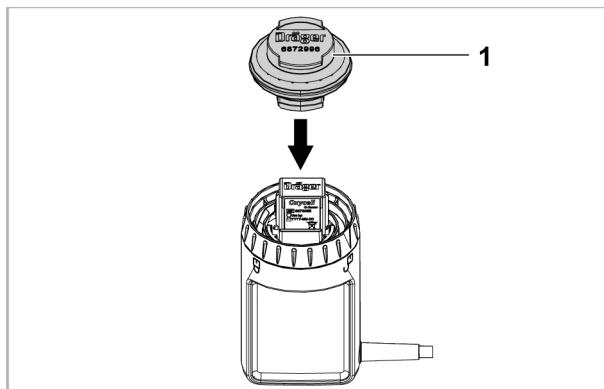


**i** After the O<sub>2</sub> sensor cell has been inserted, the initialization phase of the O<sub>2</sub> sensor takes place. The initialization lasts 30 minutes. The 30 minutes start when the mains power supply is established.

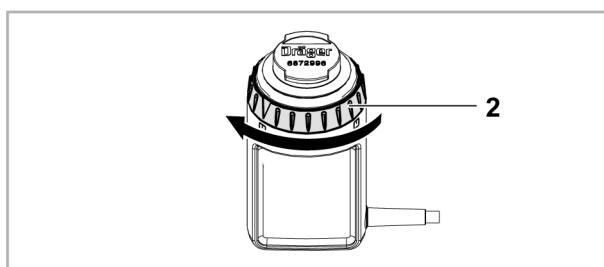
#### 4.3.2

#### Assembling and inserting the O<sub>2</sub> sensor

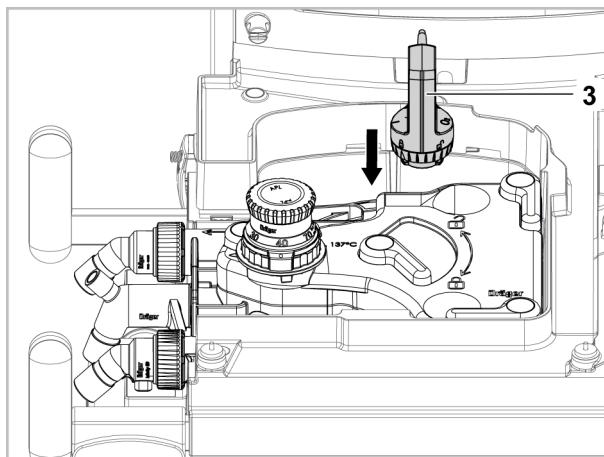
1. Place the sensor cap (1) on the O<sub>2</sub> sensor.



2. Turn the knurled nut (2) about 90° clockwise. Turn it until the palpable resistance is overcome and a click is heard. The sensor cap is now fitted.

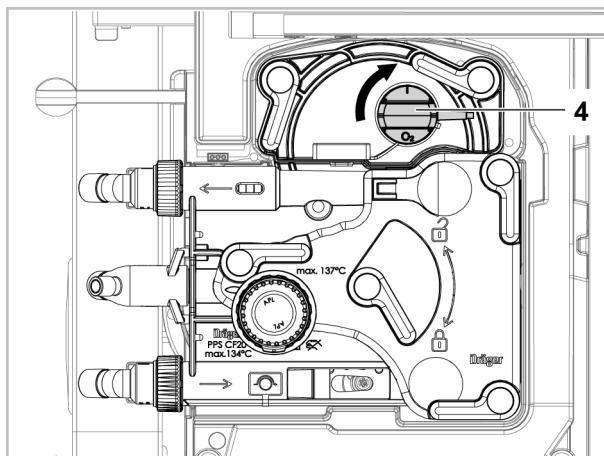


3. Insert the O<sub>2</sub> sensor (3) into the sensor port.



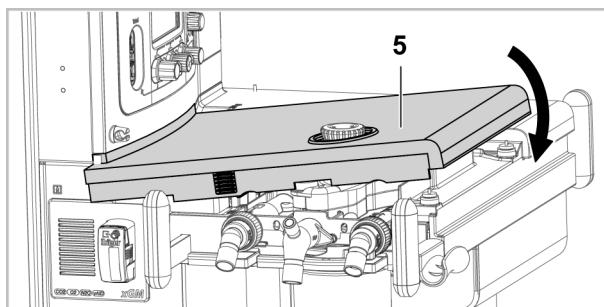
38271

4. Turn the O<sub>2</sub> sensor (4) clockwise.



38272

5. Put the breathing system cover (5) in place and click it into position.



36505

#### 4.3.3

### Establishing the mains power supply

The mains voltage must correspond to the voltage range indicated on the rating plate on the rear of the device.

To protect from inadvertent disconnection of the power cable, the power inlet of the device is secured with a guard plate.

#### ⚠ WARNING

##### Risk due to incorrect mains voltage or missing protective ground

If the device is connected to a power socket with incorrect mains voltage or a power socket without a protective ground, an electric shock may occur.

- ▶ Connect the device only to power sockets with correct mains voltage and a protective ground.

#### NOTICE

##### Risk of electrical overload

If the device is connected to an additional power socket strip, this may cause an electrical overload.

- ▶ Do not connect the device to power socket strips.
- ▶ Do not connect additional power socket strips to the auxiliary power sockets on the device, but rather to separate power sockets on the wall.

1. Plug the power plug into the power socket.

 The power plug must be readily accessible so that the power supply to the device can be interrupted quickly in the event of a device malfunction.

2. Using the information displayed on the gas mixer unit, check that power is supplied.
3. Turn on the device.

#### 4.3.4

### Charging the battery

The internal battery will automatically start charging as soon as the device is connected to the mains power supply.

#### 4.3.5

### Connecting other devices to the auxiliary power sockets

An illustration of the auxiliary power sockets can be found on page 33.

- Connect the power cable of the other device to an auxiliary power socket.

Make sure that the maximum current consumption of the other devices does not exceed the permissible value.

#### ⚠ WARNING

##### Risk of fire

Components that can heat up or cause sparks, such as electrical items, batteries, or power supply units, are unable to cool down in enclosed storage locations and can cause a fire.

- ▶ Do not keep electrical items in the drawers or in the storage compartment at the rear of the device.

#### 4.3.6

#### Establishing potential equalization

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 connector must be readily accessible and the potential equalization cable must be removable without tools.

##### 4.3.6.1

##### Connecting the potential equalization cable

- Connect the potential equalization cable to the potential equalization pin on the device (see "Connectors", page 30).
- Connect the potential equalization cable to a potential equalization connector of the health-care facility (e.g., wall, ceiling supply unit, operating table).

#### 4.3.7

#### Connecting devices to the data interfaces

This device is equipped with data interfaces such as LAN and RS232. These interfaces can be used to set up an IT network in accordance with IEC 60601-1.

##### 4.3.7.1

##### Establishing a data connection

##### ⚠ CAUTION

##### Risk of a cybersecurity attack

The following dangerous situation can arise if the network does not meet the security requirements.

An overload of the device due to high network load (e.g., caused by denial-of-service attacks) may lead to a shut-down of the device's network port. The network port will not be available again until the device is restarted. This prevents unauthorized access to the system, protecting the primary device functions.

- ▶ Restart the device and inform service personnel.

##### ⚠ WARNING

##### Risk of a cybersecurity attack

The RS-232 port is used to establish a point-to-point connection. Unauthorized access to the device can impair the device function.

- ▶ Unauthorized persons must not have access to the data sent via the RS-232 port.
- ▶ All device interfaces must be protected against malware and computer viruses.
- ▶ If commercially available RS-232-to-Ethernet converters are used, the operating organization is responsible for the use and correctness of the data.

- Connect the device to a network or a computer.

An illustration of the ports can be found on page 30.

To use the flow correction (see page 149), connect anesthetic gas monitor to the COM 2 port.

Only use the cables from the list of accessories.

For further information on configuring the particular interface, see page 220.

## 4.4

### Intrahospital transport

Transport includes any movement of the device to other rooms or functional areas. Alignment or positioning of the device within the operating room is not counted as transport.

#### 4.4.1

##### Increasing the tipping stability during transport

1. Carefully fold the arms with any mounted accessories against the device, (e.g., patient monitor, data management system, syringe pumps). Insert the additional pull-out work surface. Fold down the additional folding table extension.
2. Use a strap to prevent the arms from swinging out in an uncontrolled manner.
3. Remove all loose objects from the attached arms and the shelves.
4. Remove all objects from the standard rails.
5. Remove the vaporizers.
6. Remove all objects from the writing tray and the work surface.
7. Slide the additional pull-out writing tray (if present) completely into the device.
8. Position the breathing bag arm (if present) close to the device.
9. Push in and lock the drawers.

#### 4.4.2

##### Parking the medical device

Always apply all brakes when parking the device, especially on inclined surfaces.

#### 4.4.3

##### Visual inspection after transport

###### **WARNING**

###### **Risk of device malfunction**

The device, especially hoses and cables, can become damaged during transport. As a result, the device function may be impaired. The patient may be put at risk.

- Check the device for damage after transport, particularly the hoses and cables.

1. Check the device for damage, particularly the hoses and cables.
2. Do not operate a damaged device. The damage must be repaired by service personnel before the device is used.
3. Before connecting the device to the power supply, check the electrical connections and auxiliary power sockets for residual moisture. Wipe off the moisture. Ensure sufficient drying time.
4. Before operating the device, make sure it is on a level surface without inclination.

## 4.5 Gas supply

### 4.5.1 Connecting to the central gas supply system

1. Screw the compressed gas hoses for the central gas supply system to the gas inlets by hand, see page 31.
- 

#### **WARNING**

##### **Danger to the patient and user**

If the strain relief for the compressed gas hoses is not used, the device may be damaged.

- Use the strain relief for the compressed gas hoses.
- 

2. Insert the compressed gas hoses into the strain relief. Tighten the strain relief, see page 28.
3. Connect the compressed gas hoses to the terminal units.
4. Check that all hoses are correctly connected and that the gas supply is established. To do this, observe the corresponding displays on the gas mixer unit, depending on gas mixer:
  - Symbols on the status display
  - Integrated pressure gauges

For further information see: "Gas mixing unit", page 34.

### 4.5.2 Connecting the gas cylinders

#### 4.5.2.1 Connecting gas cylinders with screw connections

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#### **WARNING**

##### **Danger to the patient and user**

If the strain relief for the compressed gas hoses is not used, the device may be damaged.

- Use the strain relief for the compressed gas hoses.
- 

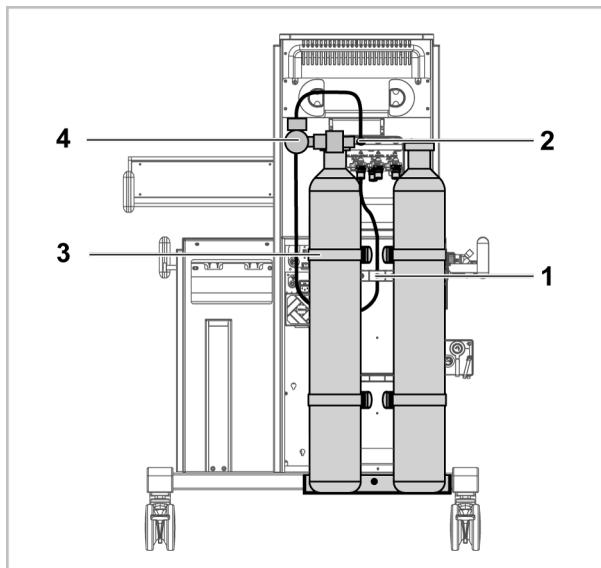
#### **WARNING**

##### **Risk of fire**

Ignition sources together with oxygen can cause fires.

- Do not position oxygen sources in the vicinity of ignition sources, e.g., electrical connectors.
  - Always fit the oxygen cylinder in the right-hand fixing position on the rear.
-

1. Insert the compressed gas hoses into the strain relief (1). Tighten the strain relief.



2. Check that the pressure measuring lines above the gas inlets are correctly connected (2).
3. Place the gas cylinders (3) in the gas cylinder holders. Secure with hook-and-loop straps.

### **⚠ WARNING**

#### **Risk of personal injury and damage to the device**

Pressure reducers have an internal release valve. If a fault occurs, gas may escape into the ambient air.

- Do not block or cover the release valve.

### **⚠ WARNING**

#### **Risk of fire**

If the device collides with an obstacle during transport, the pressure reducers may be damaged.

- When connecting the pressure reducers, ensure that they do not protrude beyond the device.

### **⚠ WARNING**

#### **Risk of fire**

The connectors on the gas cylinders and pressure reducers must be undamaged and free from dust, particles, and grease. Otherwise, there is risk of fire.

- When handling pressure reducers, follow the relevant national laws and regulations.

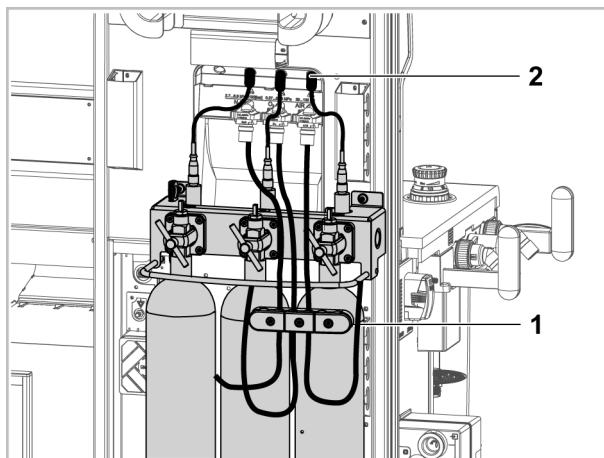
4. Tightly screw the pressure reducers (4) to the gas cylinder valves. The connectors must fit each other directly. Do not use an adapter.
5. If no gas cylinders are connected, secure the pressure reducers (4) with the hook-and-loop straps (3) so they do not bang against the rear of the device.

#### 4.5.2.2

#### Connecting suspended gas cylinders with pin-index connectors

##### Before first use

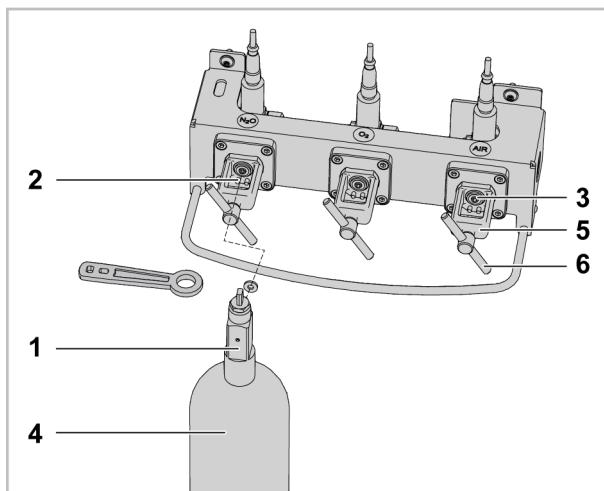
1. Insert the compressed gas hoses into the strain relief (1) on the rear of the device. Tighten the strain relief.



2. Connect the pressure measurement lines to the connectors (2).
3. The gas cylinder holder can be fastened at 2 different heights (not shown in this illustration). Adjust the position of the gas cylinder holder to the size of the gas cylinder in use. Contact service personnel to do this.

##### Fitting the gas cylinders

1. Remove the protection cap from the head of the cylinder (1).

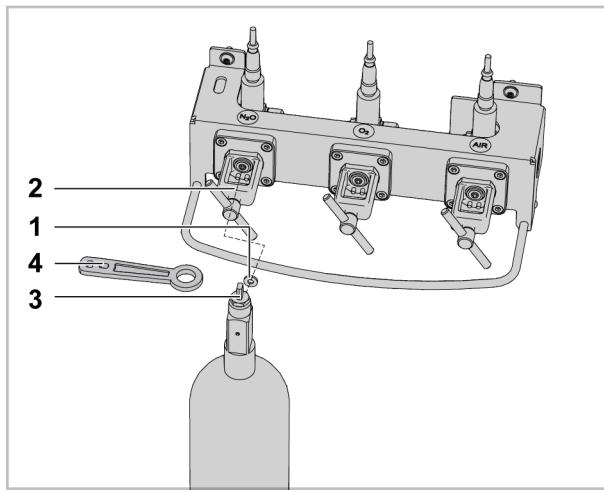


2. Make sure that both pin-index pins (2) are present below the gas inlet (3).
3. Align the gas cylinder (4) so that the pin-index holes on the head of the cylinder (1) are pointing towards the pin-index pins (2).
4. Insert the head of the cylinder (1) into the cylinder holder (5) from below.
5. Allow the pin-index pins (2) to engage in the pin-index holes.
6. Turn the handle (6) clockwise until the threaded stud is slightly screwed into the visible recess on the head of the cylinder.  
Align the gas cylinder (4) so that it is hanging vertically.
7. Tighten the handle (6).

8. Secure the gas cylinders (4) with hook-and-loop straps (not shown here).

### Replacing the gas cylinder

1. Remove the old sealing washer (1).



40163

2. Insert a new sealing washer (1) on the cylinder holder (2).
  3. Continue with fitting the gas cylinders, see "Fitting the gas cylinders".
- If required, the gas cylinder valve (3) can be opened with the supplied wrench (4).

#### 4.5.2.3 Handling O<sub>2</sub> gas cylinders

##### **⚠ WARNING**

##### Risk of explosion

When pressurized, O<sub>2</sub> is self-igniting in combination with oil or grease.

- Do not oil or grease the gas cylinder valve or the pressure reducer on the O<sub>2</sub> cylinder. Do not touch with oily or greasy fingers.
- The gas cylinder valves must only be opened and closed slowly. Do not use any tools on equipment with screw connections.

Have service personnel replace any leaky or stiff gas cylinder valves.

#### 4.5.3 Fitting the vaporizers

The device can be operated with vaporizers which have a Dräger Auto Exclusion, Interlock or Selectatec plug-in adapter. Dräger recommends using only vaporizers that are listed in the list of accessories and have been tested.

The vaporizers used must conform to the ISO 8835-4 or ISO 80601-2-13 standard.

## Connecting the vaporizers

### ⚠ WARNING

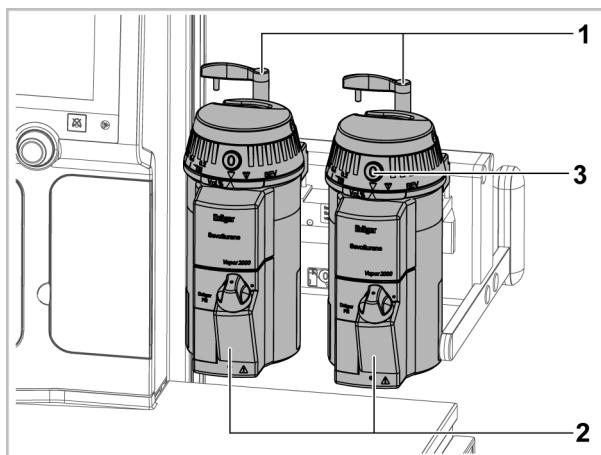
#### Risk due to improperly mounted vaporizers

Incorrectly mounted vaporizers can cause leakage. This can cause the fresh-gas delivery to be too low or contaminate the ambient air. Patient and user can be endangered.

- ▶ Make sure that the connected vaporizers are hanging vertically and are not tilted by objects leaning against them.
- ▶ When using D-Vapor vaporizers, make sure that the power cable is not pinched.
- ▶ After mounting the vaporizers, perform a leakage test.

1. Set all the vaporizers upright and securely on the plug-in adapter.
2. Turn the locking levers (1) clockwise. The vaporizers are locked when the levers are pointing to the left.

The illustration shows vaporizers of the type Dräger-Vapor 2000 with Auto Exclusion.



36493

### ⚠ WARNING

#### Risk due to incorrect anesthetic agent delivery

If the vaporizer is filled with the wrong anesthetic agent or if it is not filled sufficiently, incorrect anesthetic gas concentrations or concentrations that are too low can occur as a result.

- ▶ Compare the color code and labeling on the vaporizer used with the anesthetic agent bottle.
- ▶ Observe the vaporizer filling level.
- ▶ Follow the instructions for use for the vaporizer.

3. Check the filling levels in the sight glasses (2). Fill the vaporizers if required.
4. Turn the control dial on each vaporizer to the **0** position. The key (3) engages.

#### Checking the metering interlock

The vaporizers have an interlock system which by means of a metering interlock prevents the simultaneous opening of 2 vaporizers.

1. Turn the control dial on one of the vaporizers to a position other than **0**.

2. Test the control dials of the other vaporizers to see if they can be turned. The metering interlock is active if the control dial remains in the **0** position.
3. Turn the vaporizer opened in step 1 back to the **0** position.
4. Repeat this test for all the vaporizers.

#### **Special characteristics of the D-Vapor**

1. Connect the power cable to a power socket.
2. If required, establish a potential equalization connection.
3. Stow the cable in a cable duct if necessary.

## 4.6

## **Connecting to the gas scavenging system**

The device is equipped with an active or a passive anesthetic gas receiving system (AGS).

The receiving systems differ in their operations. The active receiving system is designed for connection to an anesthetic gas scavenging system that works with a suction flow (actively). The passive receiving system is designed for connection to a (passive) anesthetic gas scavenging system that works without a suction flow.

### 4.6.1

#### **Active anesthetic gas scavenging**

The suction flow of the connected disposal system actively transports the anesthetic gas out of the receiving system and into the disposal system.

- Make sure that the ventilation slots on the underside of the receiving system are not blocked.

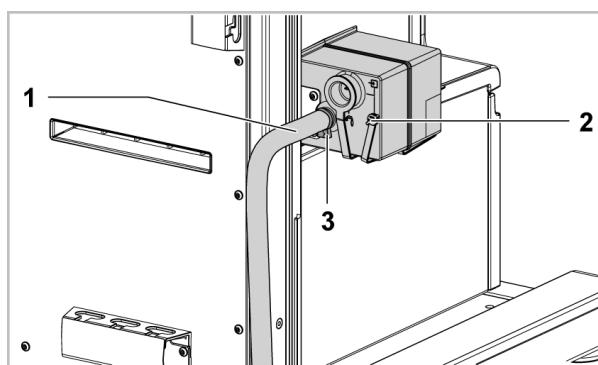
#### **⚠ CAUTION**

#### **Risk of ambient air contamination**

If the anesthetic gas receiving system is not connected to the disposal system, contamination of the ambient air with anesthetic gas may result.

► Connect the anesthetic gas receiving system correctly to the disposal system.

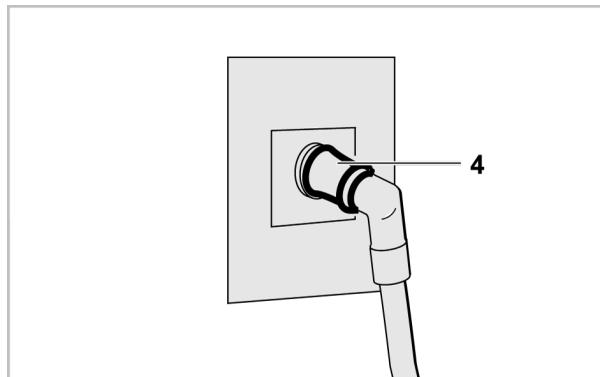
1. Connect the scavenging hose (1) to the nozzle on the receiving system. If an external anesthetic gas monitor is used, connect the sample gas outlet of the monitor with port (2) using the supplied hose connector.



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2. Secure the scavenging hose with the clip (3).

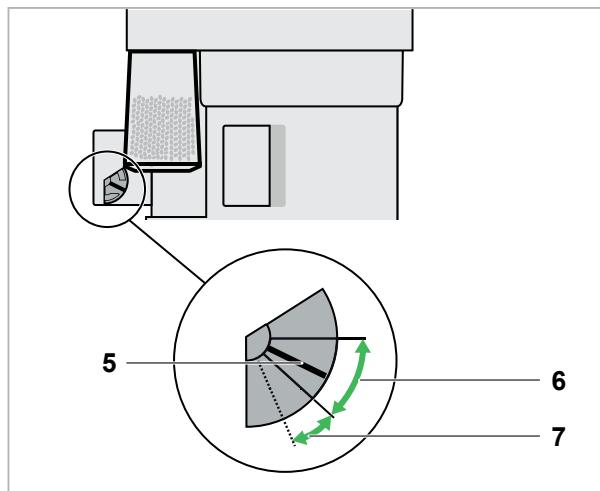
3. Connect the gas probe of the scavenging hose to the terminal unit (4) of the disposal system.



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The integrated anesthetic gas receiving system can be operated in combination with a control valve to adjust the suction flow. Observe the assembly instructions for the control valve.

4. Check the flow indicator.



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If the flow indicator (5) is within the normal range (6), the anesthetic gas scavenging system is functional.

If the flow indicator is floating in the restricted range (7), certain fresh-gas flows should not be exceeded, see "Anesthetic gas receiving system" in chapter "Technical data".

The integrated anesthetic gas receiving system can also be equipped with an ejector instead of the suctioning disposal system. Follow the relevant assembly instructions.

## 4.6.2

### Passive anesthetic gas scavenging

With passive anesthetic gas scavenging, the anesthetic gas is only transported by overpressure in the breathing system. The anesthetic gas can be routed out of the room via a connected scavenging hose.

- Make sure that the ventilation slots on the underside of the receiving system are not blocked.

#### **WARNING**

##### **Risk of negative pressure**

If a passive receiving system is connected to an active scavenging system, a negative pressure may arise in the patient's lungs.

- ▶ Connecting a passive receiving system to an active scavenging system is not permitted.

#### **WARNING**

##### **Risk of overpressure**

If the relief valve in the passive receiving system or the scavenging hose is blocked, overpressure will occur in the breathing circuit and in the patient's lungs.

- ▶ Only connect the passive receiving system using kink-proof and pressure-tight scavenging hoses.
- ▶ Take care that the scavenging hose does not become blocked.
- ▶ Perform a visual inspection of the relief valve for damage and soiling.

#### **WARNING**

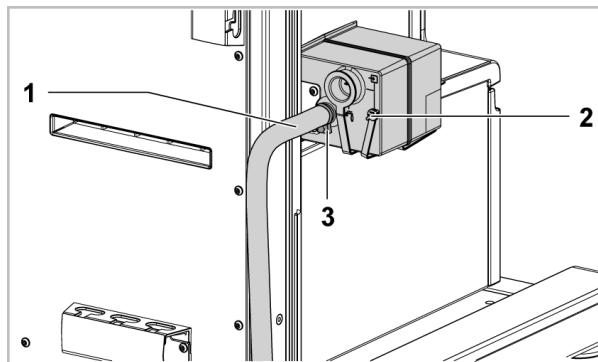
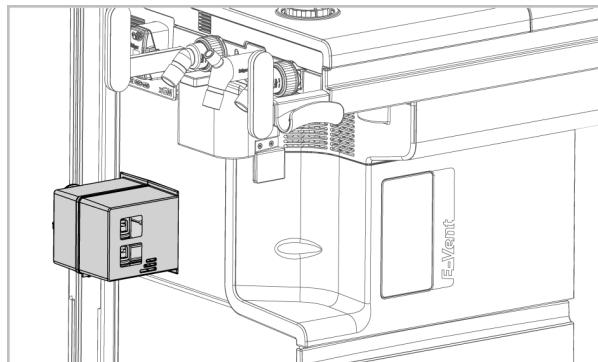
##### **Risk of ambient air contamination**

The ambient air will be contaminated if the passive receiving system feeds excess anesthetic gas to a ventilation system with circulating air.

- ▶ Use the passive receiving system only with ventilation systems that work without circulating air.

1. Connect the scavenging hose (1) to the nozzle on the receiving system. If an external anesthetic gas monitor is used, connect the sample gas outlet of the monitor with port (2) using the supplied hose connector.

 To limit contamination of the ambient air in accordance with ISO 80601-2-13, observe the specifications for the scavenging hose in the technical data.



2. Secure the scavenging hose with the clip (3).
3. Lay the scavenging hose so that the gas is disposed of, e.g., by a ventilation system.
4. Fasten the end of the hose.

## 4.7

## Preparation after reprocessing

- Assemble the device and prepare it ready for operation.  
Observe the reprocessing instructions supplied with the device.

## 4.8

# Selecting and connecting patient-specific accessories

### 4.8.1

## Fitting the breathing circuit and the filters

**i** This device is made without natural rubber latex.

To minimize the risk of contact with latex, use breathing bags and breathing hoses that are not made with natural rubber latex.

The device can be used with Infinity ID breathing hoses or conventional breathing hoses.

If no leakage test has yet been performed after switching on the device, hose compliance and hose resistance will automatically be adopted when Infinity ID breathing hoses are connected.

**i** Do not use any inspiratory or expiratory bacteria filters if the ID functionality of the Infinity ID breathing circuit is to be used. In this case, fit a filter to the Y-piece. In cases which preclude use of a bacteria filter at the Y-piece, the Infinity ID function of the Infinity ID breathing circuit cannot be used.

1. Select suitable accessories for the respective patient category.

**i** When applying tidal volumes in the transition range for a specific patient category, use the smaller breathing bag and the smaller breathing circuit.

	Adults	Pediatric patients	Neonates
Tidal volume	>700 mL	301 to 700 mL	50 to 300 mL
Breathing bag	3 L	2 L	1 L
Breathing circuit	Adults	Pediatric	Neonates (or pediatric)
Filter	Filter or HMEF		Use an HME or a filter with low resistance and compliance. Observe the following information: "Permissible hose configurations", page 87.

### **⚠ WARNING**

#### Risk due to particles and dust

In order 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 filter at the Y-piece or at the inspiratory port.

**⚠ WARNING**

**Risk of infection**

The device and the breathing system can be contaminated with pathogens. The following causes may be present:

- No bacteria filters have been used at the Y-piece or at the expiratory port.
- The device and the breathing system are used for the first time.

Perform the following measures:

- Reprocess the device and the breathing system before the first use.
- Reprocess the device and the breathing system when necessary.
- Perform the reprocessing in accordance with the reprocessing instructions supplied with the product.
- To prevent future contamination, use bacteria filters close to the patient.

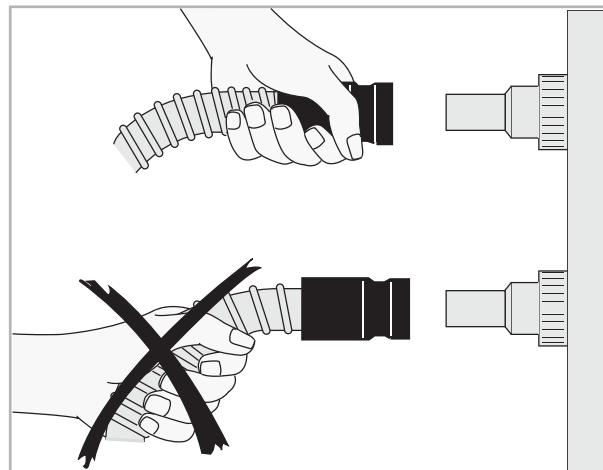
**⚠ CAUTION**

**Risk due to too low tidal volumes**

The hose configuration can influence the values for leakage, compliance, resistance, and the therapy. Consequently, the tidal volume, for example, may be too high or too low.

- Perform a leakage test after replacing breathing hoses, particularly extendable hoses, vaporizers, soda lime, or other components.
- Perform a leakage test after changing the length of extendable hoses.
- Do not use extendable hoses to ventilate neonates.

2. Assemble the breathing circuit and connect it to the Y-piece and nozzles on the breathing system. Observe the following information: "Permissible hose configurations", page 87.



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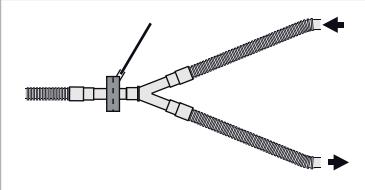
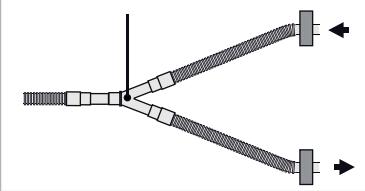
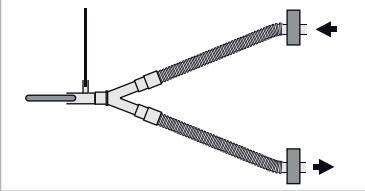
When attaching or removing the breathing hoses, always hold them by the connection sleeve and not by the hose itself.

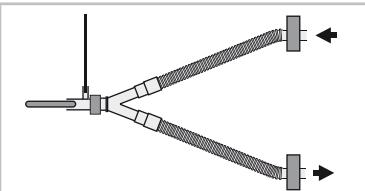
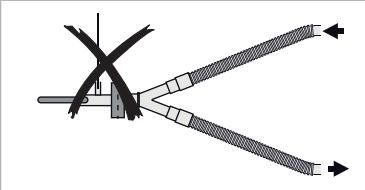
#### 4.8.2

#### Permissible hose configurations

**!** Breathing hoses, sample line, filters, etc. must be arranged carefully and adapted to the patient, particularly for neonates and pediatric patients. For further information see: "CO<sub>2</sub> measurement with pediatric patients and neonates", page 321.

The permissible hose configurations are marked with an "X" in the following table:

Configuration		Adult	Ped.	Neo.
	A breathing system filter or an HME filter between Y-piece and patient; sample line connected to the filter	X	X	
	One breathing system filter on each of the inspiratory port and expiratory port; sample line connected to the Y-piece	X	X	
	<ul style="list-style-type: none"> <li>- One breathing system filter each on the inspiratory port and expiratory port; sample line connected to a connector as close as possible to the patient</li> <li>- Extract the sample gas at a suitable connector.</li> <li>- If no filter can be used at the expiratory port (e.g., if there is intrinsic PEEP due to Air trapping), reprocess the breathing system after every patient.</li> <li>Perform the reprocessing in accordance with the reprocessing instructions supplied with the product.</li> </ul>	X	X	X

Configuration		Adult	Ped.	Neo.
	<p>When taking a gas sample at a connector located as close as possible to the patient</p> <ul style="list-style-type: none"> <li>– One breathing system filter on the inspiratory port and one on the expiratory port</li> <li>– Use only heat and moisture exchangers (HMEs) between the Y-piece and the patient that are listed in the list of accessories.</li> <li>– Do not use fine-pored filters or HME filters between the Y-piece and the patient.</li> <li>– Set the alarm limits for MV low and Paw to suitable values. Observe the following information: "Optimization of the sample gas quality", page 322.</li> </ul>		X	X
	<p>When using fine-pored filters between the Y-piece and the patient</p> <ul style="list-style-type: none"> <li>– Do not connect the sample line between the tube and the filter. Instead, connect it to the filter or the Y-piece.</li> </ul>		X	X

**i** If a filter is used on the inspiratory port and a very low fresh-gas flow has been set, increased condensate will form in the filter and in the inspiratory flow sensor. This can lead to incorrect flow measurement or to flow measurement failure. If a filter is used on the inspiratory port, Dräger recommends a fresh-gas flow of at least 1 L/min.

### 4.8.3 Breathing bag

The breathing bag can be mounted either on the breathing bag arm or, using the bag elbow and a breathing hose, mounted directly on the breathing system.

#### 4.8.3.1 Attaching the breathing bag

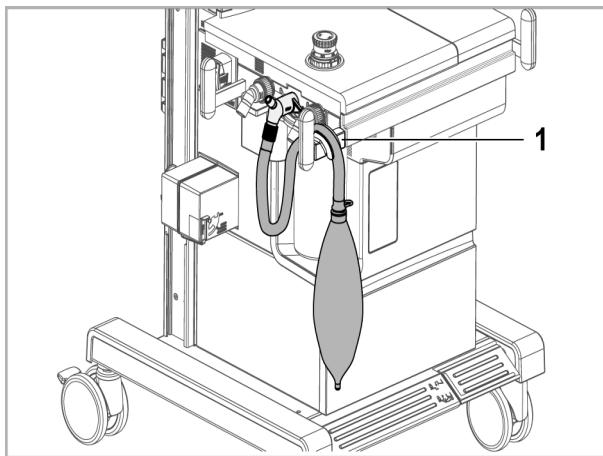
##### **⚠ WARNING**

##### **Risk due to reversed connection of the breathing hoses**

If an adapter is used to connect the breathing bag hose to the bag elbow, the breathing bag hose and breathing hoses can be mixed up when connected to the breathing system. As a result, the patient could be put at risk.

- Do not use an adapter to connect the breathing bag hose.

1. Connect the breathing bag to the breathing bag hose using the connection nozzle. Attach the breathing bag hose to the bag elbow.



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### **⚠ WARNING**

#### **Risk due to pinched breathing bag**

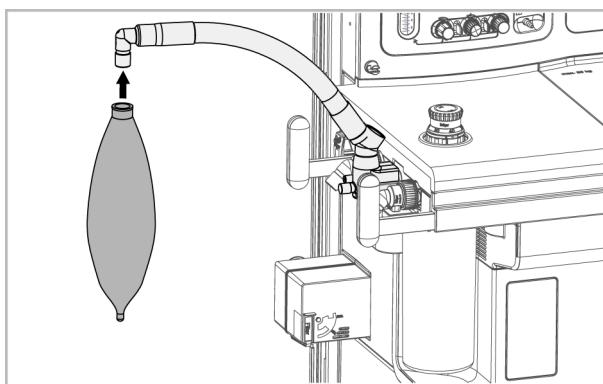
If the breathing bag is pinched, excessive airway pressures or a lack of fresh gas may result.

- ▶ When attaching, ensure the following:
  - The breathing bag is not pinched.
  - The breathing bag can inflate freely.
- 2. Lay the breathing bag hose (1) in the holder so that the bag hangs on the left of the holder.  
Make sure that the breathing bag is not impeded by breathing hoses or cables when inflating.

#### 4.8.3.2

#### **Attaching the breathing bag to the breathing bag arm**

- Attach the breathing bag to the elbow.



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#### 4.8.4

#### **Observing resistance and compliance**

Accessories such as filters influence the dead space, compliance, and resistance of the breathing circuit.

In addition, changes in resistance and compliance arise over time as a result of moisture in the breathing gas or residues of secretions.

**4.8.4.1****Calculating the resistance of the breathing system and connected accessories**

The sum of the resistance values in the inspiratory limb must not be less than –6.0 hPa (cmH<sub>2</sub>O). The sum of the resistances in the expiratory limb must not exceed 6.0 hPa (cmH<sub>2</sub>O).

Only include resistance values in calculations that were taken under the same flow conditions:

Patient category	Flow
Adults	30 L/min
Pediatric patients	15 L/min
Neonates	2.5 L/min

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

$$R_{\text{Inspiration}} =$$

$R_{\text{Breathing system\_insp}} - R_{\text{Insp hose}} - R_{\text{Breathing bag hose}} - R_{\text{Insp filter (port)}} - R_{\text{Insp filter (Y-piece)}}$

$$R_{\text{Expiration}} =$$

$R_{\text{Breathing system\_exp}} + R_{\text{Exp hose}} + R_{\text{Exp filter (port)}} + R_{\text{Exp filter (Y-piece)}}$

If necessary, take into consideration other parts such as water traps or additional hoses. The specifications for the resistance of the breathing system can be found on page 297. The specifications for all other accessories can be found in the respective instructions for use.

In these instructions for use, the specifications for the resistance in the inspiratory limb are regarded as negative values. The resistance values given in the instructions for use for the accessories must therefore be subtracted from the inspiratory resistance of the breathing system.

**Example of calculation: Adult breathing hose with filter on Y-piece, no filters on the ports**

	Inspiratory resistance [hPa (cmH <sub>2</sub> O)] at 30 L/min		Expiratory resistance [hPa (cmH <sub>2</sub> O)] at 30 L/min	
Breathing system with reusable CO <sub>2</sub> absorber and disposable dust filter	$R_{\text{Breathing\_system\_insp}}$	–1.2	$R_{\text{Breathing\_system\_exp}}$	2.9
Breathing hose	$- R_{\text{Insp\_hose}}$	0.5	$+ R_{\text{Exp\_hose}}$	0.5
Breathing bag hose	$- R_{\text{Breathing\_bag\_hose}}$	0.3		
Filter at inspiratory port	$- R_{\text{Insp\_filter(port)}}$	0		
Filter at expiratory port			$+ R_{\text{Exp\_filter(port)}}$	0
Filter at Y-piece	$- R_{\text{Insp\_filter(Y-piece)}}$	2	$+ R_{\text{Exp\_filter(Y-piece)}}$	2
<b>Result</b>	<b><math>R_{\text{Inspiration}}</math></b>	<b>–4.0</b>	<b><math>R_{\text{Expiration}}</math></b>	<b>5.4</b>

Since  $R_{\text{Inspiration}}$  is greater than –6 hPa (cmH<sub>2</sub>O) and  $R_{\text{Expiration}}$  is less than 6 hPa (cmH<sub>2</sub>O), this configuration may be used.

Depending on the breathing circuit in use, the connected accessories, and the resistance of the patient's airways, air trapping (incomplete expiration) may occur with some ventilation settings. Air trapping can be recognized on the flow waveform by the fact that the inspiration begins before the expiration has ended.

The effects are, for example, a reduced minute volume in pressure-controlled ventilation or higher mean airway pressures and peak pressures in volume-controlled ventilation.

Air trapping can be prevented on the anesthesia machine by the following measures:

- Adjusting the respiratory rate and inspiratory time
- Changing the configuration of breathing hoses and accessories that carry gases during the expiratory time

It is the responsibility of the user of the medical device to select the most suitable remedial measure.

#### 4.8.5

#### Connecting a non-rebreathing system

Non-rebreathing systems are suitable and intended only for manual ventilation or spontaneous breathing. Observe the configuration required for this. Connection is only possible with the "External fresh-gas outlet" hardware option.

Since no rebreathing via the breathing system takes place when a non-rebreathing system is in use, the fresh-gas flow must be set at least as high as the minute volume.

Follow the instructions for use for the non-rebreathing system and the transfer hose.

To prevent contamination of the ambient air with anesthetic gases, connect the gas outlet of the non-rebreathing system to the inlet on the AGS.

---

#### **WARNING**

##### **Risk of excessively high airway pressure**

Without a relief valve or breathing bag, airway pressure may become too high.

- Only non-rebreathing systems with breathing bags or relief valves in accordance with ISO 80601-2-13 may be connected.

- 
1. Select a suitable non-rebreathing system.

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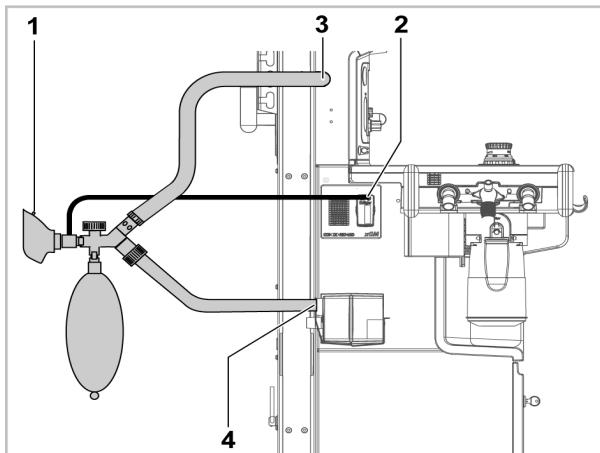
#### **WARNING**

##### **Risk of faulty gas delivery**

Faulty gas delivery and insufficient gas supply when a non-rebreathing system is used may put the patient at risk. Thus O<sub>2</sub>, CO<sub>2</sub>, and any anesthetic gases must also be monitored for non-rebreathing systems.

- The sample line must be connected to the mask and the water trap on the anesthesia machine.
- Provide for suitable gas monitoring conforming to ISO 80601-2-55.
- Provide suitable O<sub>2</sub> monitoring for devices with inspiratory O<sub>2</sub> measurement.

2. Screw the sample line securely to the mask (1) on the non-rebreathing system and to the water trap (2).



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For masks without a connector for the sample line, optionally proceed as follows:

- Place the T-piece with a T-piece filter directly on the elbow. Screw the sample line firmly onto the T-piece filter. The part numbers for the T-piece and the T-piece filter are listed in the list of accessories.
  - If necessary, connect the sample line to a filter on the Y-piece.  
Ensure the correct course of the sample line. Do not use adapters.
3. Connect the fresh-gas hose of the non-rebreathing system to the external fresh-gas outlet (3).
  4. Remove the sealing plug from the inlet nozzle (4) on the AGS.
  5. Use the transfer hose to connect the non-rebreathing system to the inlet nozzle on the AGS (4).

#### After using the non-rebreathing system

1. Dismantle the non-rebreathing system and the sample line.

#### **⚠ CAUTION**

##### Risk due to leakage from an open AGS inlet nozzle

- To prevent contamination of the ambient air with anesthetic gases, press the sealing plug back into the inlet nozzle after using a non-rebreathing system.

2. Seal the inlet nozzle (4) on the AGS again with a sealing plug.

## 4.9

# Connecting and replacing consumables

### 4.9.1

## Disposable CO<sub>2</sub> absorber

- Connect or replace the CLIC absorber in accordance with its instructions for use.

### 4.9.2

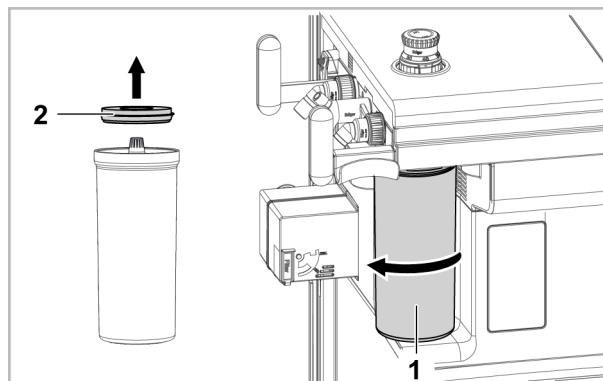
## Reusable CO<sub>2</sub> absorber

As an alternative to disposable CO<sub>2</sub> absorbers, a reusable CO<sub>2</sub> absorber may also be used.

### 4.9.2.1

## Dismounting and emptying

1. Unscrew the CO<sub>2</sub> absorber (1) from the breathing system.



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2. Remove and dispose of the disposable dust filter (2), if present.

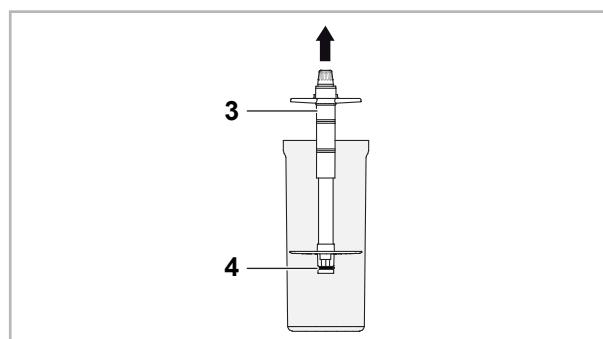
### **⚠ CAUTION**

#### Risk of chemical burns

Soda lime is caustic and is a strong irritant for eyes, skin, and airway.

- Handle the soda lime carefully and do not spill it.

3. Empty out the used soda lime and dispose of it according to its instructions for use.
4. Remove the absorber insert (3) from the absorber container. The sealing ring (4) remains on the absorber insert.

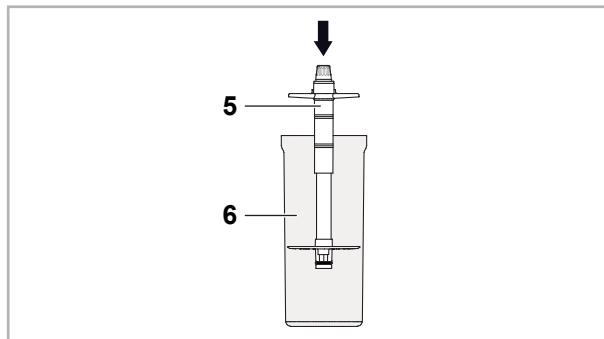


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Perform the further reprocessing of the individual components in accordance with the reprocessing instructions supplied with the product.

**4.9.2.2****Filling and mounting**

- Push the absorber insert (5) into the absorber container (6).



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**⚠ CAUTION****Risk of chemical burns**

Soda lime is caustic and is a strong irritant for eyes, skin, and airway.

- Handle the soda lime carefully and do not spill it.

**⚠ WARNING****Risk of carbon monoxide formation**

If soda lime based on potassium hydroxide is used, there is a risk of carbon monoxide formation.

- Do not use soda lime based on potassium hydroxide.
- Use a suitable soda lime such as Drägersorb Free.

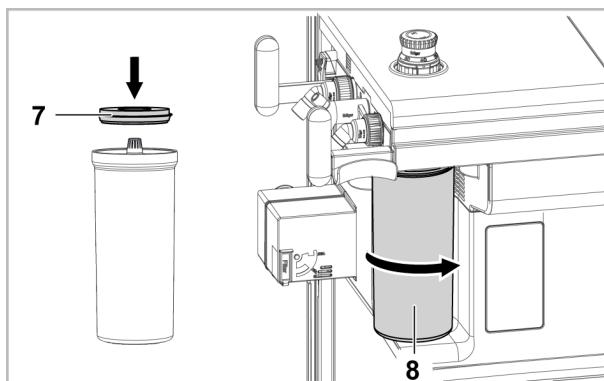
- Fill the CO<sub>2</sub> absorber with fresh soda lime to the upper mark.

Recommendation: Use Drägersorb 800 Plus or Drägersorb Free.

**⚠ WARNING****Risk of hypoventilation and incorrect gas measurement**

Reuse of the disposable dust filter can increase the filter resistance and impair the ventilation function of the device.

- If the reusable CO<sub>2</sub> absorber is used, always use a disposable dust filter. Replace the disposable dust filter with every change of soda lime.
- If soda lime from third-party manufacturers is used, insert a new disposable dust filter (7). Only use dust filters from the list of accessories. Only use undamaged filters.



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- Attach the CO<sub>2</sub> absorber (8) to the breathing system from below. Rotate it in the direction of the arrow until it reaches the stop.

Follow the instructions for use for the particular soda lime.

#### 4.9.3 Water trap

- Empty or replace the water trap according to its instructions for use.

#### 4.9.4 Connecting the sample line

##### **WARNING**

##### **Risk of underpressure in the lungs**

In the following cases, the sample gas flow can immediately cause negative pressure in the lungs, particularly in neonates or pediatric patients:

- Filters or hoses are clogged.
- The sample gas is being extracted between the patient and an occluded component.

Ensure the following when ventilating pediatric patients and neonates:

- ▶ When using a fine-pored filter close to the patient:
  - Do not connect the sample line between the tube and the filter. Instead, connect it directly to the filter or the Y-piece.
- ▶ When using an HME and a sample line port on a tube adapter close to the patient:
  - Use only HMEs that are listed in the list of accessories.
  - Set the alarm limits for MV low and Paw to suitable values.
  - Observe the following information: "CO<sub>2</sub> measurement with pediatric patients and neonates", page 321.

##### **WARNING**

##### **Risk due to incorrectly connected sample line**

If the sample line is connected to the wrong connectors, e.g., connectors on infusion pumps, fluids may be drawn in instead of sample gas. As a result, the gas measurement cannot display correct values or the device can become damaged.

- ▶ When connecting the sample line, take care that it is correctly connected.

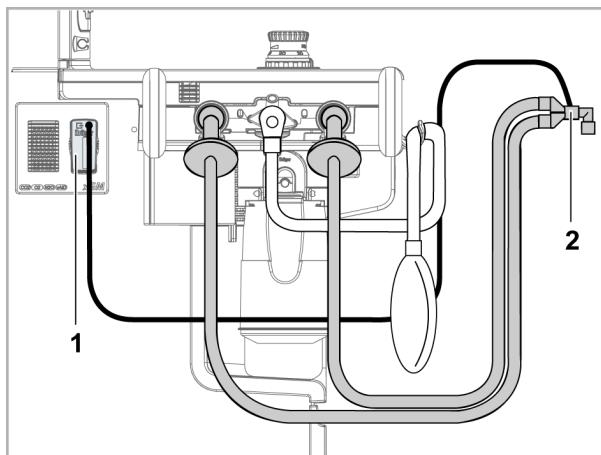
##### **WARNING**

##### **Risk of incorrect measured gas values**

Blocked water traps or blocked sample lines prevent correct gas measurement. As a result, incorrect measured gas values could be displayed.

- ▶ Only use Dräger sample lines.

1. Connect one end of the sample line to the water trap (1).



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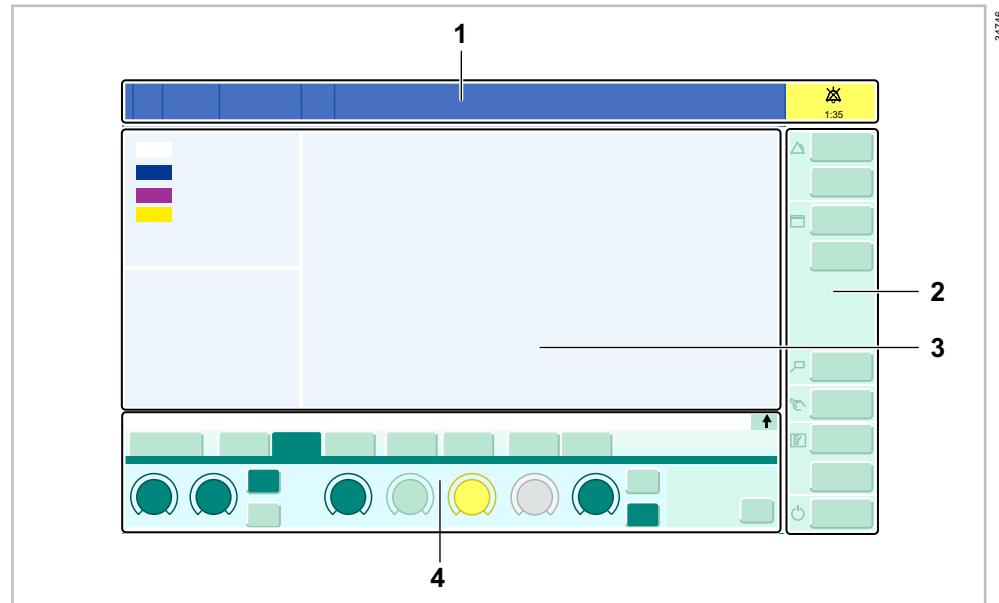
2. Connect the other end of the sample line to a suitable port (2), e.g., on a filter, HME, Y-piece, tube adapter, or hose adapter (see "Permissible hose configurations", page 87).
3. Ensure the following:
  - Ensure the correct course of the sample line.
  - Particularly when ventilating pediatric patients and neonates, a sample line connection close to the patient can improve the quality of the measured CO<sub>2</sub> values. Observe the following information: "CO<sub>2</sub> measurement with pediatric patients and neonates", page 321.
  - Particularly when ventilating pediatric patients and neonates, ensure a small volume (dead space) (e.g., for HMEs or for tube adapters for connecting the sample line).

## 5 Operating concept

### 5.1 Screen

#### 5.1.1 Main screen

The main screen displays the most important information regarding anesthesia and ventilation.



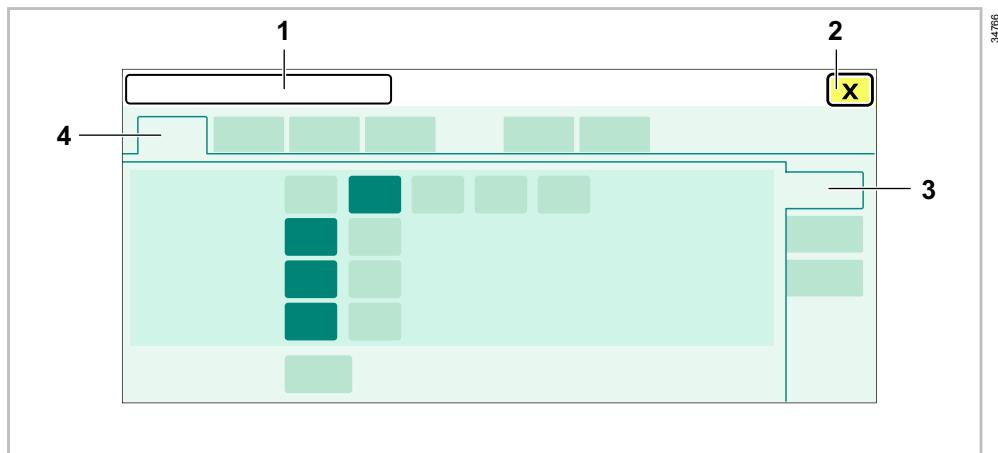
#### No. Designation

1	Header bar	The header bar shows the following information: <ul style="list-style-type: none"><li>– Patient category</li><li>– Patient data</li><li>– System information (date, time, device name)</li><li>– Alarms, messages, and notifications</li><li>– Information regarding temporarily deactivated alarms</li></ul>
2	Main menu bar	The main menu bar contains buttons to open dialogs and activate functions.  These buttons are assigned to various groups. For further information, see the following chapter: "Overview of the menu structure", page 337

No.	Designation	
3	Monitoring area	<p>The following information can be displayed in the monitoring area if the device has the corresponding equipment:</p> <ul style="list-style-type: none"> <li>– Gas measurement</li> <li>– Waveforms</li> <li>– Parameter fields</li> <li>– Loops (Pressure-Volume and Flow-Volume)</li> <li>– Mini-trends</li> <li>– Virtual flow tubes</li> </ul> <p>The current view can be adapted (see "Customizing the current view", page 171).</p>
4	Therapy bar	<p>The therapy settings can be adjusted in the therapy bar.</p> <p>Electronically controlled gas mixer:</p> <ul style="list-style-type: none"> <li>– Ventilation modes</li> <li>– Ventilation parameters</li> <li>– Fresh-gas delivery</li> </ul> <p>Mechanically controlled gas mixer:</p> <ul style="list-style-type: none"> <li>– Ventilation modes</li> <li>– Ventilation parameters</li> </ul>

### 5.1.2 Dialogs

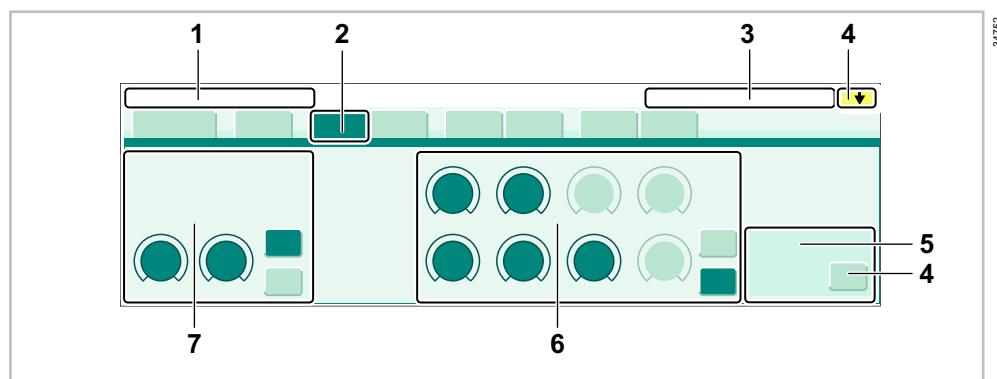
Dialogs consist of one or more pages which are displayed by touching the corresponding horizontal or vertical tab.



No.	Designation
1	Title of the dialog
2	Button for closing the dialog
3	Vertical tab to open subordinate structures
4	Horizontal tab to open a page

### 5.1.3 Therapy bar

The following illustration shows the expanded therapy bar for the electronically controlled gas mixer:



34752

#### No. Designation

- |   |  |
|---|--|
| 1 | Name of active ventilation mode  |
| 2 | Tabs   |
| 3 | Notification field   |
| 4 | Buttons to expand and collapse the therapy bar   |
| 5 | Field with additional information: <ul style="list-style-type: none"> <li>– More values</li> <li>– Spontaneous breathing activity of the patient </li> </ul> |
| 6 | Therapy controls for ventilation parameters and buttons for synchronizing the breaths  |
| 7 | With electronically controlled gas mixer:<br>Therapy controls and buttons for fresh-gas delivery   |

#### Start values

Arrows ▼ on the scales of the therapy controls mark the start values resulting from the patient data and start settings. The start values can be configured, see page 203.

#### Linked therapy controls

Certain parameters can be linked to other parameters. If one parameter is changed, the linked parameter is also selected and changed. Among other things, this applies to the adjustment of ventilation pressures, ventilation times or during electronically controlled fresh-gas delivery.

Example: The device can be configured so that a change to the PEEP setting automatically causes a change to Pinsp; as a result, the difference between PEEP and Pinsp and therefore the tidal volume remains constant.

Linking therapy controls, see page 214.

#### Setting ranges

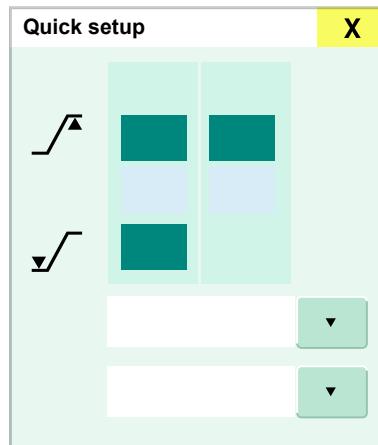
Some settable parameters may be limited or mutually restricted, so that certain combinations of therapy settings are not possible, e.g., **Ti** 6.9 s at **RR** 100 /min.

If a state is reached in which a parameter cannot be changed any more, the device displays a corresponding message in the notification field (3).

#### 5.1.4

#### Quick setup dialog

Depending on the parameter field or waveform, this dialog contains various setting possibilities, e.g., for limits or scales.



34767

This dialog can be opened by touching the corresponding parameter field in the monitoring area. This dialog can be configured so that it opens automatically in the event of an alarm, see page 208.

#### 5.1.5

#### Screen saver

A screen saver is activated if no operation takes place for more than 5 minutes and 30 seconds when in standby mode. The screen saver can be ended by touching the screen or another screen control element. The screen saver is ended automatically if an alarm message with medium or high priority appears.

The screen saver can be activated or deactivated in the system setup (see "Vertical tab "General""", page 204). Dräger recommends leaving the screen saver activated in order to prevent possible damage to the screen due to permanent still images.

## 5.2 Color concept

### 5.2.1 Colors of the control elements

Colors denote the availability of functions and settings.

#### 5.2.1.1 Therapy controls and buttons

Color	Example	Meaning
Dark green	 	Available element: function activated
Yellow	 	Selected element: not yet confirmed with rotary knob
Light green	 	Available element: function not activated
Dark gray	 	Control element: currently not available, function activated
Gray	 	Unavailable element

#### 5.2.1.2 Rotary knob

The rotary knob lights with different colors.

Color	Meaning
Blue	Therapy in progress.
Orange	A function or setting must be confirmed.
Flashing orange	A function or setting, which is still not confirmed, will be reset within the next 5 seconds.

## 5.2.2 Waveforms and parameters

Waveforms for mandatory breaths are displayed in the colors specified in the system setup, see page 205.

In the flow waveform, spontaneous breathing and pressure support are displayed in a light brown color. In Manual / Spontaneous ventilation mode, the flow waveform for manual ventilation is also displayed in a light brown color.

Measured values whose specified accuracy cannot be maintained are displayed in gray.

### 5.2.3

### Color codes for anesthetic agents and medical gases

Standardized color codes complying with ISO 5359 / ISO 32 / ISO 5360 are used to identify anesthetic agents and medical gases.

The colors for O<sub>2</sub>, Air, and N<sub>2</sub>O conform to locally applicable standards.

### 5.2.4

### Daytime colors and nighttime colors

There are 3 color schemes that can be selected:

- Day light
- Day dark
- Night

Setting the color schemes, see page 174.

## 5.3

## Selecting and setting

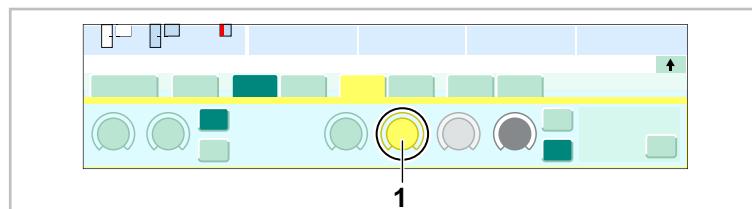
### 5.3.1

### Setting of parameters

Changes to these settings always require confirmation by pressing the rotary knob.

#### 1. Select

Touch the control element (1). The color turns yellow. For therapy controls, the unit of the parameter to be set is displayed.



#### 2. Set

Turn the rotary knob. For some therapy controls, faster turning raises the increment value.

#### 3. Confirm

Press the rotary knob. The color of the control element changes to green.

In the subsequent chapters of this document, these steps will be written in simplified form as follows:

- "Set the value."
- "Touch the button."

### 5.3.2

### **Canceling the setting procedure or the change procedure**

If a change to a parameter should be canceled (color is still yellow), the following options exist to retain the previous setting:

- Touch the changed parameter again. This resets the selection of and the change to the parameter.
- Select another parameter. This selection resets the change made to the previous parameter.
- Do not press the rotary knob. After 15 seconds, the change is reset and signal tones sound during the last 5 seconds (timeout).

### 5.3.3

### **Activation of buttons**

Some buttons are immediately active without additional confirmation. The color immediately turns to dark green.

Examples:

- Selecting a view
- Deactivating the CO<sub>2</sub> alarms

### 5.3.4

### **Operating the flow control valves**

The flow control valves of the mechanically controlled gas mixers and the O<sub>2</sub> flowmeter are operated as follows:

#### **Opening the flow control valve**

- Turn the flow control valve counterclockwise.

#### **Closing the flow control valve**

- Turn the flow control valve clockwise to the end stop.

In the subsequent chapters of this document, the following is represented by simplified explanations:

- "Open the flow control valve."
- "Close the flow control valve."

**6**

# Getting started

**6.1**

## Safety instructions

### Checking the safety systems

Some safety systems are only checked during start-up. If this check is not performed regularly, a device malfunction may occur, putting the patient at risk.

- Restart the device at least once per month so that the safety systems will be checked regularly.

### Passwords

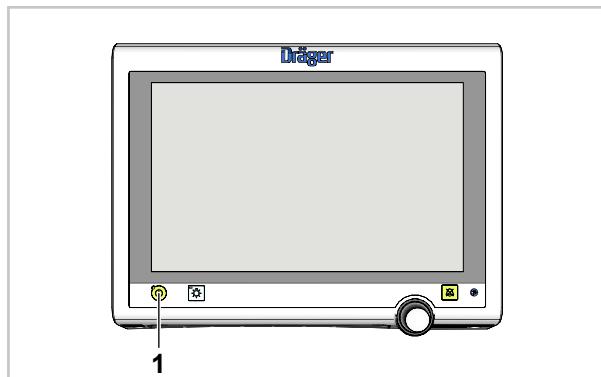
If the user password and the service password are not assigned, there is a risk of unauthorized access to the device settings. As a result, saved device settings can be changed and not be noticed. The patient may be put at risk. Skip password assignment only in emergencies.

- Assign the user password and the service password when the device is switched on for the first time.

**6.2**

## Turning on the device

**Prerequisite:** The device has been reprocessed as per the reprocessing instructions and assembled ready for operation (see page 60).



35026

1. Connect the device to the mains power supply.
2. Set the main switch to the  $\odot$  position.

**⚠ WARNING****Risk of device malfunction**

Condensed water may form when the device is brought from a cold storage location into a warm environment.

- To prevent condensation and resulting failures of electrical components, do not turn on the device after abrupt temperature changes for 1 to 2 hours.

3. Press the  $\odot$  key (1).

The device starts. The Standby page is displayed.

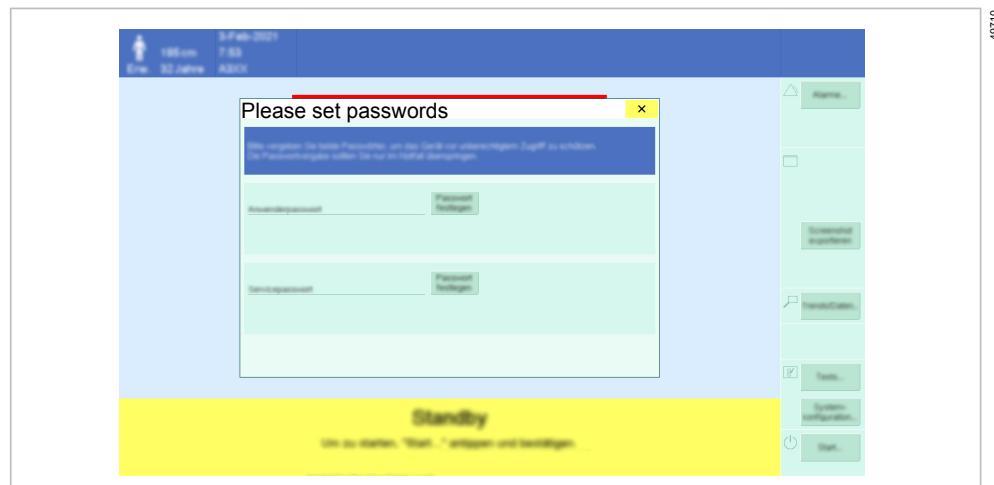
If there is sufficient battery charge, the device will also start without the power plug being plugged in.

4. If necessary, define the required passwords for users and service personnel in the displayed password dialog.

## 6.3

### Password dialog

After the device is switched on for the first time, the password dialog appears in which the user password and the service password can be assigned. Assign both passwords to protect the device settings from unauthorized access. Skip password assignment only in emergencies. If none or only one of the passwords is assigned, the password dialog will appear again each time the device is switched on.



#### User password

The password can be used to open certain dialogs to configure settings. The password can only be reset by service personnel.

#### Service password

The service dialog can be opened with the password. The password can only be reset by specialized service personnel.

## 6.4

### Checking the device configuration

The device can be customized to suit the requirements of the user. Settings for the following features are possible:

- Start settings for the ventilation
- Alarm limits
- General device behavior

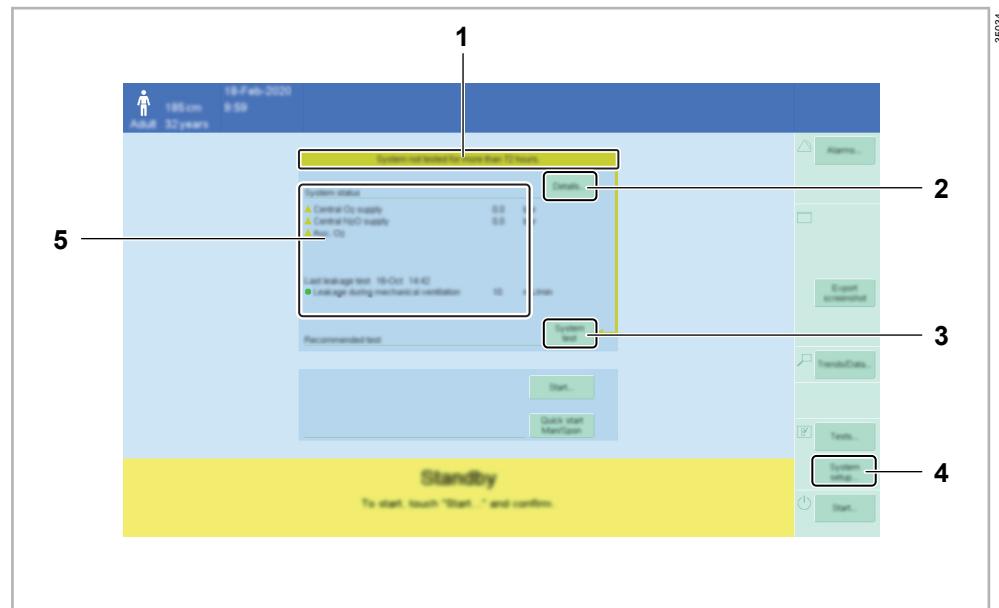
With mechanically controlled gas mixers with flow tubes, a one-time adjustment for the height above sea level is required.

For further information about the configuration, see page 203.

## 6.5

## Checking the operational readiness

The Standby page uses different colors (1) to indicate whether the system test was successful and the device is ready for operation.



Color	Meaning
Green	System is fully operational.
Yellow	System is operational with limitations. There are functional restrictions. Take further measures to ensure patient safety (e.g., external monitoring).
Red	System is not operational. Contact service personnel if necessary.

If the device is not fully operational, the most important irregularities (5) are displayed along with a recommendation to perform a specific test (3).

Additionally, the current system leakage is displayed in area (5).

To view details regarding the status of the device, touch the **Details...** button (2) or the **Tests...** button (4), see page 110.

Dräger recommends performing the system test every 24 hours. Otherwise, it will not be possible to ensure that the device is functional. To ensure that operation remains possible, the system test must be performed at the latest 28 days after the last system test.

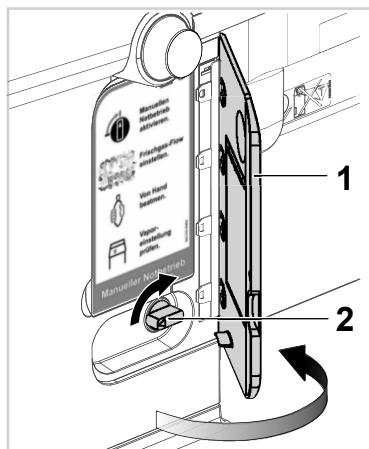
## 6.6

## Checking the backup manual switch

When starting up for the first time, check that the backup manual switch is functioning.

Prerequisite: The device is in standby mode.

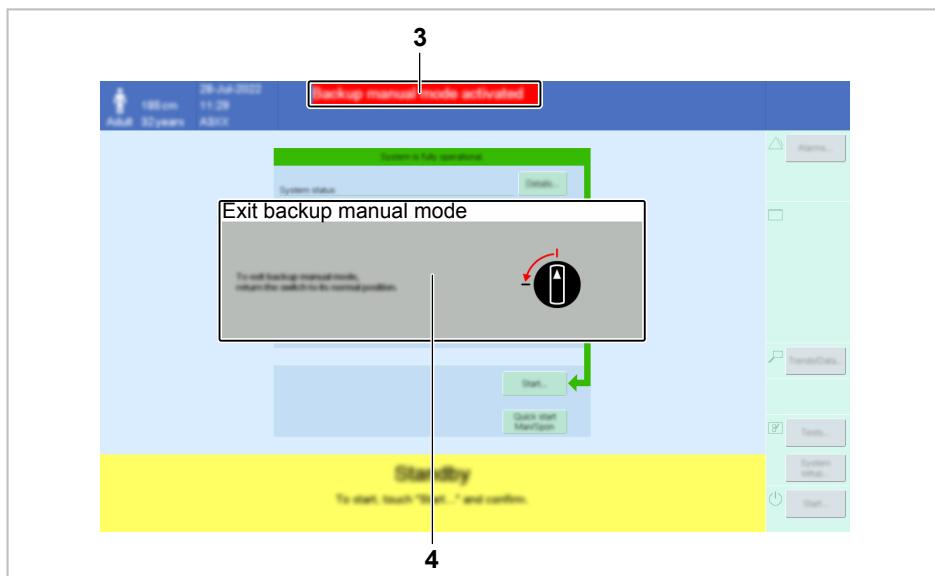
1. Open the flap (1).



551778

2. Activate the backup manual switch (2).

An optical alarm signal (3) with high priority is issued. A dialog (4) is also displayed.



55180

**!** If the alarm and dialog are not displayed, contact specialized service personnel.

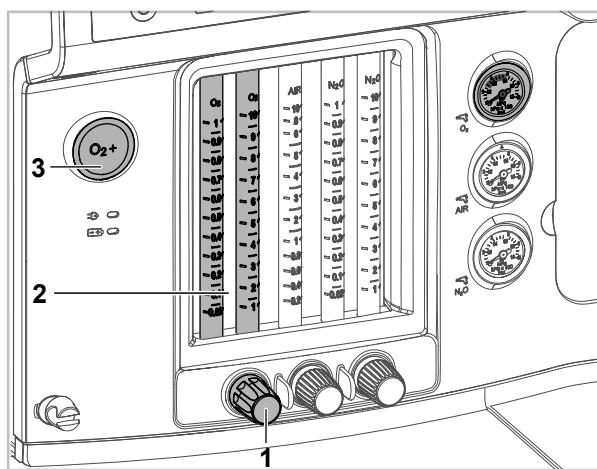
3. Deactivate the backup manual switch again.

## 6.7

### Emergency start-up

#### 6.7.1

#### Mechanically controlled gas mixer with flow tubes

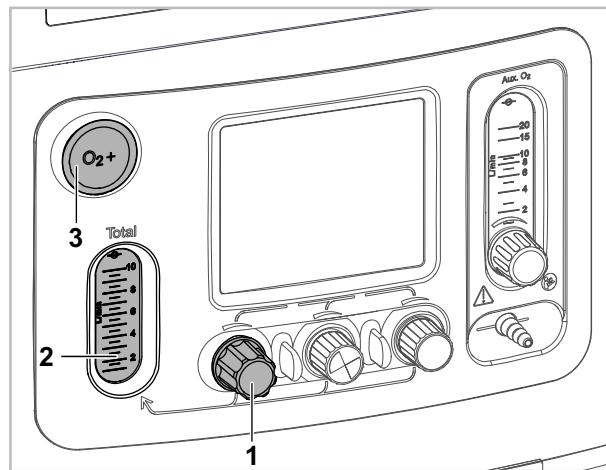


53614

1. Adjust the APL valve.
2. Open the flow control valve (1) and set the desired O<sub>2</sub> flow. If necessary, press the O<sub>2</sub>+ key (3) to quickly fill the breathing bag.
3. Monitor the flow on the flow tubes (2).
4. Set the anesthetic gas concentration on the vaporizer.
5. Ventilate the patient manually.
6. Turn on the device.
7. As soon as the Standby page is displayed, start the therapy, see page 143.

#### 6.7.2

#### Mechanically controlled gas mixer with electronic flow measurement



36054

1. Adjust the APL valve.

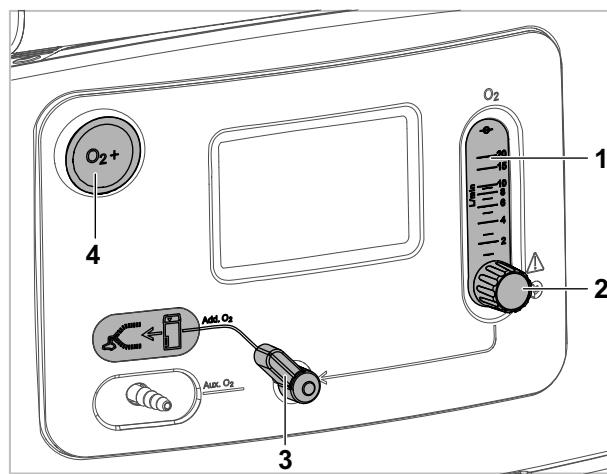
## ⚠ WARNING

### Risk of fire

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgical devices and laser surgical devices can cause fires.

- ▶ If ignition sources are present, do not open the flow control valve on the O<sub>2</sub> flowmeter. Leave the flow control valve completely closed.
2. Open the flow control valve (1) and set the desired O<sub>2</sub> flow. If necessary, press the **O<sub>2</sub>+** key (4) to quickly fill the breathing bag.
  3. Monitor the flow on the total flow tube (2).
  4. Set the anesthetic gas concentration on the vaporizer.
  5. Ventilate the patient manually.
  6. Turn on the device.
  7. As soon as the Standby page is displayed, start the therapy, see page 143.

### 6.7.3 Electronically controlled gas mixer



35041

1. Adjust the APL valve.
2. Set the O<sub>2</sub> switch (3) to the **Add. O<sub>2</sub>** position.

## ⚠ WARNING

### Risk of fire

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgical devices and laser surgical devices can cause fires.

- ▶ If ignition sources are present, do not open the flow control valve on the O<sub>2</sub> flowmeter. Leave the flow control valve completely closed.
3. Open the flow control valve (2) and set the desired O<sub>2</sub> flow. If necessary, press the **O<sub>2</sub>+** key (4) to quickly fill the breathing bag.
  4. Monitor the set flow on the O<sub>2</sub> flowmeter (1).
  5. Set the anesthetic gas concentration on the vaporizer.
  6. Ventilate the patient manually.
  7. Turn on the device.
  8. As soon as the Standby page is displayed, start the therapy, see page 143.
  9. Set the O<sub>2</sub> switch (3) to **Aux. O<sub>2</sub>**.

10.Close the flow control valve (2).

# 7

## Tests

### 7.1

### Safety instructions

#### Checklist

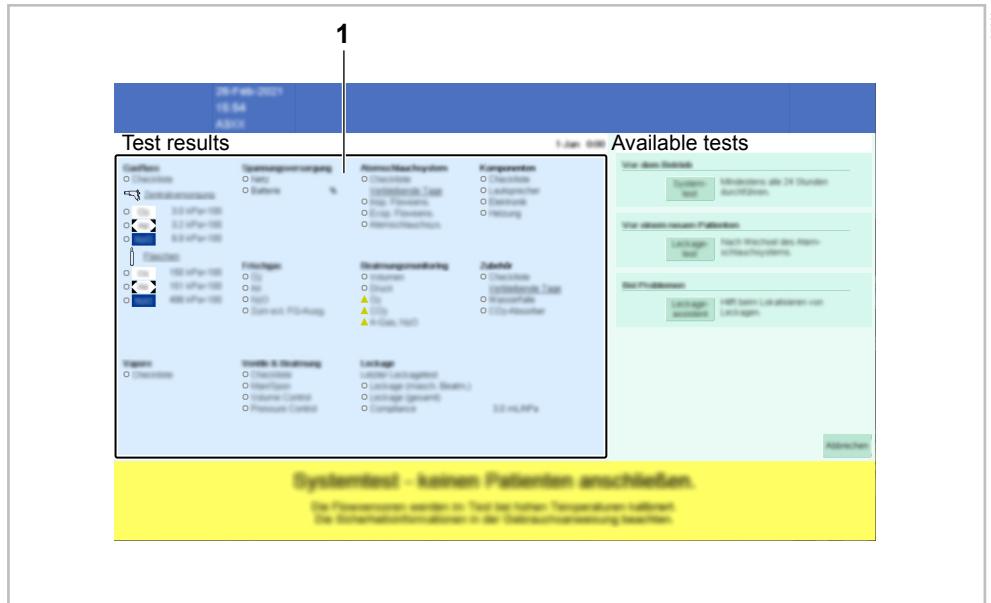
The checklist contains manual test steps that must be performed by the user at the beginning of the system test or leakage test. These test steps represent essential manual safety checks. These safety tests are necessary to obtain a valid test result and to ensure proper device operation.

- Carefully follow the instructions of the checklist.

### 7.2

### Status of the device functions

- In standby mode, touch the **Details...** or **Tests...** button.



The **Test results** list (1) shows the results of the test last performed. The following information is displayed using different colors:

- Influence of the individual device functions on the functional integrity of the device
- Leakage values

Color	Meaning
Green	Successfully tested, fully available
Yellow	A non-critical fault has been detected or the last test result is older than 72 hours. The device can be operated with restricted function.
Red	A serious fault has been detected or the last test result is older than 28 days. Operation is not possible.
Gray	Not tested

## 7.3 Available test types

System test		A100 (XL)	A300 (XL)	A350 (XL)
Type and duration:	Automatic, approx. 8 min			
Perform the test:	Daily			
Description:	<p>Scope of the pretest (initialization):</p> <ul style="list-style-type: none"> <li>– Checking situations that frequently cause operational restrictions:           <ul style="list-style-type: none"> <li>– Insufficient O<sub>2</sub> gas supply</li> <li>– No gas cylinders connected</li> <li>– High leakage</li> <li>– Condensed water in the breathing system, in the piston diaphragm, and in the breathing circuit</li> <li>– Insufficient power supply, including the internal battery</li> <li>– Mix-up of the connected breathing hoses</li> </ul> </li> <li>– Incorrectly set APL valve</li> <li>– Missing valves in the breathing system</li> <li>– Insufficient pressures of N<sub>2</sub>O and Air</li> <li>– Calibrating the inspiratory O<sub>2</sub> sensor</li> </ul>	•	•	•
	The initialization takes approximately 2 to 3 minutes. Remain by the device during this time. Make corrections if necessary.			
	<p>Scope of the fully automatic main test:</p> <ul style="list-style-type: none"> <li>– Checking the functional integrity:           <ul style="list-style-type: none"> <li>– Does the connected O<sub>2</sub> supply actually supply oxygen?<sup>1)</sup></li> <li>– Gas mixer</li> <li>– Breathing system</li> </ul> </li> <li>– Patient gas measurement</li> <li>– Alarm system and the associated loudspeakers</li> <li>– Breathing system warmer</li> <li>– Detection of an excessively high suction flow at the AGS</li> <li>– Performance of leakage test</li> <li>– Calibrating sensors and valves</li> <li>– Flushing the breathing system with ambient air</li> </ul>	---	•	•

1) Only for devices with integrated PGM. This test must be activated in the system setup (see "Vertical tab "System test""", page 219).

<b>Leakage test</b>		<b>A100 (XL)</b>	<b>A300 (XL)</b>	<b>A350 (XL)</b>
Type and duration:	Automatic, approx. 2 min			
Perform the test:	<ul style="list-style-type: none"> <li>– After filling the CO<sub>2</sub> absorber</li> <li>– After changing the hose configuration (e.g., changed hoses, changed lengths of extendable hoses etc.)</li> <li>– After replacing the breathing system</li> <li>– After inserting the piston diaphragm</li> <li>– After replacing the flow sensors</li> <li>– If leakage at vaporizer is suspected (see "Manual check of a vaporizer for leaks", page 119)</li> </ul>	•	•	•
Description:	<ul style="list-style-type: none"> <li>– Determining leakage, system compliance, and system resistance</li> <li>– Calibration of valves and flow sensors, if required. In this case, the test is extended by approximately 3 minutes.</li> </ul>			

<b>Leakage assistant</b>		<b>A100 (XL)</b>	<b>A300 (XL)</b>	<b>A350 (XL)</b>
Type and duration:	Manual, as required			
Execution recommended:	<ul style="list-style-type: none"> <li>– After occurrence of problems with leakage during automatic tests</li> <li>– If leakage in breathing system and breathing circuit is suspected</li> <li>– If leakage at vaporizer is suspected</li> <li>– If coaxial breathing circuits are used</li> </ul>	---	•	•
Description:	<ul style="list-style-type: none"> <li>– Continuous display of the test pressure and the leakage to support the manual check. Changes are visible immediately via the displayed waveforms.</li> </ul>			

## 7.4 Performing the tests

### 7.4.1 System test and leakage test

Prerequisites:

- The O<sub>2</sub> gas supply is connected.
- The anesthetic gas receiving system is correctly connected.
- The breathing circuit is correctly connected.
- When using an external anesthetic gas monitor: There is no sample gas measurement connected to the breathing circuit.

Both tests consist of a checklist followed by an automatic test.

The checklist can be presented in tabular form or as a walk-through mode. In the system setup, tests can be specified to always start in walk-through mode, see page 219.

The automatic test consists of a pretest (the initialization), which may require manual actions by the user, and a fully automatic main test.

On devices with an O<sub>2</sub> sensor, the system test checks whether an O<sub>2</sub> calibration is required. If more than 7 days have passed since the last calibration of the O<sub>2</sub> sensor, an O<sub>2</sub> calibration will be automatically performed.

**i** On devices with an integrated patient-gas measurement module, automatic calibrations are performed regularly during operation.

#### 7.4.1.1 Execution

##### ⚠ WARNING

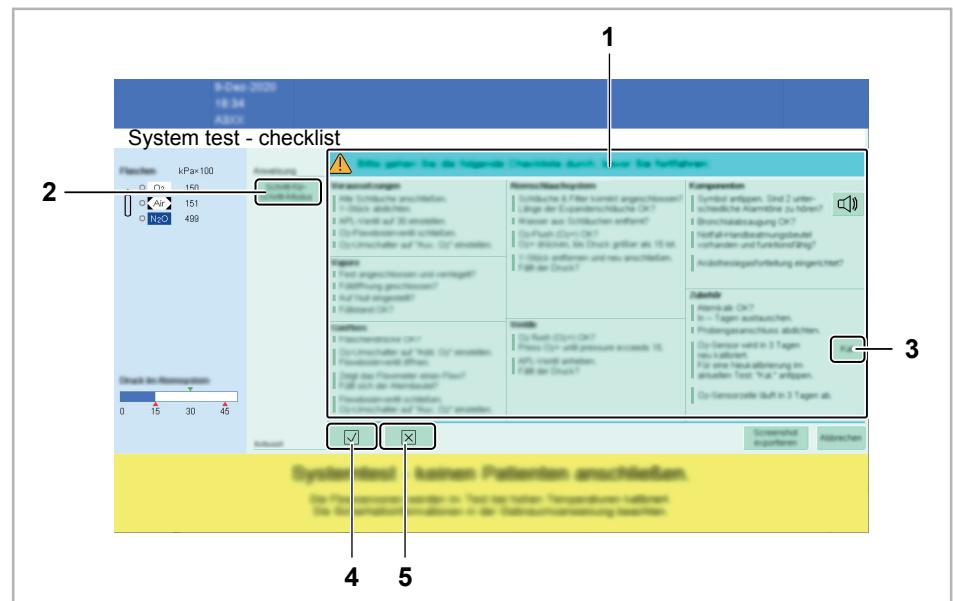
##### Risk of patient injury

During the system test, the device is pressurized.

- ▶ To prevent patient injury, do not perform the system test and leakage test if a patient is connected.

1. Touch the button for the system test.
2. Complete the tabular checklist (1).

It is possible to switch from the tabular checklist to the walk-through mode, if required. To do this, touch the button (2). For further information see: "Checklist in the walk-through mode", page 125.



3. If the O<sub>2</sub> sensor is to be calibrated despite a valid calibration, touch the **Calibrate** button (3).

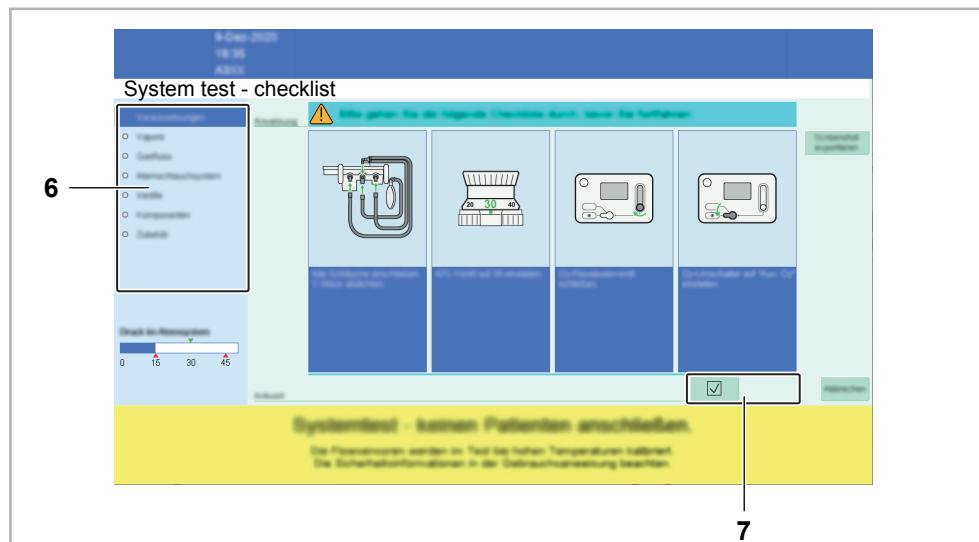
**⚠ CAUTION****Risk of device malfunction and/or patient injury**

If the system test is canceled, existing malfunctions may not be detected. As a result, device malfunctions can occur and the patient may be put at risk.

- ▶ More attention is required when operating without a system test.
- ▶ Perform the system test every day. If the system test is canceled during execution, perform it again as soon as possible.

4. If all components are operational, touch the ✓ button (4). The automatic test will start.

If a component is not operational, touch the ✗ button (5).  
The walk-through mode will start.



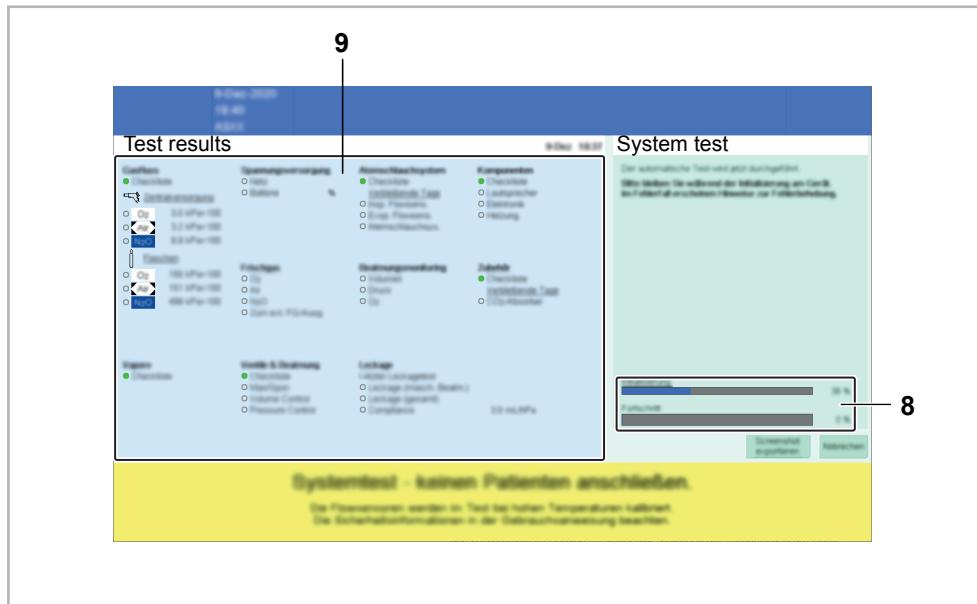
The components (6) are polled one after the other.

The buttons (7) are used to document whether the check passed.

Button	Meaning
✓	Check passed
✗	Check failed

The automatic test starts after all the checks in the walk-through mode are complete.

35085



During the automatic system test, the progress of the initialization and the system test is displayed in area (8). Remain by the device during the initialization, as manual actions by the user may be required.

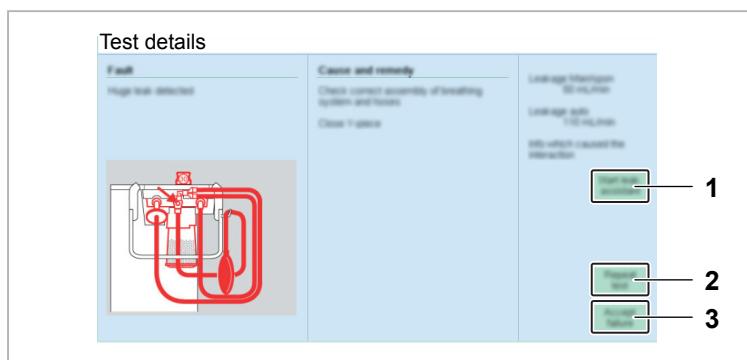
All test results are displayed in area (9).

After the test, the final test result is displayed on the standby screen, see page 106.

#### 7.4.1.2 Test interruption due to irregularities

If an irregularity is detected during the automatic test, the following occurs:

- The test is interrupted.
- An acoustic signal sounds. This signal is repeated every 15 seconds.
- Information on the cause and remedy are displayed.



Remedying the cause:

1. Remedy the cause of the interruption.  
If there is leakage, the leakage assistant (1) can be used to aid in troubleshooting.
2. Touch the **Repeat** button (2) and repeat the test of the component.

35088

Accepting the irregularity:

- Touch the **Accept** button (3) and continue the test.

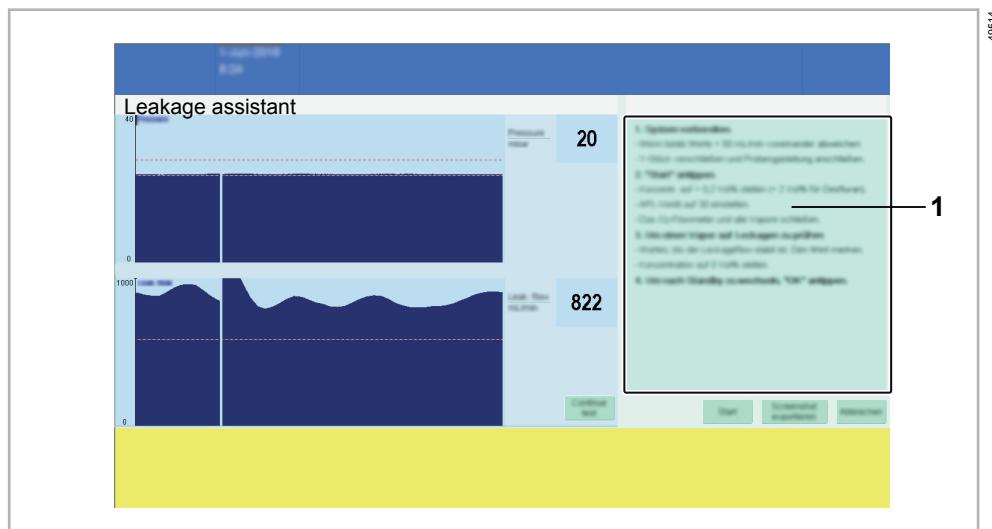
Accepted irregularities prevent the total result of the system test from indicating "fully operational" and are protocolled in the logbook.

## 7.4.2 Leakage assistant

Prerequisite when vaporizers are connected:

- Vaporizer is vertically level and securely mounted on the plug-in adapter.
- Filling inlet is closed.

In this test, a continuous pressure is generated and the current leakage value is displayed.



If the leakage value changes as a result of changes made to the device (e.g., loosening or readjusting hose connections), this can help locate the cause of the leakage.

The displayed leakage value may differ from the value that was determined in the leakage test. The reasons for this are the different measuring methods and different pneumatic ranges.

1. Touch the button for the test (**Leakage assistant**).
2. Follow the instructions (1).

### 7.4.2.1 Checking a vaporizer for leaks with the leakage assistant

Prerequisites:

- All flow control valves of the gas mixer are closed.
- The vaporizers are closed.
- The breathing circuit is correctly connected.
- The APL valve is set to 30.

Perform the test:

1. Touch the **Start** button.
  - a. Wait until the leakage value is stable. Memorize the value.
  - b. Set the anesthetic gas concentration on the vaporizer to >0.2 Vol% (>2 Vol% for desflurane).
  - c. Wait until the leakage value is stable. Memorize the value.
  - d. If the two values differ from one another by more than 50 mL/min, check the vaporizer and the vaporizer interface for leakage.
  - e. Set the anesthetic gas concentration to 0 Vol%.
2. Touch the **OK** button to switch back to the display of available tests.

#### 7.4.2.2

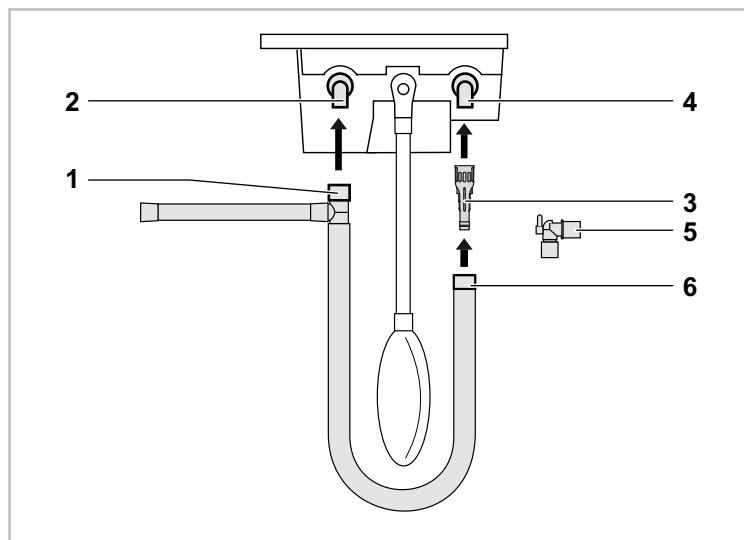
#### Checking a coaxial breathing circuit for leaks with the leakage assistant

With a coaxial breathing circuit, it is always necessary to test the inner and the outer hose. The inner hose of a coaxial breathing circuit cannot be checked by the normal system test.

The leakage assistant can be used to determine the leakage of the inner hose of Dräger coaxial breathing circuits with the help of a special test adapter. To do so, the inner hose has to be directly connected to the expiratory port of the breathing system via the test adapter.

Prerequisites:

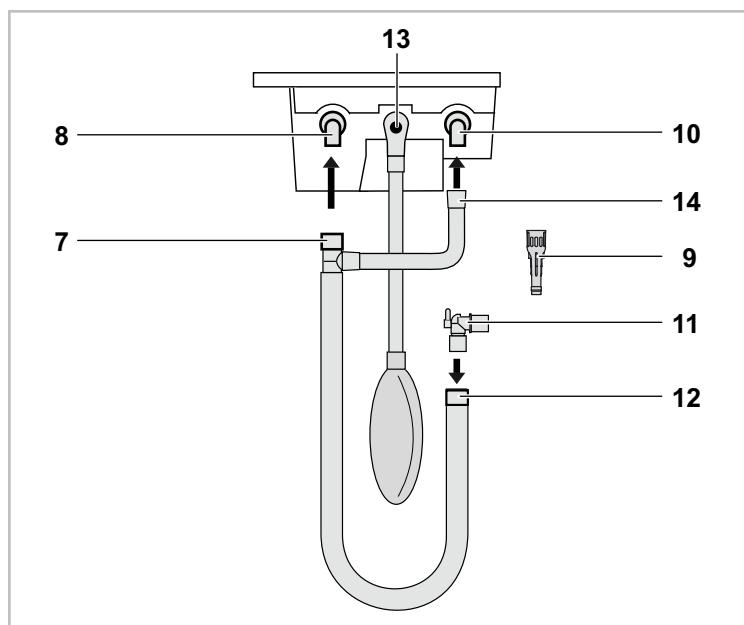
- All flow control valves of the gas mixer are closed.
  - The vaporizers are closed.
  - The APL valve is set to 30.
  - The **Verify O<sub>2</sub> delivery and circuit (requires sample line)** setting is deactivated in the system setup (see "Vertical tab "System test""", page 219).
1. To test the inner hose, connect the breathing circuit as follows:



4936

- a. Connect the hose (1) to the inspiratory port (2).
- b. Connect the coaxial test adapter (3) to the expiratory port (4).
- c. Remove the elbow (5) from the hose (6). Connect the hose (6) to the coaxial test adapter (3).

2. Touch the **Start** button.
  - a. Wait until the leakage value is stable. Note down the value as the leakage of the inspiratory hose.  
**If the leakage value exceeds 500 mL/min, use another breathing circuit.**
3. Touch the **OK** button to switch back to the display of available tests.
4. To test the outer hose, connect the breathing circuit as follows:



3955

- a. Connect the hose (7) to the inspiratory port (8).
  - b. Remove the coaxial test adapter (9) from the expiratory port (10).
  - c. Connect the elbow (11) to the hose (12).
  - d. Plug the hose (12) with the elbow connected on to the circuit plug (13).
  - e. Connect the hose (14) to the expiratory port (4).
5. Touch the **Leakage test** or **System test** button to start an automatic test.  
The determined leakage value is displayed as **Leakage (mech. vent.)**. Note down the value as the leakage of the expiratory hose.

### Evaluation of the values determined for leakage:

Test of the inspiratory hose	Test of the expiratory hose	Evaluation
≤150 mL	≤150 mL	The breathing circuit is intact.
>150 to <500 mL	≤150 mL	Low leakage. Check whether the breathing circuit is suitable for the particular patient category.
>500 mL	≤150 mL	Do not use the breathing circuit. There is a risk of rebreathing.
≤150 mL	>150 to <500 mL	Take account of the leakage when setting the parameters for fresh gas and ventilation.
≤150 mL	>500 mL	Do not use the breathing circuit.
>150 mL	>150 mL	The leakage is possibly caused by other components and not by the breathing circuit. Repeat the test with a different coaxial breathing circuit.

## 7.4.3

### Manual check for leakage

As an alternative to using the leakage assistant, vaporizers and coaxial breathing circuits can also be checked for leaks by means of the following manual methods.

#### 7.4.3.1

##### Manual check of a vaporizer for leaks

The leakage of a vaporizer can be determined with 2 tests:

- Quick tightness check: Checks whether there is leakage.
- Complete leakage test: Determines the leakage value.

Prerequisites:

- The leakage test of the device has been performed and passed.
- The vaporizer is mounted directly and securely on the plug-in adapter.
- The filling inlet is closed.
- The vaporizer is closed. The control dial is in the **0** position.
- The breathing circuit is correctly connected.
- The APL valve is set to 30.
- The Y-piece is sealed.
- All flow control valves of the gas mixer are closed.

##### Quick tightness check

1. Touch the **Tests...** button.
2. Touch the **System test** button.  
The checklist opens and the breathing system pressure is displayed as a bar graph in the lower left-hand corner.
3. Press the **O<sub>2</sub>+** key and keep it pressed until the displayed breathing system pressure no longer rises.
4. Release the **O<sub>2</sub>+** key.

5. Wait until the pressure stabilizes between 15 and 30 hPa.
  - When the pressure has stabilized, continue with the check, see step 6.
  - If the pressure continues to fall, there is a leakage present. Decide whether to end the check or continue with it.
6. Set the vaporizer to the smallest delivery setting. To do this, turn the control dial from the **0** position to the first mark on the scale.
7. Observe the breathing system pressure. The pressure must remain stable and may only drop at a minimally slow rate.  
If the pressure drops faster, the vaporizer is leaking.
8. Close the vaporizer. To do this, set the control dial to the **0** position.
9. Exit the System test again. To do this, touch the **Cancel** button.

For leaky vaporizers, the compete leakage test can be used to determine how large the leakage is.

### Complete leakage test

Testing the vaporizer in the closed state:

1. Touch the **Tests...** button.
2. Touch the **Leakage test** button.
3. Perform the leakage test with the vaporizer closed.  
If no leakage value is displayed, the test has passed. If the determined leakage is at least 500 mL, the leakage value **Leakage (total)** is displayed.

Testing the vaporizer in the open state:

1. Touch the **Tests...** button.
2. Touch the **Leakage test** button.
3. Set the vaporizer to the smallest delivery setting. To do this, turn the control dial from the **0** position to the first mark on the scale.
4. Perform the leakage test with the vaporizer opened.  
If no leakage value is displayed, the test has passed. If the determined leakage is at least 500 mL, the leakage value **Leakage (total)** is displayed.
5. Close the vaporizer. To do this, set the control dial to the **0** position.
6. Press the **O<sub>2</sub>+** key and keep it pressed for at least 5 seconds. The breathing system will be flushed and the residual anesthetic agent will be disposed of in the AGS.

Using the determined values, the user can decide whether the vaporizer can be used.

#### 7.4.3.2

### Manual check of a coaxial breathing circuit for leaks

Leakage in the inner hoses of coaxial breathing circuits cannot be detected with the normal system test. A special test adapter is used to determine the leakage in Dräger coaxial breathing circuits. The following checks are possible:

- Quick tightness check: Checks whether there is leakage.
- Complete leakage test: Determines the leakage value.

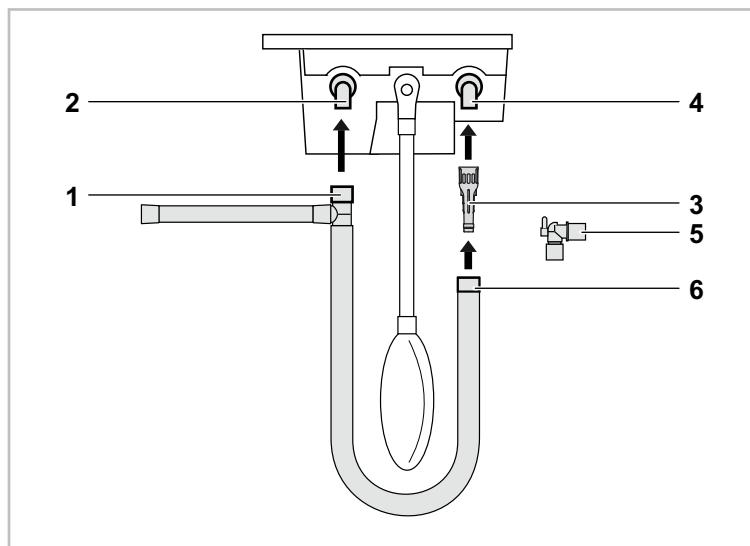
For both checks, first the inner inspiratory hose and then the outer expiratory hose is tested.

**Prerequisites:**

- The vaporizers are closed. The control dial is in the **0** position.
- The APL valve is set to 30.
- All flow control valves of the gas mixer are closed.

**Quick tightness check**

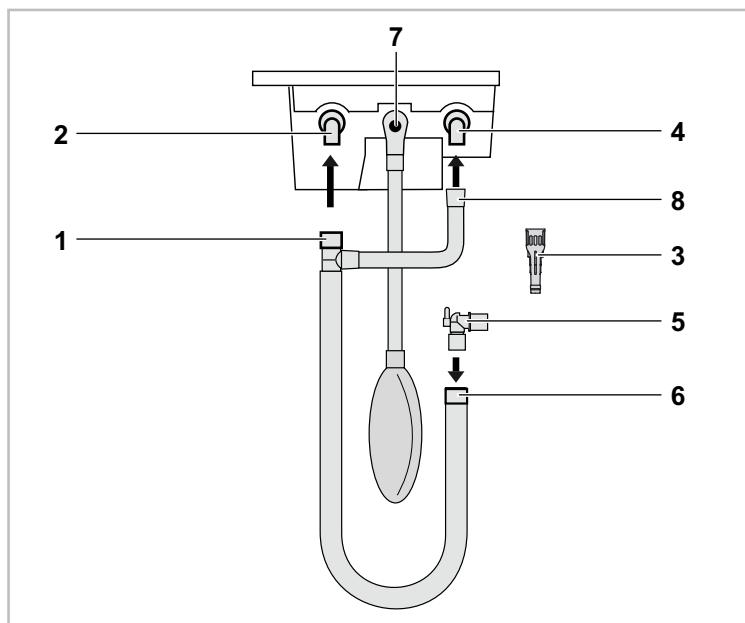
Checking the inner hose:



39554

1. Connect the breathing circuit as follows:
  - a. Connect the hose (1) to the inspiratory port (2).
  - b. Connect the coaxial test adapter (3) to the exhalation port (4).
  - c. Remove the elbow (5) from the hose (6).
  - d. Connect the hose (6) to the coaxial test adapter (3).
2. Touch the **Tests...** button.
3. Touch the **System test** button.  
The checklist opens and the breathing system pressure is displayed in the lower left-hand corner.
4. Press the **O<sub>2</sub>+** key and keep it pressed until the displayed breathing system pressure no longer rises.
5. Release the **O<sub>2</sub>+** key.
6. Wait until the pressure stabilizes between 15 and 30 hPa. If the pressure drops further, the hose is leaking.

## Checking the outer hose:



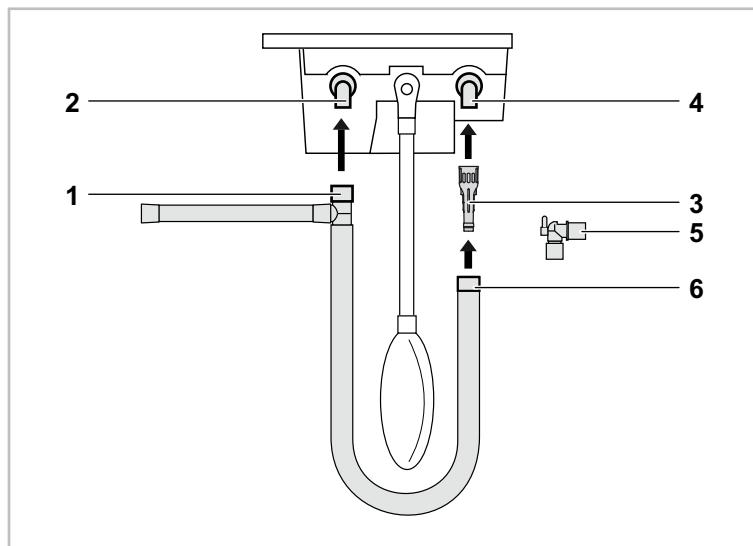
1. Connect the breathing circuit as follows:
  - a. Connect the hose (1) to the inspiratory port (2).
  - b. Remove the coaxial test adapter (3) from the expiratory port (4).
  - c. Connect the elbow (5) to the hose (6).
  - d. Plug the hose (6) with the elbow connected on to the circuit plug (7).
  - e. Connect the hose (8) to the expiratory port (4).
2. Touch the **Tests...** button.
3. Touch the **System test** button.  
The checklist opens and the breathing system pressure is displayed in the lower left-hand corner.
4. Press the **O<sub>2</sub>+** key and keep it pressed until the displayed breathing system pressure no longer rises.
5. Release the **O<sub>2</sub>+** key.
6. Wait until the pressure stabilizes between 15 and 30 hPa. If the pressure drops further, the hose is leaking.
7. Exit the system test again. To do this, touch the **Cancel** button.

For leaking hoses, the complete leakage test can be used to determine how large the leakage value is and whether the hose can continue to be used.

**Complete leakage test**

Prerequisite: The **Verify O<sub>2</sub> delivery and circuit (requires sample line)** setting is deactivated in the system setup (see "Vertical tab "System test""", page 219).

Testing the inner hose:

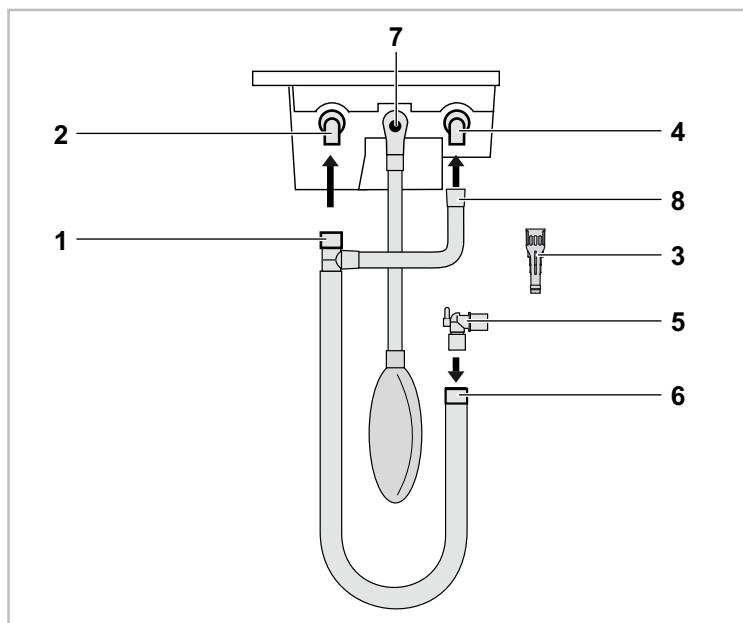


39554

1. Connect the breathing circuit as follows:
  - a. Connect the hose (1) to the inspiratory port (2).
  - b. Connect the coaxial test adapter (3) to the expiratory port (4).
  - c. Remove the elbow (5) from the hose (6).
  - d. Connect the hose (6) to the coaxial test adapter (3).
2. Touch the **Tests...** button.
3. Touch the **Leakage test** button.

The determined leakage value is displayed as **Leakage (mech. vent.)**. Note down the value as the leakage of the inspiratory hose.

## Testing the outer hose:



54658

1. Connect the breathing circuit as follows:
  - a. Connect the hose (1) to the inspiratory port (2).
  - b. Remove the coaxial test adapter (3) from the expiratory port (4).
  - c. Connect the elbow (5) to the hose (6).
  - d. Plug the hose (6) with the elbow connected on to the circuit plug (7).
  - e. Connect the hose (8) to the expiratory port (4).
2. Touch the **Tests...** button.
3. Touch the **Leakage test** button.

The determined leakage value is displayed as **Leakage (mech. vent.)**. Note down the value as the leakage of the expiratory hose.

**Evaluation of the values determined for leakage:**

<b>Test of the inspiratory hose</b>	<b>Test of the expiratory hose</b>	<b>Evaluation</b>
≤150 mL	≤150 mL	The breathing circuit is intact.
>150 to <500 mL	≤150 mL	Low leakage. Check whether the breathing circuit is suitable for the particular patient category.
>500 mL	≤150 mL	Do not use the breathing circuit. There is a risk of rebreathing.
≤150 mL	>150 to <500 mL	Take account of the leakage when setting the parameters for fresh gas and ventilation.
≤150 mL	>500 mL	Do not use the breathing circuit.
>150 mL	>150 mL	The leakage is possibly caused by other components and not by the breathing circuit. Repeat the test with a different coaxial breathing circuit.

## 7.5

## Checklist in the walk-through mode

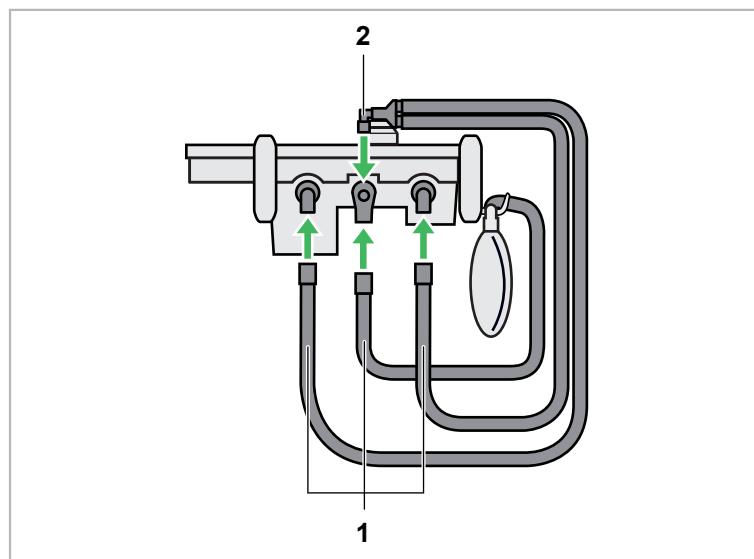
This section describes how the checklist is processed, using as an example a device with an electronically controlled gas mixer, active AGS, O<sub>2</sub> sensor, and factory defaults.

The scope of the checklist and the test steps displayed may vary due to differing system settings.

The instructions on the screen take precedence.

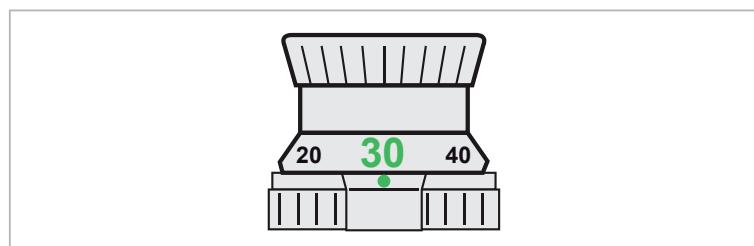
### Prerequisites

1. Connect the hoses (1).
2. Seal the Y-piece (2).



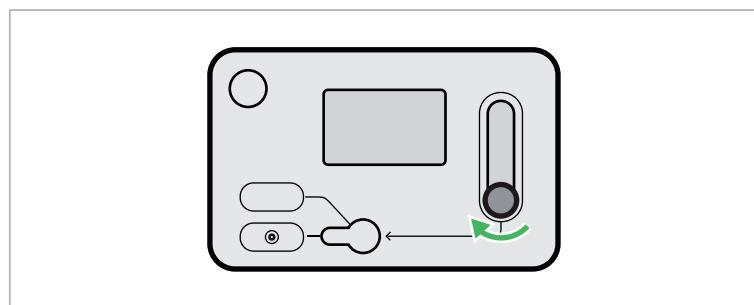
35102

3. Set the APL valve to 30.



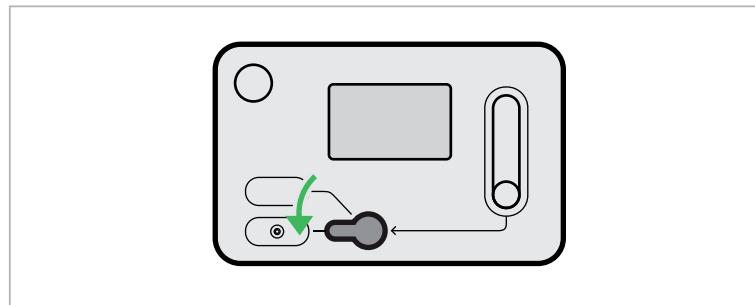
35100

4. Close the flow control valve.



35103

- Set the O<sub>2</sub> switch to **Aux. O<sub>2</sub>**.

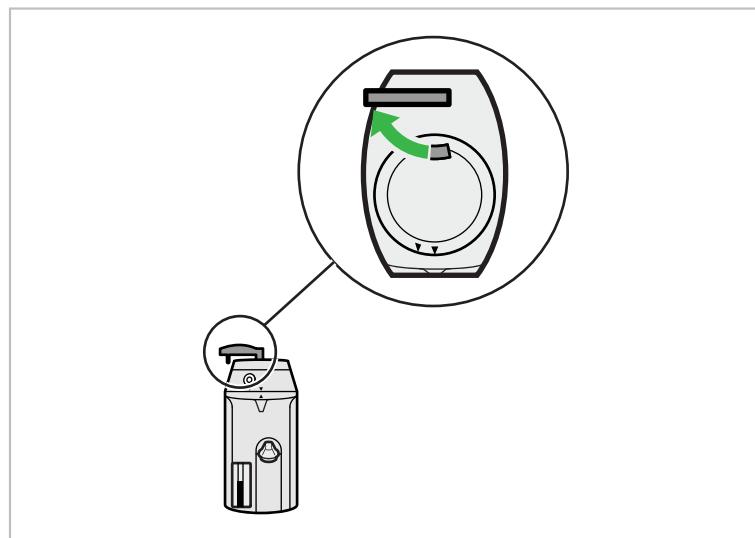


35104

### 7.5.1 Vaporizers

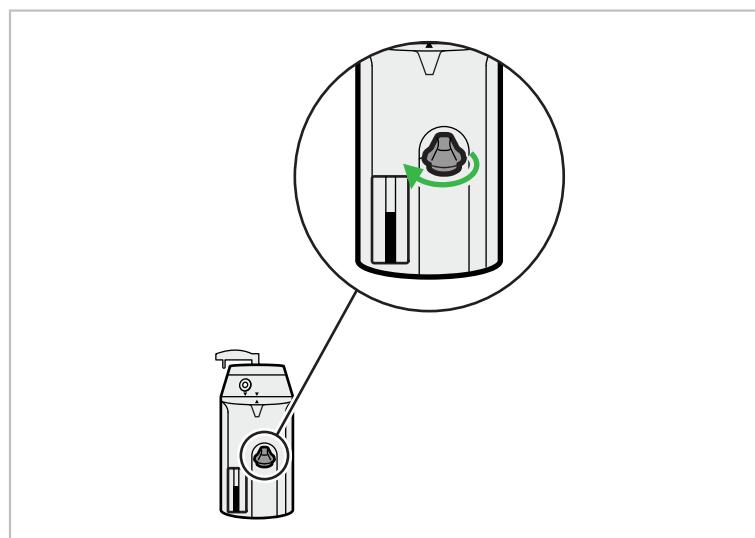
For each vaporizer, check:

- The locking lever points left, indicating the vaporizer is locked.



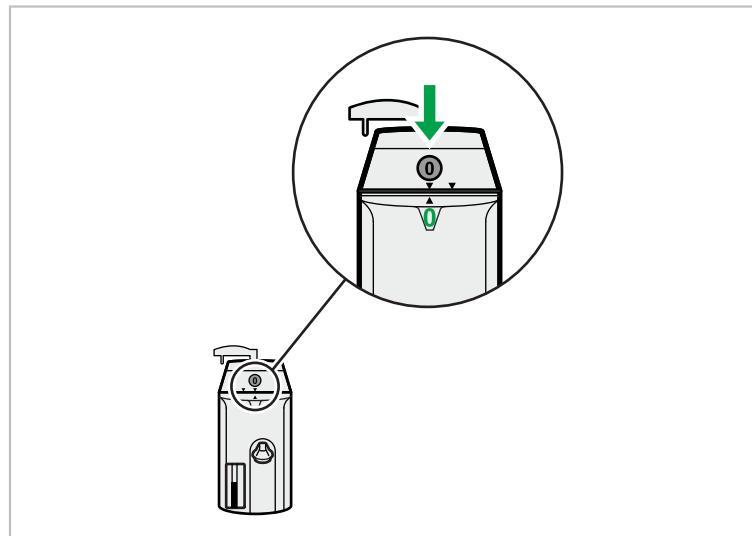
35105

- The filling inlet is closed.



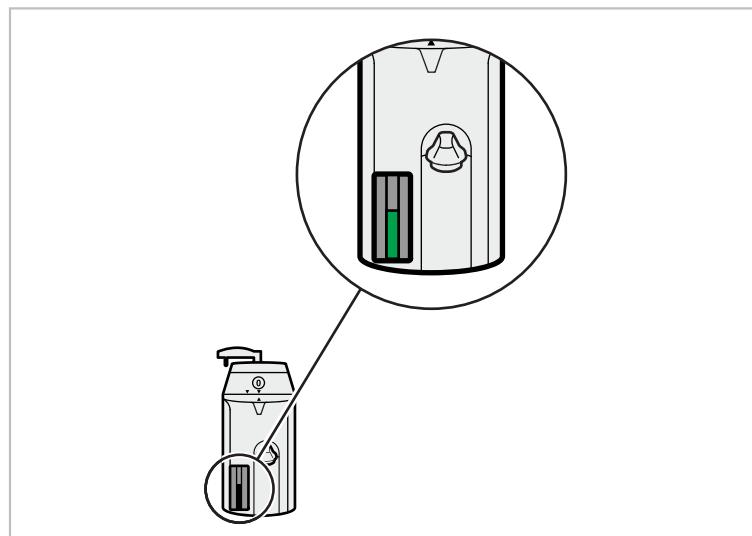
35108

3. The control dial is set to position **0** and the key is locked in placed.



35107

4. Check the filling level in the sight glass. Refill anesthetic agent if required.

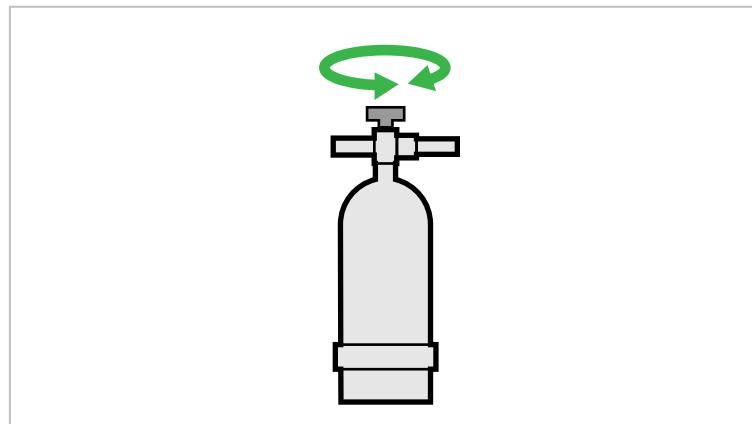


35106

## 7.5.2 Gas flow

### 7.5.2.1 Gas cylinders

1. Open the gas cylinder valves slowly.  
Check that the displayed pressures are sufficient.



35109

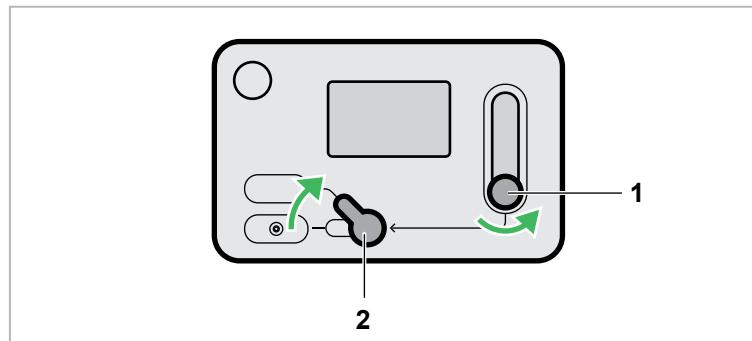
When using pressure reducers without electronic pressure measurement, read the pressure from the pressure gauge.

2. Close the gas cylinder valves.  
On devices that are equipped with Advanced Cylinder Support, the gas cylinder valves can remain open during operation. These devices are identified by an appropriate label near the gas inlets.

### 7.5.2.2 Checking the emergency O<sub>2</sub> delivery (with electronically controlled gas mixer)

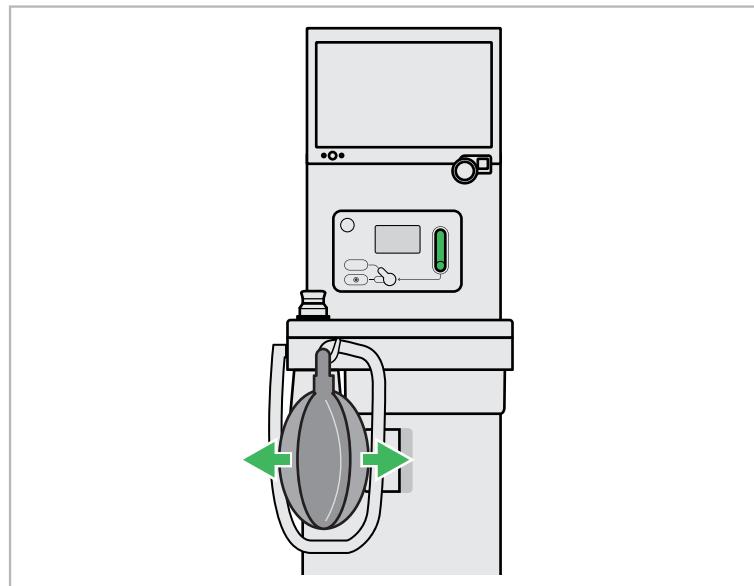
Prerequisite: Y-piece is sealed.

1. Set the O<sub>2</sub> switch (2) to the *Add. O<sub>2</sub>* position.



35110

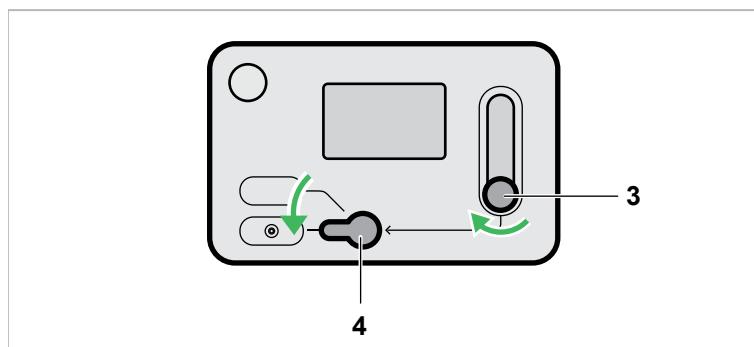
2. Open the flow control valve (1). Set the desired O<sub>2</sub> flow.



35112

The O<sub>2</sub> flowmeter indicates a flow, the breathing bag fills, and the inflow of gas is audible.

3. Close the flow control valve (3).



35111

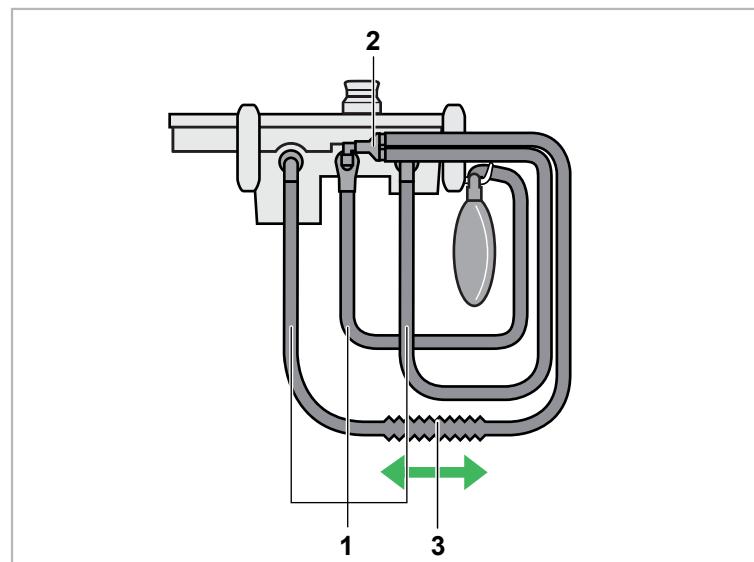
4. Set the O<sub>2</sub> switch (4) back to the **Aux. O<sub>2</sub>** position.

### 7.5.3

### Breathing circuit

Prerequisite:

- Breathing system is complete and locked.
  - Breathing system cover is fitted.
1. Hoses (1) and filters, e.g., at the Y-piece (2), are connected properly.

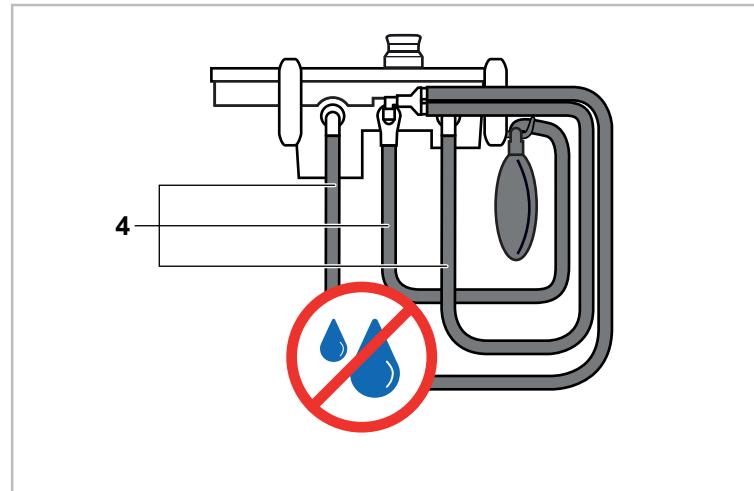


35115

2. Extendable hoses (3) are extended to the length intended for use.

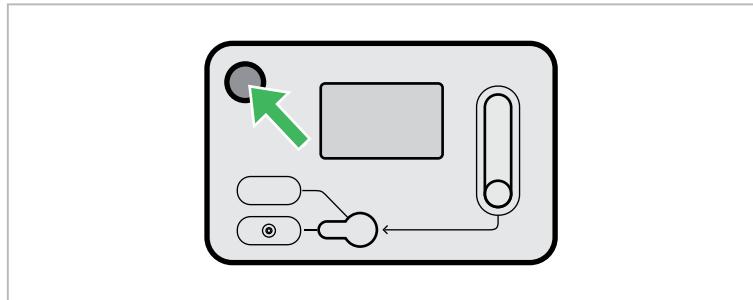
Do not change the length of the hoses after the test is done.

3. Remove the water from the hoses (4).

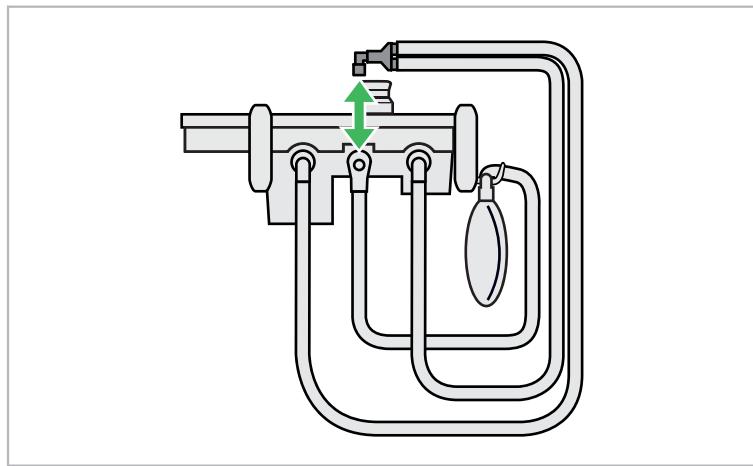


35117

4. Press the **O<sub>2</sub>+** key. The inflow of gas is audible. Keep the key pressed until the pressure exceeds 15 hPa (cmH<sub>2</sub>O).



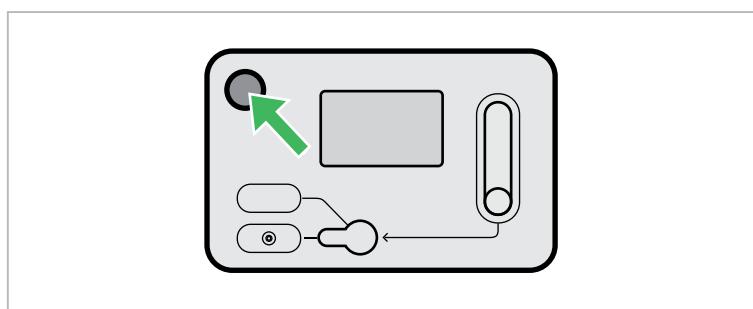
5. Pull off the Y-piece and plug it on again. The pressure drops.



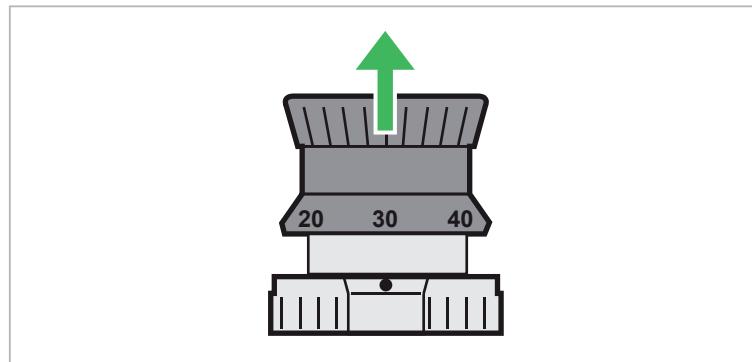
## 7.5.4 Valves

### 7.5.4.1 Checking the O<sub>2</sub> flush

1. Press the **O<sub>2</sub>+** key until the pressure exceeds 15 hPa (cmH<sub>2</sub>O).



2. Lift the APL valve.

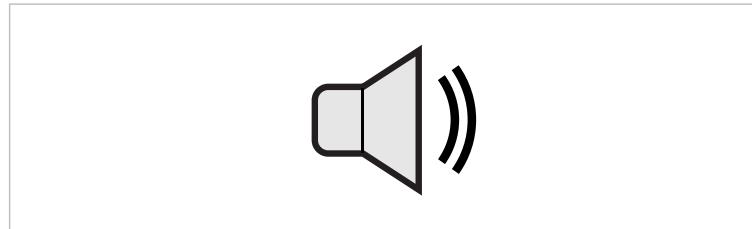


The pressure drops.

## 7.5.5 Components

### 7.5.5.1 Loudspeakers

- Touch the button and wait for 2 different acoustic signals.

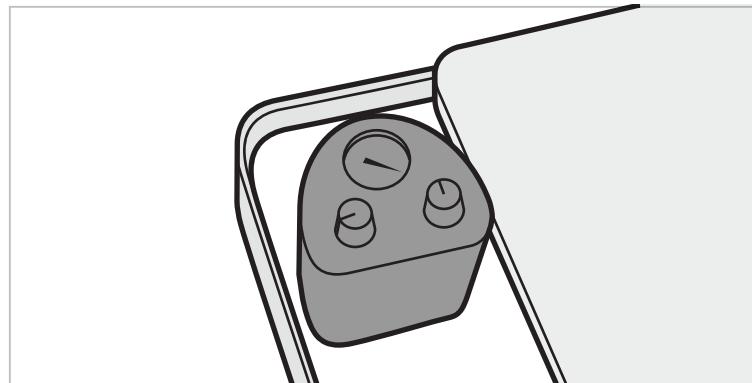


If the acoustic signals are not emitted, contact service personnel.

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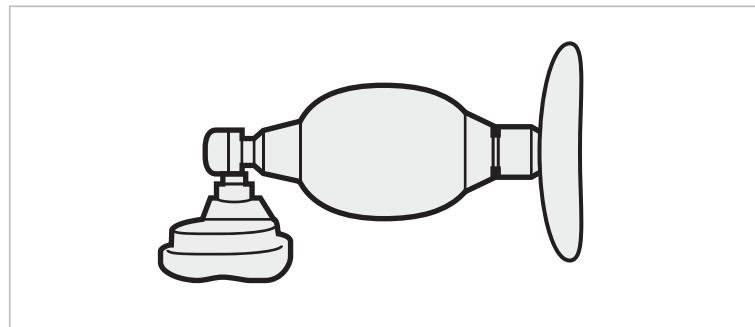
### 7.5.5.2 Bronchial suction

- Check the functional integrity of the bronchial suction.



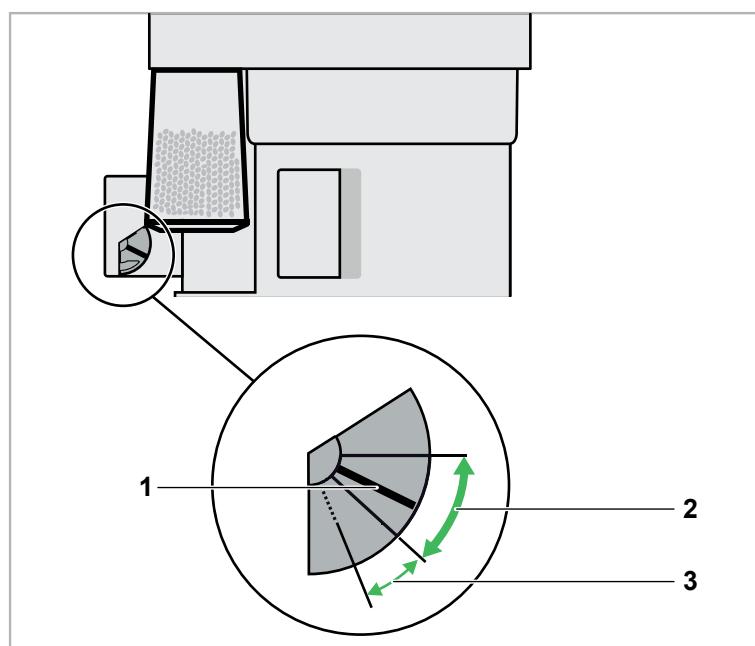
**7.5.5.3****Manual resuscitator**

1. Make sure there is a manual resuscitator on the device.

**7.5.5.4****Anesthetic gas receiving system**

With active anesthetic gas scavenging:

- Have the flow for the anesthetic gas scavenging system set so that the flow indicator (1) floats within range (2) ("normal range").



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If the flow indicator (1) is floating within range (3) ("restricted range"), certain fresh-gas flows should not be exceeded, see "Anesthetic gas receiving system" in chapter "Technical data". Contamination of the ambient air can be prevented by limiting the fresh-gas flow.

For passive anesthetic gas scavenging:

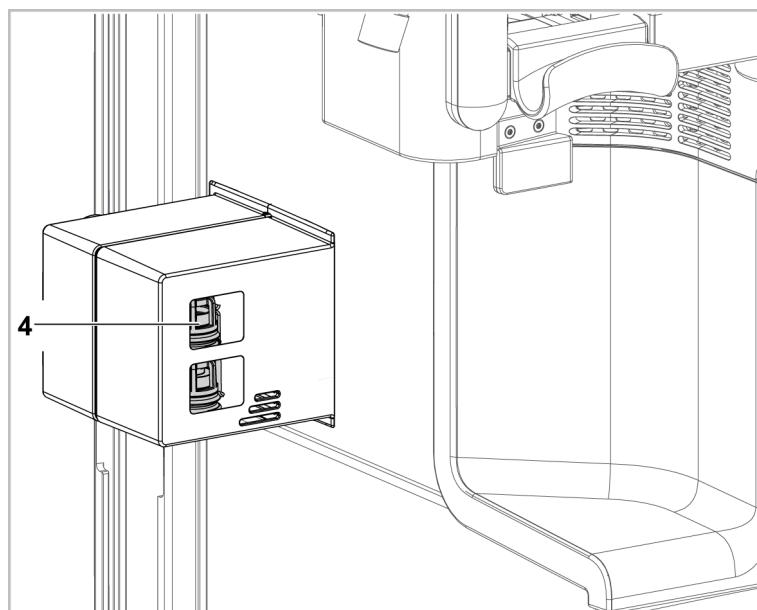
**⚠ WARNING**

**Risk of overpressure**

If the relief valve in the passive AGS or the scavenging hose is blocked, overpressure in the breathing circuit and in the patient's lungs will occur.

- ▶ Only connect the passive AGS to kink-proof and pressure-tight scavenging hoses.
- ▶ Take care that the scavenging hose does not become blocked.
- ▶ Perform a visual inspection of the relief valve for damage and soiling.

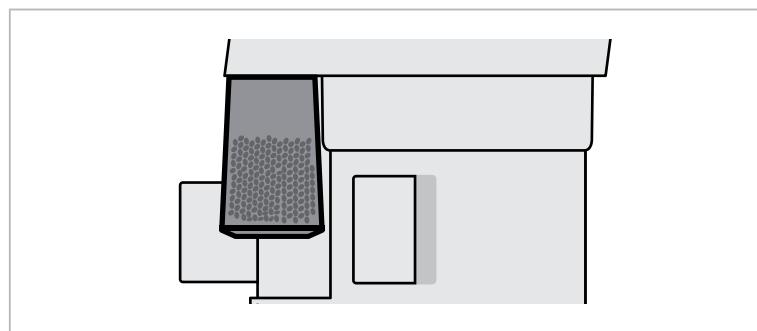
1. Check that the scavenging hose is run correctly. The hose must not be blocked.
2. Perform the visual inspection of the relief valve (4).



## 7.5.6 Accessories

### 7.5.6.1 Soda lime

- Make sure that the soda lime does not need to be exchanged. Change the soda lime if it is discolored or when its maximum period of use has been reached, see page 93.



35128

With Infinity ID function:

- Absorbers of type Infinity ID CLIC Absorber will be detected automatically.  
The replacement date will be set automatically.

Without Infinity ID function:

- Absorbers will not be detected, e.g., reusable CO<sub>2</sub> absorbers.
- Update the replacement date manually: Touch the **Reset** button after the soda lime has been replaced.

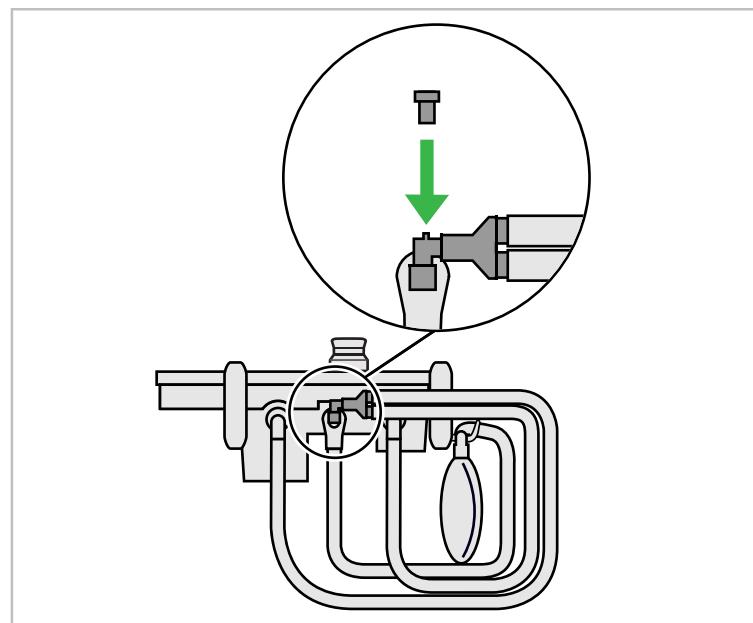
**!** Only perform the system test or leakage test with the CLIC absorber locked into place because the CLIC absorber affects the system compliance values.

#### 7.5.6.2

#### Sample line port

Prerequisite: The device is equipped with "Integrated O<sub>2</sub> monitoring".

- Seal the port for the sample line at the Y-piece.



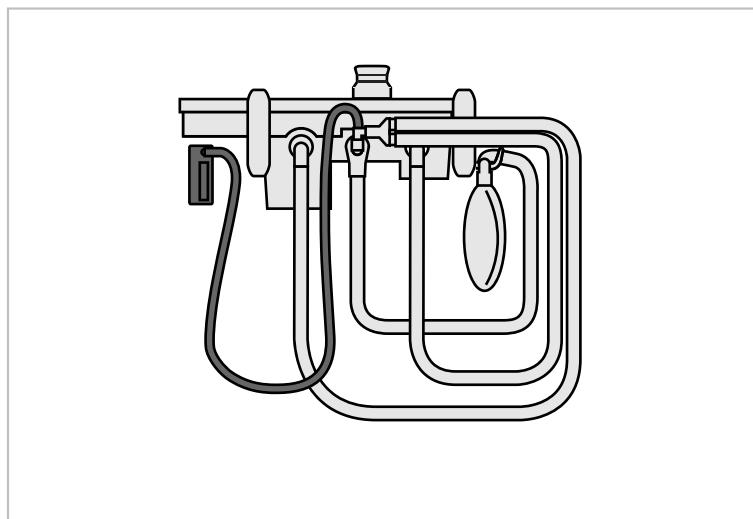
50003

#### 7.5.6.3

##### Sample line

Prerequisite: The device is equipped with the "integrated patient-gas measurement module".

- Check that the sample line is correctly connected.



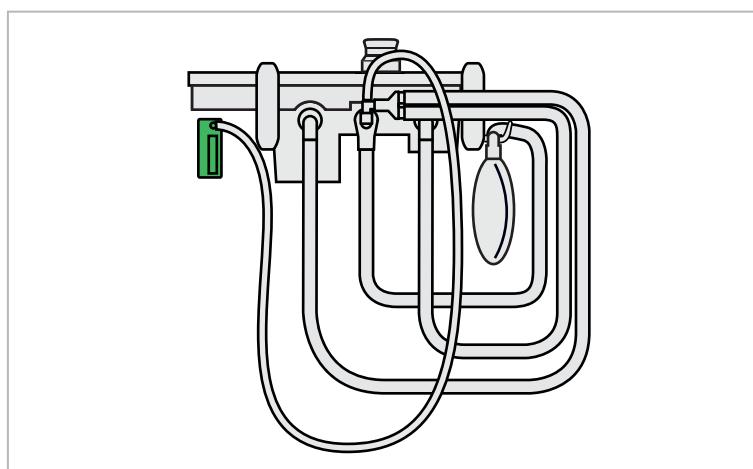
35/29

#### 7.5.6.4

##### Water trap

Prerequisite: The device is equipped with the "integrated patient-gas measurement module".

1. Check the water level in the water trap.



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2. Check the period of use of the water trap. Replace the water trap when necessary.

With Infinity ID function:

- Water traps of type Infinity ID WaterLock 2 will automatically be detected and the replacement date will automatically be set.

Without Infinity ID function:

- Water traps will not be detected.
- Update the replacement date manually: Touch the **Reset** button after a new water trap has been installed.

## 7.5.6.5

Calibrating the inspiratory O<sub>2</sub> sensor

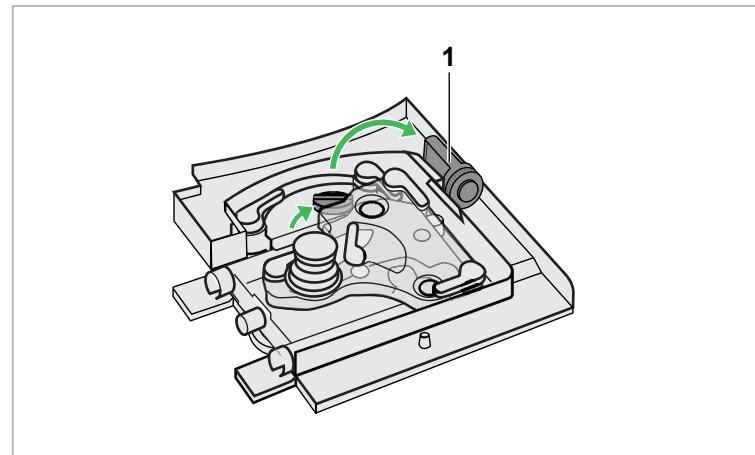
**i** During calibration, the sensor must be exposed to ambient air, i.e., 21 % oxygen concentration. Fluctuating oxygen concentrations must be avoided. The following notes must be adhered to:

- Do not fill vaporizers during the calibration.
- Close all the flow control valves.
- Do not blow into the sensor.
- Do not use any disinfectants.

1. If the O<sub>2</sub> sensor is to be calibrated despite a valid calibration, touch the **Calibrate** button.

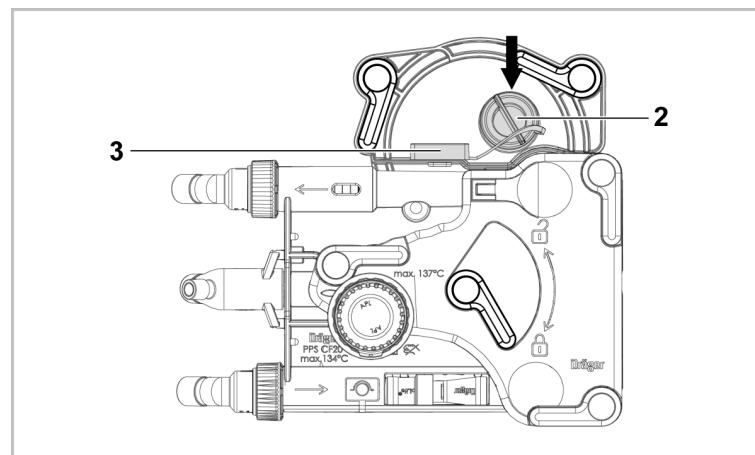
If the validity of the last calibration has expired, the prompt to perform a calibration appears automatically.

2. Touch the  $\checkmark$  button and follow the instructions on the screen.
3. Turn the O<sub>2</sub> sensor counterclockwise and remove it.  
Place the O<sub>2</sub> sensor as shown (1).



39679

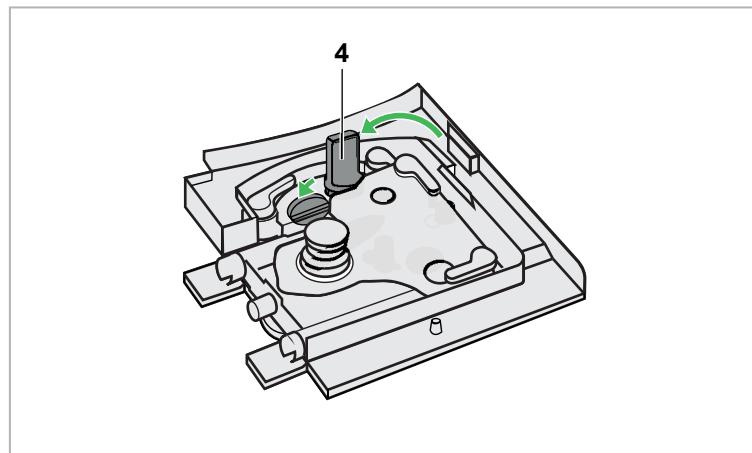
4. Take the sealing cap (2) from the holder (3).  
Seal the sensor port with the sealing cap.



39674

5. Follow the instructions on the screen.  
The device will perform the calibration.

6. After the calibration is complete, remove the sealing cap and plug it back in the holder.  
Insert the O<sub>2</sub> sensor (4) back into the sensor port and turn it clockwise until it reaches the end position.

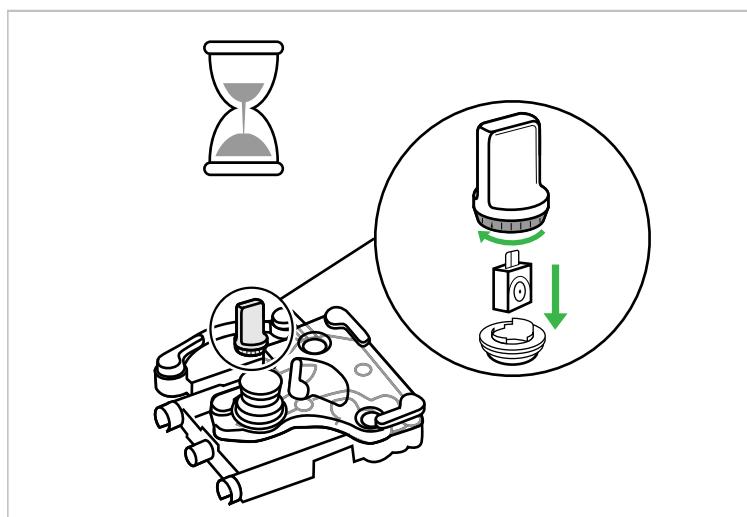


39680

7. After the calibration, the fully automatic main test is continued.

#### Note on the expiry of the life span of the O<sub>2</sub> sensor cell

The life span of the O<sub>2</sub> sensor cell is 2 years and is monitored by the device. As soon as there are 28 days or fewer of the life span left, the remaining life span will be displayed in the system test. When the life span has expired, a corresponding message and the following illustration will be displayed:



39676

If the O<sub>2</sub> calibration is possible despite the expired O<sub>2</sub> sensor cell, the O<sub>2</sub> measurement will continue to be available. With an expired O<sub>2</sub> sensor cell, a yellow test result (operational with limitations) can be achieved at best.

Replace the sensor cell when the O<sub>2</sub> sensor can no longer be calibrated, see page 69.

# 8

# Operation

## 8.1

## Safety instructions

### 8.1.1

### Alarms

#### Alarm volume

If the alarm volume is too low, alarm signals may not be heard. The patient may be put at risk.

- ▶ Set the alarm volume loud enough so that the alarm signals can be heard in the environment where the device is located.
- ▶ The user must remain within earshot of the alarm signals.

#### Recognizing alarm signals

If alarm signals are not noticed, the patient may be put at risk.

- ▶ Dräger recommends that the user remains in the vicinity of the anesthesia machine, i.e. within a distance of up to 4 meters (12 feet). This facilitates fast recognition and response in the event of an alarm.
- ▶ If the causes of the alarm are only temporary, the alarms will likewise only be indicated temporarily.

#### Impaired Infinity ID functions

Electromagnetic disturbances or faults in Infinity ID components can cause permanent alarms.

- ▶ Contact service personnel to deactivate the Infinity ID alarms.

### 8.1.2

### Therapy and applications

#### Therapy with known pre-existing conditions

Volatile anesthetic agent may trigger malignant hyperthermia. As a result, the patient could be put at risk.

- ▶ For patients suspected of malignant hyperthermia: Do not use any volatile anesthetic agent or devices with residual concentrations of these gases above 5 ppm.

For further information and recommendations for therapy settings for patients with suspected malignant hyperthermia, contact the responsible national Dräger organization. Further information is available on the following web page:  
[www.draeger.com/mh](http://www.draeger.com/mh)

Under certain conditions, acetone can accumulate in the patient's body during anesthesia. As a result, the patient could be put at risk.

- ▶ Do not perform low-flow anesthesia on patients with ketoacidosis or patients under the influence of alcohol.

#### Unintentional start of therapy

If the device is in standby mode and the flow control valves on the mechanically controlled gas mixer with electronic flow measurement are opened, the device will exit standby mode and start the Man/Spon mode.

- ▶ Take care that this does not happen unintentionally.

### Device malfunction during operation

Device malfunctions can compromise the correct therapy functionality of the device. As a result, the patient could be put at risk.

- ▶ Only operate the device under the constant supervision of users.
- ▶ Always keep a manual resuscitator ready.

A cyber attack can occur as a result of a connected service laptop.

- ▶ Do not connect a service laptop during operation.

### Displays and therapy decisions

The status display serves as an information source for the airway pressure in the internal breathing system and for the fresh-gas flow (only with mechanically controlled gas mixer with electronic flow measurement).

- ▶ In the following cases, use the display on the airway pressure gauge and the total flow tube as the information source for therapy:
  - The status display has failed.
  - The values on the status display do not match the values on the total flow tube.

The following situations could result in misdiagnoses, which could put the patient at risk:

- Measured values are misinterpreted.
- Measured values are incorrectly or inaccurately displayed.
- The accuracy of the measurements of flow and volume may be impaired if the breathing system warmer is switched off.
- The parameter under consideration is not meaningful (e.g., MV×CO<sub>2</sub>, O<sub>2</sub> uptake, anesthetic agent uptake)
- ▶ Do not make therapeutic decisions based solely on individual measured values and parameters.
- ▶ Only use the trend curve for the MV×CO<sub>2</sub> and O<sub>2</sub> uptake parameters as a basis for therapeutic decisions.
- ▶ Therapeutic decisions must be made solely by the user. For further information see: "User group requirements", page 11.
- ▶ Do not use the virtual flow tubes of the electronically controlled gas mixer alone when making therapeutic decisions.

Measured gas values and waveforms such as the CO<sub>2</sub> waveform are determined on the basis of the composition of the sample gas. The composition of the sample gas is affected by many factors and their interactions, especially in patients with low body weight. This may result in biased measured values or waveforms and thus to misinterpretations. As a result, the patient could be put at risk.

The following factors affect the sample gas measurement:

- Dead space
  - Airway resistance of the patient
  - Compliance of the patient
  - Type of surgical procedure
  - Gas sampling site
  - Breathing circuit, filter, sample line, tube
  - Ventilation settings and the resulting ventilation
  - Leakage
  - Spontaneous breathing
  - Cardiogenic oscillations
  - I:E ratio and the respiratory rate
- Adhere to the following:
- Do not make therapeutic decisions based solely on individual measured values or parameters.
  - If possible, minimize the effects of the factors described above, e.g., take the sample gas from a gas sampling site close to the patient, minimize leakage, adjust the ventilation settings.
  - The measured values are not meaningful during the warm-up time of the patient-gas measurement module.

Data (e.g., measured values, alarms) which the anesthesia machine transfers to other systems such as patient monitors or EMR systems may be displayed there incompletely or incorrectly and may thus put the patient at risk. Consequently, the data are intended to be used only for information purposes.

- Do not use data displayed on other devices for patient monitoring or device monitoring.
- Do not use data displayed on other devices on its own for diagnostic or therapeutic decisions.

### 8.1.3

### Risk of infection

#### Contamination of the circuit plug

The circuit plug on the breathing system is color-marked. This marking indicates that the circuit plug could transmit pathogens between patients. If a used Y-piece or filter is fitted to the circuit plug, and then later a reprocessed component is fitted (e.g., during a leakage test), the new component can become contaminated.

- Only fit reprocessed components to the circuit plug.
- Do not plug already used hoses with attached filters or Y-pieces onto the circuit plug but instead hang them over the handles on the left-hand side of the device.

#### 8.1.4

#### Explosion protection

##### Flammable gases

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgery, laser surgery, and faulty cables or connectors can cause fires. As a result, user and patient could be put at risk.

- ▶ This device is not approved for use in areas where oxygen concentrations greater than 25 Vol%, combustible, or explosive gas mixtures are likely to occur.
- ▶ Maintain a distance of at least 200 mm (7.9 in) between electrical connections and components which conduct oxygen and nitrous oxide.
- ▶ Cables and connections must be sufficiently insulated and must not be damaged. Check cables for damage daily.
- ▶ Disconnect all oxygen feeds if oxygen leakage is suspected in the device or its vicinity (e.g., because a corresponding flowing noise can be heard). Do not operate the device, and contact service personnel.
- ▶ Keep ignition sources away from the device.

If a fire starts in the immediate vicinity of the patient, the device could also catch fire. Personal injury and property damage may occur as a consequence.

- ▶ Disconnect the oxygen-carrying connections from the device and the patient.
- ▶ Extinguish the fire and tend to the patient's medical needs.

#### 8.1.5

#### Workplace light

Looking directly into the LEDs of the workplace light may damage the retina. User and patient could be put at risk.

- ▶ Do not look directly into the LEDs.
- ▶ Make sure that the patient is not dazzled by the LEDs.

If illumination without neutral colors is used during the medical examination of the patient, this may result in, e.g., misinterpretation of skin coloring.

- ▶ Do not use the device's working light for examinations.
- ▶ For examinations, use an examination light conforming to IEC 60601-2-41.

### 8.1.6 Exporting data

Unauthorized access to the device can impair the device function. When using USB mass storage devices, a denial of service may occur.

- ▶ Only devices that are included in the list of accessories or which correspond to the "mass storage medium" USB device class may be connected. For example, no provision has been made for connecting devices whose battery is to be charged.
- ▶ Dräger recommends the use of storage media with hardware encryption.

USB mass storage devices must be checked for malware and approved before being connected to the device. Checking and approval must be performed by the IT administrator or equipment officer of the health-care facility in accordance with the specifications of the health-care facility.

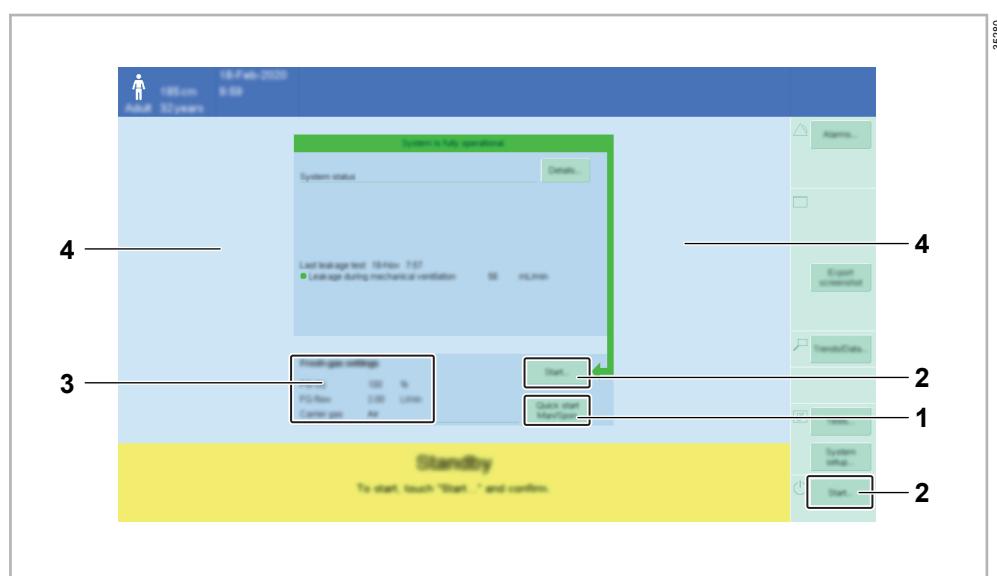
The following USB devices must not be connected:

- Active USB devices (own power supply)
- Devices that use wireless technology
- Cellular phones

## 8.2 Starting the therapy

The therapy can be started either from a quick start into the Manual / Spontaneous mode or from a normal start with customized settings.

Prerequisite: The device is in Standby mode.



### Quick start

Mechanically controlled gas mixers:

- Touch the **Quick start Man/Spon** button (1) and open the flow control valves.

Mechanically controlled gas mixer with electronic flow measurement:

- Open the flow control valves. The device switches automatically to the Manual / Spontaneous mode. Take care that the quick start does not happen unintentionally.

Electronically controlled gas mixer:

1. Observe the fresh-gas settings (3).
2. Touch the **Quick start Man/Spon** button (1).

#### Normal start with customized settings

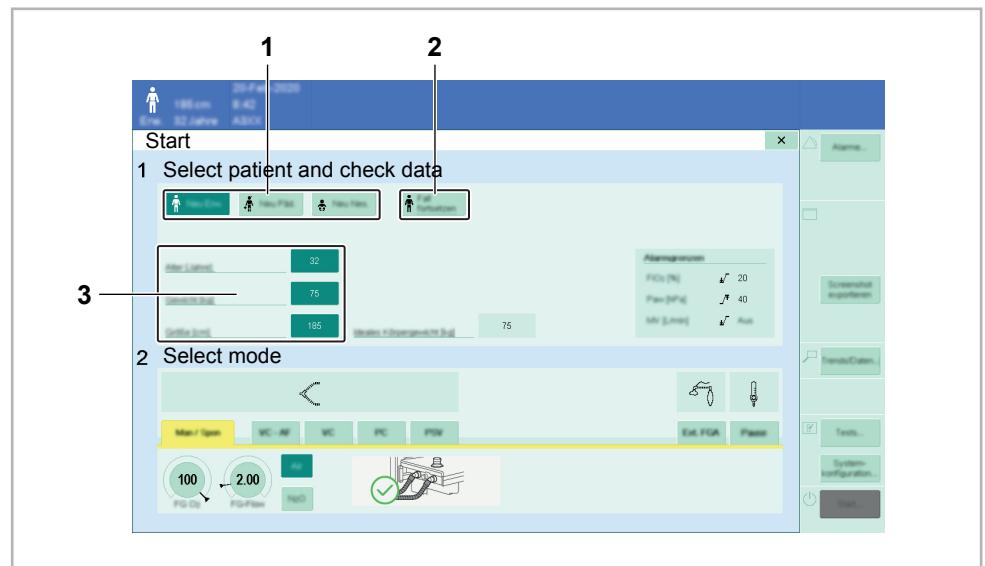
1. Optionally perform one of the following steps:
  - Touch the **Start...** button (2).
  - Touch the screen in the monitoring area (4).
  - Squeeze the breathing bag twice.
2. Adjust the patient data and ventilation settings.

#### Starting when time is limited

When time is limited, adjusting the patient data can be omitted. Start the therapy as follows:

1. Touch the screen.
2. Check the displayed start values.
3. Press the rotary knob. The therapy starts.
4. Adjust the patient data as soon as possible.

### 8.2.1 Loading the patient data



There are two possibilities for loading the patient data:

- Starting a new case (1)
- Continuing a case (2)

Depending on the selected patient category, different patient data (e.g., weight, age) are displayed in area (3).

### 8.2.1.1

#### Starting a new case

- Touch the button for the desired patient category (1).

For new patients, the device uses defined start settings for ventilation settings and alarm limits, see page 203.

Whether the ventilation settings are based on Ti or the I:E ratio can be defined in the start settings, see page 214.

The set value for Ti is automatically set based on RR to result in the I:E ratio set in the start settings, see page 211.

### 8.2.1.2

#### Continuing a case after an interruption

- Touch the **Continue case** button (2).

The device continues to use the ventilation settings and alarm limits that were set at the start of the case.

This function is only available if a case has previously been started and then interrupted.

### 8.2.2

#### Checking the patient data



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#### **⚠ WARNING**

##### Risk due to incorrect settings

Different standard alarm limits or therapy settings might be configured for medical devices within the same area. The user must observe the following:

- ▶ Make sure that the set values and alarm limits are selected to suit the patient.
- ▶ Make sure that the alarm limits are set to suitable values for the patient's current condition. Otherwise the alarm system may not indicate a change in the patient's condition, which might put the patient at risk.
- ▶ Check the therapy settings, the start settings for alarms, and the alarm settings during a change of ventilation mode.
- ▶ Only turn off alarms if the safety of the patient will not be compromised as a result.

#### **⚠ CAUTION**

##### Risk due to incorrect setting for patient age

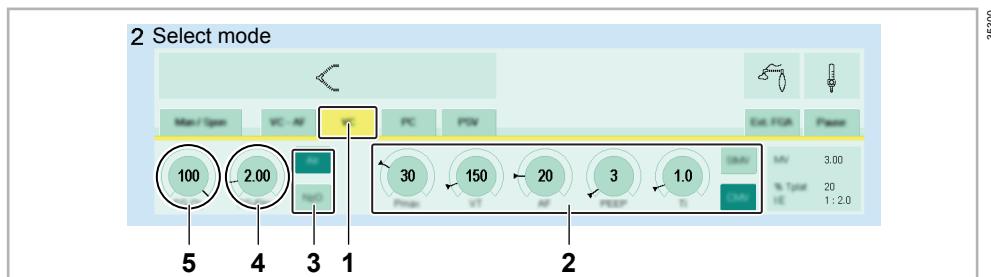
Incorrectly setting the patient age can lead to incorrect xMAC values and thus to incorrect anesthetic agent delivery.

- ▶ Always set the patient age correctly.
- Adjust the patient data (1).

The device will suggest appropriate therapy settings for these data, e.g., for tidal volume, respiratory rate, and alarm limits. For more information, see page 325.

## 8.2.3

## Setting and starting the therapy



1. Select the ventilation mode (1).

The following ventilation modes are available:

- Man/Spon
- VC - AF
- VC
- PC
- PSV

The following operation modes are also available:

- Ext. FGO
- Pause<sup>1)</sup>
- Monitoring<sup>2)</sup>

For further information see: "Description of the ventilation modes", page 308.

### **⚠ WARNING**

#### Risk of patient injury

The use of minimal-flow settings or low-flow settings can lead to the following:

- Accumulation of metabolic by-products in the breathing system
- Condensed water in hoses
- Condensed water in the piston diaphragm
- Check the hoses for condensation at regular intervals. Remove the condensed water if required.
- When repositioning the patient or changing the hose arrangement, check the hoses for condensation. Remove the condensed water if required.
- Before a change of patient, always perform the following measures:
  - Remove the condensed water.
  - Perform a leakage test or a complete system test.
- Prevent condensed water from entering the patient's airways. To do so, take at least one of the following measures:
  - Equip the Y-piece with an HME or HMEF.
  - Use water traps in the breathing hoses. Position the water traps at the lowest point of the breathing hoses.
  - Position the patient's head higher than the ports on the breathing system.
- Follow the recommendations of professional societies.

1) Pause must be activated in the system setup.

2) Only for devices with integrated PGM. Pause must be deactivated in the system setup.

## 2. Set the fresh-gas delivery.

The device is equipped with a minimum O<sub>2</sub> delivery function which ensures that a minimum quantity of oxygen is delivered. For further information see: "Minimum O<sub>2</sub> delivery (SORC)", page 324.

When performing low-flow anesthesia and minimal-flow anesthesia, observe the information on page 152.

Electronically controlled gas mixer:

- Select the carrier gas (3).  
Set the O<sub>2</sub> concentration (5) and fresh-gas flow (4).

Mechanically controlled gas mixer with electronic flow measurement:

- Open and set the flow control valves for the required gases.  
Also use the total flow tube to check the set total flow, see page 34.

Mechanically controlled gas mixer with flow tubes:

- Open and set the flow control valves for the required gases.

## 3. Adjust the ventilation settings (2).

## 4. Press the rotary knob. The therapy starts and a signal tone sounds.

### 8.2.4

## Specific points to note for equipment with inspiratory O<sub>2</sub> measurement

When the device is equipped with inspiratory O<sub>2</sub> measurement and is used in combination with an external anesthetic gas monitor, the extracted sample gas is not fed back into the breathing system.

If this sample gas flow is not taken into consideration when the fresh-gas delivery is set, a lack of fresh gas may result. Increase the fresh-gas flow accordingly, especially for minimal-flow anesthesia and low-flow anesthesia.

The sample gas flow extracted by the external anesthetic gas monitor leads to a discrepancy between the set inspiratory tidal volume and the measured expiratory tidal volume. This discrepancy affects the displayed measured values for VT, MV, ΔVT, and MVleak.

## 8.3

## Adjusting the therapy

### 8.3.1

## Setting the APL valve

The pressure limitation set with the APL valve only takes effect during manual ventilation or spontaneous breathing.

### ⚠ WARNING

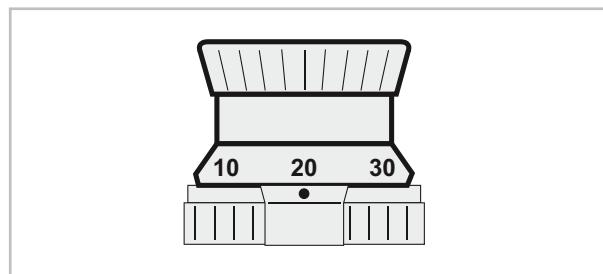
#### Risk of excessively high airway pressures

If the ventilator fails, the device switches into the Man/Spon ventilation mode.

- Follow the instructions on the screen.
- Also set the APL valve to a value suitable for the patient when using mechanical ventilation modes. If the ventilator fails, ventilate the patient manually.
- The selection between manual ventilation (**Man**) and spontaneous breathing (**Spont**) is made at the APL valve, see page 22.

**8.3.1.1****Manual ventilation**

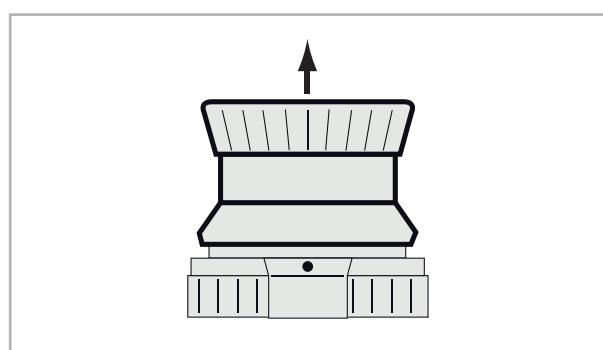
- Set the APL valve to the desired maximum airway pressure.



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The patient can be ventilated with the breathing bag. The pressure is limited to the set value.

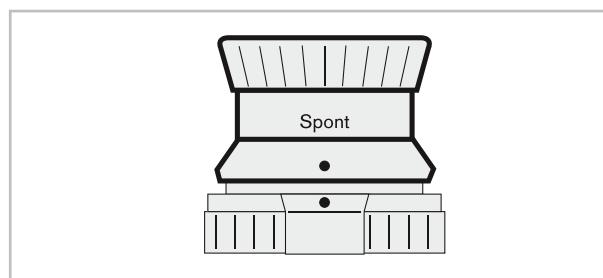
- To release pressure from the breathing system in Manual / Spontaneous mode, lift the valve.



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**8.3.1.2****Spontaneous breathing**

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



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The dots are aligned vertically over one another. The valve lifts.

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

**8.3.2****Using the O<sub>2</sub> flush**

The O<sub>2</sub> flush is used for flushing and quickly filling the breathing system and breathing bag with oxygen. The vaporizers are bypassed for this.

- Press the **O<sub>2</sub>+** key.  
O<sub>2</sub> continues to flow for as long as the key is pressed.

The gas concentration can change abruptly when the O<sub>2</sub> flush is used.

Using the O<sub>2</sub> flush has the following effects:

- In manual ventilation, pressing the O<sub>2</sub> flush results in a rapid rise in pressure to the APL level.
- In mechanical ventilation, permanently pressing the O<sub>2</sub> flush may result in a slight rise of the PEEP level. However, this rise has no effect on the peak pressure.

### 8.3.3 Using the vaporizer

- Operate the vaporizer according to its instructions for use.

### 8.3.4 Flow correction

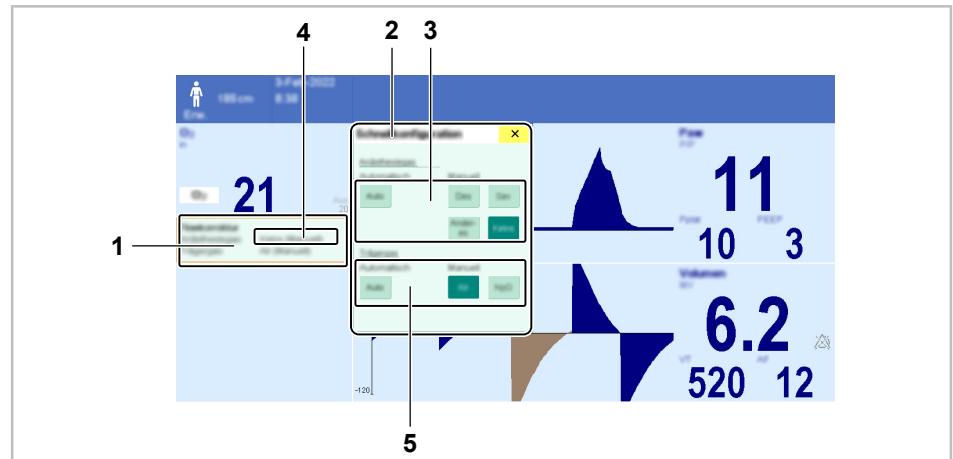
The gas composition can affect the measurement accuracy of the flow measurement.

On devices equipped with an integrated patient-gas measurement module, the flow measurement is corrected automatically.

On devices equipped with inspiratory O<sub>2</sub> measurement, the accuracy of the flow measurement can be ensured by manual or automatic flow correction.

Prerequisites for automatic flow correction on devices equipped with inspiratory O<sub>2</sub> measurement:

- The anesthetic gas monitor (Dräger Vamos or Dräger Scio) is connected to the COM 2 serial port.
- The COM 2 serial port is activated in the system setup, see the table on page 220.
- 1. Touch area (1); a further dialog (2) will open.



#### **⚠ CAUTION**

#### **Risk of inaccurate measured flow values**

If the flow is not set correctly, the resulting incorrect measured flow values can lead to incorrect measured values for the tidal volume.

- Make the settings for the flow correction carefully.

2. Select the anesthetic gas to be used (3):

- **Auto:** The flow measurements are automatically corrected for the anesthetic gas detected by the anesthetic gas monitor. If no anesthetic gas is detected or if the data connection to the anesthetic gas monitor is interrupted, no flow correction takes place and the message **None** (4) is displayed.
- **Des:** The measured flow values will be corrected for desflurane using an average value. For more information, see the table on page 214.
- **Sev:** The measured flow values will be corrected for sevoflurane using an average value. For more information, see the table on page 214.
- **Other:** Select this option if you want to use an anesthetic gas other than desflurane or sevoflurane. The measured flow values will not be corrected.
- **None:** The measured flow values will not be corrected.

The following step 3 applies only to main devices with mechanically controlled gas mixer with flow tubes:

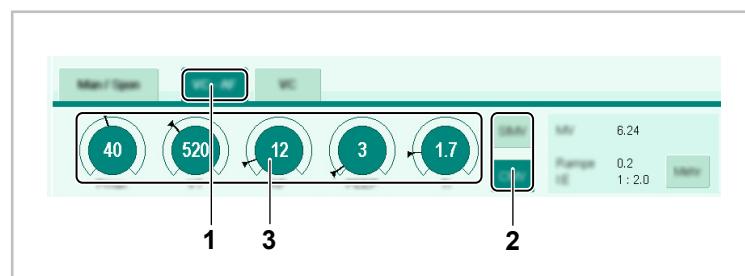
3. Select the carrier gas to be used (5):

- **Auto:** The measured flow values are automatically corrected for the carrier gas detected by the anesthetic gas monitor. If no carrier gas is detected or if the data connection to the anesthetic gas monitor is interrupted, flow correction will be performed for Air.
- **Air:** The measured flow values will be corrected for Air.
- **N<sub>2</sub>O:** The measured flow values will be corrected for nitrous oxide.

### 8.3.5 Changing the ventilation mode

1. In the therapy bar, touch the tab (1) of the new ventilation mode.

When the ventilation mode is changed, the ventilation settings are adopted from the previous ventilation mode or they are sensibly derived. In addition, the alarm settings are adjusted to reasonable values, see page 196.



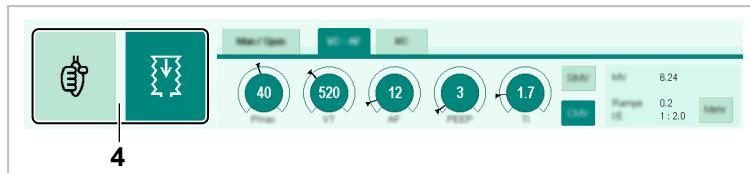
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2. Adjust the therapy controls (3) or the buttons (2).

3. Activate the ventilation mode with the rotary knob. A signal tone is emitted when the mode is changed.

### Symbol buttons

The symbol buttons (4) are additionally available for mechanically controlled gas mixers with flow tubes.



The ventilation mode can also be changed by means of the symbol buttons.

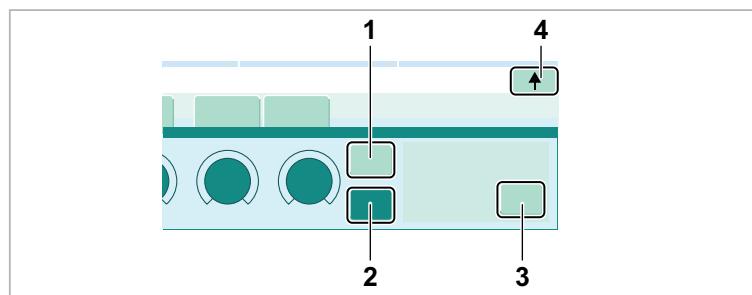
Symbol button	Description
	Switches to Manual / Spontaneous mode after confirmation with the rotary knob.
	Switches to the last used mechanical ventilation mode after confirmation with the rotary knob. If no mechanical ventilation mode was previously active, the mode is switched to VC - CMV or the configured default mechanical ventilation mode.

#### 8.3.6 Synchronizing the breaths

Prerequisite: The device has the "spontaneous breathing support" software option.

Turning on the synchronization activates the set pressure support, for example, see page 308.

1. Turn the synchronization on or off with the **SIMV** (1) or **CMV** (2) buttons.



2. If required, show the extended therapy bar with one of the **More** buttons ((3) or (4)). Then adjust the additional parameters (Trigger,  $\Delta$ Psupp, etc.).

#### WARNING

##### Risk of insufficient ventilation

In ventilation modes in which breaths are to be triggered only by the patient (e.g. PSV), adverse settings or sensor failure can lead to insufficient ventilation.

- To maintain a minimal ventilation of the patient, set the respiratory rate to a suitable value.

### **⚠ WARNING**

#### **Risk of insufficient ventilation**

The spontaneous minute volume MV<sub>spon</sub> indicates the volume which results from spontaneous breathing and from pressure-supported spontaneous breathing. If the patient frequently triggers pressure-supported breaths as a result of small tidal volumes, a large part of MV<sub>spon</sub> will be achieved by mechanical ventilation and not by spontaneous breathing of the patient. In this case, MV<sub>spon</sub> shows a high value although the actual spontaneous minute volume is very low.

- ▶ Do not base therapy decisions solely on the value displayed for MV<sub>spon</sub>.
- 

### **8.3.7**

#### **Low-flow anesthesia and minimal-flow anesthesia**

This device is suitable for and optimized for carrying out low-flow anesthesia and minimal-flow anesthesia. Functions and special characteristics are explained in the following.

Due to the patient's rebreathing, moisture condenses in the breathing circuit and the breathing system, particularly during low-flow anesthesia (flow  $\leq 1.0$  L/min). The device has equipment and functions that facilitate handling of any condensed water that is produced.

In particular cases, e.g., during minimal-flow anesthesia lasting several hours, condensed water may accumulate in the piston ventilator.

 The device detects condensed water in the piston ventilator and in the breathing hoses during the system test. A message is displayed when condensed water is detected.

Dräger recommends the following equipment and procedures:

- Activate the breathing system warmer to reduce condensation in the breathing system.
  - Use breathing circuits with water traps.
  - Regularly remove the moisture from breathing circuits.
  - Filters on the inspiration port lead to greater condensation in the breathing system than filters on the Y-piece. Optimize the position of the filters if possible.
  - Regularly check the filling level of the water traps on the patient-gas measurement module.
  - Allow the breathing system and piston ventilator to dry after low-flow anesthesia and minimal-flow anesthesia lasting several hours, for example, by flushing with Air from the central supply.
- 

When performing low-flow anesthesia and minimal-flow anesthesia, follow the recommendations of professional societies.

### **8.3.8**

#### **Ventilating pediatric patients and neonates**

For tidal volumes below 300 mL:

- Use suitable ventilation accessories, see chapter "Selecting and connecting patient-specific accessories" starting on page 85.

## 8.4

## Special forms of therapy

The device has the following additional operation modes:

- External fresh-gas outlet
- Pause<sup>1)</sup>
- Monitoring<sup>2)</sup>
- CBM mode

### 8.4.1

### External fresh-gas outlet

Prerequisites:

- The device has the "external fresh-gas outlet" hardware option.
- A non-rebreathing system is connected, see page 91.

#### Redirecting the fresh gas to the external outlet

The FiO<sub>2</sub> measurement is not possible when the external fresh-gas outlet is in use on devices with inspiratory O<sub>2</sub> measurement, as the fresh gas is not routed through the internal breathing system.

#### WARNING

#### Risk of faulty gas delivery

With non-rebreathing systems, O<sub>2</sub>, CO<sub>2</sub>, and any anesthetic gases must be monitored.

- ▶ Connect the sample line to the non-rebreathing system and the integrated patient-gas measurement module or the anesthetic gas monitor.

#### CAUTION

#### Risk of gas contamination

When the device's integrated patient-gas measurement module is used, the extracted sample gas is also returned to the internal breathing system during operation with an external fresh-gas outlet.

- ▶ Using a breathing hose, establish a closed connection between the inspiratory port and the expiratory port. Flush the breathing system each time patients or anesthetic gas are changed!

1. Start the **Ext. FGO** operation mode.
2. Adjust the fresh-gas delivery. Check the vaporizer setting.

### 8.4.2

### CBM mode

The CBM mode allows patient monitoring without unnecessary alarms during extracorporeal oxygenation of the patient by a heart-lung machine.

Properties of CBM mode:

- All gas concentrations are measured independently of the respiratory phases.
- The CO<sub>2</sub> apnea alarms and pressure apnea alarms are inactive.
- Further configurable alarms are inactive, see pages 196 and 209.

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

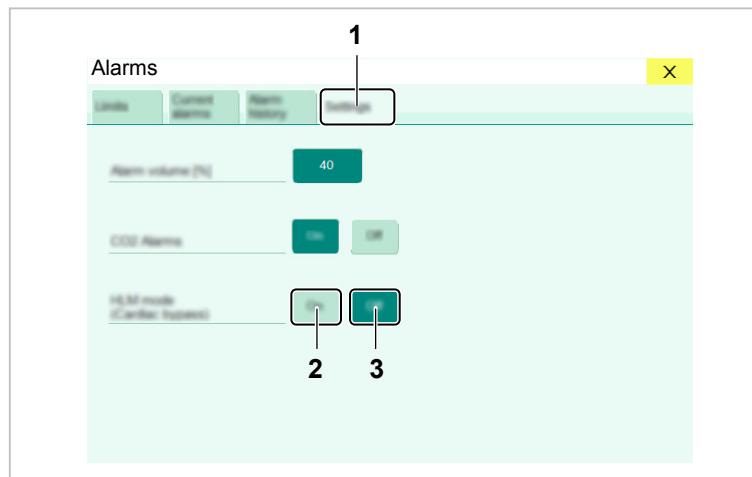
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1) Pause must be activated in the system setup.

2) Only for devices with integrated PGM. Pause must be deactivated in the system setup.

### Activating

1. Open the **Alarms** dialog.
2. Touch the **Settings** tab (1).



3. For **Cardiac bypass mode (CBM)**, touch the **On** button (3).

### Deactivating

To deactivate CBM mode, choose from the following options:

- For **Cardiac bypass mode (CBM)**, touch the **Off** button (2).
- In the main menu bar, touch the **Exit CBM** button.

### Automatic deactivation

If active, the CBM mode is automatically deactivated in the following cases:

- Switching from a ventilation mode without breathing support to a ventilation mode with medium or high breathing support
- Switching from a ventilation mode with low breathing support to a ventilation mode with medium or high breathing support
- Switching to the standby mode

For further information see: "Degree of breathing support", page 310.

Deactivating the CBM mode activates the apnea monitoring.

### 8.4.3

## Monitoring operation mode

Prerequisites:

- The device is equipped with the "integrated patient-gas measurement module".
- The Pause operation mode is switched off in the system setup (see "Vertical tab "General""", page 214).



In Monitoring operation mode, breathing gas measurement can be used to monitor the patient's spontaneous breathing activity without distracting ventilation alarms. This mode is useful during regional anesthesia or after extubation. To do this, connect the sample line of the PGM to the breathing mask used. At the same time, O<sub>2</sub> insufflation can be applied.

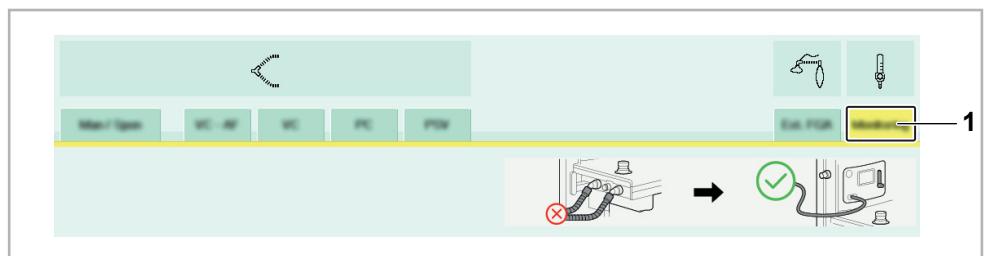
In this mode, there is no automatic gas delivery. The breathing system is depressurized so that manual ventilation is not possible. The gas concentration measurement is active and waiting for respiratory phases. With the detection of respiratory phases, apnea monitoring is automatically activated.

### 8.4.3.1

#### Activating monitoring

Prerequisite: The device is in standby or Manual / Spontaneous mode.

- Start the **Monitoring** operation mode (1).



### 8.4.3.2

#### Ending monitoring

- After standby or switching to a ventilation mode.

#### 8.4.4

#### Pause mode

Prerequisite:

- The Pause operation mode is switched on in the system setup (see "Vertical tab "General""", page 214).



In Pause mode, ventilation is stopped. With electronically controlled gas mixers, gas delivery is also stopped. The breathing system is depressurized so that manual ventilation is not possible.

This mode is useful for short-term interruptions to a therapy such as, e.g., intraoperative suctioning of mucus or relocation of the patient.

This mode is also useful during regional anesthesia. The patient's respiration can be monitored via the sample gas measurement without distracting ventilation alarms being issued. The gas concentration measurement remains active and waiting for respiratory phases. With the detection of respiratory phases, apnea monitoring is automatically activated.

The device remains in this operation mode until the user switches to a different ventilation mode. The timer defines the period of time after which an alarm is issued. This alarm reminds the user to start the ventilation manually again.

Setting the timer to Off deactivates the alarm. In addition, the total elapsed time in Pause operation mode is displayed.

To reduce contamination of the ambient air with anesthetic gases through an open Y-piece, use this operation mode for, e.g., regional anesthesia or short breaks in therapy such as disconnection or intubation.

##### 8.4.4.1

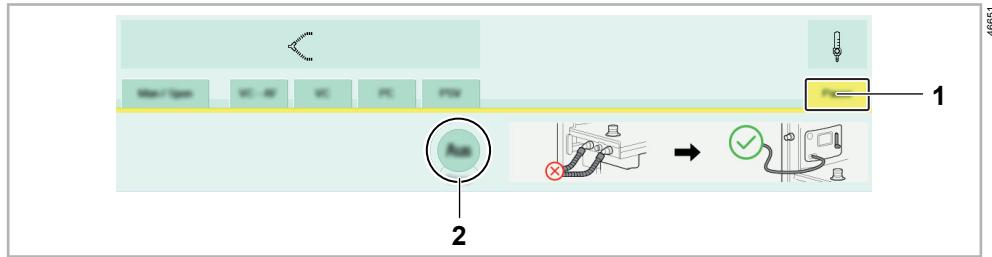
##### Activating the pause

##### **⚠ CAUTION**

##### **Danger due to hypoxic gas mixture**

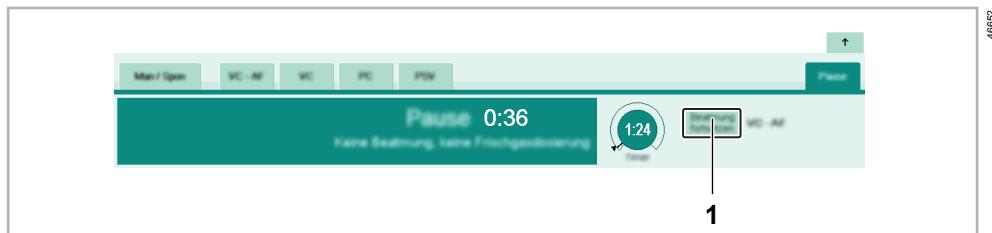
If the patient breathes spontaneously while in Pause operating mode, there is a risk of inhalation of a hypoxic gas mixture.

- Monitor the patient's breathing.



1. Start the **Pause** operation mode (1).
2. If necessary, adjust the timer (2).

#### 8.4.4.2 Returning to the previous mode



1. Touch the **Resume ventilation** button (1).
2. Confirm the ventilation mode.  
If the Pause operation mode was started from standby, ventilation will continue in Man / Spon mode.

For more information, see page 208.

## 8.5 Maneuvers

### 8.5.1 General information

The device has various maneuvers for lung recruitment. During a maneuver, various data concerning the lung mechanics are displayed so that the user can assess the progress of the maneuver.

The reminder function reminds the user to perform a maneuver. A reminder is issued after the first change to a ventilation mode with medium or high breathing support and also at settable intervals after the ending of a maneuver. The **Consider recruitment** message is displayed in the waveforms for flow and pressure.

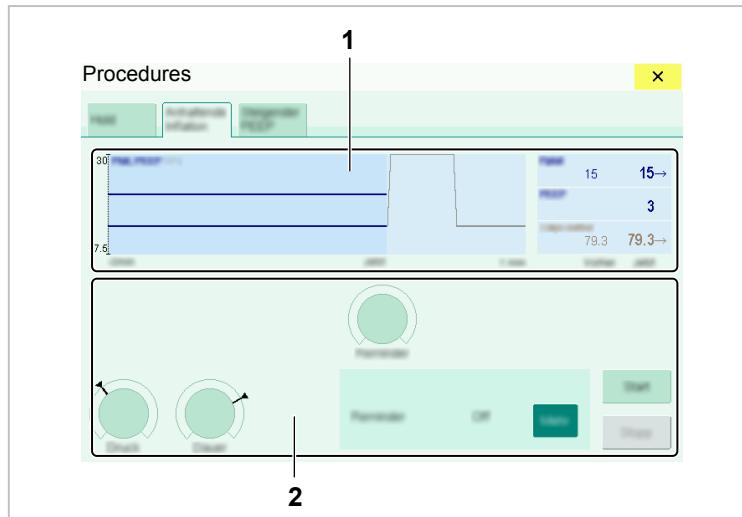
The use of lung recruitment maneuvers is the sole responsibility of the user.

Dräger recommends that the patient's hemodynamics always be monitored while the maneuvers are being performed.

#### Available maneuvers

- Insp./Exp. hold
  - One-step recruitment
  - Multi-step recruitment
1. Open the **Procedures** dialog window.
  2. Touch the tab for the required maneuver.

45003



Relevant waveforms, trends, or measured values are displayed in area (1) of the dialog window. The parameters for the particular maneuver are displayed and set in area (2).

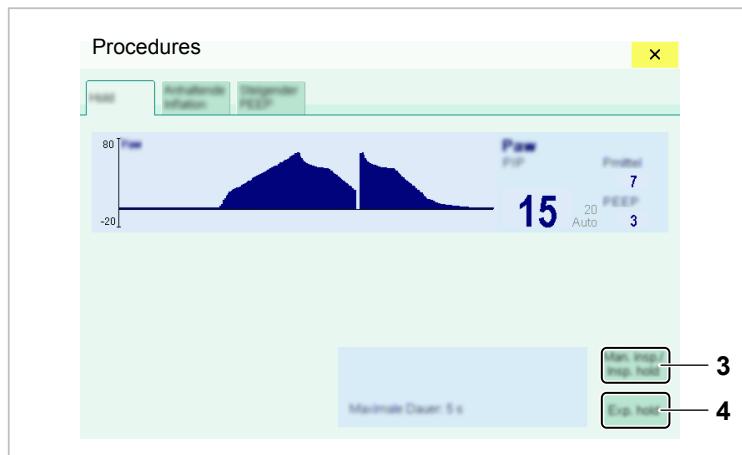
### 8.5.2

#### Inspiration Hold, Expiration Hold

The device provides functions for a breath to be initiated or extended, or for expiration to be extended.

This can be useful in situations where the lungs of the patient are not supposed to move, e.g., during use of imaging techniques.

45004



### 8.5.2.1

#### Manual Inspiration / Inspiration Hold

This maneuver is available in the volume-controlled modes, the pressure-controlled modes, and in the CPAP / PSV mode, and offers the following options:

- In the expiratory phase between 2 mandatory breaths, a breath can be manually triggered and held. The ventilation pattern of the manually triggered breath corresponds to the ventilation pattern for the active ventilation mode.
- A mandatory breath can be extended.

### Manually triggering a breath

- Touch the ***Man. insp./Insp. hold*** button (3) briefly.

### Manually extending a breath

1. Touch the ***Man. insp./Insp. hold*** button (3) and keep it pressed for the desired time.

The device will trigger an extended breath or will extend an already triggered automatic breath.

The breath is ended automatically:

- After a maximum of 40 seconds in the Adult patient category
- After a maximum of 30 seconds in the Ped patient category
- After a maximum of 5 seconds in the Neo patient category

### 8.5.2.2

### Holding or extending the expiration

1. Touch the ***Exp. hold*** button (4) and keep it pressed for the desired time.  
The device will extend the expiration and delay the next breath.

The expiration is ended automatically:

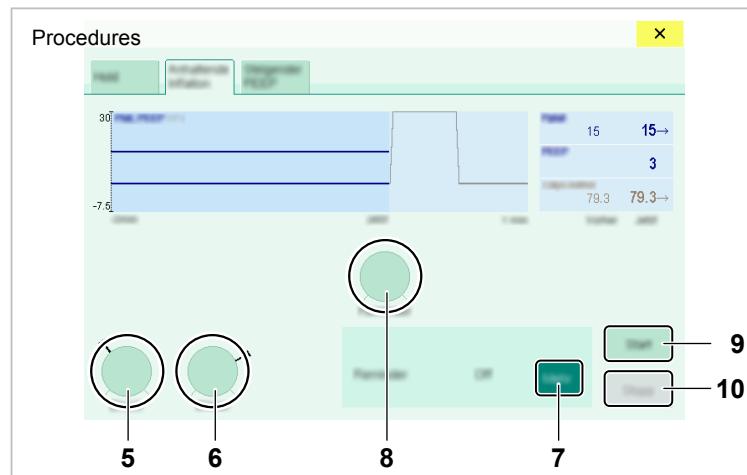
- After a maximum of 40 seconds in the Adult patient category
- After a maximum of 30 seconds in the Ped patient category
- After a maximum of 5 seconds in the Neo patient category

### 8.5.3

### One-step recruitment

This maneuver applies a set pressure for a specific duration and thus enables, e.g., an extended breath with adjustable pressure.

1. Using the therapy controls, set the ***Pressure*** (5) and the ***Duration*** (6).



45005

2. If necessary, touch the ***More*** button (7) and set a reminder with the therapy control (8).
3. Touch the ***Start*** button (9) and confirm.

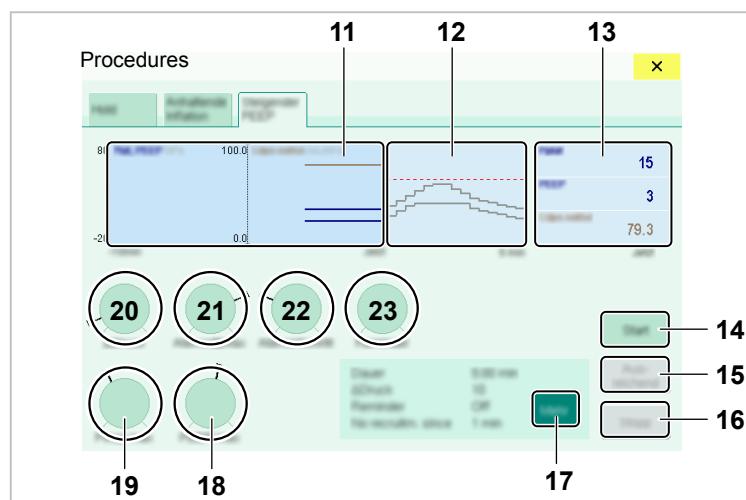
The rise in pressure from the PEEP level to the set pressure level and the decrease in pressure at the end of the maneuver take place at 20 hPa/s.

The maneuver ends automatically after the time has elapsed. To cancel the maneuver, touch the ***Cancel*** button (10) and confirm. If required, the PEEP can be adjusted before confirming.

The Paw alarm limit is checked at the start of the maneuver. If the alarm limit is too low, it is changed to a value 5 hPa above the set pressure. After the maneuver, the alarm limit is reset to its original value.

#### 8.5.4 Multi-step recruitment

This maneuver applies a sequence of pressure-controlled mandatory breaths at variable pressure levels. The inspiratory pressure and expiratory pressure are increased in steps and then reduced again to the starting levels. For parameters such as RR and Ti, the values from the previous ventilation mode are used. If there is no value available for the Slope parameter, a value of 0.2 seconds is used.



45006

- 11** Trends of the measured values of pressure, compliance, or tidal volume  
**12** Predicted trends of inspiratory pressure and expiratory pressure during the maneuver ("what if..." function)

The exact progress of the maneuver is influenced by the following values:

- Parameters entered in this dialog
- Values set for RR and PEEP in the therapy bar

- 13** Values of pressure, compliance, or tidal volume

1. Using the ***Pinsp max*** (19) and ***PEEP max*** (18) therapy controls, set the pressures that are to be reached during the maneuver.
2. If required, touch the ***More*** button (17) to display the following settings:

<b>20 ΔPressure</b>	Pressure difference between Pinsp and PEEP with which the ventilation is performed during the maneuver. After the set maximum pressure for PEEP max or Pinsp max is reached, the pressure difference is adapted accordingly so that the set values for both PEEP max and Pinsp max can be achieved.
<b>21 Breaths@Max</b>	Number of breaths at the Pinsp max pressure level

22	Breaths/Step	Number of breaths after which the next pressure step begins
23	Reminder	Time after which a reminder for a new maneuver is issued

3. Touch the **Start** button (14) and confirm.

During the maneuver, the inspiratory pressure is automatically increased in steps to the set maximum Pinsp max value and the expiratory pressure is increased to the maximum PEEP max value. Both pressures are held at the highest pressure level for a certain number of breaths (Breaths@Max) and then reduced again in steps. The level of the pressure rise and the pressure decrease is dependent on the selected patient category. The appropriate settings are made in the system setup.

The Paw alarm limit is checked at the start of the maneuver. If the alarm limit is too low, it is changed to a value 5 hPa above the set pressure. After the maneuver, the alarm limit is reset to its original value.

If the pressure is not to be increased any further during the maneuver, touch the **Descend now** button (15) and confirm. The pressure will then be reduced again in steps. The duration of the maneuver is reduced as a result.

To cancel the maneuver, touch the **Cancel** button (16) and confirm. If required, the PEEP can be adjusted before confirming. This can be useful, e.g., when the desired effect has already been achieved during the maneuver. The ventilation will now continue immediately with the previous settings and the adjusted PEEP.

Due to the technically related delay between the set and the measured airway pressures, it may happen that the current and the last measured pressures differ by up to one step level.

The cursor can be used to display the previous measured values. To do this, touch screen area (11) and move the cursor with the rotary knob. To facilitate reading the data, screen area (11) will temporarily not be updated. To show the current measured values again, touch area (12).

**8.5.5****Alarm behavior during the maneuvers**

During the maneuvers, some alarms are adapted as follows:

Alarm	Maneuvers			
	Insp./Exp. hold		One-step recruitment	Multi-step recruitment
	Man. insp./ Insp. hold	Exp. hold		
Pressure alarms:				
Airway pressure high	---	---	Alarm limit is adjusted to Pressure + 5	Alarm limit is adjusted to Pinsp max + 5
Airway press. continuously high	Stopped <sup>1)</sup>	---	Alarm limit is adjusted to Pressure + 3	Alarm limit is adjusted to half way between PEEP max and Pinsp max. Example: PEEP max = 20 hPa Pinsp max = 40 hPa Adjusted alarm limit = 30 hPa
Inspiratory pressure not achieved	Switched off	Switched off	Switched off	---
Volume alarms:				
Minute volume low	Is suppressed during the maneuver and for an additional 45 seconds after the end of the maneuver.			---
Apnea alarms:				
Apnea (no pressure)	Switched off			---
Apnea (no flow)				
Apnea (no CO <sub>2</sub> )	Stopped <sup>1)</sup>			---

1) Existing alarms are preserved. No new alarms will be issued.

Some technical alarms stop the maneuver automatically, e.g., alarms caused by a sensor failure.

## 8.6

### Using fields with special functions

#### 8.6.1

#### Breathing gas measurement and xMAC display (MAC multiple)

Prerequisite: The device is equipped with the "integrated patient-gas measurement module".



The MAC value is a guideline for anesthetic agent delivery.

The device displays the measured inspiratory and expiratory values for O<sub>2</sub>, N<sub>2</sub>O, and anesthetic gases, as well as the xMAC in the monitoring area. The nitrous oxide concentration or anesthetic gas concentration is only displayed when it is not zero.

The xMAC is the MAC multiple calculated from the current expiratory measured values and the age-dependent MAC values. If no respiratory phases are detected, expiratory values and xMAC cannot be displayed.

The integrated MAC algorithm is based on the MAC values shown in the following table. These values are guiding values only. The binding values are specified on the package information leaflet of the anesthetic agent.

The MAC values depend on the age of the patient. The values specified in the table apply to a patient age of 40 years.

1 MAC corresponds to the following concentration: (In 100 % O <sub>2</sub> )	
Halothane	0.77 Vol%
Enflurane	1.7 Vol%
Isoflurane	1.15 Vol%
Desflurane	6.0 Vol%
Sevoflurane	2.1 Vol%
N <sub>2</sub> O	105 Vol%

The age-adjusted MAC values are calculated according to the equation of W.W. Mapleson (British Journal of Anaesthesia 1996, pp. 179-185).

The equation applies to patients older than 1 year.

$$\text{xMACage-adjusted} = \text{MAC}^1) \times 10^{(-0.00269 \times (\text{age} - 40))}$$

For gas mixtures, the respective multiples for N<sub>2</sub>O and anesthetic agents are summed up according to the following equation:

$$\text{xMAC} = \frac{\text{Exp. conc. agent}_1}{\text{MACage-adjusted agent}_1} + \frac{\text{Exp. conc. agent}_2}{\text{MACage-adjusted agent}_2} + \frac{\text{Exp. conc. N}_2\text{O}}{\text{MACage-adjusted N}_2\text{O}}$$

#### 8.6.1.1

##### Example

Exp. Isoflurane = 0.65 Vol%

Exp. N<sub>2</sub>O = 69 %

Age = 32 years

MACage-adjusted for Iso: MAC<sup>2)</sup> = 1.21 Vol%

MACage-adjusted for N<sub>2</sub>O: MAC<sup>2)</sup> = 110 Vol%

$$\text{xMAC} = 0.54 + 0.63 = 1.2$$

The influence of other drugs (opioids or intravenous hypnotics) is not considered in the xMAC calculation.

#### 8.6.1.2

##### Using the xMAC display

##### CAUTION

##### Risk of patient injury due to inaccurate MAC values

The integrated MAC algorithm is based on values determined and defined by Dräger. These values are guiding values only. The binding values are specified on the package information leaflet of the anesthetic agent.

- ▶ Do not base therapy decisions solely on the xMAC display, but also always consider the information in the package information leaflets of the anesthetic agents.
- Use the MAC display as an orientation for anesthetic agent delivery.

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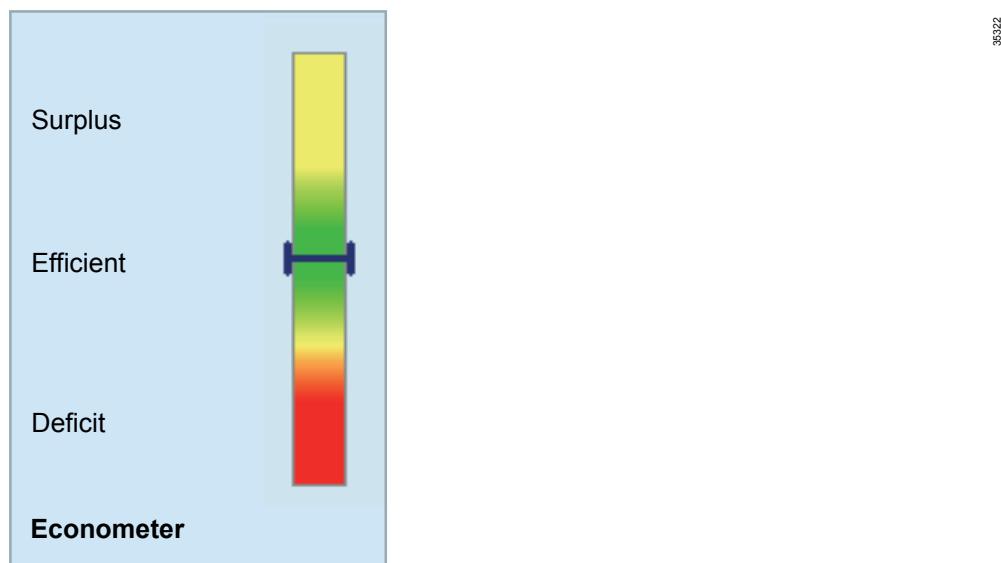
1) 40 years

2) 32 years

## 8.6.2 Econometer

Prerequisite: The device has the "advanced gas monitoring" software option.

During operation, the device monitors the breathing bag for sufficient filling.



The bar graph indicates whether the device is supplied with sufficient fresh gas.

Range	Color	Meaning
Surplus	Yellow	Indication of an opportunity to save fresh gas and, therefore, volatile anesthetic agents
Efficient	Green	<ul style="list-style-type: none"> <li>– No action necessary</li> <li>– Breathing bag sufficiently filled</li> <li>– Sufficient reserve capacity available</li> </ul>
Deficit	Red	<ul style="list-style-type: none"> <li>– Insufficient fresh-gas supply</li> <li>– Check the filling of the breathing bag. If necessary, fill up the breathing bag, e.g., with the O<sub>2</sub> flush.</li> </ul>

An insufficiently filled breathing bag can trigger the **Fresh gas low or leakage** or **Ambient air inlet activated** alarms, for example.

## 8.6.3 Stopwatch



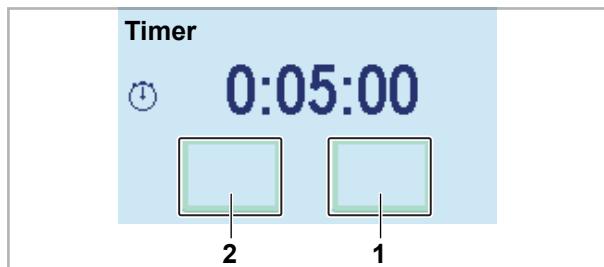
35548

### Using the stopwatch

1. Touch the **Start** button (1) to start.

2. Touch the **Stop** button (1) to stop.
3. To reset the stopwatch to zero, touch the **Reset** button (1).

#### 8.6.4 Timer



##### Setting the timer

1. Touch the **Set** button (1) or the parameter field.
2. Set the timer.

##### Using the timer

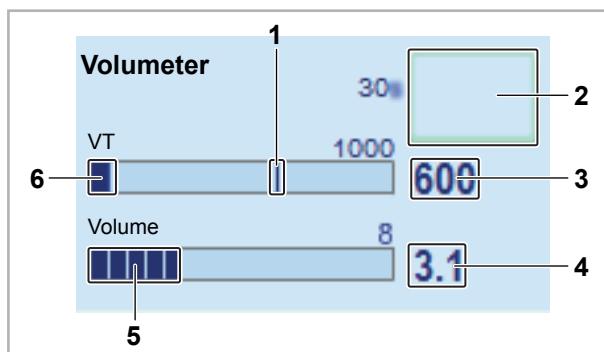
The timer always starts with the last time set.

1. Touch the **Start** button (1) to start.
2. Touch the **Stop** button (1) to stop.
3. To reset the timer to zero, touch the **Reset** button (1).

#### 8.6.5 Volumeter

**Prerequisite:** The device has the "advanced ventilation monitoring" or "loops and trends" software option.

The volumeter is used for observing and assessing the ventilation.



The bar graph indicates the inspiratory and expiratory tidal volume.

At the end of the inspiration, the delivered tidal volume is displayed as a bar (1). At the end of the expiration, the difference between inspiratory and expiratory tidal volumes (6) is displayed.

The expiratory tidal volume is displayed next to the bar graph (3).

##### Using the volumeter (minute volume measurement)

1. Touch the **Start** button (2) to start.
- The bar graph displays the individual measured spontaneous breaths in segments (5). The summed volume (4) is displayed next to the bar graph.

2. Touch the **Stop** button (2) to stop.
3. To reset the volumeter and time display to zero, touch the **Reset** button (2).

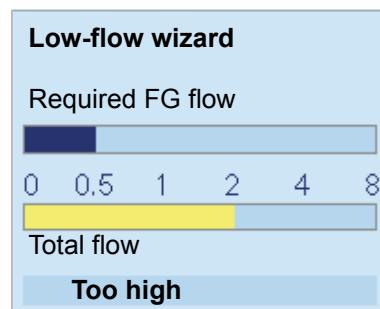
The volumeter stops automatically after 60 seconds. The measured values are displayed for 4 minutes and then deleted.

## 8.6.6

### Low-flow wizard

Prerequisite: The device has the "advanced gas monitoring" software option.

The low-flow wizard displays bar graphs for the required fresh-gas flow and the current total flow. Both bar graphs are to the same scale.



35554

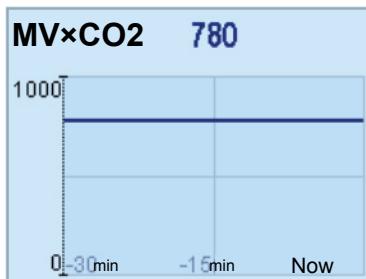
An evaluation of the total flow is displayed below the bar graph:

Evaluation	Color	Meaning
Too high	Yellow	The fresh-gas flow is possibly too high. If the fresh-gas flow can be reduced, both fresh gas and anesthetic agent will be saved.
Efficient	Green	No action is necessary.
Too low	Red	<p>The fresh-gas flow is too low.</p> <ul style="list-style-type: none"> <li>• Check the fresh-gas flow.</li> <li>• Check the position of the breathing bag.</li> </ul>
Refill bag	Red	<p>The fresh-gas flow is too low.</p> <ul style="list-style-type: none"> <li>• Check the filling of the breathing bag. If necessary, fill up the breathing bag, e.g., with the O<sub>2</sub> flush.</li> </ul>

An insufficient fresh-gas flow may trigger the **Fresh gas low or leakage** or **Ambient air inlet activated** alarms, for example.

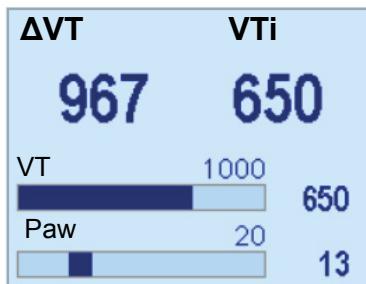
### 8.6.7 MV×CO<sub>2</sub> trend

Prerequisite: The device has the "advanced gas monitoring" software option.



The MV×CO<sub>2</sub> parameter field displays the CO<sub>2</sub> elimination trend. The trend is calculated as the product of the minute volume (MV) and the difference of the measured expiratory CO<sub>2</sub> concentrations (etCO<sub>2</sub>) and inspiratory CO<sub>2</sub> concentrations (inCO<sub>2</sub>).

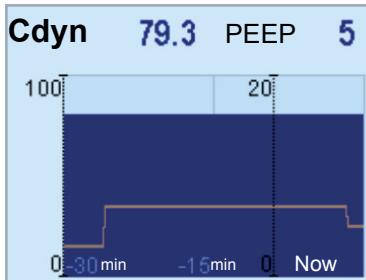
### 8.6.8 ΔVT



The ΔVT parameter field displays the inspiratory tidal volume (VTi) and expiratory tidal volume (VT) measured values and the difference between these two measured values (ΔVT). In addition, the expiratory tidal volume (VT) and airway pressure (Paw) measured values are displayed as bar graphs.

### 8.6.9 Compliance trend

Prerequisite: The device has the "advanced ventilation monitoring" or "loops and trends" software option.



The Compliance trend parameter field displays the current measured values for the dynamic patient compliance (Cdyn and PEEP) as well as the trend of the mean dynamic patient compliance (Cdyn mean).

## 8.7

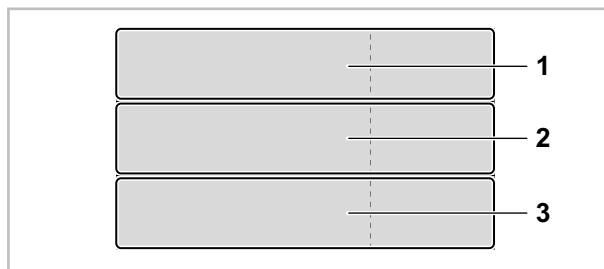
# Customizing the screen display

### 8.7.1

## Available views

The following views are available:

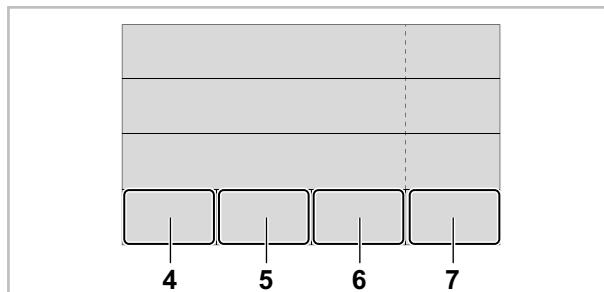
### Standard view



35683

Up to three waveforms (1), (2), and (3) are displayed along with their associated parameter fields.

### Expert view



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In addition to the standard view, an additional waveform or 4 additional parameter fields (4), (5), (6), and (7) are displayed.

## 8.7.2

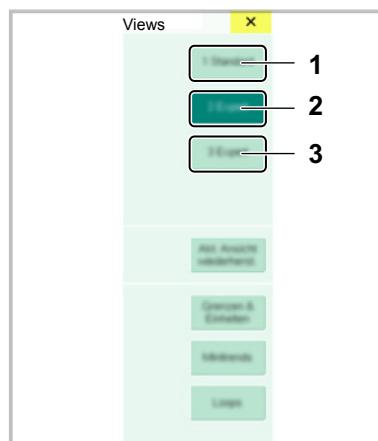
## Changing the view

The view can be changed as follows:

- Views... button
-  View

### Changing with the Views... button

1. Touch the **Views...** button.



35698

2. Touch the button for the desired view.

- Opens the standard view (1)
- Opens an expert view (2) or (3)

The views can be renamed, see page 204.

### Changing with the View button

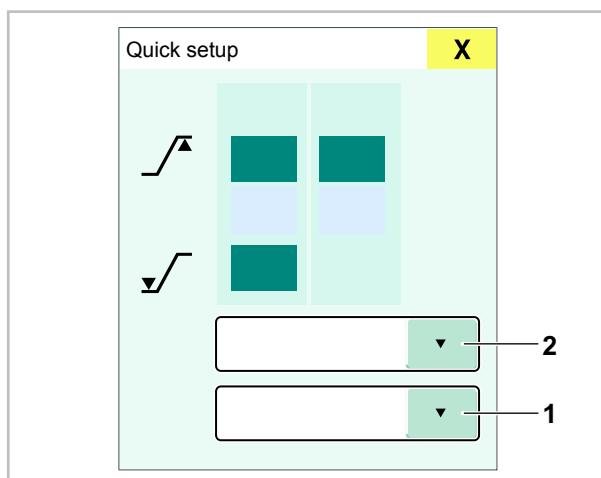
- Touch the  **View** button.  
The screen displays the second view .
- Touch the  **View** button.  
The screen displays the third view .
- Touch the  **View** button.  
The screen displays the first view .

### 8.7.3

### Customizing the current view

Waveforms and parameter fields can be customized as follows:

1. Touch the waveform or parameter field.  
The **Quick setup** dialog opens.



35986

#### **⚠ WARNING**

#### Risk due to inadequate monitoring

National and medical regulations may require certain parameters to be displayed.

- Always consider the relevant regulations when configuring the screen layout.

2. For **Content** (1), select the desired content.  
For a list of the possible screen content, see page 225.
3. For **Scale** (2), select the desired setting.

Unsaved changes to the current view are kept until the next device restart.

#### 8.7.3.1

#### Restoring the current view

The changes to the current view can be canceled.

1. Open the **Views** dialog.
2. Touch the **Restore current view** button.

### 8.7.4

### Using loops

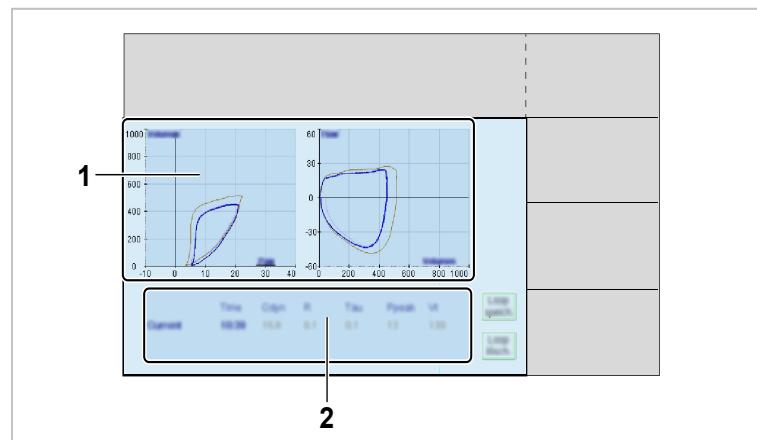
Prerequisite: The device has the "advanced ventilation monitoring" or "loops and trends" software option.

The following loops are available:

- Pressure-Volume loop
- Flow-Volume loop

### Displaying loops

1. Open the **Views** dialog.
2. Touch the **Loops** button.

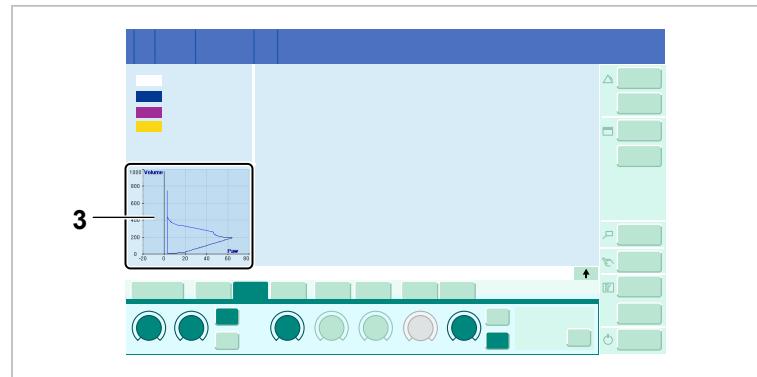


35866

The following information is displayed:

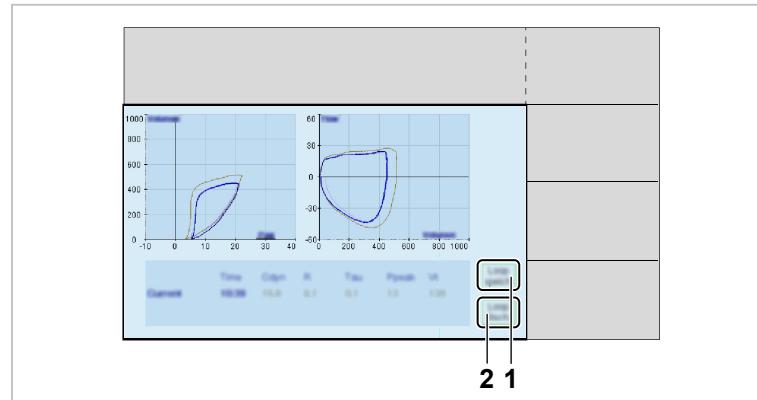
- The current loop (1) and 5 previous loops
- The Cdyn, R, and TC parameters (2)

Alternatively, the Pressure-Volume loop can also be displayed in area (3).



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### Saving or deleting reference loops



36396

Saving the reference loop:

- Touch the **Save ref.** button (1).

Deleting the reference loop:

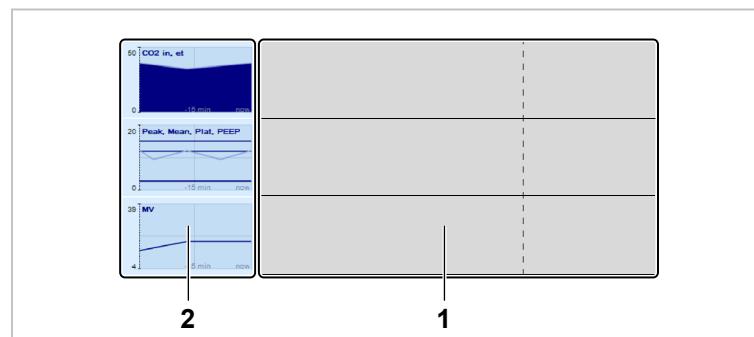
- Touch the **Delete ref.** button (2).

For the area (3), these buttons are displayed in the Quick setup dialog.

### 8.7.5 Displaying mini-trends

Prerequisite: The device has the "advanced trends" or "loops and trends" software option.

Mini-trends (2) can be displayed for the waveforms (1).



35670

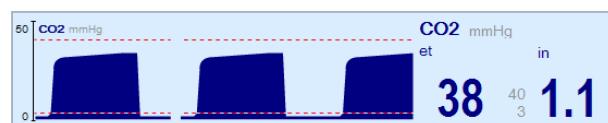
1. Open the **Views** dialog.

2. Touch the **Mini-trends** button.

For larger and more detailed graphical and numerical trends, see page 176.

### 8.7.6 Displaying alarm limits and units of measurement

The alarm limits and the units of measurement can also be displayed in the waveform and parameter fields.



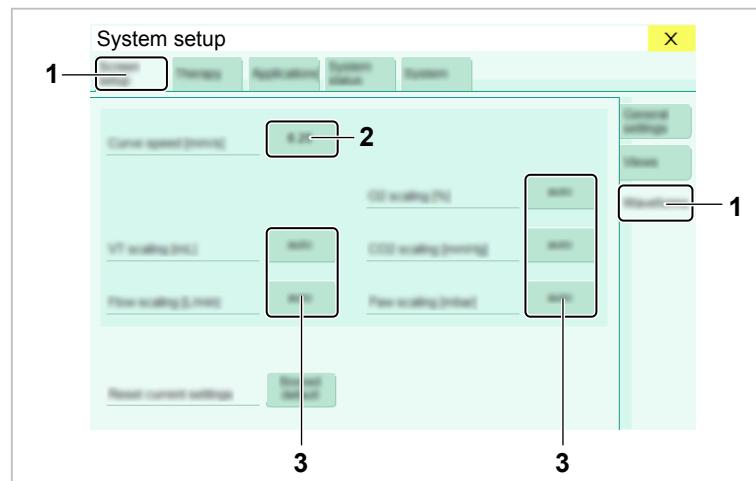
35874

1. Open the **Views** dialog.
2. Touch the **Limits & units** button.

### 8.7.7

### Adjusting the sweep speed and the scale

1. Open the **System setup** dialog.
2. Touch the **Screen > Waveforms** tab (1).



Setting the sweep speed:

- Touch the button (2) and set the sweep speed.

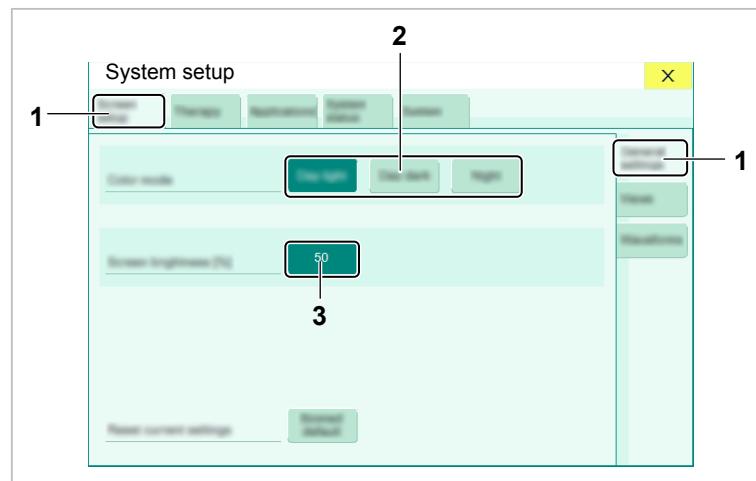
Adjusting the waveform scale:

- To change the scale, touch one of the buttons (3) and select the value.

### 8.7.8

### Changing the color scheme and the screen brightness

1. Open the **System setup** dialog.
2. Touch the **Screen > General** tab (1).



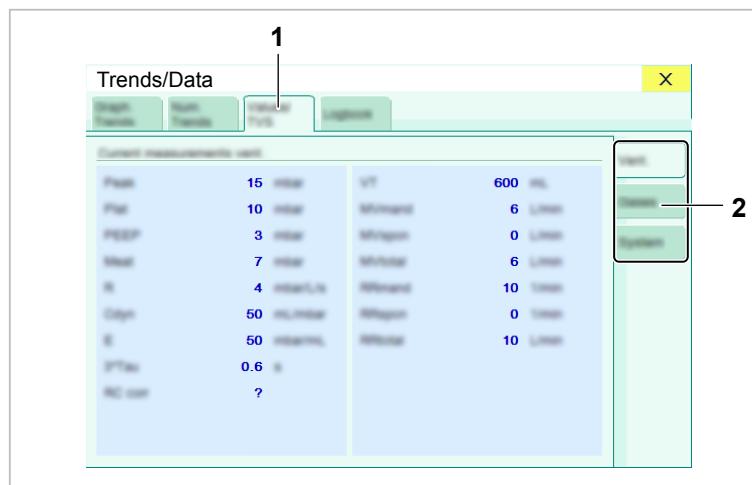
3. Set the color scheme (2).
4. Set the screen brightness (3).

## 8.8 Displaying additional data

### 8.8.1 Viewing current measured values

In operation mode, there are tabular overviews available for various measured values.

1. Open the **Trends/Data** dialog.
  2. Touch the **Values** tab (1).
- The vertical tabs (2) contain various combinations of parameters.

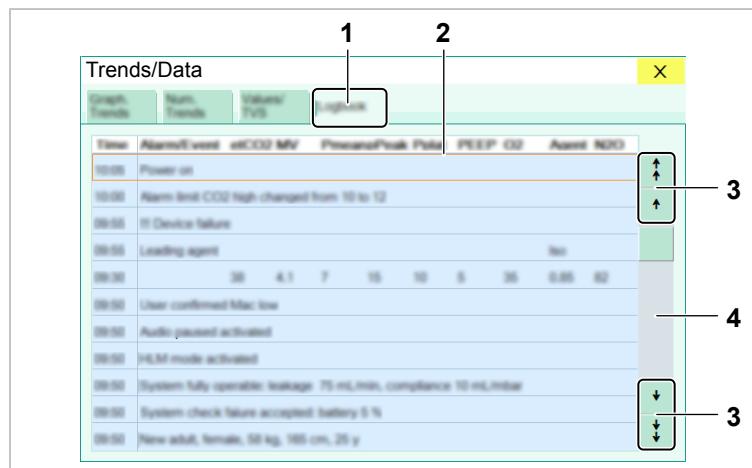


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### 8.8.2 Logbook

The logbook can save up to a maximum of 20000 entries. The entries in the logbook cannot be deleted and are retained even after the device has been turned off and on again or following a power supply failure. When the storage limit is reached, the oldest entries are overwritten. Logbook data are displayed in table form.

1. Open the **Trends/Data** dialog.
2. Touch the **Logbook** tab (1).



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Use the rotary knob or the arrow buttons (3) to scroll the cursor (2) up or down in the logbook. To scroll quickly, touch the gray area (4).

For creating entries and the associated settings, see page 184.

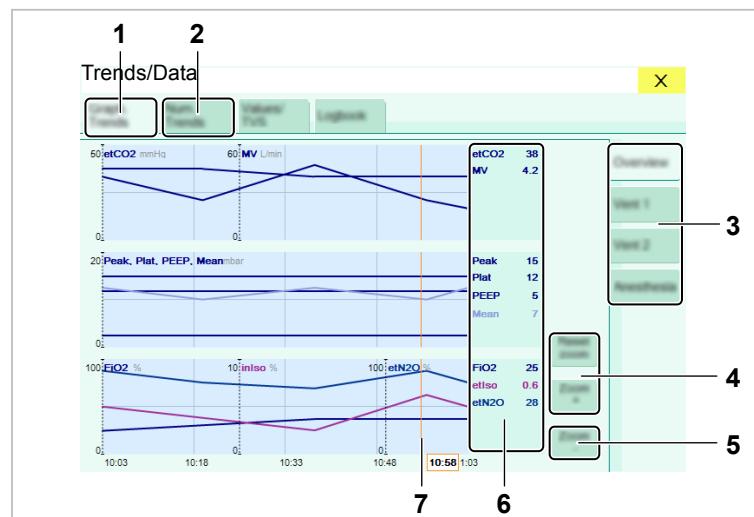
### 8.8.3 Trends

**Prerequisite:** The device has the "advanced trends" or "loops and trends" software option.

Trends contain different measured values from the current case and are displayed as tables or graphics.

1. Open the **Trends/Data** dialog.
2. Touch the **Graphical trends** tab (1) or the **Tabular trends** tab (2).

The following illustration shows the graphical trend:



39917

The vertical tabs (3) contain various combinations of parameters.

#### Zooming

In both trend displays, the displayed time period can be increased or decreased in increments between the last 30 minutes and the last 24 hours.

Changing the time period:

- Touch the **Zoom +** or **Zoom -** button (4):

Displaying the standard time period and the current point in time:

- Touch the **Reset zoom** button (5).

#### Moving the cursor

The exact measured values for a specific point in time are displayed numerically in area (6). To view the values, move the cursor to the corresponding position.

The following options are available for moving the cursor:

- Use the rotary knob to move the cursor (7).
- Touch the corresponding area on the screen.

**8.8.4****Displaying installed software options**

Listing of the additionally installed software options.

1. Open the **System setup** dialog.
2. Touch the **Licenses/Options** tab.

**8.8.5****Displaying an overview of accessories and consumptions**

1. Open the **System setup** dialog.
2. Touch the **System status** tab.

<b>Vertical tab</b>	<b>Overview</b>
Accessories	Accessories (when Dräger Infinity ID accessories are used) and information as to when the accessory must be replaced.
Supply	Status display of the connected gas supplies and power supplies
Consumption	<p>Fresh-gas consumption values (with electronic flow measurement) in operation:</p> <ul style="list-style-type: none"> <li>– For the current case</li> </ul> <p>Fresh-gas consumption values (with electronic flow measurement) in Standby:</p> <ul style="list-style-type: none"> <li>– For the last case</li> <li>– Since the last reset</li> </ul> <p>The fresh-gas consumption values can be reset to zero in <b>Standby &gt; System setup &gt; System status &gt; Consumption</b>, see page 222.</p>

**8.9****Setting the volume**

1. Open the **System setup** dialog.

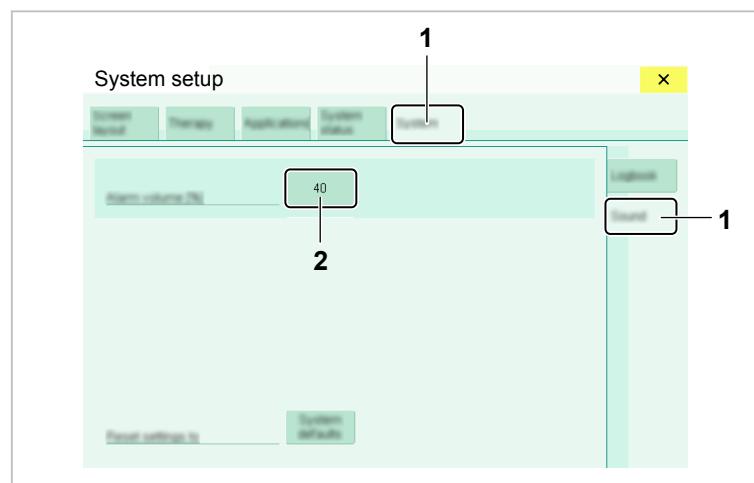
 **WARNING**

**Risk of an operating error**

During operation in louder environments, the acoustic alarm signals might not be heard.

- Always set the alarm tone to be sufficiently loud.

2. Touch the **System > Sound volume** tab (1).



3. For **Alarm volume**, set the desired value (2).

## 8.10 Adjusting the alarms

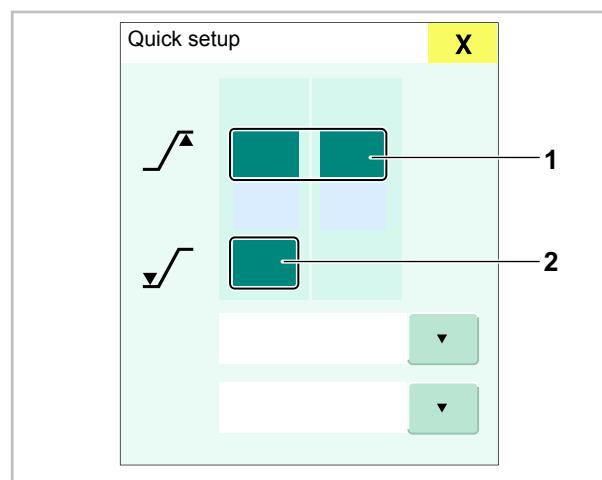
### 8.10.1 Setting the alarm limits

For a current case, the alarm limits can be set in 2 ways:

- Setting using the Quick setup dialog
- Setting using the Alarms dialog

#### Setting using the Quick setup dialog

1. Touch the respective waveform or the parameter field.
2. Set the upper alarm limit (1).



3. Set the lower alarm limit (2).

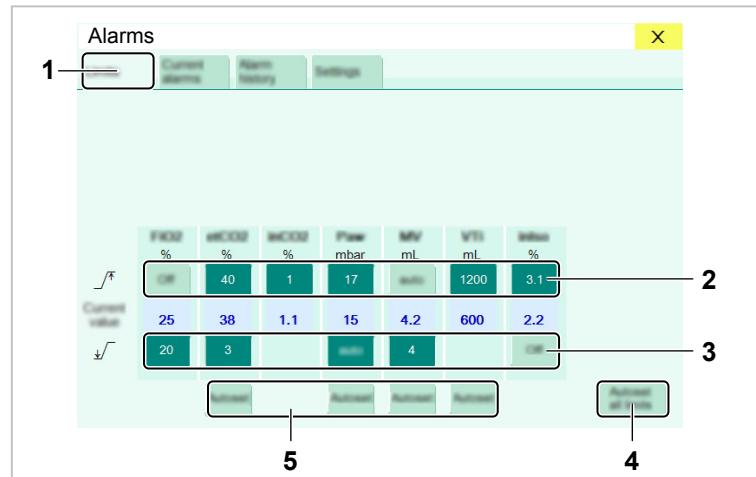
35918

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### Manual setting

In the Alarms dialog, the alarm limits can be set either manually or automatically.

1. Open the **Alarms** dialog.
2. Open the **Limits** tab (1).



3. Set the upper alarm limit (2).
4. Set the lower alarm limit (3).

### Automatic setting

Alarm limits can be automatically adapted to current measured values or set values.

1. Open the **Alarms > Limits** dialog.
2. To adjust the alarm limits for **one** individual parameter, touch and confirm one of the **Autoset** buttons (5).
- To adjust the alarm limits for **all** parameters, touch and confirm the **Autoset all** button (4).

The function for adjusting all alarm limits can be called up directly with the **Autoset limits** button in the main menu bar.

Only use the automatic adjustment when measured values and set values are stable.

The lower alarm limit for the xMAC level is also adjusted during automatic setting, see page 180.

For the configuration and algorithm, see page 208.

## 8.10.2

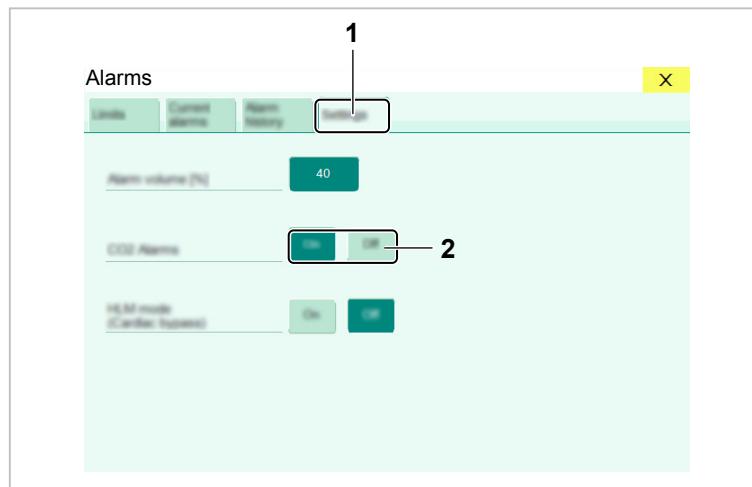
### Activating and deactivating CO<sub>2</sub> alarms

**Prerequisite:** The device is equipped with the "integrated patient-gas measurement module".

CO<sub>2</sub> monitoring (alarms for inCO<sub>2</sub>, etCO<sub>2</sub>, and CO<sub>2</sub> apnea) can be activated or deactivated.

1. Open the **Alarms** dialog.

2. Touch the **Settings** tab (1).



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3. For ***CO<sub>2</sub>* alarms**, touch the button (2):

**On:** Alarms are activated.

**Off:** Alarms are deactivated.

Or

- Use the ***CO<sub>2</sub> alarms off*** button in the main menu bar to deactivate or activate the alarms.  
This button is only visible in the following ventilation modes:
  - Manual / Spontaneous
  - External fresh-gas outlet
  - Pause<sup>1)</sup>
  - Monitoring<sup>2)</sup>

The alarm system is immediately activated when the CO<sub>2</sub> monitoring is activated.

Deactivation is indicated in the header bar and in the parameter field by the  symbol.

### 8.10.3 Automatic xMAC monitoring

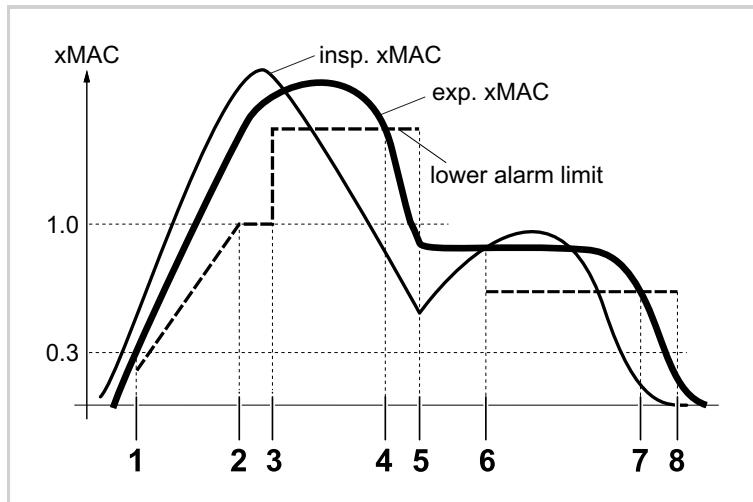
Prerequisite: The device is equipped with the "integrated patient-gas measurement module".

The xMAC monitoring is automatically activated as soon as the following conditions are met:

- Anesthetic gas is administered.
- The inspiratory xMAC value is greater than the expiratory xMAC value.
- The expiratory xMAC value reaches approximately 0.3.

1) Pause must be activated in the system setup.

2) Only for devices with integrated PGM. Pause must be deactivated in the system setup.



If the xMAC value rises, the xMAC monitoring (1) is activated and the lower alarm limit for the xMAC level is automatically adapted to the anesthetic gas concentration. The lower alarm limit (2) can reach a maximum value of 1.0. The lower alarm limit can be recalculated by touching the **Autoset** button (3). This allows the alarm limit for the **xMAC low** alarm to be adjusted in special anesthesia situations and to exceed the value of 1.0 if necessary. If the expiratory xMAC value falls below the alarm limit (4 or 7), the device issues the **xMAC low** alarm with low priority. If the alarm is not reset with the **ALARM RESET** button within 60 seconds, the priority will be increased to medium priority.

#### 8.10.3.1 Deactivating the automatic xMAC monitoring

If the **xMAC low** alarm (4 or 7) is reset with the **ALARM RESET** button (5 or 8), monitoring is deactivated. This prevents renewed alarms as a result of the anesthetic gas concentration continuing to fall at the end of anesthesia (8). If the anesthesia is continued (5), the monitoring will be automatically reactivated as soon as the inspiratory xMAC value rises above the expiratory xMAC value (6). In CBM mode, the lower alarm limit is adjusted so that no alarm is issued during this time. Similarly, the value is not limited to 1.0 during this time.

## 8.11

## Changing the patient data

Patient data can be changed during operation.

1. Open the **Patient** dialog.



2. Modify the patient data.

Changes influence the therapy suggestions, among others, which is indicated by the position of the arrow ▼ on the therapy controls.

The current therapy settings remain unaffected. Observe the following information: "Influence of patient category, weight, and age on device behavior", page 325.

When the patient category is changed, the age, weight, and height are automatically adapted so that they remain within the defined limits, see page 210.

## 8.12

## Exporting data

### 8.12.1

### General information

This device enables the export of screen contents, trends, and data on a USB mass storage device.

Prerequisites:

- The USB port is activated in the system setup.
- A USB mass storage device is connected to the USB port.

During a saving process, the button turns dark green.

The data are stored in the "Draeger\ExportData" directory.

### 8.12.2

### Exporting the screen contents

The screen contents can be exported to a USB mass storage device as a screenshot.

- Touch the **Export screenshot** button in the main menu bar.

The screenshot will be saved as a ".png" file.

### 8.12.3

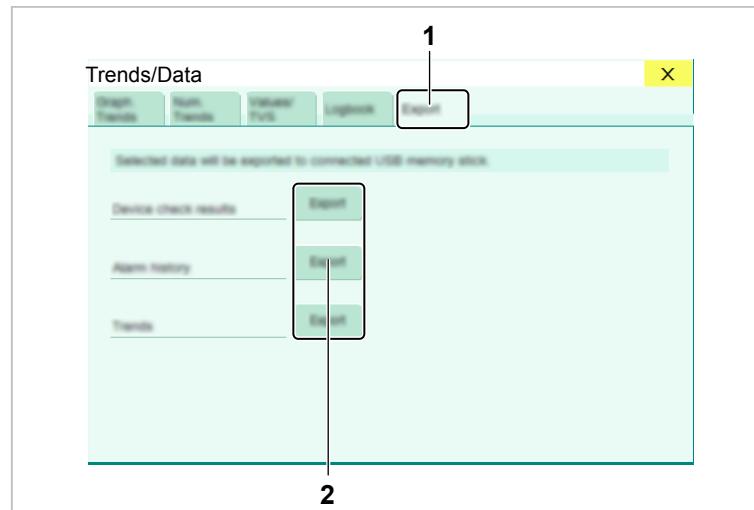
### Exporting trends and data

Prerequisite: The device has the "advanced trends" or "loops and trends" software option.

In the standby mode, the following data can be exported to a USB mass storage device:

- System test results
- Logbook
  - Selection from the following time periods is possible:
    - Last case
    - Today
    - All
- Alarm logbook
- Trends

1. Open the **Trends/Data** dialog.
2. Touch the **Export** tab (1).



3. Touch the respective button (2).

The data will be saved as a ".txt" file.

## 8.13

### Other settings

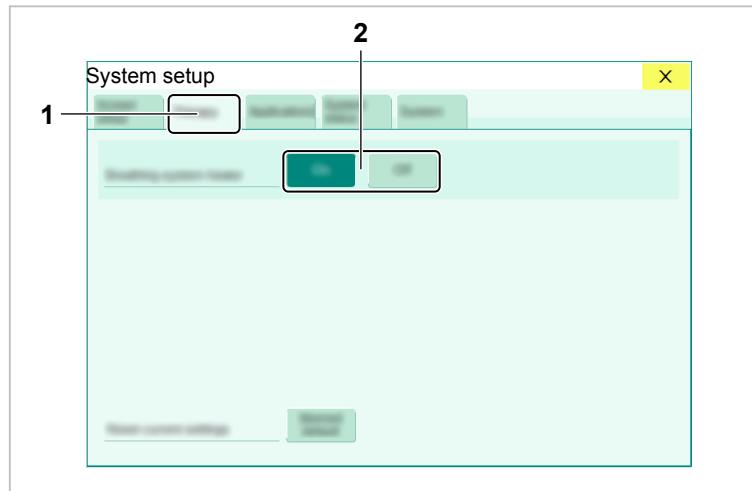
#### 8.13.1

#### Switching the breathing system warmer on or off

The breathing system warmer can be switched off in special situations (e.g., for intentional reduction of the body temperature of the patient).

1. Open the **System setup** dialog.

2. Touch the **Therapy** tab (1).



35982

3. Touch the appropriate button (2).

When switching to standby mode, the heater is reset to the value configured in the system setup.

**⚠ CAUTION**

**Risk due to faulty or switched-off breathing system warmer**

Without the breathing system warmer, increased condensation may occur in the breathing system. This may also impair the flow measurement and the metering accuracy of the set tidal volume.

- ▶ Increase the fresh-gas flow if necessary.
- ▶ Regularly remove the condensed water from hoses, water traps, and the breathing system.
- ▶ Have service personnel repair the faulty breathing system warmer.

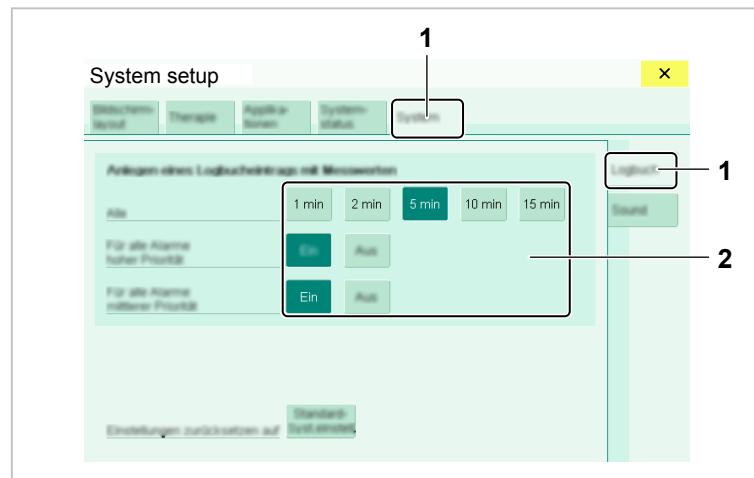
### 8.13.2

### Creating additional logbook entries

The following events can generate a logbook entry with measured values for the parameters etCO<sub>2</sub>, MV, Pmean, PIP, Pplat, PEEP, FiO<sub>2</sub>, expiratory concentration of the primary anesthetic gas, and etN<sub>2</sub>O:

- Settable interval
  - Alarms with high or medium priorities
1. Open the **System setup** dialog.

2. Touch the **System > Logbook** tab (1).



3. Touch the appropriate button (2).

### 8.13.3

### Resetting user-specific settings

Changes made in the System setup dialog during operation can be reset to the default settings.

1. Open the **System setup** dialog.
2. Open the corresponding page.
3. Touch the **System defaults** button and confirm.

## 8.14

### Ending the therapy

#### 8.14.1

#### Switching to the standby mode

1. Touch the **Standby...** button in the main menu bar.  
Or  
Press the key below the screen.
2. Confirm with the rotary knob.

#### WARNING

#### Soda lime drying out

Moisture losses occur if fresh gas is continuously passed through the soda lime. If the moisture falls below the minimum level, the following adverse reactions occur regardless of the type of soda lime and inhalational anesthetic agent used:

- Reduced CO<sub>2</sub> absorption and consequently an increase in inspiratory CO<sub>2</sub> values
- Increased generation of heat in the CO<sub>2</sub> absorber and consequently increased breathing gas temperature
- Formation of carbon monoxide
- Absorption and/or degradation of the inhalational anesthetic agent
- With mechanically controlled gas mixers:  
Do not leave the flow control valves open for an unnecessarily long period of time.

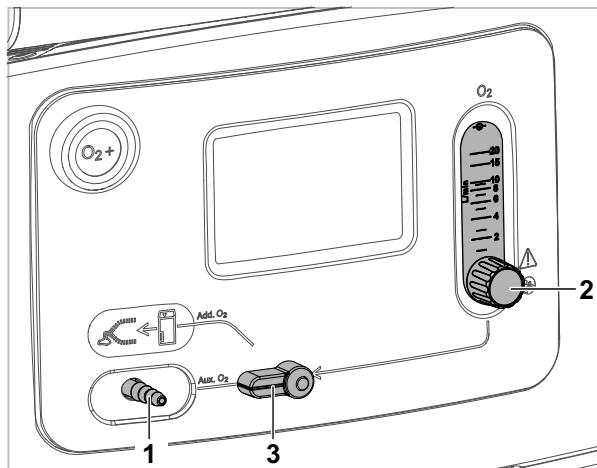
3. With mechanically controlled gas mixers:  
Close the flow control valves.

## 8.14.2 O<sub>2</sub> insufflation

### 8.14.2.1 Overview

On the electronically controlled gas mixer, O<sub>2</sub> insufflation is performed using the O<sub>2</sub> flowmeter. On the mechanically controlled gas mixer, O<sub>2</sub> insufflation is performed using an integrated O<sub>2</sub> flowmeter or an external O<sub>2</sub> flowmeter.

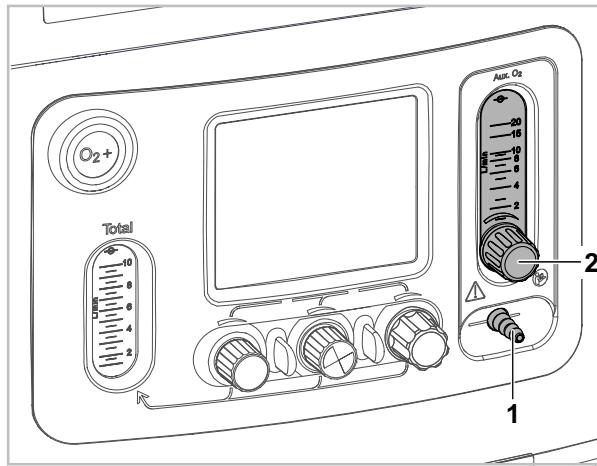
Electronically controlled gas mixer:



53637

Prerequisite: The O<sub>2</sub> switch is horizontal in the **Aux. O<sub>2</sub>** position (3).

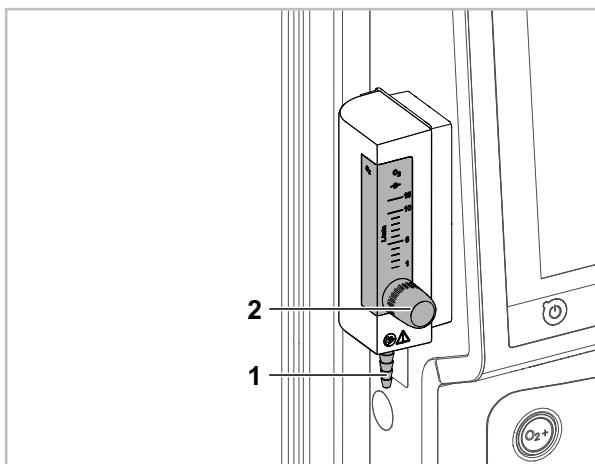
Mechanically controlled gas mixer with electronic flow measurement:



53638

Prerequisite: The device is equipped with the "integrated O<sub>2</sub> flowmeter" hardware option.

External O<sub>2</sub> flowmeter:



59639

Prerequisite: The device is equipped with an external O<sub>2</sub> flowmeter.

#### 8.14.2.2 Using O<sub>2</sub> insufflation

Procedure for all 3 gas mixers:

**⚠ WARNING**

**Risk of fire**

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgical devices and laser surgical devices can cause fires.

- ▶ Prevent leakage, e.g., at endotracheal tubes, laryngeal masks, face masks, the Y-piece, the breathing system including hoses, filters, and breathing bag, at the external fresh-gas outlet, and at the outlet for O<sub>2</sub> insufflation.
- ▶ Use only intact and leak-free hoses at the outlet for O<sub>2</sub> insufflation.
- ▶ Before beginning laser surgery or electrosurgery, flush with sufficient air (<25 % O<sub>2</sub>), and flush beneath the surgical drapes as well.
- ▶ When O<sub>2</sub> outlets are in use (e.g., for insufflation), do not use any ignition sources in the immediate vicinity.
- ▶ Do not position oxygen sources in the vicinity of ignition sources, e.g., electrical connectors.

1. Connect the appropriate accessories to the outlet for O<sub>2</sub> insufflation (1).

**⚠ WARNING**

**Risk due to overpressure**

When the patient is connected to the outlet for O<sub>2</sub> insufflation without a relief valve, increased pressure may be applied to the patient.

- ▶ Only connect the patient in a way that allows excess gas to escape (e.g., through a relief valve).

2. Connect the patient using a mask or nasal cannula.

### **⚠ WARNING**

#### **Risk of fire**

In combination with oxygen or nitrous oxide, ignition sources such as electrosurgical devices and laser surgical devices can cause fires.

- ▶ If ignition sources are present, do not open the flow control valve on the O<sub>2</sub> flowmeter. Leave the flow control valve completely closed.
- 3. Open the flow control valve (2) to begin O<sub>2</sub> insufflation.

#### **Ending O<sub>2</sub> insufflation:**

- Close the flow control valve (2).

## **8.15 Change of patient**

### **8.15.1 Cleaning and disinfecting the workstation**

- Clean and disinfect the workstation in accordance with the infection prevention policy of the health-care facility. Observe the reprocessing instructions supplied with the device.

### **8.15.2 Checking or replacing consumables**

Prerequisite: The device is in standby mode.

#### **Integrated patient-gas measurement module**

### **⚠ WARNING**

#### **Risk of infection**

Used sample lines may be infectious due to the breathing gases that passed through them.

- ▶ If the sample line is connected directly to the Y-piece without a filter, replace the sample line after every patient.
- ▶ Replace the sample line regularly. Follow the infection prevention policies and reprocessing regulations of the health-care facility.

- 
- 1. If no filter was used, replace the sample line and dispose of the used sample line.

### **⚠ WARNING**

#### **Risk of infection**

The water trap may contain infectious fluid.

- ▶ In order to prevent infectious fluid from spurting out, first remove the sample line from the water trap and perform surface disinfection.
- ▶ Empty or replace the water trap according to its instructions for use.
- ▶ Follow the infection prevention policies and reprocessing regulations of the health-care facility.

- 
- 2. Check the water trap of the patient-gas measurement module (PGM) for leakage. If necessary, empty or replace the water trap.

#### **Vaporizer filling level**

- Check the vaporizer filling level in the sight glass. Fill the vaporizer if required.

**CO<sub>2</sub> absorber**

- Check the soda lime for discolouration and replace it if necessary, see page 93.

**Breathing hoses and filters**

1. Replace the hoses and filters according to infection prevention policy of the health-care facility.
2. Connect a suitable breathing circuit and filters, see page 85.

**8.15.3****Checking the device**

Prerequisite: The device is in standby mode.

1. Perform the leakage test, see page 112.
2. Flush the breathing system if necessary.

**9****Ending operation****9.1****At the end of the OR day**

Dräger recommends shutting down the device during longer periods of non-use such as overnight or on weekends. This can lower power consumption and prolong the life span of the medical device without negatively influencing device availability.

Before shutting down, the device can optionally be prepared for automatic switch-on including an automatic system test.

**9.1.1****End of operation**

1. Make sure that all flow control valves are closed.
2. Press the  key.
3. Follow the instructions on the screen.

**9.1.2****Programming the system test (Auto On)**

Using the Auto On function, the device can be programmed so that it performs an automatic system test and is tested at a specific time.

During the initialization, the Auto On function checks the components that frequently cause irregularities, e.g., high leakage, insufficient gas supply. After that, the device remains in Standby mode until the automatic system test, or it is shut down.

1. Press the  key.
2. Touch the **Auto On preparation** button.
3. Prepare the device in accordance with the instructions on the screen. For details on the test steps, see page 125.
4. Set the desired day and time for the device to be ready for operation.
5. Select whether the device should remain in Standby mode or be shut down.
6. Touch the **Start** button.
7. If necessary, observe any messages that occur.

After the Auto On initialization is complete, the time remaining until the system test is displayed in Standby mode. While the device is being shut down, the corresponding symbol is shown in the status display, see page 35.

For a final test of the operational readiness of the device, it is only necessary to perform some brief manual checks after the automatic system test.

## 9.2

### Storing the device

Proceed as follows when the device is to be disconnected from the mains power supply for longer than 2 weeks:

1. Set the main switch to the  $\textcircled{O}$  position.
2. Disconnect the power plug.

This will prevent deep discharge of the battery.

## 9.3

### Disconnecting the mains power supply

When the device is disconnected from the mains power supply, the internal battery takes over the function of supplying power. The status display remains active on main devices with corresponding gas mixer. Follow the instructions for storing the device.

- Disconnect the power plug.

## 10

### Alarms

#### 10.1

#### Safety instructions

##### Alarm volume

If the alarm volume is too low, alarm signals may not be heard. The patient may be put at risk.

- ▶ Set the alarm volume loud enough so that the alarm signals can be heard in the environment where the device is located.
- ▶ The user must remain within earshot of the alarm signals.

##### Recognizing alarm signals

If alarm signals are not noticed, the patient may be put at risk.

- ▶ Dräger recommends that the user remains in the vicinity of the anesthesia machine, i.e. within a distance of up to 4 meters (12 feet). This facilitates fast recognition and response in the event of an alarm.
- ▶ If the causes of the alarm are only temporary, the alarms will likewise only be indicated temporarily.

##### Impaired Infinity ID functions

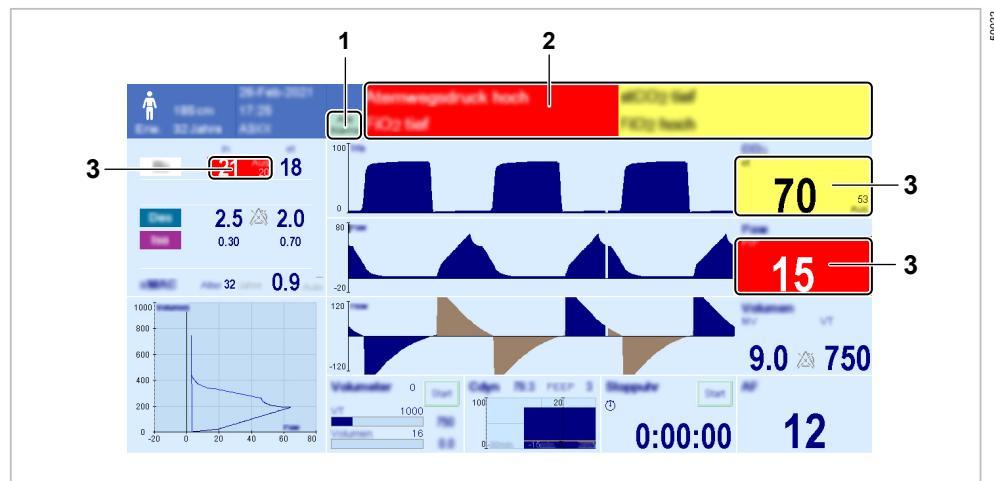
Electromagnetic disturbances or faults in Infinity ID components can cause permanent alarms.

- ▶ Contact service personnel to deactivate the Infinity ID alarms.

## 10.2 Alarm signaling

Alarms are signaled optically and acoustically during the therapy. In standby mode, alarms are signaled optically. However, if the user must respond to certain alarms in standby mode, these alarms will also be signaled acoustically.

### 10.2.1 Optical alarm signals



#### No. Designation

- 1 All alarms button
- 2 Alarm message field
- 3 Alarm-triggering parameters

In the event of an alarm, the device displays the relevant alarm message in the alarm message field. For certain alarms, the parameter field of the parameter triggering the alarm will flash.

In the alarm message field (2), up to 8 alarms can be displayed at a time. If more alarms occur, the **All alarms** button (1) is displayed. Touching this button opens the **Alarms > Current alarms** dialog with information about all active alarms, see page 192.

### 10.2.2 Acoustic alarm signals

The alarm with the highest priority is always acoustically signaled. The signal is emitted until either the cause of the alarm is remedied or the alarm silence key is pressed.

In situations where several alarms occur at the same time, alarms with higher priority may only be signaled with a 5-tone sequence instead of a 10-tone sequence.

Regardless of the set alarm volume, the **No O<sub>2</sub> delivery** alarm is issued at maximum volume.

### 10.2.3 Overview of alarm priorities

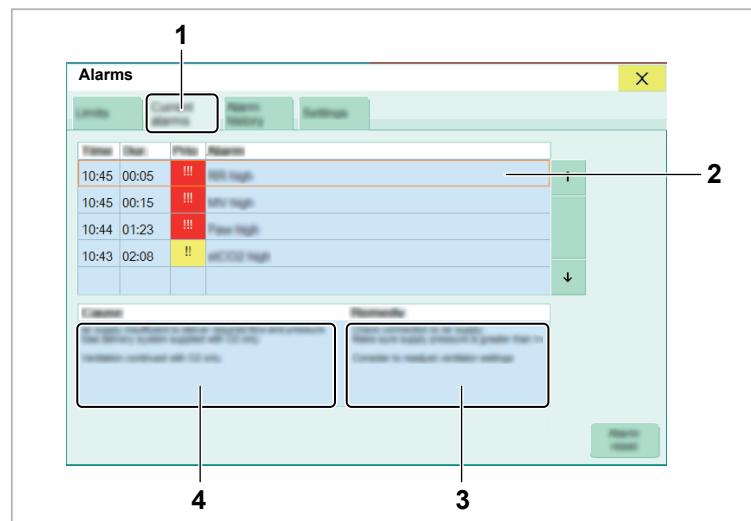
Every alarm is assigned a certain priority that reflects its urgency.

Priority	Back-ground color	Marking in the logbook and in the chapter entitled "Alarm – Cause – Remedy"	Need for action
High	Red	!!!	Immediate action required to avert an acute hazard
Medium	Yellow	!!	Immediate action required to avert a hazard
Low	Cyan	!	Take note or action required

## 10.3 Response to alarms

### 10.3.1 Displaying information on alarms

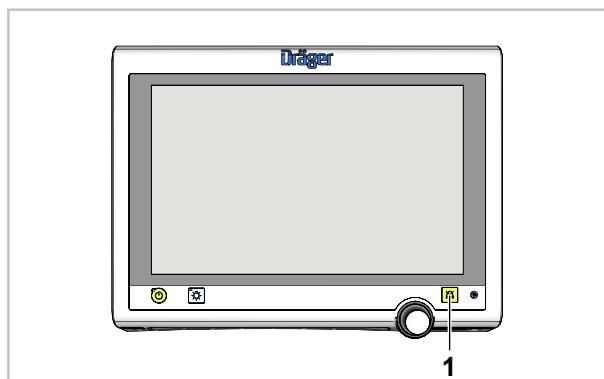
- Information on the alarms can optionally be displayed as follows:
  - Touch the alarm in the header bar.
  - Open the **Alarms** dialog and touch the **Current alarms** tab (1).



- In the list (2), touch the corresponding alarm or select it with the rotary knob.
- Refer to the information under **Cause** (4) and **Remedy** (3) to remedy the error. A list of all possible alarms can be found in chapter "Alarm – Cause – Remedy", see page 245.

### 10.3.2 Silencing the alarm tone

The alarm tone can be silenced for a maximum of 2 minutes.



30004

- Press the alarm silence key  (1) below the screen, see page 21.

The  symbol and the remaining time for the silenced alarm tone are displayed in the header bar.

If the cause of the alarm persists, the alarm tone starts again immediately after the alarm silence ends.

During the alarm silence, only new alarms with a higher alarm priority or a higher internal priority number compared with the silenced alarm are acoustically signaled. For further information see: "Alarm – Cause – Remedy", page 245.

#### 10.3.2.1 Reactivating the alarm tone

- Press the alarm silence key  again.

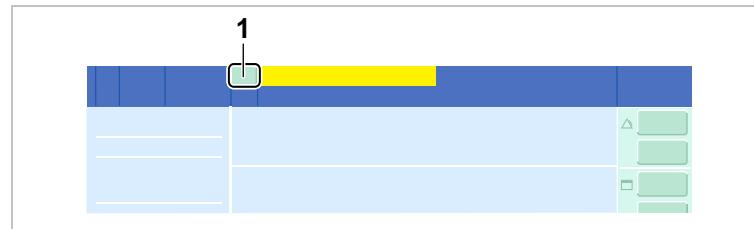
### 10.3.3 Downgrading and resetting alarm messages

Some alarms can be downgraded to low priority or they can be cleared completely. The relevant alarms can be recognized in the table "Alarm – Cause – Remedy" on page 245 by the following remedial messages:

Remedial message	Effect
Use "ALARM RESET" to downgrade alarm priority.	Alarm priority is changed to low.
Use "ALARM RESET" to reset alarm.	Alarm is cleared.

There are 2 options for downgrading or clearing the alarms:

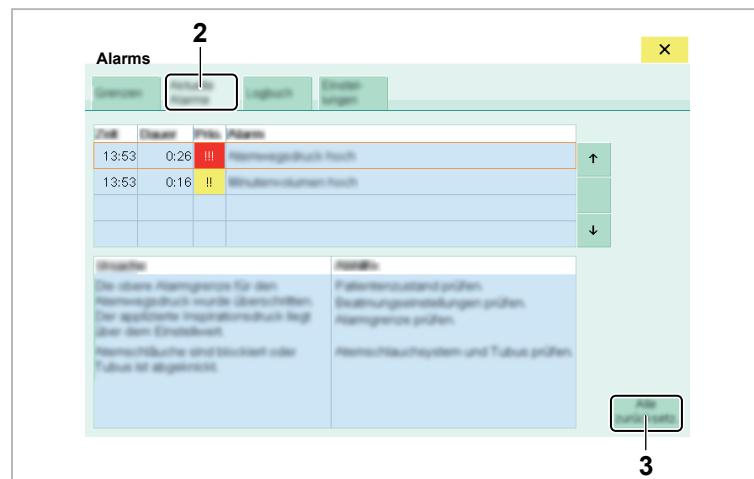
Option 1:



36008

Or

Option 2:



36011

#### Option 1

Touch the **ALARM RESET** button (1) in the header bar and confirm.

All the alarms displayed in the alarm message field will be downgraded or reset.

#### Option 2

In the **Alarms > Current alarms** dialog (2), touch the **Reset all** button (3) and confirm.

All alarms will be downgraded or reset.

### 10.3.4 Opening the alarm logbook

The alarm logbook records all alarm messages for the current case in chronological sequence.

1. Open the **Alarms** dialog.
2. Touch the **Alarm logbook** tab (1).



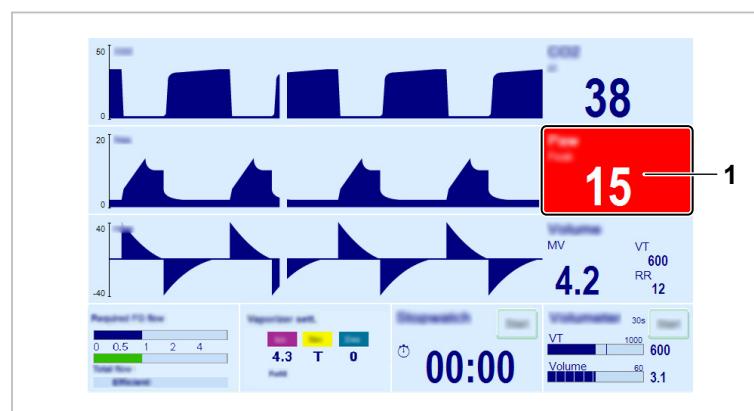
36010

Use the rotary knob or the arrow buttons (2) to scroll the cursor up or down.

The alarm logbook is cleared when the device is shut down or a new case is started.

### 10.3.5 Adjusting the alarm limits

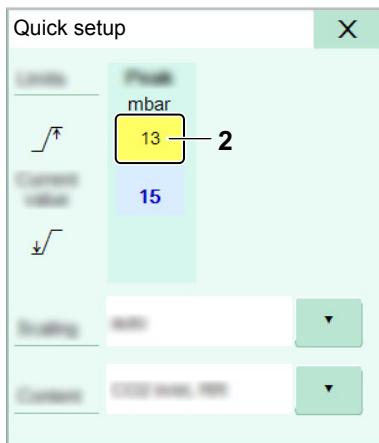
If an alarm is triggered because a lower limit or an upper limit is exceeded, it might be necessary to adjust the alarm limits. To do this, either set the alarm limits, see page 178, or change the alarm limits using the Quick setup dialog.



36015

1. Touch the parameter field (1).

The relevant alarm limit (2) is preselected.



2. Adjust the value (2) and confirm.

The device can be configured so that the Quick setup dialog opens automatically in the event of an alarm, see page 208.

## 10.4 Adopting alarm settings when changing the ventilation mode

When the ventilation mode is changed, the alarm settings are also adapted.

Depending on the mode, alarm settings can either be adopted or set to **Off**.

For some modes, it can be configured whether or not the settings are adopted. Observe the information in the following section: "Vertical tab "Config. 2""", page 209  
However, the settings can be adjusted during operation at any time.

Alarm or alarm limit	CBM mode	Pause, Monitoring	Man / Spon, PSV with $\Delta P_{supp} < 5 \text{ hPa}$ ( $\text{cmH}_2\text{O}$ )	Ext. FGO	VC, VC - AF, PC, PSV with $\Delta P_{supp} \geq 5 \text{ hPa}$ ( $\text{cmH}_2\text{O}$ )
FiO <sub>2</sub> low <sup>1)</sup>			Is adopted.		
FiO <sub>2</sub> high <sup>1)</sup>	Configurable		Configurable	Not measured	
FiO <sub>2</sub> low <sup>2)</sup>			Is adopted.		
inAgent high <sup>2)</sup>					
Apnea (no CO <sub>2</sub> ) <sup>2)</sup>	Off	Off <sup>3)</sup>	Is adopted.		
etCO <sub>2</sub> high <sup>2)</sup>					Is restored or remains active.
etCO <sub>2</sub> low <sup>2)</sup>					
inCO <sub>2</sub> high <sup>2)</sup>			Configurable		
FiO <sub>2</sub> high <sup>2)</sup>	Configurable				
inAgent low <sup>2)</sup>					
xMAC low <sup>2)</sup>	Not activated				
Paw			Is adopted.		
MV high	Configurable				
MV low			Configurable		
Apnea (no flow)	Configurable <sup>4)</sup>	Off	Off <sup>3)</sup>	Not measured	
Apnea (no pressure)	Off		Off		On

1) With inspiratory O<sub>2</sub> measurement with O<sub>2</sub> sensor

2) With integrated patient-gas measurement module

3) The alarm remains suppressed until respiratory activity is detected.

4) This alarm is only activated if the MV low alarm limit is also activated.

#### 10.4.1 Activating the alarms related to volume

The upper alarm limit for MV is deactivated at the start of the ventilation, but can be set during the ventilation.

The MV low alarm is delayed in certain cases and is issued as follows:

- No sooner than 45 seconds after a case starts
- No sooner than 45 seconds after changing to a mode with greater breathing support, see page 310
- No sooner than 45 seconds after an Apnea (no flow) alarm or an Apnea (no pressure) alarm
- No sooner than 45 seconds after one of the following maneuvers: Inspiration Hold, Expiration Hold, or one-step recruitment

#### 10.4.2 Resetting the Apnea (no CO<sub>2</sub>) alarm

Prerequisite: The device is equipped with the "integrated patient-gas measurement module".

When changing to a ventilation mode with higher breathing support, the **Apnea (no CO<sub>2</sub>)** alarm is reset. If the apnea situation persists, an alarm appears after the time specified in table "Alarm delay, alarm escalation, and alarm deescalation".

## 10.5 Alarm delay, alarm escalation, and alarm deescalation

To prevent unnecessary alarms, some alarms are not displayed immediately after a limit violation, but after a delay. In addition, certain circumstances can cause the alarm priority to change.

### Gas measurement alarms with integrated patient-gas measurement module

Alarm	Priority Low	Priority Medium	Priority High
inCO <sub>2</sub> high	---		
etcO <sub>2</sub> high			
etcO <sub>2</sub> low			
FiO <sub>2</sub> high			
Inspiratory N <sub>2</sub> O high			
inAgent low	After 2 consecutive respiratory phases and 15 s	---	---
FiO <sub>2</sub> low	---	---	After 2 consecutive respiratory phases and 15 s  or after 30 s if no respiratory phases are detected
inAgent high	---	After 2 consecutive respiratory phases and 15 s  or after 30 s if no respiratory phases are detected	>165 s later
Inspiratory xMAC high	---	Insp. MAC ≥3 for more than 180 s	longer than 30 s: insp. MAC ≥3 and exp. MAC ≥2.5  or insp. MAC ≥5
xMAC low	0 to 60 s	>60 s	---
Apnea (no CO <sub>2</sub> )	---	At the latest after 20 s (for RR ≥6)  or At the latest after 35 s (for RR <6)	30 s later (for RR ≥6)  or 30 s later (for RR <6)  or At the latest after 65 s
No CO <sub>2</sub> detected	>60 s	---	---

Alarm	Priority Low	Priority Medium	Priority High
O <sub>2</sub> measurement not available	>20 s	---	---
N <sub>2</sub> O measurement not available			
Agent measurement not available			
O <sub>2</sub> measurement temporarily inaccurate			
CO <sub>2</sub> sensor accuracy low			
Agent measurement temporarily inaccurate			
N <sub>2</sub> O measurement temporarily inaccurate			
Measured gas concentrations temporarily inaccurate			

#### Gas measurement alarms with inspiratory O<sub>2</sub> measurement

Alarm	Priority Low	Priority Medium	Priority High
FiO <sub>2</sub> low	---		After at least 5 s
FiO <sub>2</sub> high	---	After at least 5 s	
O <sub>2</sub> measurement not available	>20 s	---	---
O <sub>2</sub> measurement temporarily inaccurate			
O <sub>2</sub> sensor not ready			

#### Ventilation alarms

Alarm	Priority Low	Priority Medium	Priority High
Apnea (no flow)	---	At the latest after 20 s (for RR ≥6)  or At the latest after 35 s (for RR <6 or in Manual / Spontaneous mode)	15 s later (for RR ≥6)  or 30 s later (for RR <6 or in Manual / Spontaneous mode)
Apnea (no pressure)	---	At the latest after 20 s (for RR ≥6)  or At the latest after 35 s (for RR <6)	15 s later (for RR ≥6)  or 30 s later (for RR <6)
Apnea Ventilation		At the latest after 40 s in CPAP / PSV mode with active RRmin. (configurable alarm priority, see page 208)	---

Alarm	Priority Low	Priority Medium	Priority High
Tidal volume not achieved	---	After 3 consecutive breaths	---
Airway press. continuously high	---	---	>15 s above the automatically set limit
Inspiratory pressure not achieved	---	After 3 consecutive breaths	---
Cardiac bypass mode still active?	---	If a minute volume of >50 % of the suggested value is measured after CBM mode has been activated for >60 s	---
Fresh gas low or leakage	---	Breathing bag empty	In the event of an additional "Apnea (no flow)", "Apnea (no pressure)", or "Inspiratory pressure not achieved" alarm
Backup manual mode activated	>20 s	---	0 to 20 s

## 10.6 Activation of alarms after breath detection

### Devices equipped with inspiratory O<sub>2</sub> measurement and integrated patient-gas measurement module

In the Man/Spon mode, the alarms for Minute volume low and Apnea (no flow) are only activated after spontaneous breaths have been detected.

### Devices equipped with integrated patient-gas measurement module

If still no breaths have been detected after leaving the Standby, Pause, or Monitoring modes, the breathing gas is monitored with regard to an O<sub>2</sub> concentration that is too low or an anesthetic gas concentration that is too high. At the same time, the message **Waiting for respiratory phases** is displayed in the CO<sub>2</sub> waveform.

Once 2 breaths have been detected, the message disappears and only then are the O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic gas alarms active.

## 10.7 Intelligent alarm behavior

### 10.7.1 Combined alarms

If multiple alarms occurring at the same time are caused by the same problem, they are combined into one alarm.

Problem	Alarms occurring at the same time	Combined alarm
Several causes of apnea are present.	Apnea (no flow) Apnea (no pressure) Apnea (no CO <sub>2</sub> )	Apnea

### 10.7.2 Limited generation of alarms

Some low-priority alarms indicate a fault in a measurement function. If this measurement function monitors parameters, no alarms based on these parameters can be generated.

Example:

Fault	Displayed alarm	Non-generated alarm
CO <sub>2</sub> measurement is faulty	Sample line occluded	Apnea (no CO <sub>2</sub> )

## 11 Configuration

### 11.1 Safety instructions

#### Unauthorized configuration changes

If the device configuration has been changed without authorization, settings may be incorrect. As a result, device malfunctions can occur and the patient may be put at risk.

- Restore the device configuration.

#### Passwords

If the user password and the service password are not assigned, there is a risk of unauthorized access to the device settings. As a result, saved device settings can be changed and not be noticed. The patient may be put at risk. Skip password assignment only in emergencies.

- Assign the user password and the service password when the device is switched on for the first time.

### 11.2 User password

To prevent unauthorized changes, the start settings for this device are protected by a password. After a specified interval, a new password must be assigned. This interval can be configured in the service dialog. If the password needs to be reset, contact service personnel.

Give the password only to authorized persons.

## 11.3 Device settings

Some device functions are available as an option and consequently are only available on appropriately equipped devices.

### 11.3.1 Factory defaults

Dräger delivers the device with factory defaults that are used when starting the device for the first time. Service personnel can reset the device to the factory defaults.

### 11.3.2 Start settings

Start settings take effect after every restart of the device or when starting a new case (touching one of the **New adult**, **New pediatric** or **New neonate** buttons). The start settings can be adjusted after the user password is entered.

If required, the device can be delivered with start settings that may differ from the factory defaults.

### 11.3.3 User-specific settings

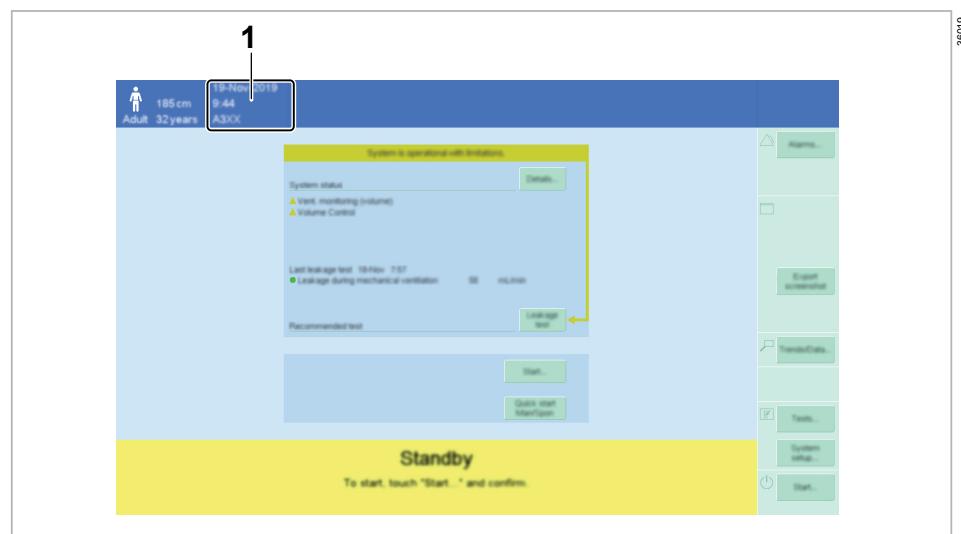
User-specific settings can be adjusted by the user without a user password. The settings take effect immediately but are discarded at the latest after a device restart.

## 11.4 Setting the date and time

The device can adopt the time from a network or from a device connected via MEDIBUS. The time synchronization takes place shortly after switch-on and at regular intervals thereafter.

If time synchronization is not set, the time can be changed manually in 2 ways:

- Touch the field (1).



- Set the date and time in the system setup.  
The source for the time synchronization can also be set in the system setup. For further information, see the following chapter: "Vertical tab "General""", page 217.

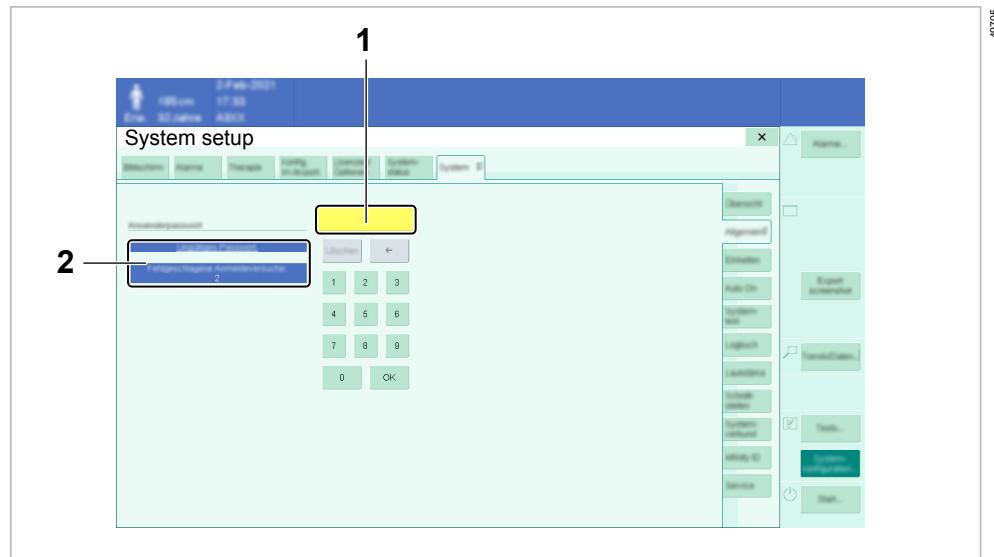
## 11.5

## Specifying the start settings

Settings in the System setup dialog require the user password (1) to be entered as soon as a vertical tab is selected. Entering the password is required only once for as long as the dialog is open. Section 2 displays password information, e.g., failed login attempts.

Failed login attempts may indicate a security attack.

- The number of failed login attempts is displayed on the screen and recorded in the security event log.
- Failed login attempts may indicate an attempt to gain unauthorized access to protected device settings.
- If unauthorized access is suspected, inform the responsible party (e.g., the health-care facility's IT representative or the device owner).



### 11.5.1

### Adjusting the settings

The following tables show all the setting possibilities in the System setup dialog. Some setting options are available only for certain equipment or only with certain software options.

The respective factory defaults are marked in **bold** format.

## 11.5.2 System setup > Screen

### 11.5.2.1 Vertical tab "General"

Headline/ Parameter	Setting range			Description
Color scheme	<b>Day light</b> ; Day dark; Night			Sets the color scheme. Observe the information in the following section: "Daytime colors and nighttime colors", page 102
Screen brightness	10 to 100 <b>80</b>			Sets the screen brightness.
Screen saver	<b>On</b> , Off			Activates the screen saver. For further information see: "Screen saver", page 100.

### 11.5.2.2 Vertical tab "Views"

Headline/ Parameter	Setting range			Description
Rename views	1 Standard; 2 Expert; 3 Expert			Defines the name of a view. Touch the button for the view, enter the new name on the keyboard, and confirm with the  button or with the rotary knob.
Number of waveforms (view 3)	<b>3; 4</b> (Applies only to the electronically controlled gas mixer and the mechanically controlled gas mixer with electronic flow measurement.)			
	<b>2; 3</b> (Applies only to the mechanically controlled gas mixer with flow tubes.)			
Default view	<b>1 Standard</b> ; 2 Expert; 3 Expert			Specifies the standard view.
Save as system defaults	Current view (only available during operation)			Saves the current screen layout.
	All views			Saves all screen layouts.

### 11.5.2.3 Vertical tab "Waveforms"

Headline/ Parameter	Setting range			Description
Sweep speed [mm/s]	<b>6.25</b> ; 12.5; 25	<b>6.25</b> ; 12.5; 25	6.25; <b>12.5</b> ; 25	Specifies the sweep speed.
VT scale [mL]	<b>Auto</b> ; 0 to 10; 0 to 50; 0 to 150; 0 to 500; 0 to 1000; 0 to 2000	<b>Auto</b> ; 0 to 10; 0 to 50; 0 to 150; 0 to 500; 0 to 1000; 0 to 2000	<b>Auto</b> ; 0 to 10; 0 to 50; 0 to 150; 0 to 500; 0 to 1000; 0 to 2000	Specifies the scale for the volumeter.
Flow scale [L/min]	<b>Auto</b> -5 to 5 -10 to 10; -30 to 30; -60 to 60; -120 to 120	<b>Auto</b> -5 to 5 -10 to 10; -30 to 30; -60 to 60; -120 to 120	<b>Auto</b> -5 to 5 -10 to 10; -30 to 30; -60 to 60; -120 to 120	Specifies the scale for the flow waveform.
O <sub>2</sub> scale [%]	<b>Auto</b> ; 0 to 100; 15 to 35; 25 to 45; 35 to 55; 45 to 65; 55 to 75; 65 to 85; 75 to 95; 85 to 105			Specifies the scale for the O <sub>2</sub> waveform.
CO <sub>2</sub> scale	[%]; [kPa]: <b>Auto</b> ; 0 to 6; 0 to 12 [mmHg]: <b>Auto</b> ; 0 to 50; 0 to 100			Specifies the scale for the CO <sub>2</sub> waveform.
Paw scale [mbar]; [hPa]; [cmH <sub>2</sub> O]	<b>Auto</b> ; -5 to 20; -7.5 to 30; -10 to 40; -20 to 80			Specifies the scale for the Paw waveform.
Flow-volume loop	<b>ISO standard</b> ; Dräger			Specifies coordinate axes for the Flow-Volume loop.

### 11.5.2.4 Vertical tab "Colors"

Headline/ Parameter	Setting range			Description
CO <sub>2</sub> ; Paw; Flow, volume	<b>Default color</b> ; color palette with 7 additional colors			Specifies the parameter colors.
O <sub>2</sub> ; Agent	<b>Default color</b> ; ISO color			

### 11.5.3 System setup > Alarms

#### 11.5.3.1 Vertical tab "Limits"

Headline/ Parameter	Setting range			Description
FiO <sub>2</sub> $\sqrt{\text{A}}$ [%]	19 to 99; <b>Off</b>	19 to 99; <b>Off</b>	19 to 99; Off <b>90</b>	Inspiratory oxygen fraction
FiO <sub>2</sub> $\sqrt{\text{V}}$ [%]	18 to 98 <b>20</b>	18 to 98 <b>20</b>	18 to 98 <b>20</b>	
etCO <sub>2</sub> $\sqrt{\text{A}}$ [%]; [kPa] [mmHg]	0.1 to 9.8; Off <b>7.0</b> 1 to 75; Off <b>53</b>	0.1 to 9.8; Off <b>7.0</b> 1 to 75; Off <b>53</b>	0.1 to 9.8; Off <b>7.0</b> 1 to 75; Off <b>53</b>	Expiratory CO <sub>2</sub> concentration
etCO <sub>2</sub> $\sqrt{\text{V}}$ [%]; [kPa] [mmHg]	Off; 0.0 to 9.7; Off; 0 to 74	Off; 0.0 to 9.7; Off; 0 to 74	Off; 0.0 to 9.7; Off; 0 to 74	
inCO <sub>2</sub> $\sqrt{\text{A}}$ [%]; [kPa] [mmHg]	0.1 to 1.4; Off <b>1.1</b> 1 to 10; Off <b>8</b>	0.1 to 1.4; Off <b>1.1</b> 1 to 10; Off <b>8</b>	0.1 to 1.4; Off <b>1.1</b> 1 to 10; Off <b>8</b>	Inspiratory CO <sub>2</sub> concentration
Paw $\sqrt{\text{A}}$ [mbar]; [hPa]; [cmH <sub>2</sub> O]	5 to 99 <b>40</b>	5 to 99 <b>25</b>	5 to 99 <b>20</b>	Airway pressure
inSev $\sqrt{\text{A}}$ [%]; [kPa]	0.10 to 9.95 <b>4.40</b>	0.10 to 9.95 <b>5.10</b>	0.10 to 9.95 <b>6.70</b>	Sevoflurane
inSev $\sqrt{\text{V}}$ [%]; [kPa]	Off; 0.00 to 9.85	Off; 0.00 to 9.85	Off; 0.00 to 9.85	
inDes $\sqrt{\text{A}}$ [%]; [kPa]	0.1 to 20.0 <b>12.5</b>	0.1 to 20.0 <b>14.5</b>	0.1 to 20.0 <b>19.0</b>	Desflurane
inDes $\sqrt{\text{V}}$ [%]; [kPa]	Off; 0.0 to 19.9	Off; 0.0 to 19.9	Off; 0.0 to 19.9	
inEnf $\sqrt{\text{A}}$ [%]; [kPa]	0.10 to 9.95 <b>3.60</b>	0.10 to 9.95 <b>4.10</b>	0.10 to 9.95 <b>5.40</b>	Enflurane
inEnf $\sqrt{\text{V}}$ [%]; [kPa]	Off; 0.00 to 9.85	Off; 0.00 to 9.85	Off; 0.00 to 9.85	

Headline/ Parameter	Setting range			Description
inIso $\sqrt{A}$ [%]; [kPa]	0.10 to 8.50 <b>2.40</b>	0.10 to 8.50 <b>2.80</b>	0.10 to 8.50 <b>3.70</b>	Isoflurane
inIso $\sqrt{V}$ [%]; [kPa]	Off; 0.00 to 8.40	Off; 0.00 to 8.40	Off; 0.00 to 8.40	
inHal $\sqrt{A}$ [%]; [kPa]	0.10 to 8.50 <b>1.60</b>	0.10 to 8.50 <b>1.90</b>	0.10 to 8.50 <b>2.40</b>	Halothane
inHal $\sqrt{V}$ [%]; [kPa]	Off; 0.00 to 8.40	Off; 0.00 to 8.40	Off; 0.00 to 8.40	

#### 11.5.3.2 Vertical tab "Sound volume"

Headline/ Parameter	Setting range			Description
Alarm volume	10 to 100 <b>40</b>			Sets the alarm volume.
Minimum alarm volume	10 to 100 <b>10</b>			Sets the minimum volume with which an alarm tone will be signaled.

#### 11.5.3.3 Vertical tab "Autoset"

Headline/ Parameter	Setting range			Description
Offset for "Autoset limits" function				
	Automatic adjustment of the parameters to current measured values. For further information, see the following section: "Automatic setting", page 179.. By touching the Autoset button, the alarm limits are adjusted so that the upper alarm limit is above the current measured value by at least the percentage or value set here and the lower alarm value is correspondingly below it. Example: In the PC - CMV mode: Measured MV: 5 L/min Set offset: $\pm 40\%$ New alarm limits: 7 and 3 L/min			
etCO <sub>2</sub> $\pm$ [%]	Off; 20 to 80 <b>20</b>		In modes with low or no breathing support (Man/Spon, Ext. FGO, CPAP / PSV, Pause, and Monitoring), a further 20 percentage points are added to the configured value.	

Headline/ Parameter	Setting range			Description
Paw +[mbar]; [hPa]; [cmH <sub>2</sub> O]	Off; 5 to 20 <b>5</b>			The following parameters are taken into account when determining the Paw value: PIP, Pplat, Pinsp, PEEP and ΔPsupp. In the Man/Spon, Pause, and Monitoring modes, the new alarm limit is at least 25 hPa (cmH <sub>2</sub> O).
MV ± [%]	Off; 20 to 80 <b>40</b>			In modes with low or no breathing support (Man/Spon, CPAP / PSV, Pause, and Monitoring), a further 20 percentage points are added to the configured value.

#### 11.5.3.4 Vertical tab "Config. 1"

Headline/ Parameter	Setting range			Description
General alarm behavior				
Open "Quick setup" when alarm occurs	<b>On</b> ; Off			Automatically opens the Quick setup dialog in the event of an alarm.
"Second agent detected" alarm	<b>On</b> ; Off			Issues an alarm when an anesthetic gas mixture is detected.
"xMAC low" alarm	<b>On</b> ; Off			Activates the xMAC low alarm.
"FiO <sub>2</sub> too high for neonates" threshold value [%]	<b>50</b> ; 25 to 90			Sets the FiO <sub>2</sub> value that is considered critical for neonates. If this value is exceeded for a certain time, the FiO <sub>2</sub> too high for neonates alarm will be triggered.
"FiO <sub>2</sub> too high for neonates" alarm after [h:mm]	Off; 0:10 to 9:50 <b>0:15</b>			Sets the time after which the FiO <sub>2</sub> too high for neonates alarm will be triggered.
Priority of "Apnea ventilation" alarm	<b>Medium</b> ; Low			Specifies the alarm priority when the set minimum respiratory rate is not reached in PSV ventilation mode.
Alarm behavior in "Pause" mode				
Priority of "Pause time expired" alarm	<b>High</b> ; Medium			Specifies the alarm priority for the alarm that is issued when the time set in the Pause mode has expired.
Default value for "Timer" [mm:ss]	<b>2:00</b>	0:30 to 2:00 <b>1:00</b>	0:30 to 2:00 <b>0:30</b>	Specifies the default duration for Pause. Is only applicable when switching to Pause from a ventilation mode.

### 11.5.3.5 Vertical tab "Config. 2"

Headline/ Parameter	Setting range			Description
Deactivate the alarm limit in the following modes: Man/Spon, Pause, CPAP/PSV with $\Delta P_{supp} < 5$ , ext. FGO <sup>1)</sup>				
FiO2 high	Yes; No	Yes; No	Yes; No	Specifies the alarm behavior when changing to a different ventilation mode.
MV low		Yes; No		
MV high		Yes; No		
xMAC low		Yes; No		
etCO2 low		Yes; No		
etCO2 high		Yes; No		
inCO2 high		Yes; No		
inAgent low		Yes; No		
Deactivate the alarm limit in cardiac bypass mode (CBM)?				
FiO2 high		Yes; No		Specifies the alarm behavior in the CBM mode.
MV low		Yes; No		
MV high		Yes; No		
inAgent low		Yes; No		

1) Pause must be activated in the system setup.

2) Only for devices with integrated PGM. Pause must be deactivated in the system setup.

### 11.5.3.6 Vertical tab "Config. 3"

Headline/ Parameter	Setting range			Description
Alarm limits for "Cylinder almost empty"				
O2	[bar]; [kPax100]: Off; 15 to 50 <b>20</b> [psi]: Off; 218 to 725 <b>290</b>			Specifies the alarm limits for the supply pressure of connected gas cylinders.
Air	[bar]; [kPax100]: Off; 15 to 50 <b>20</b> [psi]: Off; 218 to 725 <b>290</b>			
N2O	[bar]; [kPax100]: Off; 15 to 40 <b>20</b> [psi]: Off; 218 to 580 <b>290</b>			

## 11.5.4 System setup > Therapy

### 11.5.4.1 Vertical tab "Vent. 1"

Headline/ Parameter	Setting range			Description
Default ventilation mode	Buttons with available ventilation modes <b>Man/Spon</b>			Specifies the default ventilation mode at the start of therapy.
VT and RR start settings				Specifies the tidal volume and the respiratory rate.
Based on	<b>Patient category; Ideal body weight</b>			
Selected: [Patient category]				Specifies the tidal volume and the respiratory rate based on the patient category.
VT [mL]	5 to 1500 <b>500</b>	5 to 1500 <b>150</b>	5 to 1500 <b>50</b>	
RR [1/min]	3 to 100 <b>12</b>	3 to 100 <b>20</b>	3 to 100 <b>30</b>	
Selected: [Ideal body weight]				Specifies the tidal volume and the respiratory rate that are based on the ideal body weight.
VT [mL]	5 to 1500 100 kg (220 lb): <b>700</b> 75 kg (165 lb): <b>520</b> 15 kg (33 lb): <b>110</b> 5 kg (11 lb): <b>35</b>			Set the tidal volume and the respiratory rate for the supporting points 5; 15; 75; 100 kg (11; 33; 165; 220 lb).
RR [1/min]	3 to 100 100 kg (220 lb): <b>10</b> 75 kg (165 lb): <b>12</b> 15 kg (33 lb): <b>26</b> 5 kg (11 lb): <b>32</b>			For calculated values for ideal body weights that lie between these 4 supporting points, the start settings for tidal volume and respiratory rate are interpolated linearly. For ideal body weight values lying outside these supporting points, calculation proceeds with the values of the highest or lowest supporting point.

The start settings for VT and RR influence the start values of the alarm limits for MV high and MV low:

$$\text{MV high} = \text{VT} \times \text{RR} \times (1 + \text{offset}); \\ \text{minimal: } 2.0 \text{ L/min}$$

$$\text{MV low} = \text{VT} \times \text{RR} \times (1 - \text{offset}); \\ \text{minimal: } 0.3 \text{ L/min}$$

The "offset" value corresponds to the respective offset setting for automatic alarm adjustment. The "offset" value can be set in **System setup > Alarms > vertical Autoset** tab. If "Offset" is set to Off, the factory default value of 40 % is used for the automatic calculation of the alarm limits.

#### 11.5.4.2 Vertical tab "Vent. 2"

Headline/ Parameter	Setting range			Description
Start settings for ventilation				
Pmax [mbar]; [hPa]; [cmH <sub>2</sub> O]	12 to 80 <b>40</b>	12 to 80 <b>30</b>	12 to 80 <b>25</b>	Specifies the start settings for the ventilation.
Pinsp [mbar]; [hPa]; [cmH <sub>2</sub> O]	7 to 80 <b>15</b>	7 to 80 <b>15</b>	7 to 80 <b>15</b>	
ΔPsupp [mbar]; [hPa]; [cmH <sub>2</sub> O]	Off; 3 to 80 <b>10</b>	Off; 3 to 80 <b>10</b>	Off; 3 to 80 <b>10</b>	
Insp term [%]	5 to 80 <b>25</b>	5 to 80 <b>25</b>	5 to 80 <b>25</b>	
PEEP [mbar]; [hPa]; [cmH <sub>2</sub> O]	Off; 2 to 35 <b>3</b>	Off; 2 to 35 <b>3</b>	Off; 2 to 35 <b>3</b>	
Slope [s]	0 to 2 <b>0.2</b>	0 to 1.5 <b>0.2</b>	0 to 1.5 <b>0.2</b>	
RRmin [/min]	Off; 3 to 25 <b>6</b>	Off; 3 to 25 <b>10</b>	Off; 3 to 25 <b>15</b>	
I:E	1:10 to 4:1 <b>1:2</b>	1:10 to 4:1 <b>1:2</b>	1:10 to 4:1 <b>1:1</b>	
% Tplat [%]	0 to 60 <b>20</b>	0 to 60 <b>20</b>	0 to 60 <b>20</b>	
Trigger [L/min]	0.3 to 15 <b>4.0</b>	0.3 to 15 <b>2.0</b>	0.3 to 15 <b>1.0</b>	
Sync.	SIMV; <b>CMV</b>	SIMV; <b>CMV</b>	SIMV; <b>CMV</b>	

#### 11.5.4.3 Vertical tab "Proced. 1"

Headline/ Parameter	Setting range			Description
General settings				
Default maneuver	One-step recruitment; Multi-step recruitment; <b>Insp./Exp. hold</b>			Defines the default maneuver.
Reminder [min]	<b>Off</b> , 10 to 180	<b>Off</b> , 10 to 180	<b>Off</b> , 10 to 180	If the value is not set to <b>Off</b> , a reminder for a maneuver is given after the first switch to a controlled ventilation mode. Defines the time after which a reminder for a further maneuver is issued after the end of a One-step recruitment or Multi-step recruitment maneuver.

<b>Headline/ Parameter</b>	<b>Setting range</b>			<b>Description</b>
Layout				
Displayed parameter	<b>Cdyn; VT</b>			Defines which additional parameter is displayed in the One-step recruitment and Multi-step recruitment dialogs.

#### 11.5.4.4 Vertical tab "Proced. 2"

<b>Headline/ Parameter</b>	<b>Setting range</b>			<b>Description</b>
Default settings for one-step recruitment				
Pressure [mbar]; [hPa]; [cmH <sub>2</sub> O]	PEEP + 1 to <b>80</b> <b>30</b>	PEEP + 1 to <b>80</b> <b>25</b>	PEEP + 1 to <b>80</b> <b>20</b>	Sets the pressure level for the maneuver.
Duration [s]	3 to 40 <b>30</b>	3 to 40 <b>15</b>	3 to 40 <b>5</b>	Sets the duration of the maneuver.
Default settings for multi-step recruitment				
PEEP max [mbar]; [hPa]; [cmH <sub>2</sub> O]	PEEP to 35 <b>20</b>	PEEP to 35 <b>15</b>	PEEP to 35 <b>12</b>	Sets the maximum PEEP pressure for the maneuver.
Pinsp max [mbar]; [hPa]; [cmH <sub>2</sub> O]	15 to 80 <b>35</b>	15 to 80 <b>30</b>	15 to 80 <b>25</b>	Sets the maximum inspiratory pressure for the maneuver.
ΔPressure [mbar]; [hPa]; [cmH <sub>2</sub> O]	5 to 30 <b>10</b>	5 to 30 <b>10</b>	5 to 30 <b>10</b>	Sets the pressure difference between Pinsp and PEEP with which pressure-controlled ventilation is carried out. If PEEP max or Pinsp max is reached in the course of the maneuver, the pressure difference will be reduced in steps until the other set value is also reached. The smallest possible value has to be at least 3 above the set value for the pressure rise per step.
Breaths/Step	1 to 20 <b>3</b>	1 to 20 <b>4</b>	1 to 20 <b>5</b>	Number of breaths at a pressure level during the increase or reduction
Breaths@Max	1 to 20 <b>6</b>	1 to 20 <b>8</b>	1 to 20 <b>10</b>	Number of breaths at the Pinsp max pressure level
Pressure rise per step [mbar]; [hPa]; [cmH <sub>2</sub> O]	2 to 10 <b>5</b>	2 to 10 <b>4</b>	2 to 10 <b>3</b>	Specifies the pressure by which PEEP and Pinsp will be increased in steps.
Pressure decrease per step when PEEP > 15 [mbar]; [hPa]; [cmH <sub>2</sub> O]	2 to 10 <b>5</b>	2 to 10 <b>4</b>	2 to 10 <b>3</b>	For PEEP >15: Specifies the pressure by which PEEP and Pinsp will be reduced in steps.

<b>Headline/ Parameter</b>	<b>Setting range</b>			<b>Description</b>
Pressure decrease per step when PEEP ≤ 15 [mbar]; [hPa]; [cmH <sub>2</sub> O]	1 to 10 <b>2</b>	1 to 10 <b>2</b>	1 to 10 <b>2</b>	For PEEP ≤ 15: Specifies the pressure by which PEEP and Pinsp will be reduced in steps.

#### 11.5.4.5 Vertical tab "Fresh gas" (only with electronically controlled gas mixer)

<b>Headline/ Parameter</b>	<b>Setting range</b>			<b>Description</b>
Start settings for fresh gas				Selects the start settings for the fresh-gas delivery.
FG O <sub>2</sub> [%]	21 to 100 <b>100</b>	21 to 100 <b>100</b>	21 to 100 <b>100</b>	Sets the O <sub>2</sub> concentration in the fresh gas.
FG flow [L/min]	0.20 to 15.00 <b>2.00</b>	0.20 to 15.00 <b>2.00</b>	0.20 to 15.00 <b>2.00</b>	Sets the fresh-gas flow.
Minimal O <sub>2</sub> flow (carrier gas: Air) [mL/min]	Off; 50 to 300 <b>200</b>	Off; 50 to 300 <b>200</b>	Off; 50 to 300 <b>200</b>	Sets the minimal O <sub>2</sub> flow that is delivered when Air is used as carrier gas.  Do not set the value too low, but suitable for the patient category. The recommendation is, e.g., 200 for adults, 100 for pediatric patients, and 50 for neonates.
Minimal O <sub>2</sub> flow (carrier gas: N <sub>2</sub> O) [mL/min]	50 to 300 <b>200</b>	50 to 300 <b>200</b>	50 to 300 <b>200</b>	Sets the minimum O <sub>2</sub> flow that is delivered when N <sub>2</sub> O is used as carrier gas.  Do not set this value too small; recommended is, e.g., 200 for adults, 100 for pediatric patients, and 50 for neonates.
Carrier gas	<b>Air; N<sub>2</sub>O</b>	<b>Air; N<sub>2</sub>O</b>	<b>Air; N<sub>2</sub>O</b>	Sets the carrier gas.

#### 11.5.4.6 Vertical tab "Patient"

Headline/ Parameter	Setting range			Description
Default selection for "Start" dialog	Continue case; <b>New adult</b> ; New pediatric; New neonate			Specifies which button is preselected the first time the Start dialog is opened, and after changes to the system setup.
Weight [kg]  [lb]	Off; 30 to 300 <b>Off</b> Off; 67 to 661 <b>176</b>	Off; 5 to 50 <b>Off</b> Off; 12 to 110 <b>55</b>	0.4 to 10 <b>3.0</b> 0.9 to 22 <b>6.6</b>	Specifies the following starting values: – Body weight – Body height – Patient age  If the setting is configured to <b>Off</b> , the corresponding therapy control will not be displayed in the Start dialog.
Height [cm]  [in]	120 to 300 <b>185</b> 48 to 118 <b>73</b>	50 to 300 <b>100</b> 20 to 118 <b>39</b>	Off; 20 to 80 <b>Off</b> Off; 8 to 31 <b>Off</b>	
Age [years, Neo: months]	12 to 130 <b>32</b>	0 to 16 <b>8</b>	0 to 24 <b>6</b>	

#### 11.5.4.7 Vertical tab "General"

Headline/ Parameter	Setting range			Description
Pinsp changes with PEEP	<b>On</b> ; Off			Determines whether changing PEEP automatically also changes Pinsp, so that the difference between PEEP and Pinsp remains constant.
Inspiratory-time control	<b>Ti</b> ; I:E			Determines whether the ventilation settings are based on Ti or on the I:E ratio.
Ti changes with RR in CMV	<b>On</b> ; Off			Determines whether the change of RR automatically causes a change of Ti. In this way, the I:E ratio remains constant.  Applies to the following ventilation modes: – PC - CMV – VC - CMV – VC - CMV / AutoFlow Prerequisite: Inspiratory-time control is set to Ti.

<b>Headline/ Parameter</b>	<b>Setting range</b>			<b>Description</b>
I:E changes with RR in SIMV		On; Off		Determines whether the change of RR automatically causes a change of I:E. In this way, Ti remains constant.  Applies to the following ventilation modes: <ul style="list-style-type: none"><li>– PC - SIMV</li><li>– PC - SIMV / PS</li><li>– VC - SIMV</li><li>– VC - SIMV / PS</li><li>– VC - SIMV / AutoFlow</li><li>– VC - SIMV / PS / AutoFlow</li></ul> Prerequisite: Inspiratory-time control is set to I:E.
Breathing system warmer		On; Off		Switches the breathing system warmer on or off.
Auto Wake-up (opens start dialog upon respiratory activity)		On; Off		Determines whether the Start dialog opens automatically when ventilation activity is detected (e.g., as a result of repeated squeezing of the breathing bag).
Anesthetic gas for flow correction		Auto; Des; Sev; Other; <b>None</b>		Corrects the accuracy of the flow measurement on devices with inspiratory O <sub>2</sub> measurement.
	Auto			Corrects the measured flow values automatically when an anesthetic gas monitor is connected (see "Flow correction", page 149).
	None			Deactivates the correction.
	Sev	0 to 6.5 <b>2.1</b>		Corrects the measured flow values when sevoflurane is used. Select the value according to the typical setting on the vaporizer control dial. (The vaporizer automatically makes any correction necessary for altitude.)
	Des	0 to 18 <b>6</b>		Corrects the measured flow values when desflurane is used. Select the value according to the typical setting on the vaporizer control dial. (The vaporizer automatically makes any correction necessary for altitude.)
	Other			Deactivates the correction.
Carrier gas for flow correction		<b>Auto</b> ; Air; N <sub>2</sub> O		Corrects the accuracy of the flow measurement on devices with inspiratory O <sub>2</sub> measurement and mechanically controlled gas mixer with flow tubes.

Headline/ Parameter	Setting range			Description
Auto				Corrects the measured flow values automatically when an anesthetic gas monitor is connected.
Air				Corrects the measured flow values when Air is used.
N <sub>2</sub> O				Corrects the measured flow values when N <sub>2</sub> O is used.
Enable pause mode	On; Off			Defines whether the Pause mode is available. On: Pause mode is activated. Off: Pause is deactivated. For devices with integrated patient-gas measurement module, Monitoring mode is available as an alternative.

## 11.5.5 System setup > Licenses/Options

### 11.5.5.1 Vertical tab "Licenses/Options"

Headline/ Parameter	Setting range			Description
Licenses for software options				<ul style="list-style-type: none"> <li>– Overview of available and active software options.</li> <li>– Activating software options.</li> </ul> <p>Observe the information in the following section: "Activating software options", page 224</p>
Gas supply				
Disable N <sub>2</sub> O	On; Off			<p>A device with electronic gas mixer and connectors for nitrous oxide can be configured so that nitrous oxide is no longer displayed and cannot be selected as a carrier gas.</p> <p>Prerequisite:</p> <ul style="list-style-type: none"> <li>– The current carrier gas is Air.</li> <li>– Nitrous oxide is not connected or available.</li> </ul> <p>Restart the device if necessary to implement the settings.</p> <p>On: Nitrous oxide cannot be delivered. Off: Nitrous oxide can be delivered.</p>

## 11.5.6 System setup > System

### 11.5.6.1 Vertical tab "General"

Headline/ Parameter	Setting range			Description
Language	List of available languages <b>English (United States)</b>			Selects the language. A flag symbol identifies the tabs that lead to the page with the language settings.
Height above sea level [m]; [ft]	[m]: <b>0</b> up to 4000 [ft]: <b>0</b> up to 13120			Sets the height above sea level.
Time source	MEDIBUS 1; MEDIBUS 2; NTP server; <b>None</b>			Selects the source for the time synchronization. Prerequisite: The connected device supports this function.
Date and time	day; month; year hour; minute			Sets the date and time. The change is applied on leaving the "General" vertical tab.
Automatic switch to daylight savings time	<b>On</b> ; Off			Activates or deactivates the automatic changeover to daylight saving time.
OR working hours	Hour : Minute to Hour : Minute <b>6:30 to 18:30</b>			Sets the working hours of the operating room.  During this time, the gas measurement is kept in a pre-warmed and calibrated state so measured values are available after only a short waiting period. However, this decreases the life span of the patient-gas measurement module.
Device name	Device name (up to 16 alphanumeric characters) <b>A3XX</b>			Changes the device name in order, e.g., to enter the operating location.
User password	Change password			Changes the user password.
Reset all pages to	Factory defaults			Resets all the settings on all pages in the System setup dialog to the factory defaults.

### 11.5.6.2 Vertical tab "Units"

Headline/ Parameter	Setting range			Description
Weight	<b>kg; lb</b>			Sets the units.
Height	<b>cm, m; in, ft</b> (Applies only to the mechanically controlled gas mixer with flow tubes.)			
	<b>cm; in</b> (Applies only to the electronically controlled gas mixer and the mechanically controlled gas mixer with electronic flow measurement.)			
Airway pressure	<b>mbar; hPa; cmH<sub>2</sub>O</b>			
Supply pressure	<b>bar; kPa×100; psi; MPa</b>			
CO <sub>2</sub>	<b>%; kPa; mmHg</b>			
Volatile agents	<b>%; kPa</b>			

### 11.5.6.3 Vertical tab "Auto On"

Headline/ Parameter	Setting range			Description
Auto On				Sets the Auto On software option. The device provides a calendar function which, when the device is shut down, suggests the next time the device should be ready for use, depending on the weekday. To activate the automatic ready-for-use time for a desired day, select the corresponding day and set the time, see page 189.
Day and time	<b>Monday to Sunday; hour : Minute</b> <b>Monday to Friday: 6:30</b> <b>Saturday &amp; Sunday: Off</b>			
When completed	<b>Standby/Shut down</b>			Pay attention to the correct setting of the gas supplies to be tested, see page 219.

#### 11.5.6.4 Vertical tab "System test"

Headline/ Parameter	Setting range			Description
<b>General</b>				
Always use walk-through mode	<b>On; Off</b>			Sets the walk-through mode function.  When On is configured, system tests and leakage tests will always be executed in walk-through mode.
Verify O <sub>2</sub> delivery and circuit (requires sample line)	<b>On; Off</b>			Specifies whether the automatic tests will check whether the O <sub>2</sub> supply actually delivers oxygen and whether the breathing circuit is correctly connected. Prerequisite: The sample line is connected to the Y-piece or the filter on the Y-piece during the tests.  If On is configured, the device automatically checks the O <sub>2</sub> supply and the correct connection of the breathing circuit. If Off is configured, the O <sub>2</sub> supply is not checked. In order to verify the correct connection of the breathing circuit, additional manual test steps must be completed in the checklist.
<b>Test gas supply</b>				
Central O <sub>2</sub> supply	<b>On; Off</b>			Specifies which gas supplies are tested during the automatic system test.
Central Air supply	<b>On; Off</b>			If Auto On is configured, only the gas supplies are checked whose actual availability is guaranteed after automatic start-up.
Central N <sub>2</sub> O supply	<b>On; Off</b>			
O <sub>2</sub> cylinder	<b>On; Off</b>			At least one O <sub>2</sub> source must be tested during the system test.
Air cylinder				
N <sub>2</sub> O cylinder				

#### 11.5.6.5 Vertical tab "Logbook"

Headline/ Parameter	Setting range			Description
A logbook entry with measured values is created				Enables the creation of additional logbook entries with measured values.
Every	1 min; 2 min; <b>5 min</b> ; 10 min; 15 min			Generates periodic entries.
For all high-priority alarms	<b>On; Off</b>			Generates entries in the event of an alarm.
For all medium-priority alarms	<b>On; Off</b>			

**11.5.6.6 Vertical tab "Sound volume"**

Headline/ Parameter	Setting range			Description
Alarm volume	10 to 100 <b>40</b>			Sets the alarm volume.
Minimum alarm volume	10 to 100 <b>10</b>			Sets the minimum volume with which an alarm tone will be signaled.

**11.5.6.7 Vertical tab "Interfaces"**

Headline/ Parameter	Setting range			Description	
LAN					
DHCP	On; Off				
IP address	XXX . XXX . XXX . XXX				
Subnet mask	XXX . XXX . XXX . XXX				
Default gateway	XXX . XXX . XXX . XXX				
MAC address					
COM 1					
Protocol	MEDIBUS.X; <b>None</b>				
Baud rate	1200; 2400; 4800; 9600; <b>19200</b> ; 38400				
COM 2					
Protocol	MEDIBUS.X; <b>None</b>				
Baud rate	1200; 2400; 4800; 9600; <b>19200</b> ; 38400				
USB					
USB interface	On; Off				

### 11.5.6.8 Vertical tab "Infinity ID"

Headline/ Parameter	Setting range			Description
Monitoring of Infinity ID accessories				
Breathing circuit		<b>On; Off</b>		Activates or deactivates the Infinity ID functionality. On: <ul style="list-style-type: none"><li>– Generates a message when the maximum period of use is exceeded</li><li>– Generates a message when Infinity ID breathing hoses are incorrectly connected</li></ul> Off: <ul style="list-style-type: none"><li>– Messages are suppressed.</li></ul>
Water trap		<b>On; Off</b>		
Flow sensors		<b>On; Off</b>		
CO <sub>2</sub> absorber		<b>On; Off</b>		
Exchange interval [days]				
Breathing circuit		Off; 2 to 9 <b>2</b>		Specifies the replacement intervals for Infinity ID accessories.
Water trap		Off; <b>28</b>		
Flow sensors		Off; 1 to 180 <b>90</b>		
CO <sub>2</sub> absorber		Off; 1 to 28 <b>7</b>		

### 11.5.6.9 Vertical tab "Service"

Headline/ Parameter	Setting range			Description
Service password				The following functions are available after the appropriate credentials have been entered: <ul style="list-style-type: none"><li>– Access to the service dialog</li></ul> If the password needs to be reset, contact specialized service personnel.

## 11.5.7 Resetting the start settings

Certain pages in the System setup dialog have a button for resetting the respective start settings to the factory defaults.

### 11.5.7.1 Resetting the changes on a page

1. Open the appropriate tab.
2. Touch the **Factory defaults** button and confirm.

### 11.5.8

### Resetting the consumptions

Prerequisite: The device has the "advanced gas monitoring" software option.

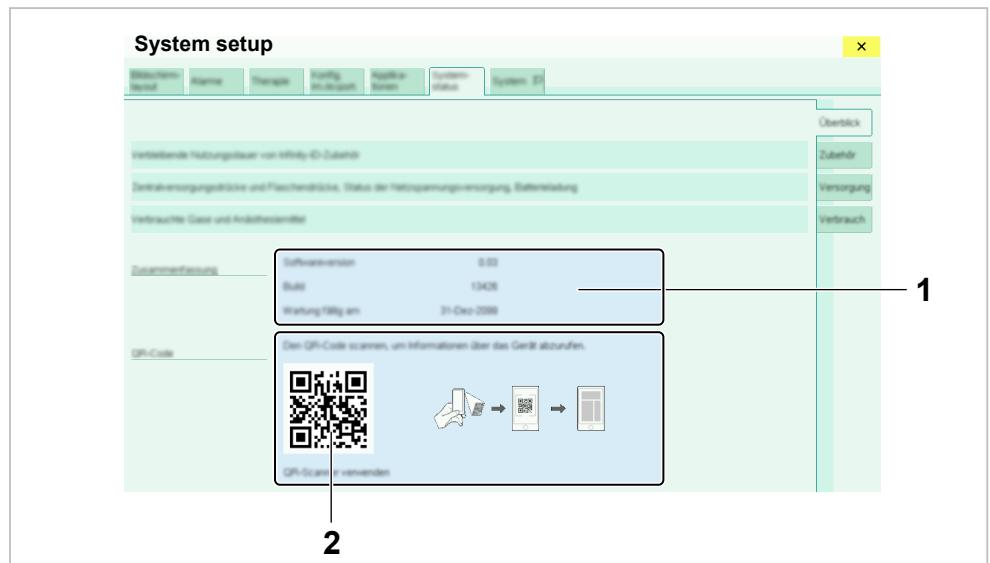
The gas consumption values can be reset in **Standby > System setup > System status > Consumption**.

- Touch the **Reset data** button and confirm.

### 11.5.9

### General device information

Further information is displayed in **Standby > System setup > System status**:



No.	Designation
1	General information
2	QR code for further product information

1 General information

- Installed software version
- Next maintenance date

2 QR code for further product information

This information can be retrieved:

- Device description
- Software options
- Available accessories
- Service options

- Scan the QR code with suitable equipment.

The QR code is decoded into an internet address which enables access to the stated information in a browser.

## 11.6 Transferring device configurations

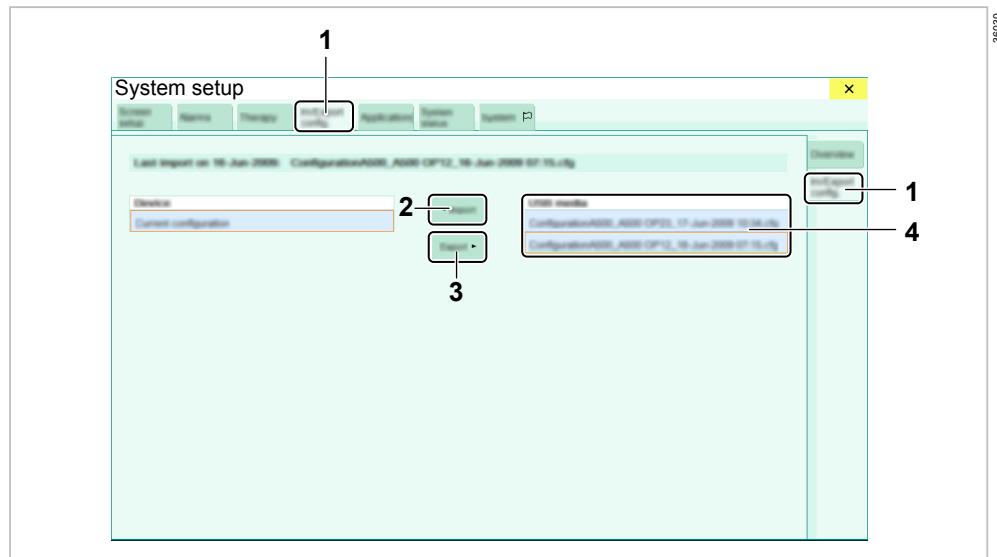
The configuration of a device can be exported to a USB mass storage device and then imported on another device.

The configuration can only be transferred completely if the hardware and software characteristics are identical on both devices. If these characteristics (e.g., gas mixer, gas measurement) are different or if configuration data are missing, certain settings will be reset to the factory defaults or switched off.

**i** To achieve as complete a transfer as possible, use a device with the greatest possible range of features as the starting point for exporting to a device with fewer features.

Prerequisites:

- The USB port is activated in the system setup.
- A USB mass storage device is connected to the USB port.
- Open the **System setup > Im/Export config. > Im/Export config.** page (1).



The configurations saved on the USB mass storage device are displayed in a list (4). If not all of the configurations are displayed, delete all configurations from the USB mass storage device that are not needed or move them to a subdirectory on the USB mass storage device.

The following settings are neither imported nor exported:

- Device name
- Date and time
- IP address
- Passwords

### 11.6.1

#### Importing the configuration

1. Touch one of the configurations in the list (4).
2. Touch the **Import** button (2) and confirm.
3. Restart the device.
4. Check the device configuration for correctness.

### 11.6.2

#### Exporting the configuration

- To export the configuration, touch the **Export** button (3) and confirm.

### 11.7

#### Activating software options

The following software options require an activation code to be entered, followed by activation:

- Pressure-controlled ventilation (PC)
- Spontaneous breathing support (SIMV / PS)
- Spontaneous breathing support (PSV)
- Spontaneous breathing support (SIMV / PS, PSV)
- AutoFlow (VC - AF)
- Pause
- Monitoring<sup>1)</sup>
- Advanced trends
- Advanced ventilation monitoring
- Loops and trends
- Advanced gas monitoring
- Advanced neonatal support
- Expert view
- Lung recruitment
- Auto On
- SDC system integration
- Leakage assistant

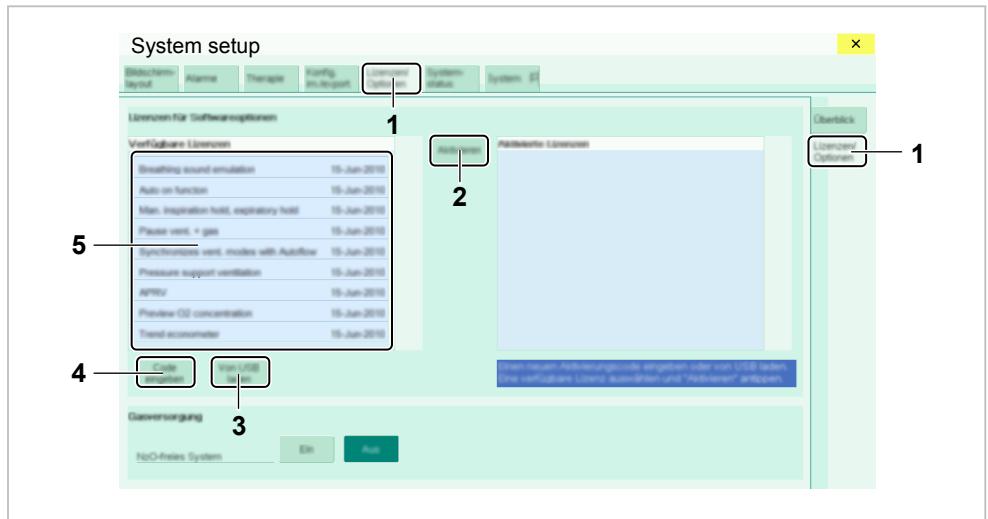
Trial licenses for these software options are time-limited.

An activation code is linked with the serial number of the respective device and cannot be transferred. The activation codes can either be loaded from a USB mass storage device or entered manually.

- Open the **System setup > Licenses/Options > Licenses/Options** page (1).

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1) Only for devices with integrated PGM



### Loading the activation code from a USB mass storage device

Prerequisite: A USB mass storage device with valid licenses is connected to the USB port.

- Touch the ***Load from USB*** button (3).

The activation codes are read and displayed in the list (5).

### Entering the activation code

1. Touch the ***Enter code*** button (4).
2. Enter the activation code and confirm with ***OK***.

The license is displayed in the list (5).

### Activating the licensed software option

The licensed software options must be activated as follows before they become available:

1. Select the corresponding license from the list (5).
2. Touch the ***Activate*** button (2) and confirm.
3. After activating all desired licenses, restart the device.

## 11.8

## Overview of configurable screen contents

Waveforms and parameter fields are selected in the Quick setup dialog, see page 171.

All available waveforms and parameter fields are listed below. The actually available waveforms and parameter fields depend on the main device and the device equipment.

### 11.8.1

### Waveforms and associated parameter fields

#### etCO<sub>2</sub>



36158

**CO<sub>2</sub> in/et**

36156

**CO<sub>2</sub> in/et, RR**

36157

**Paw**

36162

**Paw (3)**

Volume-controlled modes:

Parameters PIP, Pplat, PEEP

All other modes:

Parameters PIP, Pmean, PEEP



36163

**Paw (4)**

Parameters PIP, Pplat, Pmean, PEEP:



36164

**Volume MV, VT, RR**

36165

**Volume MV, VT**

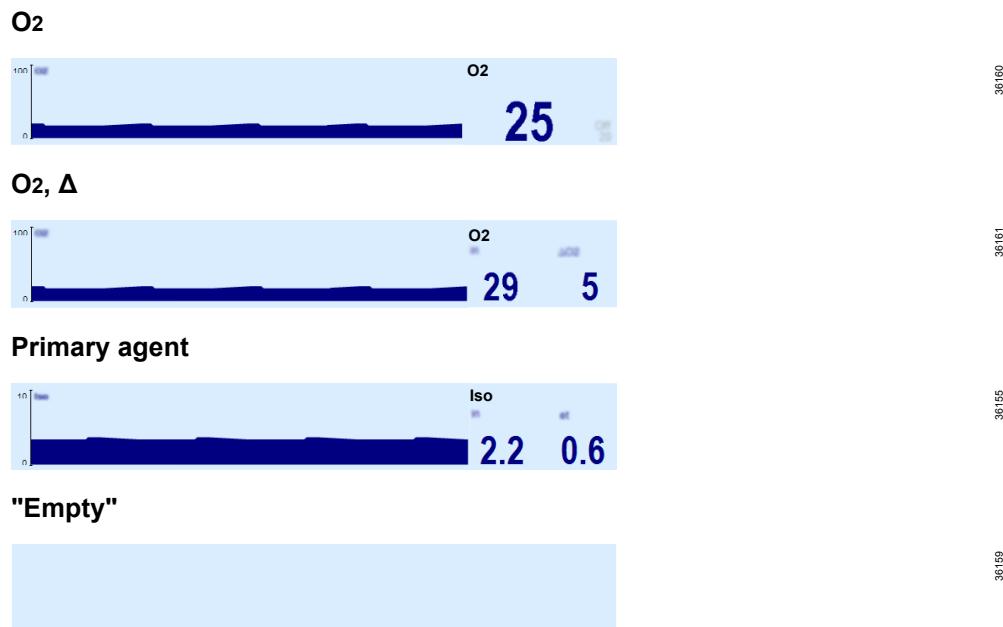
36164

**Volume VT, MV, RR**

36166

**Volume VT, MV**

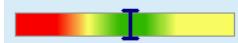
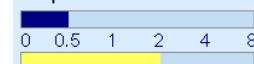
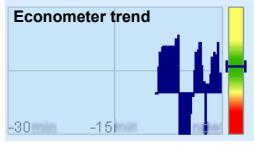
36216

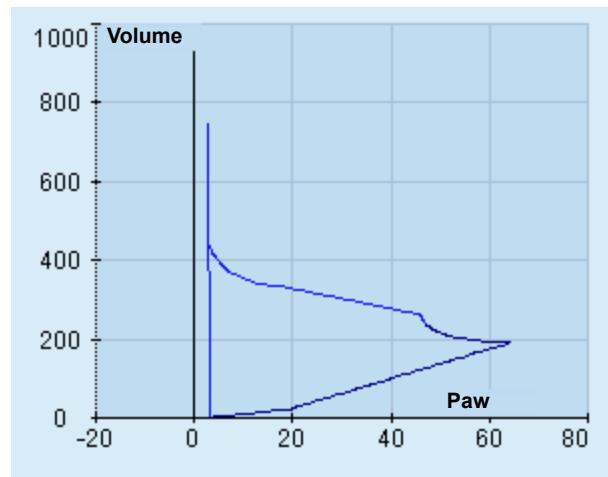


## 11.8.2 Parameter fields

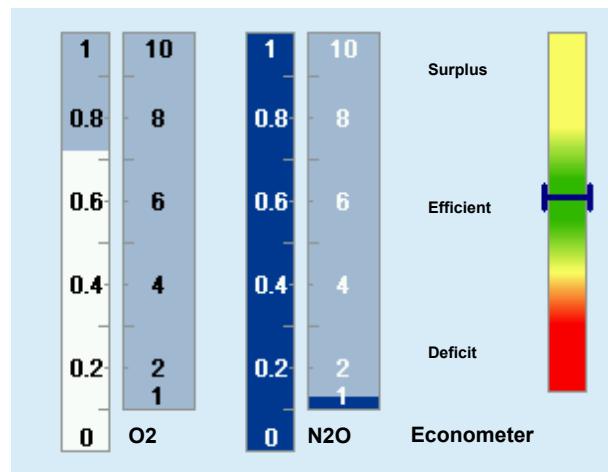
etCO <sub>2</sub>	CO <sub>2</sub> in/et	CO <sub>2</sub> in/et, RR
CO <sub>2</sub> et <b>38</b>	CO <sub>2</sub> et      in <b>38      1.1</b>	CO <sub>2</sub> et      in <b>38      1.1</b> RR      12
Paw	Paw (3)	Paw (4)
Paw PIP <b>15</b>	Paw PIP      Pmean <b>15      7</b> PEEP <b>3</b>	Paw PIP      Pplat <b>15      15</b> Pmean      PEEP <b>7      3</b>
MVmand, spon	MV, VT, RR	MV, VT
MV Mand      Spon <b>9.0      0.0</b>	Volume MV      VT <b>9.0      750</b> RR <b>12</b>	Volume MV      VT <b>9.0      750</b>

Volume-controlled modes:  
PIP, Pplat, PEEP parameters  
All other modes:  
PIP, Pmean, PEEP parameters

<b>VT, MV, RR</b>	<b>VT, MV</b>	<b>O<sub>2</sub></b>
<b>Volume</b> VT              MV <b>750</b> 9.0 RR              12	<b>Volume</b> VT              MV <b>750</b> 9.0	<b>O<sub>2</sub></b> in <b>21</b>
<b>O<sub>2</sub>, Δ</b> <b>O<sub>2</sub></b> in              Δ <b>29</b> 5	<b>Primary agent</b> <b>Iso</b> in              et <b>2.2</b> 0.6	<b>RR</b> <b>20</b>
<b>Econometer</b> <b>Econometer</b> Deficit      Efficient      Surplus 	<b>Low-flow wizard</b> <b>Required FG flow</b>  Total flow Too high	<b>Gases in/et</b> <b>Gases in/et</b> in              et O <sub>2</sub> 30           27 N <sub>2</sub> O        70           69 Iso            0.85        0.65
<b>Gas supply</b> <b>Gas supply</b> O <sub>2</sub> Air   N <sub>2</sub> O 5.1    5      4.5 160   170    180	<b>Volumeter</b> <b>Volumeter</b> VT              30      Start 1000            600 Volume        8      3.1	<b>Stopwatch</b> <b>Stopwatch</b> Start <b>00:00</b>
<b>Timer</b> <b>Timer</b> 0:05:00 Set      Start	<b>ΔVT</b> <b>ΔVT</b> 6      VTi 72 VT              500      66 Paw            20      12	<b>Compliance trend</b> <b>Cdyn</b> 7.5      PEEP 3 15              20 0   -30   -15   0
<b>MV×CO<sub>2</sub> trend</b> <b>MV×CO<sub>2</sub></b> 66 150 0   -30   -15   0	<b>O<sub>2</sub> uptake trend</b> <b>O<sub>2</sub> uptake</b> 34 60 0   -30   -15   0	<b>Econometer trend</b> 
<b>Compliance</b> <b>Compliance</b> Cdyn mean <b>51.5</b>		

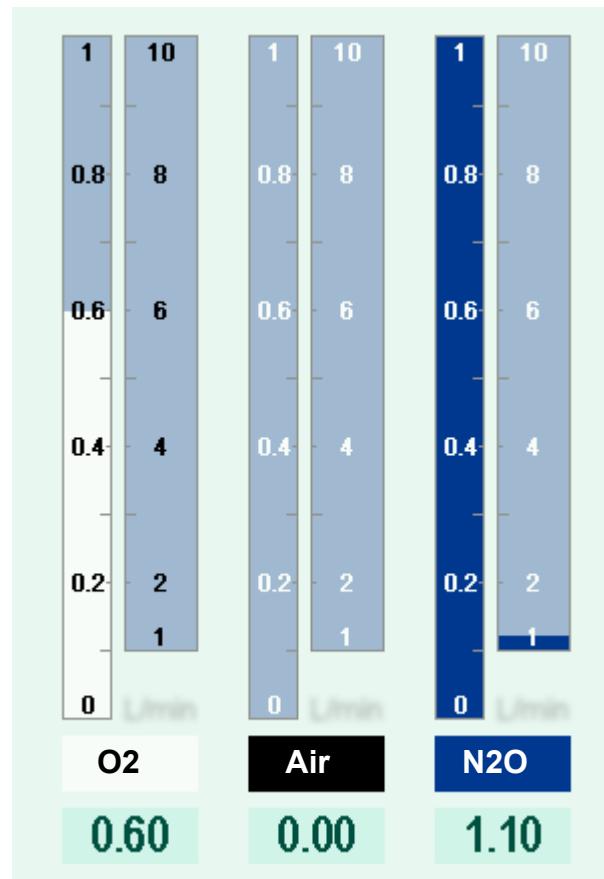
**PV loop**

42195

**Flow tubes (electronically controlled gas mixer with econometer)**

36178

**Flow tubes (mechanically controlled gas mixer with electronic flow measurement)**



42191

When the **PV loop** parameter field is displayed, the flow tubes will be displayed at reduced size:



42192

## 12

# Troubleshooting

### 12.1

## Leakage

Leakage may result in the system not being operational or being ready for operation with limitations only.

#### 12.1.1

### Possible causes of leakage

- The CO<sub>2</sub> absorber or the CLIC adapter is not securely screwed to the breathing system.
- The APL valve is not correctly fitted to the breathing system or is not set to 30 hPa (cmH<sub>2</sub>O).
- The breathing bag, the breathing hoses, the Y-piece, or the bacteria filter is incorrectly fitted or damaged.
- The breathing bag arm is incorrectly fitted to the breathing system. The sealing ring is soiled or damaged.
- The O-ring on the inspiratory port or expiratory port is damaged, soiled, or missing.
- The flow sensors are incorrectly installed or damaged. The rear O-ring is missing.
- The upper part of the breathing system is incorrectly fitted or damaged.
- The pneumatic connection nozzles are not screwed into the breathing system mount or are not screwed in fully.<sup>1)</sup>
- The breathing system is not locked.
- The valves or seals of the breathing system are damaged.
- The sensor port for the O<sub>2</sub> sensor is not sealed with the sealing cap.
- The circuit plug is scratched or damaged.
- The filling or emptying connections on the vaporizer are leaking or are open. The vaporizer is incorrectly fitted. The O-ring is missing or damaged. The control dial is not set to the **0** position.

On devices with inspiratory O<sub>2</sub> measurement:

- The O<sub>2</sub> sensor is not correctly fitted in the breathing system.
- The O<sub>2</sub> sensor cell has not been correctly inserted in the sensor.

On devices with integrated patient-gas measurement module:

- The water trap is not connected.
- The sample line is not connected, is kinked, or is leaking.
- The connections for the sample line are damaged.

---

1) Applies only to devices with removable pneumatic connection nozzles.

**12.1.2****Systematic localization of leakage**

To find causes for leakage, isolate individual components from the leakage test.

<b>Component</b>	<b>Measure</b>
Sample line	Remove the sample line and seal the Luer-Lock connector on the Y-piece.
Breathing hoses	Disconnect the breathing hoses. Connect the inspiratory port and expiratory port with a hose that is known to be without leakage. Connect the breathing bag directly to the breathing system.
Vaporizers	Remove the vaporizers.
O <sub>2</sub> sensor	Remove the O <sub>2</sub> sensor. Seal the sensor port with the sealing cap.

1. Perform the leakage test, see page 112.  
If necessary, perform the manual check for leaks or use the leakage assistant.
2. Contact service personnel if the leakage cannot be localized.

**12.2****Power supply failure****12.2.1****Mains power supply failure**

If mains power supply fails, the device automatically switches to the internal battery. A fully charged battery will maintain operation for at least 45 minutes. For further information see: "Technical data", page 272.

Remaining battery charge is displayed on the status display.

The breathing system warmer is deactivated during battery operation. The peak inspiratory flow may be limited.

**12.2.2****Mains power supply failure and battery discharged**

If mains power supply fails and the battery is discharged, a signal tone is emitted. Manual ventilation and spontaneous breathing are still available. O<sub>2</sub> and anesthetic agent can still be delivered using the emergency O<sub>2</sub> delivery (with electronically controlled gas mixer) or the flow control valves (with mechanically controlled gas mixer) and the vaporizers.

The following components and functions are not available:

- Ventilator
- Electronically controlled gas mixer
- Device monitoring and patient monitoring

 **WARNING**

**Risk of patient injury**

If all power sources fail, the screen goes dark and mechanical ventilation ends.

- Ventilate the patient manually.

Further procedures:

1. Check the vaporizer setting.
2. Electronically controlled gas mixer:  
Use the emergency O<sub>2</sub> delivery, see page 50.

Mechanically controlled gas mixer:

Close the flow control valves for Air and N<sub>2</sub>O. Use only O<sub>2</sub> as fresh gas.

3. Electronically controlled gas mixer:  
Monitor the O<sub>2</sub> flow with the O<sub>2</sub> flowmeter.  
  
Mechanically controlled gas mixer with electronic flow measurement:  
Monitor the O<sub>2</sub> flow on the total flow tube.
4. Check the setting of the APL valve.
5. Ventilate the patient manually.
6. Ensure corresponding substitute monitoring.

### 12.2.3

#### After power supply is restored

1. Restart the device, see page 104.
2. Charge the discharged battery for at least 8 hours.
3. Using the information displayed on the gas mixer unit, check that power is supplied.

## 12.3

### Failure of the gas supply

#### 12.3.1

#### Failure of the central gas supply system

A failure of the central supply can result in simultaneous device malfunctions on all systems connected to it.

Devices that are equipped with gas mixers with electronic flow measurement generate corresponding alarms in the event of failure of the central supply for the gases O<sub>2</sub>, Air or N<sub>2</sub>O.

 The alarm for N<sub>2</sub>O is only generated if N<sub>2</sub>O is configured accordingly.

With devices that are equipped with gas mixers with flow tubes, failure of the central supply is indicated by the pressure gauges for the gas supply on the gas mixer unit.

If the central supply fails, gas supply for the device can be performed temporarily by the connected gas cylinders. On devices that are equipped with Advanced Cylinder Support, this takes place automatically when the gas cylinders are open.

Otherwise, proceed as follows:

- Open the corresponding gas cylinder valve.
- Re-establish the central supply.

The following applies only for the electronically controlled gas mixer:

If the central supply for a gas fails and no sufficiently filled gas cylinder is connected, (see "Gas mixing unit (electronically controlled)", page 36), the device automatically uses a substitute gas:

Failed gas	Substitute gas
O <sub>2</sub>	100 % Air
N <sub>2</sub> O	100 % O <sub>2</sub>
Air	100 % O <sub>2</sub>

The level of the fresh-gas flow is maintained.

### 12.3.2 Failure of one gas

Operation of fresh-gas delivery is still possible when supply of one gas fails. If, e.g., N<sub>2</sub>O fails, proceed as follows:

Electronically controlled gas mixer:

- Switch to Air or O<sub>2</sub> as the carrier gas.

Mechanically controlled gas mixer:

- Open the appropriate flow control valve for the substitute gas.

If the O<sub>2</sub> supply fails, delivery of N<sub>2</sub>O is not possible. For further information see: "Minimum O<sub>2</sub> delivery (SORC)", page 324.

### 12.3.3 Replacing an empty gas cylinder

1. Close the valve of the empty gas cylinder.
2. Completely use up or completely release any gas remaining in the pressure reducer and in the hose between the device and the gas cylinder.  
If there is no patient connected, venting can be performed as follows:
  - Disconnect the central O<sub>2</sub> supply.
  - Open the flow control valve of the O<sub>2</sub> flowmeter. Wait until gas is no longer flowing.
  - Close the flow control valve of the O<sub>2</sub> flowmeter again.
3. Unscrew the pressure reducer from the gas cylinder valve.
4. Replace the gas cylinder with a full gas cylinder.
5. Connect the pressure reducer to the new filled gas cylinder, see page 76.
6. Open the valve of the filled gas cylinder slowly.

### 12.3.4

### Complete failure of the gas supply

#### ⚠️ WARNING

##### Risk of patient recovering consciousness

If the gas supply fails completely, further operation takes place through gas supply of the anesthesia machine with ambient air. The ventilation continues with the ambient air, however no more anesthetic agent or additional oxygen is delivered. The inspiratory anesthetic gas concentration and the inspiratory oxygen concentration in the breathing gas fall.

- ▶ Monitor the gas mixture carefully and use intravenous anesthetic agents if necessary.

If the central O<sub>2</sub> supply and the central Air supply fail at the same time and no gas cylinders are connected, the patient can nevertheless be mechanically ventilated. This is possible because the piston ventilator does not require a drive gas.

#### ⚠️ CAUTION

##### Risk of increased anesthetic gas concentrations in the ambient air

If the breathing bag is not connected, expiratory anesthetic gases may escape from the breathing system.

- ▶ Ensure adequate circulation of the ambient air or connect a breathing bag.

1. Remove the breathing bag.
2. Continue the mechanical ventilation.

When the breathing bag is removed, the missing fresh-gas volume will automatically be filled by ambient air. Nevertheless, the **Fresh gas low or leakage** alarm is likely to be triggered.

### 12.3.5

### After the central supply is restored

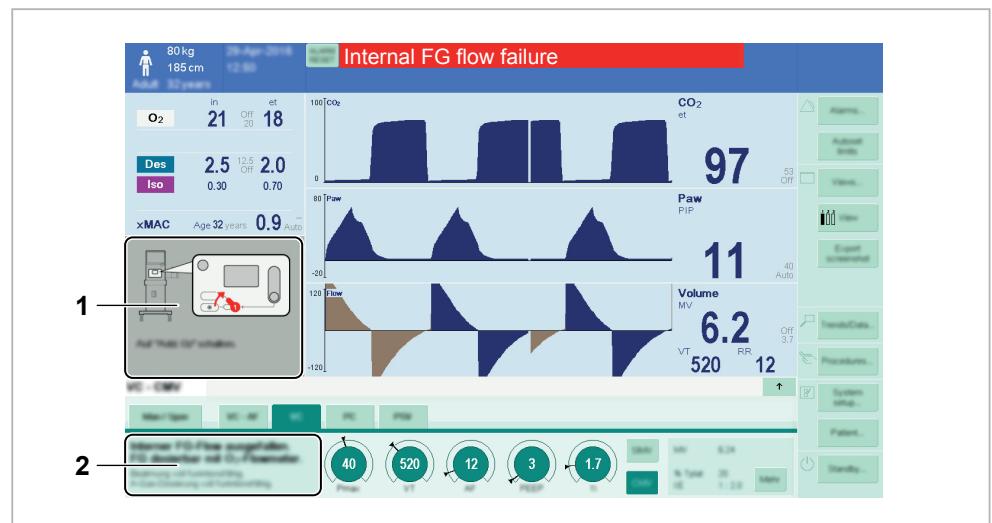
1. Connect the compressed gas hoses to the terminal units.
2. Close the gas cylinder valve on the corresponding gas cylinder again.

On devices that are equipped with Advanced Cylinder Support, the gas cylinder valves can remain open.

## 12.4

## Failure of fresh-gas delivery (electronically controlled gas mixture)

If the fresh-gas delivery has failed, the emergency O<sub>2</sub> delivery can be used to deliver oxygen and anesthetic agent. The current ventilation mode and the fresh-gas deficiency detection remain active.



In the event of a fault, illustrations and instructions showing how to start the emergency O<sub>2</sub> delivery are displayed in areas (1) and (2).

The emergency O<sub>2</sub> delivery is started as follows:

### **⚠ WARNING**

#### Risk of patient injury

If the gas mixer fails, no fresh gas is delivered.

- ▶ Check the vaporizer setting.
- ▶ Supply the patient with O<sub>2</sub>.
- ▶ Use the emergency O<sub>2</sub> delivery.
- ▶ If fresh gas still is not delivered or manual ventilation is not possible, close the flow control valve of the O<sub>2</sub> flowmeter.
- ▶ Disconnect the patient from the device. Use a substitute device.

1. Set the O<sub>2</sub> switch upwards to the **Add. O<sub>2</sub>** position. (Follow the illustration on the screen.)  
The **Internal FG flow failure** alarm will then be automatically downgraded.
2. Open the flow control valve on the O<sub>2</sub> flowmeter. Set the desired flow. This O<sub>2</sub> flow flows through the vaporizer.
3. Check the vaporizer setting.
4. Continuously monitor the O<sub>2</sub> flow of the emergency delivery.

Take the following measures if necessary:

- Perform the ventilation with ambient air. For further information see: "Complete failure of the gas supply", page 235.
- Ventilate the patient with the manual resuscitator.

## 12.5

### Failure of the piston ventilator

If the ventilator fails, only manual ventilation or spontaneous breathing remain possible. No other ventilation modes can be selected. The fresh-gas delivery remains ready for operation.

1. Switch to **Man / Spon** ventilation mode.
2. Ventilate the patient manually.

## 12.6

### Failure of the O<sub>2</sub> sensor

If the **O<sub>2</sub> measurement not available** alarm is displayed, the O<sub>2</sub> measurement has failed.

 **WARNING**

**Risk due to faulty O<sub>2</sub> sensor**

If the O<sub>2</sub> measurement fails, it will no longer be possible to monitor the patient adequately.

- Make sure that substitute O<sub>2</sub> monitoring conforming to the general safety requirements is available.
1. Perform a system test and calibrate the O<sub>2</sub> sensor.
  2. If the calibration fails and the **O<sub>2</sub> sensor failure** alarm is displayed, refer to the following table:

Cause	Remedy
<p>During the calibration, the sensor was exposed to a gas mixture with a fluctuating O<sub>2</sub> concentration.</p> <p>The O<sub>2</sub> sensor was not correctly placed.</p> <p>The O<sub>2</sub> sensor was placed close to mobile radio equipment or similar sources.</p>	<p>During calibration:</p> <ul style="list-style-type: none"> <li>– Remove the sensor from the breathing system and place it on the work surface.</li> <li>– Do not fill vaporizers during the calibration.</li> <li>– Close the additional O<sub>2</sub> flow delivery for the fresh gas mixer.</li> <li>– Do not blow into the sensor.</li> <li>– Do not use any disinfectants.</li> <li>– Close off other gas sources in the vicinity of the sensor.</li> </ul>
<p>The O<sub>2</sub> sensor cell is not present or is not plugged in correctly.</p>	<p>Check the O<sub>2</sub> sensor cell:</p> <ul style="list-style-type: none"> <li>– Insert the sensor cell if it is not present.</li> <li>– Check that the sensor cell is correctly seated.</li> <li>– Calibrate the sensor cell again.</li> </ul> <p> An initialization phase of up to 30 minutes is required after a new O<sub>2</sub> sensor cell is inserted. Only then is O<sub>2</sub> measurement and calibration possible once more.</p>

Cause	Remedy
The O <sub>2</sub> sensor cell is faulty or is expiring.	Replace the O <sub>2</sub> sensor cell.

## 12.7 Failure of the integrated patient-gas measurement module (PGM)

### ⚠ WARNING

#### Risk due to gas measurement failure

If the gas measurement fails, the patient can no longer be adequately monitored.

- ▶ Check the sample line and the water trap for damage or blockages. Pay attention to the replacement intervals.
  - ▶ Replace the patient-gas measurement module.
  - ▶ Ensure corresponding substitute monitoring.
- 
- Arrange for appropriate substitute monitoring conforming to ISO 80601-2-55.

### 12.7.1 Replacing the patient-gas measurement module (PGM)

Contact service personnel to replace the PGM.

Prerequisite:

- There is no patient connected.
- The device is switched off.
- The device is disconnected from the power supply. To do this, disconnect the power plug.
- The water trap has been removed.

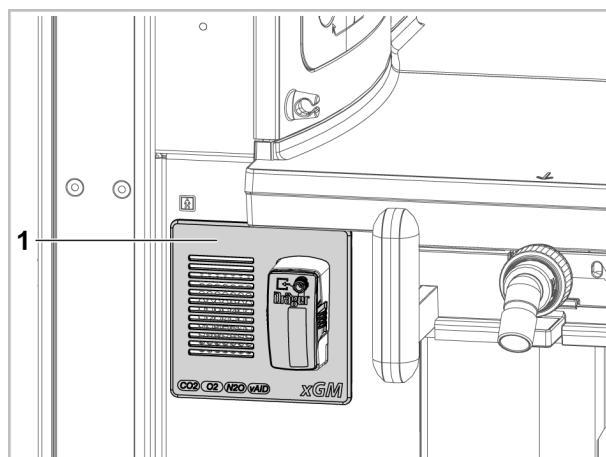
### ⚠ WARNING

#### Incorrect gas measurement

Faulty or non-functional PGMs can cause incorrect gas measurements. As a result, the patient could be put at risk.

- ▶ Have the PGM replaced by service personnel.

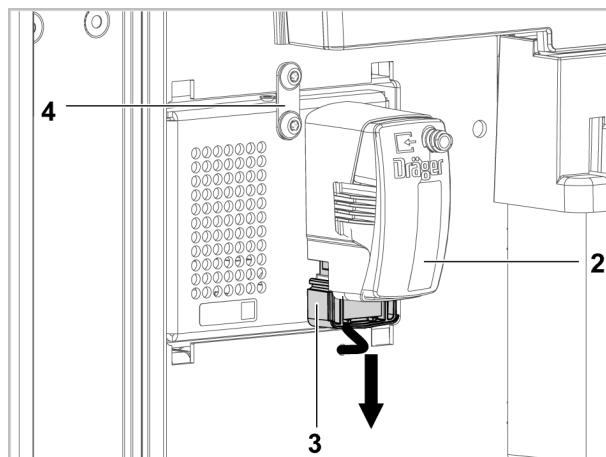
1. At the left-hand side of the device, take hold of the cover (1) at the top and bottom and pull it off directly to the front.



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2. On the underside, remove the water trap (2) and the RFID antenna, if present. To do this, gently press the side surfaces (3) of the RFID antenna together. Pull the RFID antenna off downwards and leave it on the device.

**i** Do not pull on the antenna cable. Do not kink the antenna cable.



40837

3. Remove the 2 screws and the fixing plate (4).
4. Withdraw the patient-gas measurement module from the compartment.
5. Fit a new patient-gas measurement module. Proceed in reverse order to do this.
6. Insert a new water trap.
7. Turn on the device.
8. Perform a software download for the new PGM if required.
9. Perform a system test.

## 12.8

### Flow measurement failure

If the flow measurement fails, mechanical ventilation can still continue. There may be limitations with regard to displayed measured values, measurement accuracies, and when triggering mandatory breaths. The flow sensors can be replaced as soon as the device is in standby mode.

1. Replace the flow sensors.
2. Perform the leakage test, see page 112.

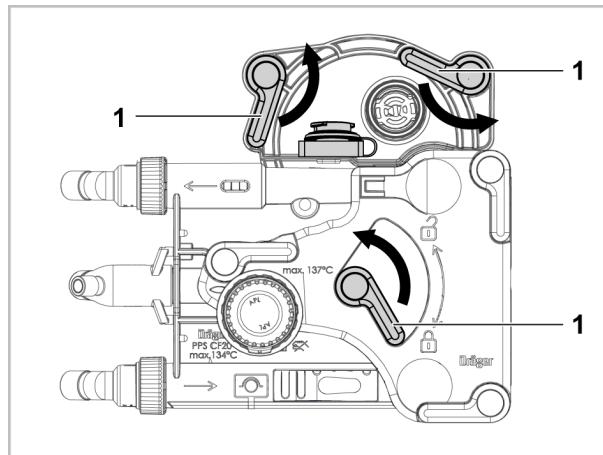
## 12.8.1 Replacing the flow sensors

### 12.8.1.1 Removing the breathing system

**!** To prevent accidental penetration of soda lime into the breathing system, make sure that the reusable CO<sub>2</sub> absorber has been removed.

Prerequisite: The breathing system cover has been removed.

1. To unlock, turn the 3 levers (1) counterclockwise by approximately 120°.



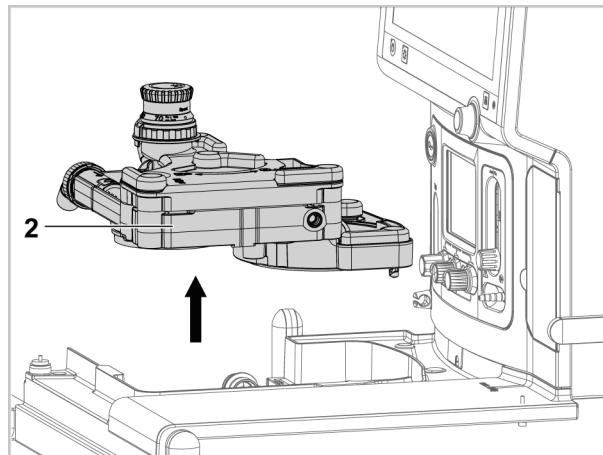
37063

#### **⚠ CAUTION**

#### **Risk of injury due to breathing system warmer**

When the breathing system warmer is switched on, the bottom side of the breathing system and the heating plate beneath it can become very hot.

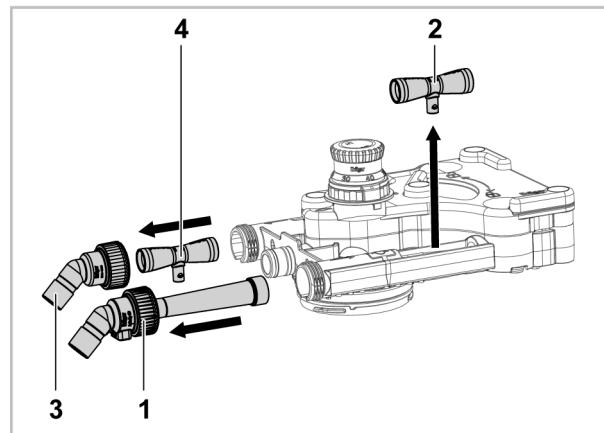
- Allow the breathing system to cool off before removing.
- 2. Remove the breathing system (2) vertically upwards from the breathing system mount.



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**12.8.1.2****Removing the flow sensors and the ports**

1. Unfasten and remove the expiratory port (1).

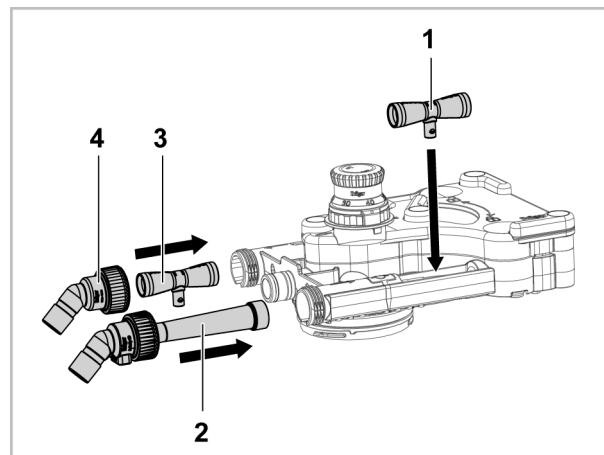


37071

2. Remove the expiratory flow sensor (2).
3. Unfasten and remove the inspiratory port (3).
4. Remove the inspiratory flow sensor (4).

**12.8.1.3****Fitting the flow sensors and the ports**

1. Insert the expiratory flow sensor (1).



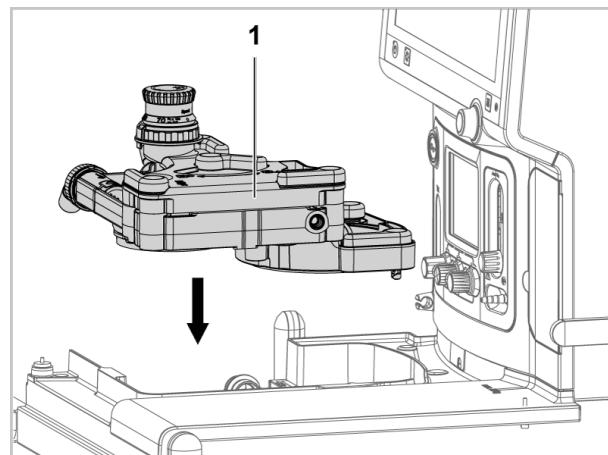
39508

2. Push in the expiratory port (2). Tighten the knurled nut.
3. Insert the inspiratory flow sensor (3).
4. Push in the inspiratory port (4). Tighten the knurled nut.

#### 12.8.1.4

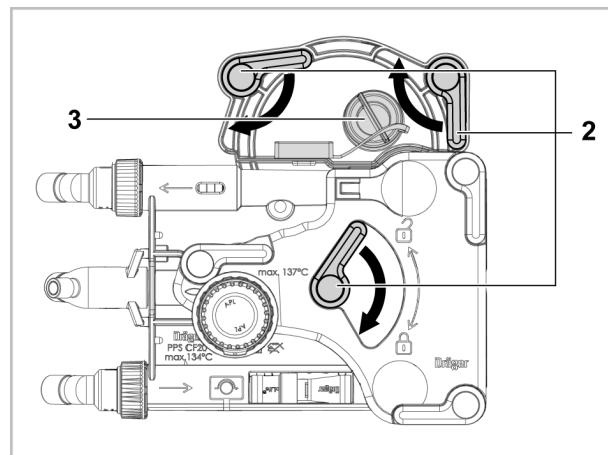
#### Inserting the breathing system

1. Insert the assembled breathing system (1) vertically into the breathing system mount.



36503

2. Turn the levers (2) by approximately 120° clockwise. The breathing system is now locked. If the device is equipped with an integrated patient-gas measurement module, seal the O<sub>2</sub> sensor port with the sealing cap (3).



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## 12.9

## Screen fault or failure of the graphical user interface

The screen does not respond to operation. It has failed or the screen display is faulty.

1. Activate the backup manual switch, see page 50.
2. Use the emergency O<sub>2</sub> delivery, see page 50.
3. Check the vaporizer setting.
4. Ventilate the patient manually.
5. Ensure appropriate substitute monitoring.

## 12.10 Complete failure

The device no longer responds to user operation.

### **WARNING**

#### **Risk of device malfunction**

If the breathing bag does not fill with fresh gas, the patient cannot be sufficiently ventilated.

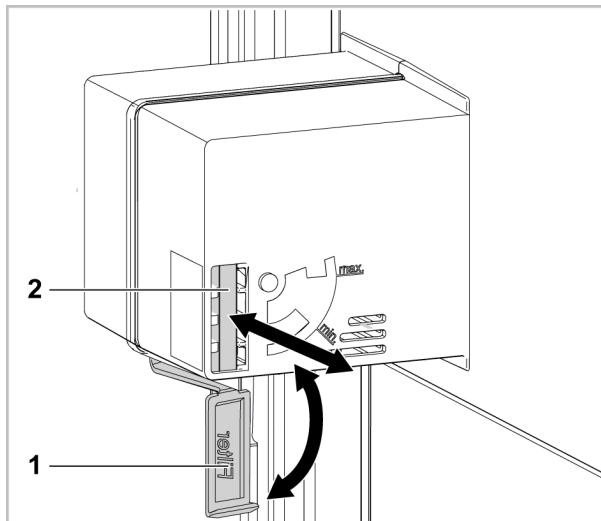
- ▶ Check the oxygen supply. If necessary, open the gas cylinder valves.
  - ▶ If fresh gas still is not delivered or manual ventilation is not possible, close the flow control valve of the O<sub>2</sub> flowmeter.
  - ▶ Disconnect the patient from the device. Use a substitute device.
1. Activate the backup manual switch, (see "Backup manual mode", page 50).
  2. Follow the instructions on the product label.
  3. If no ventilation of the patient is possible, use a manual resuscitator. Use a substitute device.

## 12.11 Problems with the active anesthetic gas receiving system (AGS)

Fault	Cause	Remedy
Flow indicator is below the restricted range.	The suction power of the ejector in the terminal unit of the anesthetic gas scavenging system (AGSS) is insufficient.	Have the function of the AGSS terminal unit checked. Follow the corresponding instructions for use.
The flow indicator is above the normal range.	The particle filter is contaminated or blocked.	Replace the particle filter.
	The suction power of the ejector in the AGSS terminal unit is too high.	Have the suction power of the ejector in the AGSS terminal unit adjusted to the working range of the AGS.
	The particle filter is missing.	If no soiling can be seen in the transparent housing of the AGS or on the flow indicator, insert the particle filter.  If soiling can be seen in the transparent housing of the AGS or on the flow indicator, have the AGS replaced by specialized service personnel.

### 12.11.1 Replacing the particle filter of the active anesthetic gas receiving system (AGS)

1. Fold down the cover (1).



36127

2. Withdraw the particle filter (2).
3. Clean the particle filter and reinsert it.  
Or  
Insert a new particle filter.

#### **⚠ CAUTION**

#### **Risk of contaminating the ambient air**

A filter cover that is not properly closed can cause contamination of the ambient air with anesthetic gases.

- Take care that the cover is properly closed.

4. Fold up the cover.

## 12.12 Cylinder pressure reducer

Fault	Cause	Remedy
The connection between the gas cylinder and the pressure reducer leaks.	The sealing ring is damaged.	Replace the sealing ring.
The outlet pressure rises, the relief valve relieves the outlet of the pressure reducer.	The valve seat is soiled or damaged.	Close the gas cylinder valve. Have the item repaired by service personnel.
Leakage in the housing area	The diaphragm is faulty.	Have the item repaired by service personnel.

## 12.13 Support request

If the device is configured for remote maintenance, device information can be sent to Dräger in the event of a problem. Proceed as follows to send a support request to Dräger:

1. In the **Standby** mode, touch the **Tests...** button.
2. Touch the **Request support** button.

## 12.14 Alarm – Cause – Remedy

Alarm messages are displayed in hierachal order in the alarm message field of the header bar, see page 192.

Different background colors indicate the priority levels of the alarms.

In the Current alarms and Logbook tables, the priority of the alarm messages is also indicated by exclamation marks.

Alarm priority	Indicator	Priority number	Background color
High	!!!	0 - 255	Red
Medium	!!	0 - 255	Yellow
Low	!	0 - 255	Cyan

Every alarm priority (high, medium, low) shown on screen is subdivided into further classifications by an internal priority number between 0 and 255. If several alarm messages of the same alarm priority are active at the same time, the internal priority number defines the order of the displayed alarm messages within the same alarm priority. A more critical alarm message of one alarm priority has a higher priority number than a less critical alarm message of the same alarm priority.

In the following example with three active alarm messages, the **etCO<sub>2</sub> low** and **Minute volume low** alarm messages have a medium alarm priority (!! ) and are displayed above the **O<sub>2</sub> cylinder almost empty** alarm message, which has a low alarm priority (!). The display order of the two alarm messages with medium priority (!! ) is defined by the internal priority number. Due to its higher priority number 135, the **etCO<sub>2</sub> low** alarm message is displayed above the **Minute volume low** alarm message with priority number 80.

Alarm	Priority	Display order on screen
etCO <sub>2</sub> low	!! 135	1.
Minute volume low	!! 80	2.
O <sub>2</sub> cylinder almost empty	! 220	3.

If the alarm priority and internal priority number of several alarm messages are the same, the newer alarm message will be displayed above the older alarm message.

In the following table, the alarm messages are listed in alphabetical order. If an alarm occurs, the table helps to identify causes and remedies. The different causes and remedies should be worked through in the order listed until the alarm has been resolved.

Some alarms are listed several times because their priority may change under certain conditions, see page 198.

The following list is a complete list of all available alarms. Some alarms depend on specific device equipment.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
! 100	Absorber disconnected?	Infinity ID CLIC absorber is not correctly connected.	Check absorber. Use "ALARM RESET" to reset alarm.
!! 100	"Add. O <sub>2</sub> " activated	O <sub>2</sub> switch is set to "Add. O <sub>2</sub> ".	Close the flow control valve of the O <sub>2</sub> flowmeter. Set the O <sub>2</sub> switch to "Aux. O <sub>2</sub> ". Use "ALARM RESET" to downgrade alarm priority.
!! 255	Agent measurement failed	There is electromagnetic interference. There is an internal failure.	Check for electromagnetic radiation in the vicinity. Use an alternative gas measurement system. If the problem persists, call Dräger. Use "ALARM RESET" to downgrade alarm priority.
! 255	Agent measurement not available	The ambient air used for calibrating the sensor was impure.  There are multiple anesthetic agents in the breathing gas. There is electromagnetic interference. Ambient temperature is too high.	Position the device in an environment with clean ambient air. Wait for the automatic calibration.  Wait until anesthetic agent identification is complete. Check for electromagnetic radiation in the vicinity. Check ambient conditions.
! 255	Agent measurement temporarily inaccurate	The sensor has not yet warmed up.  The ambient air used for calibrating the sensor was impure.	Wait for the automatic calibration.  Position the device in an environment with clean ambient air. Wait for the automatic calibration.
! 220	Air cylinder almost empty	The cylinder is almost empty.	Replace the cylinder. Use the central supply.
! 255	Air cylinder empty	The cylinder is empty or closed.	Replace the cylinder. Use the central supply.
! 190	Air cylinder sensor?	Cylinder pressure sensor is not connected.	Check if cylinder pressure sensor is connected. Use "ALARM RESET" to reset alarm.

Priority	Alarm	Cause	Remedy
!! 150	Air FG flow measurement failed	The measurement system for the Air fresh-gas flow has failed.	Only use O <sub>2</sub> as fresh gas. Use the total flow tube to check the fresh-gas flow. Adjust the fresh-gas flow so that it equals or exceeds the minute volume.
!!! 110	Air supply low	Central supply pressure and cylinder pressure are low.	Check central Air supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
!!! 255	Airway press. continuously high	Airway pressure has been continuously high.	Check spontaneous breathing ability of the patient. Check ventilation settings. Check breathing hoses, breathing system, and anesthetic gas scavenging system.
!!! 255	Airway pressure high	The upper alarm limit for the airway pressure has been exceeded. The applied inspiratory pressure is higher than the set value.  Breathing hoses are blocked or the tube is kinked.	In Man/Spon mode, check the APL valve setting. Check patient condition. Check ventilation settings. Check alarm limit. Check breathing circuit and tube.
!!! 255	Airway pressure negative	Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.  Suction maneuver during ventilation.  Failure of the anesthetic gas scavenging system.	Check fresh-gas settings and position of breathing bag.  Check the bronchial suction system.  Check anesthetic gas scavenging system.
! 100	Alarm silence key stuck	Key is stuck or was pressed for more than 10 seconds.	The therapy will continue with current settings.  If the problem persists, call Dräger.
!! 150	Ambient air inlet activated	There was not enough gas to ventilate the patient. To maintain a minimum ventilation, the device has started to use ambient air.  An external anesthetic gas monitor is extracting gas from the breathing system via a sample line.	Refill the breathing bag, e.g., with O <sub>2</sub> flush. Increase fresh-gas flow. Check the breathing circuit for tight connections and leakages.  Disconnect the sample line. Seal the sample line port.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!!! 220	Apnea	No breathing or ventilation.	Start manual ventilation! Check ventilation settings. Check spontaneous breathing ability of the patient.
!! 255	Apnea	No breathing or ventilation.	Start manual ventilation! Check ventilation settings. Check spontaneous breathing ability of the patient.
!!! 220	Apnea (no CO <sub>2</sub> )	No breathing or ventilation.	Start manual ventilation! Check ventilation settings. Check spontaneous breathing ability of the patient.
		Sample line is not connected.	Connect sample line to breathing circuit.
!! 255	Apnea (no CO <sub>2</sub> )	No breathing or ventilation.	Start manual ventilation! Check ventilation settings. Check spontaneous breathing ability of the patient.
		Sample line is not connected.	Connect sample line to breathing circuit.
!!! 220	Apnea (no flow)	No breathing or ventilation.	Start manual ventilation! Check ventilation settings. Check spontaneous breathing ability of the patient.
		Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.	Check fresh-gas settings and position of breathing bag.
		The breathing hoses are blocked or leaking.	Check breathing circuit and tube.
!! 255	Apnea (no flow)	No breathing or ventilation.	Start manual ventilation! Check ventilation settings. Check spontaneous breathing ability of the patient.
		Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.	Check fresh-gas settings and position of breathing bag.
		The breathing hoses are blocked or leaking.	Check breathing circuit and tube.

Priority	Alarm	Cause	Remedy
!!! 220	Apnea (no pressure)	No breathing or ventilation.	Start manual ventilation! Check ventilation settings.
		Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.	Check fresh-gas settings and position of breathing bag.
		The breathing hoses are blocked or leaking.	Check breathing circuit and tube.
!! 255	Apnea (no pressure)	No breathing or ventilation.	Start manual ventilation! Check ventilation settings.
		Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.	Check fresh-gas settings and position of breathing bag.
		The breathing hoses are blocked or leaking.	Check breathing circuit and tube.
!! 90	Apnea Ventilation	No inspiratory effort of the patient detected.	Check spontaneous breathing ability of the patient. Adjust the setting for "Trigger". Change to pressure-controlled or volume-controlled ventilation mode. Use "ALARM RESET" to downgrade alarm priority.
! 0	Apnea Ventilation	No inspiratory effort of the patient detected.	Check spontaneous breathing ability of the patient. Adjust the setting for "Trigger". Change to pressure-controlled or volume-controlled ventilation mode.
!!! 100	Backup manual mode activated	The backup manual switch has been activated.	Start manual ventilation! Check vaporizer and fresh-gas settings. To exit backup manual mode, return the switch to its normal position.
! 100	Backup manual mode activated	The backup manual switch has been activated.	Start manual ventilation! Check vaporizer and fresh-gas settings. To exit backup manual mode, return the switch to its normal position.
!! 100	Backup speaker failure	The backup speaker for alarm tones is faulty.	Call Dräger. Use "ALARM RESET" to reset alarm.

Priority	Alarm	Cause	Remedy
!! 180	Battery charge low	The battery charge is low and the mains power supply is not available.	Make sure that the mains power supply is correctly connected.  The breathing system warmer has been switched off. Check the breathing circuit for condensate. Increase the fresh-gas flow if necessary.  Use "ALARM RESET" to downgrade alarm priority.
!!! 30	Battery charge very low	The battery charge is critical and the mains power supply is not available. The device may shut down in the next minutes.	Restore mains power supply.  The breathing system warmer has been switched off. Check the breathing circuit for condensate. Increase the fresh-gas flow if necessary.  Once the battery has been depleted, ventilate the patient manually.
!! 170	Battery failure	The battery is faulty. If the mains power supply fails, the device will switch off immediately.	When the case has been completed, perform a system test.  If the problem persists, call Dräger.
! 100	Battery temperature high	The battery temperature is high. Charging of the battery has been suspended to protect it from damage.	Ensure that the system is connected to the mains power supply.  Check the ambient temperature.  Use "ALARM RESET" to reset alarm.
! 100	Breathing circuit expired	Accessory has been used too long.	Replace the accessory if necessary.  Use "ALARM RESET" to reset alarm.

Priority	Alarm	Cause	Remedy
!!! 120	Breathing system failure	The breathing system is not correctly installed or has leakage.	<p>Check patient condition.</p> <p>Check the breathing system.</p> <p>Verify that the sensor port for the O<sub>2</sub> sensor is sealed.</p> <p>If the problem persists, use a manual resuscitator.</p> <p>When the case has been completed, perform a system test.</p> <p>Check if the piston diaphragm is correctly inserted.</p> <p>If the problem persists, replace the breathing system.</p>
!! 255	Breathing system failure	The breathing system is not correctly installed or has leakage.	<p>Check patient condition.</p> <p>Check the breathing system.</p> <p>Verify that the sensor port for the O<sub>2</sub> sensor is sealed.</p> <p>If ventilation is impaired, use a manual resuscitator.</p> <p>When the case has been completed, perform a system test.</p> <p>Check if the piston diaphragm is correctly inserted.</p> <p>If the problem persists, replace the breathing system.</p>
!!! 255	Breathing system temp. high?	The breathing system warmer is faulty.	<p>Check the inspiratory breathing gas temperature as close to the Y-piece as possible.</p> <p>Remove breathing system cover.</p> <p>Use longer inspiratory hose.</p> <p>Open the system setup and turn off the breathing system warmer.</p> <p>If necessary, proceed as follows:</p> <ul style="list-style-type: none"> <li>-Turn off the device with the main switch, then ventilate the patient with the breathing bag. Or</li> <li>-Disconnect the patient, then use a manual resuscitator.</li> </ul>
! 100	Breathing system warmer failure	The breathing system warmer is faulty.	<p>Check breathing circuit for condensation. Increase fresh-gas flow if necessary.</p> <p>Call Dräger.</p>

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!! 100	Cardiac bypass mode still active?	A significant minute volume was measured during cardiac bypass mode.	Deactivate the cardiac bypass mode. Use "ALARM RESET" to downgrade alarm priority.
! 100	Central Air supply high	The central supply pressure is high. The gas delivery might fail.	Check central supply.
! 255	Central Air supply low	Central supply pressure is low.	Check central supply.
! 100	Central N <sub>2</sub> O supply high	The central supply pressure is high. The gas delivery might fail.	Check central supply.
! 255	Central N <sub>2</sub> O supply low	Central supply pressure is low.	Check central supply.
! 100	Central O <sub>2</sub> supply high	The central supply pressure is high. The gas delivery might fail.	Check central supply.
!!! 210	Central O <sub>2</sub> supply low	Central supply pressure is low.	Check central O <sub>2</sub> supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
! 255	Central O <sub>2</sub> supply low	Central supply pressure is low.	Check central supply.
! 100	CO <sub>2</sub> absorber expired	Accessory has been used too long.	Replace the accessory if necessary. Use "ALARM RESET" to reset alarm.
!! 255	CO <sub>2</sub> measurement failed	There is electromagnetic interference. There is an internal failure.	Check for electromagnetic radiation in the vicinity. Use an alternative gas measurement system. If the problem persists, call Dräger. Use "ALARM RESET" to downgrade alarm priority.
! 255	CO <sub>2</sub> sensor accuracy low	The sensor has not yet warmed up. The ambient air used for calibrating the sensor was impure.	Wait for the automatic calibration. Position the device in an environment with clean ambient air.
!! 135	Cooling fan failure	An internal fan for evacuating gases is faulty.	To prevent potential damage, turn off the device at your earliest convenience. Increased risk of fire. Call Dräger.
!! 135	etCO <sub>2</sub> high	etCO <sub>2</sub> has exceeded the upper alarm limit.	Check ventilation.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!! 135	etCO <sub>2</sub> low	etCO <sub>2</sub> is below the lower alarm limit.	Check ventilation.
!! 100	Exp. pressure sensor failure	Sensor calibration failed.	Ensure that a suitable substitute monitoring is available. When the case has been completed, perform a system test. If the problem persists, call Dräger.
! 100	Expiratory flow sensor expired	Accessory has been used too long.	Replace the accessory if necessary. Use "ALARM RESET" to reset alarm.
! 255	Expiratory flow sensor failure	Failure of the flow sensor.	Replace the flow sensor and perform a leakage test.
!!! 200	External fresh-gas outlet failure?	The internal fresh-gas valve is faulty. It is unclear whether the fresh gas is being fed into the internal breathing system or towards the external fresh-gas outlet.	Use "O <sub>2</sub> +" button to determine flow direction of fresh gas: -If internal breathing system or breathing bag fill, external fresh-gas outlet is not available. -If gas flows out of the external fresh-gas outlet, external fresh-gas outlet can be used. Internal breathing system can only be used when the breathing bag is not connected (ventilation with ambient air only). Check fresh-gas settings. If the problem persists, call Dräger.
! 100	External fresh-gas outlet not available	The external fresh-gas outlet is faulty.	Ventilate the patient via the internal breathing system. Perform the system test. If the problem persists, call Dräger.
!! 10	FiO <sub>2</sub> high	FiO <sub>2</sub> has exceeded the upper alarm limit for 2 consecutive breaths and for more than 15 seconds.	Check O <sub>2</sub> concentration and fresh-gas settings.
!! 10	FiO <sub>2</sub> high	FiO <sub>2</sub> has exceeded the upper alarm limit.	Check O <sub>2</sub> concentration and fresh-gas settings.
!!! 255	FiO <sub>2</sub> low	FiO <sub>2</sub> has fallen below the lower alarm limit for 2 consecutive breaths and for more than 15 seconds.	Check O <sub>2</sub> concentration and fresh-gas settings. Check the breathing system for high leakage. Check O <sub>2</sub> supply.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!!! 255	FiO <sub>2</sub> low	FiO <sub>2</sub> has fallen below the lower alarm limit.	Check O <sub>2</sub> concentration and fresh-gas settings. Check the breathing system for high leakage. Check O <sub>2</sub> supply.
!! 135	FiO <sub>2</sub> too high for neonates	FiO <sub>2</sub> has exceeded the threshold value for longer than the time configured in the system setup.	Check O <sub>2</sub> concentration and fresh-gas settings. Use "ALARM RESET" to reset alarm.
!! 30	Flow control valve is open	At least one flow control valve is open.	Close all flow control valves.
! 80	Flow sensor calibration required	The flow sensor calibration is invalid.  The sensor is not calibrated. The breathing system has been replaced or disconnected since last calibration.	Perform the leakage test.  Perform the leakage test.
!!! 100	Fresh gas low or leakage	Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.  Leakage or disconnection.	Refill the breathing system immediately, e.g., with O <sub>2</sub> flush.  Check fresh-gas settings and position of breathing bag.  Check the breathing circuit for tight connections and leakages.  Check tube or mask.
!! 155	Fresh gas low or leakage	Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.  Leakage or disconnection.	Check fresh-gas settings and position of breathing bag.  Check the breathing circuit for tight connections and leakages.  Check tube or mask.  Use "ALARM RESET" to downgrade alarm priority.
! 100	Fresh-gas flow high	The total fresh-gas flow is greater than 15 L/min.	Reduce fresh-gas flow.
!! 60	Fresh-gas flow inaccurate	The delivered fresh-gas flow differs from the set fresh-gas flow.	Make sure that sufficient fresh-gas and anesthetic agent are delivered.  Check the measured gas concentrations.  Use "ALARM RESET" to downgrade alarm priority.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!! 50	Fresh-gas flow inaccurate	The accuracy of the fresh-gas flow measurement is reduced.	Use the total flow tube to verify the current fresh-gas flow. Check the measured gas concentrations.
!! 255	Gas sensor failure	The patient-gas measurement module has failed.	Use "ALARM RESET" to downgrade alarm priority. Perform the system test. If the problem persists, call Dräger.
!! 255	Hose connected to wrong port	A breathing hose is not correctly connected.	Use an alternative gas measurement system.
!! 100	Hose does not fit to pat. category	The detected breathing hose is not suitable for the selected patient category.	Use "ALARM RESET" to downgrade alarm priority. Call Dräger.
! 100	Hose does not fit to pat. category	The detected breathing hose is not suitable for the selected patient category.	Use compatible accessory. Use "ALARM RESET" to reset alarm.
!! 150	inCO <sub>2</sub> high	Soda lime is depleted.	Check soda lime. Increase fresh-gas flow. Check fresh-gas settings.
		There is leakage in the breathing system or in the coaxial breathing hose.	Replace the breathing system or the coaxial breathing hose.
		Gas measurement is inaccurate due to high respiratory rate.	Adjust alarm limits if necessary.
		Large dead space.	Check the ventilation settings and the breathing circuit.
! 100	Infinity ID breathing circuit not compatible	An incompatible accessory is connected.	Check accessory. Use "ALARM RESET" to reset alarm.
! 100	Infinity ID CO <sub>2</sub> absorber not compatible	An incompatible accessory is connected.	Check accessory. Use "ALARM RESET" to reset alarm.
! 100	Infinity ID water trap not compatible	An incompatible accessory is connected.	Check accessory. Use "ALARM RESET" to reset alarm.
!!! 255	Inspiratory desflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!! 255	Inspiratory desflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
! 255	Inspiratory desflurane low	The inspiratory anesthetic gas concentration is below the lower alarm limit.	Check vaporizer and fresh-gas settings. Refill the vaporizer. Check the breathing system for high leakage.
		The soda lime has dried out.	Replace the soda lime.
!!! 255	Inspiratory enflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
!! 255	Inspiratory enflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
! 255	Inspiratory enflurane low	The inspiratory anesthetic gas concentration is below the lower alarm limit.	Check vaporizer and fresh-gas settings. Refill the vaporizer. Check the breathing system for high leakage.
		The soda lime has dried out.	Replace the soda lime.
! 100	Inspiratory flow sensor expired	Accessory has been used too long.	Replace the accessory if necessary. Use "ALARM RESET" to reset alarm.
! 255	Inspiratory flow sensor failure	Failure of the flow sensor.	Replace the flow sensor and perform a leakage test.
!!! 255	Inspiratory halothane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
!! 255	Inspiratory halothane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
! 255	Inspiratory halothane low	The inspiratory anesthetic gas concentration is below the lower alarm limit.	Check vaporizer and fresh-gas settings. Refill the vaporizer. Check the breathing system for high leakage.
		The soda lime has dried out.	Replace the soda lime.
!!! 255	Inspiratory isoflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
!! 255	Inspiratory isoflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
! 255	Inspiratory isoflurane low	The inspiratory anesthetic gas concentration is below the lower alarm limit.	Check vaporizer and fresh-gas settings. Refill the vaporizer. Check the breathing system for high leakage.
		The soda lime has dried out.	Replace the soda lime.
!! 10	Inspiratory N <sub>2</sub> O high	Inspiratory N <sub>2</sub> O exceeds 82 %.	Check fresh-gas composition. Press the O <sub>2</sub> + button to flush the breathing system.
! 255	Inspiratory O <sub>2</sub> measurement inaccurate	The O <sub>2</sub> measurement accuracy is reduced.	When the case has been completed, perform a system test.
!! 90	Inspiratory pressure not achieved	Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly.  Leakage or disconnection.	Check fresh-gas settings and position of breathing bag.  Check the breathing circuit for tight connections and leakages.
!!! 255	Inspiratory sevoflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
!! 255	Inspiratory sevoflurane high	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit.	Check vaporizer and fresh-gas settings.
! 255	Inspiratory sevoflurane low	The inspiratory anesthetic gas concentration is below the lower alarm limit.	Check vaporizer and fresh-gas settings. Refill the vaporizer. Check the breathing system for high leakage.
		The soda lime has dried out.	Replace the soda lime.
!! 50	Inspiratory tidal volume high	The ventilation settings are not adequate for AutoFlow.	Change the ventilation mode or increase the tidal volume.
!!! 255	Inspiratory xMAC high	The inspiratory anesthetic gas concentration has exceeded 3 xMAC for more than 30 seconds. The expiratory anesthetic gas concentration has exceeded 2.5 xMAC for more than 30 seconds.	Check vaporizer and fresh-gas settings.
		The inspiratory anesthetic gas concentration has exceeded 5 xMAC.	Check vaporizer and fresh-gas settings.
!! 255	Inspiratory xMAC high	The inspiratory anesthetic gas concentration has exceeded 3 xMAC for more than 180 seconds.	Check vaporizer and fresh-gas settings.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
!! 100	Internal device temperature high	A ventilation slot at the rear of the device is blocked.	Check the ventilation slots. Ensure air flow at the rear of the device.
		Ambient temperature is too high.	Check ambient conditions.
		A fan is faulty.	Call Dräger.
		Excessive ventilation settings are applied (e.g., high respiratory rate, high inspiratory pressure, short slopes).	Check ventilation settings.
! 255	Internal device temperature high	A ventilation slot at the rear of the device is blocked.	Check the ventilation slots. Ensure air flow at the rear of the device.
		Ambient temperature is too high.	Check ambient conditions.
		Excessive ventilation settings are applied (e.g., high respiratory rate, high inspiratory pressure, short slopes).	Check ventilation settings.
		A fan is faulty.	Call Dräger.
!!! 150	Internal FG flow failure	The internal gas delivery system is not operational. A system test may be able to resolve the issue.	<p>Deliver O<sub>2</sub>: 1. Set the O<sub>2</sub> switch to "Add. O<sub>2</sub>". 2. Set the O<sub>2</sub> flowmeter to the desired flow. Check the vaporizer setting. Make sure that fresh gas is reaching the patient.</p> <p>When the case has been completed, perform a system test.</p> <p>If the problem persists, call Dräger.</p>
! 150	Internal FG flow failure	The internal gas delivery system is not operational. A system test may be able to resolve the issue.	<p>Set the O<sub>2</sub> flowmeter to the desired flow. Check the vaporizer setting. Make sure that fresh gas is reaching the patient.</p> <p>When the case has been completed, perform a system test.</p> <p>If the problem persists, call Dräger.</p>
! 60	License expired	A license has expired. After next startup, some functions will no longer be available.	To order a permanent license, call Dräger.
! 50	License will expire soon	A trial license will expire within the next 14 days.	<p>Use "ALARM RESET" to reset alarm.</p> <p>To order a permanent license, call Dräger.</p>

Priority	Alarm	Cause	Remedy
!!! 0	Loss of data	An internal memory failure has occurred. System data and system settings are lost.	Check current settings and default settings. Call Dräger.
! 50	Maintenance will be due soon	Maintenance will be due within the next 30 days.	Call Dräger. Use "ALARM RESET" to reset alarm.
! 255	Measured gas concentrations out of range	The measured values are out of the measurement range.	Check patient condition. Check the vaporizer setting and the fresh-gas settings. Use an alternative gas measurement system. Perform the system test.
! 255	Measured gas concentrations temporarily inaccurate	The sensor has not yet warmed up.  The ambient air used for calibrating the sensor was impure.	Wait for the automatic calibration.  Position the device in an environment with clean ambient air.  Wait for the automatic calibration.
! 0	MEDIBUS COM 1 failure	Communication via the corresponding COM port is interrupted.  The configured baud rate is not sufficient for the amount of data to be transferred.	Re-establish the connection. Use "ALARM RESET" to reset alarm.  Increase the baud rate. Check the configuration of the external device.
! 0	MEDIBUS COM 2 failure	Communication via the corresponding COM port is interrupted.  The configured baud rate is not sufficient for the amount of data to be transferred.	Re-establish the connection. Use "ALARM RESET" to reset alarm.  Increase the baud rate. Check the configuration of the external device.
!! 30	Minute volume high	Upper alarm limit for the minute volume has been exceeded.  Flow measurement is inaccurate.	Check spontaneous breathing.  Check ventilation settings (e.g., VT, Pinsp, RR).  In PSV mode, correct the trigger threshold if necessary.  Check alarm limit.  Replace the expiratory flow sensor. Perform the leakage test.

Priority	Alarm	Cause	Remedy
!! 80	Minute volume low	The minute volume is below the lower alarm limit.	Check patient condition. Check ventilation settings. Check tube or mask. Check alarm limit.
		Flow measurement is inaccurate.	Replace the expiratory flow sensor. Perform the leakage test.
! 220	N <sub>2</sub> O cylinder almost empty	The cylinder is almost empty.	Replace the cylinder. Use the central supply.
! 255	N <sub>2</sub> O cylinder empty	The cylinder is empty or closed.	Replace the cylinder. Use the central supply.
! 190	N <sub>2</sub> O cylinder sensor?	Cylinder pressure sensor is not connected.	Check if cylinder pressure sensor is connected. Use "ALARM RESET" to reset alarm.
!! 150	N <sub>2</sub> O FG flow measurement failed	The measurement system for the N <sub>2</sub> O fresh-gas flow has failed.	Only use O <sub>2</sub> as fresh gas. Use the total flow tube to check the fresh-gas flow. Adjust the fresh-gas flow so that it equals or exceeds the minute volume.
!! 255	N <sub>2</sub> O measurement failed	There is electromagnetic interference. There is an internal failure.	Check for electromagnetic radiation in the vicinity. Use an alternative gas measurement system. If the problem persists, call Dräger. Use "ALARM RESET" to downgrade alarm priority.
! 255	N <sub>2</sub> O measurement not available	The ambient air used for calibrating the sensor was impure.  There is electromagnetic interference.  Ambient temperature is too high.	Position the device in an environment with clean ambient air. Wait for the automatic calibration. Check for electromagnetic radiation in the vicinity. Check ambient conditions.
! 255	N <sub>2</sub> O measurement temporarily inaccurate	The sensor has not yet warmed up.  The ambient air used for calibrating the sensor was impure.	Wait for the automatic calibration. Position the device in an environment with clean ambient air. Wait for the automatic calibration.

Priority	Alarm	Cause	Remedy
!!! 110	N <sub>2</sub> O supply low	Central supply pressure and cylinder pressure are low.	Check central N <sub>2</sub> O supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
!!! 110	No Air delivery	Air is not available. Gas mixer is using 100 % O <sub>2</sub> instead.	Check central Air supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
! 120	No anesthetic gas compensation	The automatic flow correction is not available. There is no signal from an external anesthetic gas monitor. Volume monitoring may be inaccurate.	Connect an anesthetic gas monitor to COM 2 or change the anesthetic gas setting from "Auto" to a manual setting.
! 120	No carrier-gas compensation	The automatic flow correction is not available. There is no signal from an external anesthetic gas monitor. Volume monitoring may be inaccurate.	Connect an anesthetic gas monitor to COM 2 or change the carrier gas setting from "Auto" to a manual setting. Perform the system test. If the problem persists, call Dräger.
! 255	No CO <sub>2</sub> detected	Ventilation was started, but no exhaled CO <sub>2</sub> was detected for more than 60 seconds.	Check patient condition. Check sample line, water trap, and patient-side filter. Use "ALARM RESET" to reset alarm.
!!! 200	No fresh-gas flow	No fresh-gas flow is set.	Open the flow control valves. Use "ALARM RESET" to downgrade alarm priority.
!!! 110	No N <sub>2</sub> O delivery	N <sub>2</sub> O is not available. Gas mixer is using O <sub>2</sub> instead.	Check central N <sub>2</sub> O supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
!!! 210	No O <sub>2</sub> delivery	O <sub>2</sub> is not available. Gas mixer is using Air instead.	Check central O <sub>2</sub> supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
!!! 120	No ventilation	An internal error occurred. Ventilation has stopped.	Change to Man/Spon mode and ventilate the patient manually, or change back to mechanical ventilation. Check the upper alarm limit for the airway pressure. If the problem persists, call Dräger. Use "ALARM RESET" to downgrade alarm priority.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
! 255	O2 concentration implausibly high	The O2 sensor calibration is invalid.	Use substitute O2 monitoring. When the case has been completed, perform a system test.
! 220	O2 cylinder almost empty	The cylinder is almost empty.	Replace the cylinder. Use the central supply.
!!! 210	O2 cylinder empty	The cylinder is empty or closed.	Replace the cylinder. Use the central supply. Use "ALARM RESET" to downgrade alarm priority.
! 255	O2 cylinder empty	The cylinder is empty or closed.	Replace the cylinder. Use the central supply.
! 190	O2 cylinder sensor?	Cylinder pressure sensor is not connected.	Check if cylinder pressure sensor is connected. Use "ALARM RESET" to reset alarm.
!! 150	O2 FG flow measurement failed	The measurement system for the O2 fresh-gas flow has failed.	Only use O2 as fresh gas. Use the total flow tube to check the fresh-gas flow. Adjust the fresh-gas flow so that it equals or exceeds the minute volume.
!! 255	O2 measurement not available	The ambient air used for calibrating the sensor was impure.  There is electromagnetic interference.  Ambient temperature is too high.	Position the device in an environment with clean ambient air.  Wait for the automatic calibration.  Check for electromagnetic radiation in the vicinity.  Check ambient conditions. Use "ALARM RESET" to downgrade alarm priority.
! 255	O2 measurement temporarily inaccurate	The sensor has not yet warmed up.  The ambient air used for calibrating the sensor was impure.	Wait for the automatic calibration.  Position the device in an environment with clean ambient air.  Wait for the automatic calibration.
!! 255	O2 sensor failure	The O2 sensor in the patient-gas measurement module is faulty.	Use substitute O2 monitoring. Use "ALARM RESET" to downgrade alarm priority. Perform the system test. Call Dräger.

Priority	Alarm	Cause	Remedy
!! 255	O2 sensor failure	The O2 sensor is faulty.	Use substitute O2 monitoring. Use "ALARM RESET" to downgrade alarm priority. When the case has been completed, perform a system test. Replace the sensor cell if necessary. If the problem persists, call Dräger.
!! 255	O2 sensor not ready	A new O2 sensor cell was inserted.	Wait for the O2 sensor to warm up. Perform a system test and calibrate the O2 sensor. Use "ALARM RESET" to downgrade alarm priority.
		The O2 sensor calibration is invalid.	Perform a system test and calibrate the O2 sensor.
!!! 210	O2 supply low	Central supply pressure and cylinder pressure are low.	Check central O2 supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
!!! 210	O2 supply low	Central supply pressure and cylinder pressure are low.	Check central O2 supply or use cylinder. Use "ALARM RESET" to downgrade alarm priority.
! 100	On/Standby key stuck	Key is stuck or was pressed for more than 10 seconds.	The therapy will continue with current settings. If the problem persists, call Dräger.
! 75	Patient-gas measurement module is calibrating	The automatic calibration of the patient-gas measurement module is in progress.	Wait for the calibration to complete.
!!! 230	Pause time expired	Ventilation and gas delivery have been paused longer than the set pause time.	Resume ventilation or adjust timer.
!! 230	Pause time expired	Ventilation and gas delivery have been paused longer than the set pause time.	Resume ventilation or adjust timer.
!! 100	PEEP/CPAP low	Fresh-gas flow is insufficient, breathing bag is blocked or positioned incorrectly. Leakage or disconnection.	Check fresh-gas settings and position of breathing bag. Check the breathing circuit for tight connections and leakages.
		Failure of the anesthetic gas scavenging system.	Check anesthetic gas scavenging system.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
! 170	Power failure	Mains power supply is not available. The device has switched to battery operation.	Restore mains power supply.
!! 100	Power supply failure	Internal fault in the power supply.	When the case has been completed, perform a system test. If the problem persists, call Dräger.
!! 100	Pressure sensor failure	There is condensate in the breathing hoses. Sensor calibration failed.	Check the breathing hoses. Perform the system test. If the problem persists, call Dräger.
! 255	Pressure-relief valve opened	The internal pressure-relief valve has been activated due to overpressure.	Check APL valve and fresh-gas settings.
!!! 200	Rotary knob stuck	Key is stuck or was pressed for more than 10 seconds.	The therapy will continue with current settings. Press and turn the rotary knob repeatedly. If necessary, proceed as follows: -Activate the backup manual mode, then ventilate the patient with the breathing bag. Or -Disconnect the patient, then use a manual resuscitator.
! 170	Sample line disconnected?	The sample line or the water trap has been disconnected.	Check sample line and water trap.
! 170	Sample line occluded	Sample line is occluded.	Check sample line, water trap, and patient-side filter.
! 75	Second agent detected	A second anesthetic agent has been detected.	Flush the system if necessary. Check fresh-gas settings. Wait for transition phase to end.
! 60	Service date reached	Maintenance is due.	Use "ALARM RESET" to reset alarm. Call Dräger.
!!! 200	Set O <sub>2</sub> switch to "Add. O <sub>2</sub> "	The internal gas delivery system has failed and the O <sub>2</sub> switch is still set to "Aux. O <sub>2</sub> ".	Set the O <sub>2</sub> switch to "Add. O <sub>2</sub> ". Set the O <sub>2</sub> flowmeter to the desired flow.
!! 0	Speaker failure	The loudspeaker is faulty.	Call Dräger. Use "ALARM RESET" to downgrade alarm priority.

Priority	Alarm	Cause	Remedy
!!! 100	System failure	The gas delivery and the controlled ventilation have failed due to an internal fault.	Proceed as follows: -Activate the backup manual mode, then ventilate the patient with the breathing bag. Or -Disconnect the patient, then use a manual resuscitator. Call Dräger.
!!! 0	Therapy settings not applied	The last changes to the therapy settings were not applied.	Change to Man/Spon mode, then switch back to the desired ventilation mode. Use "ALARM RESET" to reset alarm. If the problem persists, call Dräger.
!! 100	Third agent detected	A mixture of more than 2 anesthetic agents has been detected.	Flush the system if necessary. Check fresh-gas settings. Wait for transition phase to end.
		There is electromagnetic interference.	Check for electromagnetic radiation in the vicinity.
!! 90	Tidal volume not achieved	The delivered inspiratory tidal volume is lower than the set value.	Check ventilation settings. Check Pmax setting. Check patient compliance. Check if the patient is breathing spontaneously.
! 0	USB write error	The USB flash drive is full, faulty, write-protected, or not compatible. The USB flash drive is not correctly connected. The USB flash drive is not correctly formatted.	Check the USB flash drive. Use "ALARM RESET" to reset alarm.
!!! 120	Ventilator failure	The piston ventilator or at least one pressure sensor is faulty.	Start manual ventilation! When the case has been completed, perform a system test. If the problem persists, call Dräger. Use "ALARM RESET" to downgrade alarm priority.
! 160	Volume inaccurate (ambient pressure implausible)	The ambient pressure measurement is implausible. Volume monitoring and volume delivery may be inaccurate.	Check the setting for "Height above sea level" in the system setup. Perform the system test. If the problem persists, call Dräger.
! 100	Water trap disconnected?	Infinity ID water trap is not correctly connected.	Check water trap.

<b>Priority</b>	<b>Alarm</b>	<b>Cause</b>	<b>Remedy</b>
! 100	Water trap expired	Accessory has been used too long.	Replace the accessory if necessary. Use "ALARM RESET" to reset alarm.
! 170	Water trap full	The water trap of the gas measurement is full. Sample line is occluded.	Check water trap. Check sample line, water trap, and patient-side filter.
!!! 255	Wrong patient connection?	The patient is connected to the internal breathing system, but there is no oxygen delivery. Breathing activity has been detected at an inactive breathing system.	Change to Man/Spon mode and ventilate the patient manually. Check if the patient is connected to the correct breathing system.
!! 80	xMAC low	Inspiratory and expiratory gas concentrations are lower than the automatically calculated limit.	Check patient condition. Check filling level. Refill if necessary. Check vaporizer setting. Check the breathing system and the breathing bag for leakages. If the current xMAC is acceptable, use "ALARM RESET" to reset the alarm.
! 170	xMAC low	Inspiratory and expiratory gas concentrations are lower than the automatically calculated limit.	Check patient condition. Check filling level. Refill if necessary. Check vaporizer setting. Check the breathing system and the breathing bag for leakages. If the current xMAC is acceptable, use "ALARM RESET" to reset the alarm.

## 13 Service

### 13.1 Safety instructions

#### Intervals and implementation

Wear and material fatigue of the components may lead to device failure and malfunctions. If services activities are not performed regularly or properly, malfunctions may occur, which can result in personal injury and property damage.

- ▶ Perform service at the specified intervals.
- ▶ Service activities must be performed by user groups that are assigned to the specific activity.
- ▶ Only perform service activities when there is no patient connected to the device.
- ▶ Before performing maintenance, disconnect all electrical connections from the power supply and all gas connections from the gas supply.
- ▶ Perform a system test after service activity.

#### Housing

Under the housing, there are live electrical components, which may cause an electric shock.

- ▶ The housing may only be opened by user groups that are assigned to the specific activity.

#### Risk of infection

If the product has not been reprocessed properly, it may be contaminated with pathogens. As a result, persons could be put at risk.

Perform the following measure before servicing, before returning the device, and before disposal:

- ▶ Perform the reprocessing in accordance with the reprocessing instructions supplied with the product.

### 13.2 Definition of service terminology

Concept	Definition
Service	All measures (inspection, maintenance, repair) intended to maintain or restore the functional integrity of a product. These measures can be supported using the connected service functionality (data exchange between the product and DrägerService via a network). For further information see: "LAN", page 303.
Inspection	All measures intended to assess the current state of a product
Maintenance	Regular specified measures intended to maintain the functional integrity of a product
Repair	Measures intended to restore the functional integrity of a product after a failure

### 13.3

## Inspection

Measure	Interval	User group
Inspection and safety check	Every 12 months	Service personnel

The maximum scope for all main devices and options is listed below. Observe the equipment that is applicable for the present device.

### Safety checks

Safety checks are not a substitute for maintenance, which includes the preventive replacement of wearing parts as specified by the manufacturer.

Performing the safety checks:

1. Check that the associated instructions for use are available in the correct version.
2. Perform a functional test of the following functions in accordance with the instructions for use:
  - Emergency O<sub>2</sub> delivery
3. Check that the product is in good condition:
  - All labels are complete and legible
  - No visible damage to the following components:
    - Trolley and castors
    - Housing parts
    - Brakes
    - Vaporizer mount
    - Water trap holder
    - O-rings of the water trap holder
    - Sample line
    - Screen
    - Gas inlets
    - Status display
    - Breathing system
    - Piston drive and piston diaphragm
    - AGS and AGS valves
    - Hoses and cables
    - Strain relief for compressed gas hoses and cables
    - Support arms
    - Pressure reducers and their sensor cables
  - Fuses that are accessible from the outside are in compliance with the specified values.
  - Check that the country-specific labeling of the gas type matches the screen display.
  - Check the end stops of the support arms for patient monitors.
4. Check the electrical safety in accordance with the IEC 62353 standard.

5. Check the safety equipment:
  - Functional integrity of optical and acoustic alarm generators
  - O<sub>2</sub> switch on the electronically controlled gas mixer
  - Internal battery
  - Check the function of the minimum O<sub>2</sub> delivery (mechanically controlled 3-gas gas mixer).
6. Check the accuracy of the gas measurement of the patient-gas measurement module based on a certified test gas concentration:
  - Anesthetic gas measurement:  
Isoflurane, 1 Vol%  
Sevoflurane, 1 Vol%  
Accuracy ±0.35 Vol%
  - N<sub>2</sub>O measurement, 70 Vol%  
Accuracy ±7.6 Vol%
  - CO<sub>2</sub> measurement, 5 Vol%  
Accuracy ±0.83 Vol%
7. Check the accuracy of the O<sub>2</sub> measurement:
  - Ambient air 21 Vol%  
Accuracy ±3 Vol%
  - 100 Vol%  
Accuracy –5 Vol%
8. Check sample gas flow of the patient-gas measurement module:
  - Accuracy 200 ±20 mL/min
9. Check the patient-gas measurement module for leakage:
  - Leakage at –200 hPa (cmH<sub>2</sub>O)
  - <20 hPa/min (cmH<sub>2</sub>O/min)
10. Check the non-return valves in the central supply for leakage:
  - Leakage ≤20 mL/min
11. Check the operational readiness by means of a system test.
12. Check the accuracy of the airway pressure gauge:
  - Accuracy 30 hPa (cmH<sub>2</sub>O) ±10 hPa (cmH<sub>2</sub>O)
13. Perform a visual inspection of both safety valves of the passive AGS for damage and soiling.

## 13.4 Maintenance

The maximum scope for all main devices and options is listed below. Observe the equipment that is applicable for the present device.

Component	Interval	Measure	User group
CO <sub>2</sub> absorber/soda lime with disposable dust filter	When colored violet or according to the configured Infinity ID replacement interval	Replace, see page 93	Users
Water trap	As required, when soiled, or according to the configured Infinity ID replacement interval	Replace, see page 95	Users
Flow sensors	As required, if calibration is no longer possible, or according to the configured Infinity ID replacement interval	Replace, see page 240	Users
Piston diaphragm	Annually	Replace <sup>1)</sup>	Users
O <sub>2</sub> sensor cell	Every 2 years	Replace, see page 69	Users
AGS	As required, when soiled	Replace	Specialized service personnel
AGS particle filter	If required, if filter is soiled, or flow is no longer achieved	Replace	Users
O-rings on the water trap holder	Every 2 years	Replace	Service personnel
Pressure reducers	Every 6 years	Replace	Specialized service personnel
Filter cloth	Every 2 years	Replace	Service personnel
– Above the gas mixer			
– Power supply unit			
CLIC adapter	Every 4 years	Replace	Users
Lead battery (2 pieces)	Every 2 years	Replace	Service personnel

1) The replacement is described in the separate reprocessing instructions for the anesthesia machine. The reprocessing instructions are included in the delivery of the anesthesia machine.

It is recommended that only original parts from Dräger are used and that the parts are replaced by DrägerService.

A service contract with DrägerService is recommended.

## 13.5 Repair

Repairs may be performed only by specialized service personnel.

It is recommended that only original parts from Dräger are used and that the parts are replaced by DrägerService.

A service contract with DrägerService is recommended.

The replacement of the integrated patient-gas measurement module is described in the chapter "Replacing the patient-gas measurement module (PGM)" (see "Replacing the patient-gas measurement module (PGM)", page 238).

## 14 Disposal

### 14.1 Safety instructions

#### Risk of infection

If the product has not been reprocessed properly, it may be contaminated with pathogens. As a result, persons could be put at risk.

Perform the following measure before servicing, before returning the device, and before disposal:

- ▶ Perform the reprocessing in accordance with the reprocessing instructions supplied with the product.

#### Risk of environmental pollution

If electrical and electronic equipment is not disposed of professionally, this may cause damage to the environment.

- ▶ Dispose of this device in accordance with the national regulations (see "Disposing of the device", page 271).

### 14.2 Disposing of the device

The disposal of electrical and electronic devices is subject to special guidelines. This device must be disposed of in accordance with national regulations. In countries of the European Union, Dräger will organize the return of the device. Additional information is available at [www.draeger.com](http://www.draeger.com) (search term: WEEE).

### 14.3 Disposing of accessories

When disposing of the following accessories, follow the infection prevention policy of the health-care facility and the respective instructions for use:

- Flow sensors
- Breathing hoses
- Filter, HME, HMEF
- Breathing bag
- Masks
- Water trap
- CLIC absorber, Infinity ID CLIC absorber
- Soda lime

Due to potential contamination, dispose of other disposable products with patient gas contact in accordance with the infection prevention policy of the health-care facility.

Observe the reprocessing instructions supplied with the device.

## 15 Technical data

All available main devices with all available options are described in this document. Observe the equipment that is applicable for the present device. For further information see: "Main devices and options", page 37.

### 15.1 General information

<b>Units of measurement for pressure</b>	1 hPa = 1 mbar = 1 cmH <sub>2</sub> O 100 kPa = 0.1 MPa = 1 bar = 1 kPa x 100
<b>User's operating location</b>	At the front at a distance of 1 m (39 in) and a height of 1.5 m (59 in)
<b>Tolerances</b>	All specified tolerances apply for ambient conditions of 20 °C (68 °F), 60 % relative humidity, and 1013 hPa (760 mmHg).
<b>Accuracies</b>	The accuracies indicated below change according to ambient pressure, temperature, and relative humidity. If one of the ambient conditions is changed up to the permissible limit, the accuracy can change by up to 50 %. If more than one of the ambient conditions is changed, the accuracy may change by up to 100 %. Example: Accuracy of a measured pressure value: ±4 % under standard conditions. At 10 °C (50 °F), the accuracy changes to ±6 %; at 10 °C (50 °F) and 20 % relative humidity, to ±8 %.
<b>Standardization</b>	All patient-related volumes and flows are based on dry oxygen, converted to the conditions in the lungs (BTPS).

### 15.2 Ambient conditions

#### During operation

Temperature	10 to 40 °C (50 to 104 °F)
Ambient pressure	650 to 1060 hPa (9.5 to 15.3 psi)
Relative humidity	20 to 95 %, without condensation
CO <sub>2</sub> concentration	300 to 1000 ppm
Height above sea level	Up to 3500 m (11483 ft)

#### During storage and transport

Temperature	
Device without battery	-20 °C to 60 °C (-4 °F to 140 °F)
Battery	-15 °C to 40 °C (5 °F to 104 °F)

For storage longer than 12 months	-15 °C to 25 °C (5 °F to 77 °F)
Maximum storage duration without recharging	180 days
Ambient pressure	500 to 1060 hPa (7.3 to 15.3 psi)
Relative humidity	10 to 95 %, without condensation
CO <sub>2</sub> concentration	Not relevant
<b>Information</b>	The permissible ambient conditions depend on the accessories used. Follow the corresponding instructions for use.

## 15.3 Fresh-gas delivery

### Gas mixer

The device is equipped with either an electronically controlled gas mixer or a mechanically controlled gas mixer. The mechanically controlled gas mixer is available with electronic flow measurement or with flow tubes.

### Standardization

All data are standardized to STPD conditions.

### O<sub>2</sub> flush

25 to 75 L/min  
At 2.7 to 6.9 kPa x 100 [bar] (39 to 100 psi; 0.27 to 0.69 MPa) supply pressure

### O<sub>2</sub> flow with integrated flowmeter for O<sub>2</sub> insufflation

#### Setting range

Off to 20 L/min  
At a low supply pressure of 2.7 kPa x 100 [bar] (39 psi or 0.27 MPa), the maximum O<sub>2</sub> flow can be limited to 10 L/min.

#### Accuracy

±10 % of the set value for flows >2.0 L/min

#### Resolution of displayed value

1 L/min (in the range from 2 to 10 L/min)  
5 L/min (above 10 L/min)

### O<sub>2</sub> flow with external flowmeter for O<sub>2</sub> insufflation

#### Setting range

Off to 15 L/min  
At a low supply pressure of 2.7 kPa x 100 [bar] (39 psi or 0.27 MPa), the maximum O<sub>2</sub> flow can be limited to 10 L/min.

#### Accuracy

±10 % of the set value

#### Resolution of displayed value

1 L/min (below 10 L/min)  
5 L/min (above 10 L/min)

## 15.4 Fresh-gas delivery with electronically controlled gas mixer

<b>Standardization</b>	All data are standardized to STPD conditions.
<b>O<sub>2</sub> concentration FG O<sub>2</sub></b>	
Setting range	21 to 100 Vol% (carrier gas: Air) 25 to 100 Vol% (carrier gas: N <sub>2</sub> O)
Increment value	1 Vol%
Accuracy	±5 % of the set value or ±2 Vol% (the greater value applies)
<b>Fresh-gas flow FG flow</b>	
Setting range	Off; 0.20 to 15.00 L/min
Increment value	0.05 L/min (below 1.00 L/min) 0.10 L/min (between 1.00 and 5.00 L/min) 0.50 L/min (above 5.00 L/min)
Accuracy	±10 % of the set value or ±50 mL/min (the greater value applies)
Information	The maximum flow dispensed can be reduced depending on the ambient pressure or temperature. At the limits of the permissible operating conditions, a rate of at least 13.5 L/min is reached. (An STPD flow of 13.5 L/min corresponds to an ATPD flow of 21 L/min at 650 hPa ambient pressure, for instance.)

## 15.5 Fresh-gas delivery with a mechanically controlled gas mixer and electronic flow measurement

<b>Standardization</b>	All data are standardized to STPD conditions.
<b>O<sub>2</sub> concentration</b>	21 to 100 Vol%
<b>Setting range for fresh-gas flow</b>	Off to at least 12.0 L/min (O <sub>2</sub> , Air, and N <sub>2</sub> O)
<b>Information</b>	The specified setting range can be reduced depending on the ambient pressure or temperature. At the limits of the permissible operating conditions, a rate of at least 10 L/min is reached. (An STPD flow of 10 L/min corresponds to an ATPD flow of 15.6 L/min at 650 hPa ambient pressure, for instance.)
<b>Electronic measurement of fresh-gas flow</b>	
Range	0.00 to 15.00 L/min (O <sub>2</sub> , Air, and N <sub>2</sub> O)
Accuracy	±10 % of the delivered flow or ±0.12 L/min (the greater value applies)
Resolution of the value displayed on the screen	0.01 L/min (from 0.00 to 0.20 L/min) 0.02 L/min (from 0.20 to 0.50 L/min) 0.05 L/min (from 0.50 to 1.00 L/min) 0.10 L/min (from 1.00 to 15.00 L/min)

Resolution of the value displayed in the status display	0.1 L/min
<b>Total flow tube</b>	
Standardization	All data are standardized to STPD conditions.
Range	Off to 10 L/min
Accuracy	±10 % of the set value at 100 % O <sub>2</sub> and for flows >1 L/min
Resolution of displayed value	0.5 L/min (in the range from 1 to 10 L/min)

## 15.6 Fresh-gas delivery with a mechanically controlled gas mixer and flow tubes

<b>Standardization</b>	All data are standardized to STPD conditions.
<b>O<sub>2</sub> concentration</b>	21 to 100 Vol%
<b>Setting range for fresh-gas flow</b>	Off to at least 10.0 L/min (O <sub>2</sub> , Air, and N <sub>2</sub> O)
<b>Measurement of the fresh-gas flow for O<sub>2</sub> and N<sub>2</sub>O</b>	
Range	0.02 to 10.0 L/min
Accuracy	±10 % of the delivered flow (from 0.1 to 10.0 L/min) ±50 % of the delivered flow (below 0.1 L/min)
Resolution of displayed value	0.05 L/min (from 0.05 to 1.00 L/min) 0.50 L/min (from 1.00 to 10.0 L/min)
<b>Measurement of the fresh-gas flow for Air</b>	
Range	0.2 to 10.0 L/min
Accuracy	±10 % of the delivered flow (from 0.6 to 10.0 L/min) ±50 % of the delivered flow (below 0.6 L/min)
Resolution of displayed value	0.2 L/min (from 0.2 to 1.0 L/min) 0.5 L/min (from 1.0 to 6.0 L/min) 2.0 L/min (from 6.0 to 10.0 L/min)

## 15.7 Ventilator

<b>Design</b>	Electronically driven ventilator, fresh-gas decoupled
<b>Time-based settings</b>	
Respiratory rate RR	
Setting range	3 to 100 /min
Increment value	1 /min
Accuracy	±10 % of the set value or ±1 /min (the greater value applies)
Minimum respiratory rate RRmin in PSV mode	
Setting range	Off, 3 to 60 /min
Increment value	1 /min

Accuracy	±10 % of the set value or ±1 /min (the greater value applies)
Inspiratory time Ti	
Setting range	0.2 to 10.0 s
Increment value	0.1 s
Accuracy	±5 % of the set value or ±150 ms (the greater value applies)
Resulting ratio of inspiratory time to expiratory time I:E	1:49 to 49:1
Maximum inspiratory time for assisted breaths (not adjustable)	4.0 s for the "Adults" patient category 1.5 s for the "Pediatric patients" and "Neonates" patient categories
Pressure rise time Slope (T10...90 time)	
Setting range	0.0 to 2.0 s
Increment value	0.1 s
Accuracy	±25 % of the set value or ±250 ms (the greater value applies)
Ratio of inspiratory time to expiratory time I:E	
Setting range	4:1 to 1:10
Increment value	0.1
Accuracy	The inspiratory time for the ventilator is calculated based on the I:E and RR settings. The I:E accuracy results from the accuracy of the inspiratory time, see the information on Ti.
Inspiration termination criterion Insp term (as a percentage of the peak inspiratory flow) for pressure-supported breaths	
Setting range	5 to 80 %
Increment value	5 %
Accuracy	±5 % absolute error
Proportion of plateau time % Tplat to inspiratory time Ti for mandatory breaths in the VC - CMV, VC - SIMV, and VC - SIMV / PS modes	
Setting range	0 to 60 %
Increment value	10 %
Accuracy	±25 % absolute error
Inflation time (Duration) including rising and falling slopes in the One-step recruitment maneuver	
Setting range	3 to 40 s
Increment value	1 s
Accuracy	±10 % of the set value

Number of breaths at each level  
(Breaths/Step), with the exception of the highest level in the Multi-step recruitment maneuver

Setting range	1 to 20
Increment value	1

Number of breaths at the highest level  
(Breaths@Max) in the Multi-step recruitment maneuver

Setting range	1 to 20
Increment value	1

Reminder for repeated One-step recruitment or Multi-step recruitment maneuver

Setting range	Off, 10 to 180 min
Increment value	10 min
Accuracy	±1 min

### Volume-based and flow-based settings

Tidal volume VT

Setting range	10 to 1500 mL
Setting range for "advanced neonatal support" software option	5 to 1500 mL
Increment value	5 mL in the range from 10 to 100 mL 10 mL in the range from 100 to 1500 mL
Increment value for "advanced neonatal support" software option	1 mL in the range from 5 to 25 mL 5 mL in the range from 25 to 100 mL 10 mL in the range from 100 to 1500 mL
Accuracy	±5 % of the set value or ±15 mL (the greater value applies) in the range above 150 mL ±10 % of the set value or ±10 mL (the greater value applies) in the range from 20 to 150 mL ±50 % of the set value or ±4 mL (the greater value applies) in the range below 20 mL

Information

The applied tidal volume is automatically adjusted to compensate for the compliance of the breathing circuit. As soon as CO<sub>2</sub> respiratory phases are detected, the sample gas flow for the patient-gas measurement module is additionally compensated.  
With set values above 1400 mL, the specified accuracy can be reduced if a very long breathing circuit or a breathing circuit with a very high compliance is used.

Trigger threshold Trigger

Setting range	0.3 to 15.0 L/min
Increment value	0.1 L/min in the range from 0.3 to 2.0 L/min 1 L/min in the range from 2.0 to 15.0 L/min
Accuracy	±20 % of the set value or ±1 L/min (the greater value applies)

Peak inspiratory flow	180 L/min or higher Results from the following set values: - VT and Ti in volume-controlled ventilation modes - Pinsp and Ti in pressure-controlled ventilation modes Applies for mains operation or in the first 5 minutes of battery operation with a fully charged battery. In other situations, the peak inspiratory flow may be restricted to 75 L/min.
<b>Pressure-related settings</b>	
Inspiratory pressure Pinsp	
Setting range	PEEP +5 to 80 hPa (cmH <sub>2</sub> O) (7 to 80 hPa (cmH <sub>2</sub> O) when PEEP = Off)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±3 hPa (cmH <sub>2</sub> O) (the greater value applies)
Pressure limitation Pmax	
Setting range	PEEP +5 to 80 hPa (cmH <sub>2</sub> O) (7 to 80 hPa (cmH <sub>2</sub> O) when PEEP = Off)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±3 hPa (cmH <sub>2</sub> O) (the greater value applies)
Relative pressure support above PEEP ΔPsupp in CPAP / PSV and PC - SIMV / PS modes	
Setting range	Off, 3 to (80 - PEEP) hPa (cmH <sub>2</sub> O) (Off, 3 to 78 hPa (cmH <sub>2</sub> O) when PEEP = Off)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±3 hPa (cmH <sub>2</sub> O) (the greater value applies)
Relative pressure support above PEEP ΔPsupp in VC - SIMV / PS and VC - SIMV / PS / AutoFlow modes	
Setting range	Off, 3 to (Pmax - PEEP) hPa (cmH <sub>2</sub> O) (Off, 3 to (Pmax - 2) hPa (cmH <sub>2</sub> O) when PEEP = Off)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±3 hPa (cmH <sub>2</sub> O) (the greater value applies)
Positive end-expiratory pressure PEEP	
Setting range	Off, 2 to 35 hPa (cmH <sub>2</sub> O)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±2 hPa (cmH <sub>2</sub> O) (the greater value applies)

Inspiratory pressure (Pressure) in the One-step recruitment maneuver

Setting range	PEEP +1 to 80 hPa (cmH <sub>2</sub> O) (3 to 80 hPa (cmH <sub>2</sub> O) when PEEP = Off)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±2 hPa (cmH <sub>2</sub> O) (the greater value applies)

Highest inspiratory pressure (Pinsp max) in the Multi-step recruitment maneuver

Setting range	15 to 80 hPa (cmH <sub>2</sub> O)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±2 hPa (cmH <sub>2</sub> O) (the greater value applies)

Highest PEEP (PEEP max) in the Multi-step recruitment maneuver

Setting range	PEEP to 35 hPa (cmH <sub>2</sub> O) (2 to 35 hPa (cmH <sub>2</sub> O) when PEEP = Off)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±2 hPa (cmH <sub>2</sub> O) (the greater value applies)

Pressure amplitude above PEEP: ΔPressure in the Multi-step recruitment maneuver

Setting range	5 to 30 hPa (cmH <sub>2</sub> O)
Increment value	1 hPa (cmH <sub>2</sub> O)
Accuracy	±10 % of the set value or ±2 hPa (cmH <sub>2</sub> O) (the greater value applies)

Minimum pressure at patient port in accordance with ISO 80601-2-13

## 15.8 Breathing system

**Total volume (when applying a maximum tidal volume of 1500 mL)**

Without CO <sub>2</sub> absorber	2.18 ± 0.2 L
With CLIC absorber 800+ disposable CO <sub>2</sub> absorber	3.53 ± 0.2 L
With reusable CO <sub>2</sub> absorber and Drägersorb 800+	3.67 ± 0.2 L

Information

The total volume of the breathing system is typically smaller and is calculated based on the set tidal volume plus a reserve volume for compliance compensation.

**Compliance (without breathing circuit)**

In the Man / Spon mode (including disposable CO<sub>2</sub> absorber)

2.7 ±0.2 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 81 ±6 mL at 30 hPa (cmH<sub>2</sub>O)  
for the "Neonates" patient category

2.9 ±0.2 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 87 ±6 mL at 30 hPa (cmH<sub>2</sub>O)  
for the "Pediatric patients" patient category

3.0 ±0.2 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 90 ±6 mL at 30 hPa (cmH<sub>2</sub>O)  
for the "Adults" patient category

In mechanical ventilation modes

1.0 ±0.2 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 30 ±6 mL at 30 hPa (cmH<sub>2</sub>O)  
for the "Neonates" patient category

1.2 ±0.2 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 36 ±6 mL at 30 hPa (cmH<sub>2</sub>O)  
for the "Pediatric patients" patient category

1.3 ±0.2 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 39 ±6 mL at 30 hPa (cmH<sub>2</sub>O)  
for the "Adults" patient category

**Total leakage of the breathing system**

<150 mL/min at 30 hPa (cmH<sub>2</sub>O) standardized to BTPS conditions

**Filling volume of the CO<sub>2</sub> absorber**

Reusable CO<sub>2</sub> absorber

1500 mL ±50 mL

Disposable CO<sub>2</sub> absorber CLIC absorber 800+

1300 mL ±50 mL

Disposable CO<sub>2</sub> absorber CLIC absorber Free

1200 mL ±50 mL

**Flexible breathing bag arm**

Volume

0.11 L ±50 mL

Compliance

0.11 ±0.05 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 3.3 ±1.5 mL at 30 hPa (cmH<sub>2</sub>O)

**Rigid breathing bag arm**

Volume

0.13 L ±50 mL

Compliance

0.13 ±0.05 mL/hPa (mL/cmH<sub>2</sub>O)  
corresponds to 3.9 ±1.5 mL at 30 hPa (cmH<sub>2</sub>O)

**APL valve**

Setting range

Open, 5 to 70 hPa (cmH<sub>2</sub>O)

Accuracy (at a flow of 20 ±1 L/min):

±20 % of the set value or ±3 hPa (the greater value applies), but not more than +10 hPa (cmH<sub>2</sub>O)

Pressure drop at 30 L/min (ATPD), fully opened

Dry: 2.1 ±0.3 hPa (cmH<sub>2</sub>O)  
Wet: 2.2 ±0.3 hPa (cmH<sub>2</sub>O)

**Recommendation for breathing hoses**

Information	All compliances and volumes specified include inspiratory and expiratory filters.
Neonates (typical VT <50 mL)	Maximum compliance: 2.0 mL/hPa (mL/cmH <sub>2</sub> O)
Pediatric patients (typical VT between 50 and 300 mL)	Maximum compliance: 4.0 mL/hPa (mL/cmH <sub>2</sub> O)
Adults (typical VT >300 mL)	Maximum compliance: 6.0 mL/hPa (mL/cmH <sub>2</sub> O)
Maximum length	200 cm (78.7 in) 350 cm (137.8 in) (leads to limitations in compliance compensation and pressure accuracy)

**Recommendation for a breathing bag hose  
(if no breathing bag arm is being used)**

Maximum length	180 cm (70.9 in) 350 cm (137.8 in) with increased fresh-gas consumption
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**Recommendation for the breathing bag size**

Volume	0.5 L to 5.0 L (at least double the value of the tidal volume)
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**15.9 External fresh-gas outlet**

Connection	22 mm (outer taper), 15 mm (inner taper), ISO
Delivery	See "Fresh-gas delivery"
Pressure limitation	Not pressure-limited

**15.10 Anesthetic gas receiving system (AGS)**

Information	The device is equipped with an active or a passive anesthetic gas receiving system.
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**15.11 Active AGS**

Information	This system is designed for connection to an anesthetic gas scavenging system which works with a suction flow.
Suction flow	
Normal range	30 to 50 L/min
At lower end of restricted range	≥10 L/min
Maximum fresh-gas flow to prevent contaminating ambient air	
For external breathing systems (normal range)	9 L/min

For external breathing systems (restricted range) 5 L/min

For internal breathing systems (restricted range) 7 L/min

**Connection for sample gas disposal when using external patient-gas measurement**

Outer hose diameter 3 to 6 mm

Maximum inlet flow 500 mL/min

## 15.12 Passive AGS

**Information**

This system is designed for an anesthetic gas scavenging system which works without suction flow. To limit contamination of the ambient air in compliance with ISO 80601-2-13, follow the specifications for the scavenging hose.

**Scavenging hose**

Maximum length 8 m (26 ft)

Minimum diameter 19 mm (0.75 in)

**Connection for sample gas disposal when using external patient-gas measurement**

Outer hose diameter 3 to 6 mm

Maximum inlet flow 500 mL/min

## 15.13 Measuring systems and displays

**Information**

Alarms and internal calculations are based on values that are more precise than the displayed values. Consequently, there may be minor deviations between the current alarm status and the displayed measured values.

**Airway pressure Paw**

**Plateau pressure Pplat**

**Positive end-expiratory pressure PEEP**

**Peak inspiratory pressure PIP**

**Mean airway pressure Pmean**

Range -20 to +99 hPa (cmH<sub>2</sub>O)

Accuracy  $\pm 4\%$  of the measured value or  $\pm 2$  hPa (cmH<sub>2</sub>O) (the greater value applies)

Resolution of displayed value 1 hPa (cmH<sub>2</sub>O)

**Airway pressure gauge**

Range -20 to 80 hPa (cmH<sub>2</sub>O)

Accuracy  $\pm 5\%$  of the measured value or  $\pm 2$  hPa (cmH<sub>2</sub>O) (the greater value applies)

Resolution of displayed value 5 hPa (cmH<sub>2</sub>O)

**Volume**

## Information

The measured volume values displayed already take account of the compliance of the breathing circuit. For devices with the integrated patient-gas measurement module (PGM), the determined gas composition and the sample gas flow of the gas measurement are also taken into consideration as soon as CO<sub>2</sub> respiratory phases are detected.

For devices without integrated PGM, the specified accuracies apply if the flow correction is correctly set (see the "Flow correction" chapter).

The accuracies specified apply under test conditions in accordance with ISO 80601-2-13 (ventilation with dry oxygen, corrected to BTPS conditions).

## Expiratory tidal volume VT

## Range

0 to 2500 mL

## Lowest detectable VT

≤3 mL for the "Pediatric patients" and "Neonates" patient categories

≤20 mL for the "Adults" patient category

## Accuracy

±4 mL in the range below 20 mL

±10 % of the measured value or ±4 mL (the greater value applies) in the range from 20 to 150 mL

±10 % of the measured value or ±15 mL (the greater value applies) in the range above 150 mL

1 mL

## Resolution of displayed value

## Minute volume

## Total MV

## Mandatory MVmand

## Spontaneous MVspon

## Range

0.00 to 40.0 L/min

## Accuracy

±10 % of the measured value or ±0.15 L/min (the greater value applies)

## Resolution of displayed value

0.01 L/min (for MV <1 L/min) or 0.1 L/min (for MV ≥1 L/min)

## T10...90

<45 s (for RR ≥6 /min)

<105 s (for RR <6 /min)

## Minute volume MV

## Range

0.00 to 40.0 L/min

## Accuracy

±10 % of the measured value or ±0.15 L/min (the greater value applies)

## Resolution of displayed value

0.01 L/min (for MV <1 L/min) or 0.1 L/min (for MV ≥1 L/min)

## T10...90

<45 s (for RR ≥6 /min)

<105 s (for RR <6 /min)

**Respiratory rate**

**Total RR**

**Mandatory RRmand**

**Spontaneous RRspont**

Range	0 to 150 /min
Accuracy	±10 % of the measured value or ±1 /min (the greater value applies)
Resolution of displayed value	1 /min
T10...90	<45 s (for RR ≥ 6 /min) <105 s (for RR < 6 /min)

**Respiratory rate RR**

Range	0 to 150 /min
Accuracy	±10 % of the measured value or ±1 /min (the greater value applies)
Resolution of displayed value	1 /min
T10...90	<45 s (for RR ≥ 6 /min) <105 s (for RR < 6 /min)

**Supply pressures**

Central gas supply system (electronic measurement)

Range	0.0 to 10.0 kPa x 100 [bar] 0 to 145 psi 0.00 to 1.00 MPa
Accuracy (up to 7 kPa x 100 [bar])	±4 % or ±0.2 kPa x 100 [bar] (the greater value applies) ±4 % or ±3 psi (the greater value applies) ±4 % or ±0.02 MPa (the greater value applies)
Resolution of displayed value	0.1 kPa x 100 [bar] 1 psi 0.01 MPa

Central supply (physical measurement with pressure gauge)

Range	0 to 10 kPa x 100 [bar] 0 to 160 psi 0 to 1.0 MPa
Accuracy	±(4 % of the measurement range + 8 % of the displayed value) in the range above 1.0 kPa x 100 [bar] (20 psi or 0.1 MPa)
Resolution of displayed value	0.5 kPa x 100 [bar] 20 psi 0.05 MPa

Gas cylinders (electronic measurement)

Range	0 to 285 kPa x 100 [bar] 0 to 4140 psi 0.0 to 28.5 MPa
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Accuracy	$\pm 4\%$ or $\pm 6\text{ kPa} \times 100\text{ [bar]}$ (the greater value applies) $\pm 4\%$ or $\pm 87\text{ psi}$ (the greater value applies) $\pm 4\%$ or $\pm 0.6\text{ MPa}$ (the greater value applies)
Resolution of displayed value	$1\text{ kPa} \times 100\text{ [bar]}$ 1 psi 0.1 MPa
<b>Results in the system test</b>	
Total leakage	
Range	10 to 5000 mL/min (measured at BTPS, based on a pressure of 30 hPa)
Accuracy	$\pm 25\%$ of the measured value or $\pm 150\text{ mL/min}$ (the greater value applies)
Resolution of displayed value	1 mL/min
Leakage during mechanical ventilation	
Range	10 to 1000 mL/min (measured at BTPS, based on a pressure of 30 hPa)
Accuracy	$\pm 25\%$ of the measured value or $\pm 50\text{ mL/min}$ (the greater value applies)
Resolution of displayed value	1 mL/min
Compliance of the breathing circuit	
Range	0.0 to 9.9 mL/hPa (mL/cmH <sub>2</sub> O), measured at BTPS
Accuracy	$\pm 30\%$ of the measured value or $\pm 0.2\text{ mL/hPa}$ (mL/cmH <sub>2</sub> O) (the greater value applies)
Resolution of displayed value	0.1 mL/hPa (mL/cmH <sub>2</sub> O)
<b>Waveform display</b>	
Waveforms	O <sub>2</sub> concentration (only with PGM) Primary anesthetic gas concentration (only with PGM) CO <sub>2</sub> concentration (only with PGM) Airway pressure Volume (only for loops) Flow
Sweep speed	6.25; 12.5; 25.0 mm/s
Sweep speed	6.25; 12.5 mm/s
Loops	Pressure-Volume Flow-Volume
Scale	
Airway pressure	-20 to 80 hPa (cmH <sub>2</sub> O)
Flow	-120 to 120 L/min
Volume	0 to 2000 mL
O <sub>2</sub>	0 to 100 Vol%
CO <sub>2</sub>	0 to 100 mmHg (0 to 12 Vol%, 0 to 12 kPa)
Halothane	0 to 5 Vol% (kPa)

Enflurane	0 to 6 Vol% (kPa)
Isoflurane	0 to 5 Vol% (kPa)
Sevoflurane	0 to 10 Vol% (kPa)
Desflurane	0 to 20 Vol% (kPa)

## 15.14 Display of calculated values

### Information

The following calculated values are partly based on measured values from various sensors with different measurement accuracies. Due to the combination of these measured values, the resulting accuracy of the calculated values may be reduced.

### Airway parameters

#### Dynamic compliance Cdyn

#### Mean dynamic compliance Cdyn mean

Range	0 to 200 mL/hPa (mL/cmH <sub>2</sub> O)
Accuracy	±15 % of the displayed value or ±1 mL/hPa (cmH <sub>2</sub> O) (the greater value applies)
Resolution of displayed value	0.1 mL/hPa (mL/cmH <sub>2</sub> O)
Information	The values may be distorted by spontaneous breathing, thus reducing the measurement accuracy.

### Resistance R

Range	0 to 100 hPa/L/s (cmH <sub>2</sub> O/L/s)
Accuracy	±30 % of the displayed value or ±3 hPa/L/s (cmH <sub>2</sub> O/L/s) (the greater value applies)
Resolution of displayed value	1 hPa/L/s (cmH <sub>2</sub> O/L/s)
Information	The values may be distorted by spontaneous breathing, thus reducing the measurement accuracy.

### Elastance E

Range	0.005 to 10.000 hPa/mL (cmH <sub>2</sub> O/mL)
Resolution of displayed value	0.001 hPa/mL (cmH <sub>2</sub> O/mL)
Information	The elastance E is calculated as 1 / Cdyn mean.

### Time constant TC

Range	0.0 to 5.0 s
Resolution of displayed value	0.1 s
Information	The time constant TC is calculated as R x Cdyn mean.

### Leakage

#### Difference between inspiratory and expiratory tidal volumes ΔVT

Range	0 to 2500 mL
Accuracy	±20 % of the displayed value or ±30 mL (the greater value applies)
Resolution of displayed value	1 mL

**Leakage minute volume MVleak**

Range	0.00 to 40.0 L/min
Accuracy	±25 % of the displayed value or ±0.2 mL/min (the greater value applies)
Resolution of displayed value	0.01 L/min (with MVleak <1 L/min) 0.1 L/min (with MVleak ≥1 L/min)

**Measurement of consumption and elimination****CO<sub>2</sub> elimination per minute**

Standardization	The following data are standardized to STPD conditions.
Range	0 to 9999 mL/min
Accuracy	±25 % of the displayed value or ±100 mL/min (the greater value applies)
Resolution of displayed value	1 mL/min

**O<sub>2</sub> uptake per minute**

Standardization	The following data are standardized to STPD conditions.
Range	0 to 9999 mL/min
Accuracy	±25 % of the displayed value or ±100 mL/min (the greater value applies)
Resolution of displayed value	1 mL/min

**Anesthetic agent uptake**

Range	0.0 to 99.9 mL fluid
Accuracy	±25 % of the displayed value or ±1 mL (the greater value applies)
Resolution of displayed value	0.1 mL

**Anesthetic agent consumption**

Range	0.0 to 999.9 mL fluid
Accuracy	±25 % of the displayed value or ±1 mL (the greater value applies)
Resolution of displayed value	0.1 mL

**Fresh-gas consumption**

Standardization	The following data are standardized to STPD conditions.
Range	0 to 99999 L
Accuracy	±15 % of the displayed value or ±2 L/min (the greater value applies)
Resolution of displayed value	1 L

Information

Gas consumption related to O<sub>2</sub> flush and O<sub>2</sub> therapy is not included in this calculation.

## 15.15 Gas measurement

<b>Information</b>	The device is equipped with a patient-gas measurement module (PGM) for O <sub>2</sub> , CO <sub>2</sub> , N <sub>2</sub> O, and anesthetic agent, or with an O <sub>2</sub> sensor.
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## 15.16 Gas measurement with PGM

<b>Information</b>	This is a sidestream gas measurement, in which the sample gas is fed back into the breathing system. End-tidal measured values are calculated for each breath from the local maxima and minima of the real-time measurements during expiration.
<b>Standardization</b>	All data are standardized to ATPS conditions.
<b>Accuracies</b>	Due to the T <sub>10...90</sub> time and the sample gas flow, the measurement accuracies for O <sub>2</sub> , CO <sub>2</sub> , N <sub>2</sub> O, and anesthetic agent may deviate at respiratory rates of 60 /min or higher and an I:E ratio of 1:1. The influence of respiratory rate and the I:E ratio on the accuracy has been verified in a simulated breathing system using a rectangular waveform for the gas concentration.
<b>Sample gas flow</b>	200 ±20 mL/min standardized to STPD conditions
<b>Maximum time until emptying of the water trap is necessary</b>	41 hours (sample gas under BTPS conditions and at 23 °C (73.4 °F) ambient temperature)
<b>System response time</b>	The system response time results from the typical delay by the sample line and the gas-type-specific T <sub>10...90</sub> time of the sensor.
<b>Sensor sampling rate</b>	<50 ms
<b>Time after switch-on until the specified accuracy is attained</b>	<270 s at 20 °C (68 °F) ambient temperature <480 s at 10 °C (50 °F) ambient temperature
<b>Time until measured CO<sub>2</sub> values are displayed (with at least reduced accuracy)</b>	<90 s
<b>Typical delay by the sample line</b>	<2.5 s with Dräger sample line, 2.5 m (98.4 in)
<b>Cross sensitivity</b>	None concerning alcohol (<3000 ppm in blood), acetone (<1000 ppm), methane, water vapor, NO, and CO
<b>Drift</b>	Compensated by automatic cyclic calibration
<b>Calibration</b>	During automatic calibration, ambient air is fed to the breathing system and used as the sample gas.
<b>O<sub>2</sub></b>	
<b>Measuring principle</b>	Paramagnetic (consumption-free)
<b>Range</b>	0 to 100 Vol%
<b>Accuracy</b>	±(2.5 Vol% + 2.5 % of the measured value)
<b>Resolution of displayed value</b>	1 Vol%
<b>T<sub>10...90</sub> time of the sensor</b>	<500 ms

**CO<sub>2</sub>**

Measuring principle	Infrared spectrometry (consumption-free)
Range	0.0 to 13.6 Vol% 0.0 to 13.6 kPa 0 to 102 mmHg
Accuracy	±(0.43 Vol% + 8 % of the measured value) ±(0.43 kPa + 8 % of the measured value) ±(3.3 mmHg + 8 % of the measured value)
Resolution of displayed value	0.1 Vol% 0.1 kPa 1 mmHg
T <sub>10...90</sub> time of the sensor	<350 ms

**N<sub>2</sub>O**

Measuring principle	Infrared spectrometry (consumption-free)
Range	0 to 100 Vol%
Accuracy	±(2 Vol% + 8 % of the measured value)
Resolution of displayed value	1 Vol%
T <sub>10...90</sub> time of the sensor	<500 ms

**Anesthetic gases**

Measuring principle	Infrared spectrometry (consumption-free)
Range	
Halothane	0.00 to 8.50 Vol% (kPa)
Isoflurane	0.00 to 8.50 Vol% (kPa)
Enflurane	0.00 to 10.00 Vol% (kPa)
Sevoflurane	0.00 to 10.00 Vol% (kPa)
Desflurane	0.0 to 20.0 Vol% (kPa)
Accuracy	±(0.2 Vol% + 15 % of the measured value) ±(0.2 kPa + 15 % of the measured value)
Resolution of displayed value	0.1 Vol% (kPa) for desflurane 0.01 Vol% (kPa) for all other anesthetic gases
T <sub>10...90</sub> time of the sensor	<500 ms
Anesthetic agent identification	
Detection	Automatic
Primary gas	At the latest at 0.3 Vol%
Secondary gas	At the latest at 0.4 Vol% or 0.1 xMAC (the greater value applies) With a desflurane concentration greater than 4 Vol%, mixture detection occurs at the latest when the concentration of the second anesthetic gas rises above 10 % of the desflurane concentration. The secondary gas becomes the primary gas when the expiratory xMAC value is more than 0.2 xMAC above that of the primary gas.

Minimum displayed concentration	The specified detection thresholds refer to rising anesthetic gas concentrations (e.g., at the start of surgery). If the anesthetic gas concentration falls, a concentration of as low as 0.05 Vol% will be measured, based on the last anesthetic agent detected. Below this concentration, a value of 0 Vol% will be displayed.
xMAC	
Information	Based on the age of the patient, the anesthetic gas concentration, and the nitrous oxide concentration (the xMAC value is corrected for ambient pressure)
Range	0.0 to 9.9
Accuracy	Refer to the accuracies of the respective measured gas values.
Resolution of displayed value	0.1

## 15.17 Gas measurement with O<sub>2</sub> sensor

<b>Information</b>	The oxygen measurement is performed in the inspiratory limb of the breathing system and is pressure-corrected.
<b>Time after switch-on until the specified accuracy is attained</b>	<180 s
<b>Time after the insertion of the sensor cell until the specified accuracy is attained</b>	<30 min
<b>Replacement interval of the O<sub>2</sub> sensor cell</b>	2 years
<b>Cross sensitivity</b>	None concerning alcohol (<3000 ppm in blood), acetone (<1000 ppm), methane, water vapor, NO, and CO
<b>Drift</b>	Compensated by calibration to ambient air, which is required at least every 7 days within the context of the system test.
<b>O<sub>2</sub></b>	
<b>Measuring principle</b>	Electrochemical
<b>Range</b>	0 to 100 Vol%
<b>Accuracy (according to ISO 80601-2-55)</b>	<p>±(2.5 Vol% + 2.5 % of the measured value) for gas mixtures with anesthetic gas concentrations from 0 to max. 2 Vol% (kPa) halothane, isoflurane, enflurane, or sevoflurane, or from 0 to max. 8 Vol% (kPa) desflurane</p> <p>±(2.5 Vol% + 5.0 % of the measured value) for gas mixtures with anesthetic gas concentrations from 2 to max. 4 Vol% (kPa) halothane, or from 2 to max. 5 Vol% (kPa) isoflurane, enflurane, or sevoflurane, or from over 8 to max. 15 Vol% (kPa) desflurane</p>
<b>Resolution of displayed value</b>	1 Vol%

Sensor sampling rate	<40 ms
Typical delay of the measured value	<15 s

## 15.18 Operating characteristics

### Mains power supply

Mains voltage	100 to 240 V AC at 50/60 Hz
Maximum power consumption	4 A

### Power cable

Maximum length	5 m (16.4 ft)
Protective ground resistance	Maximum 0.1 Ω
Operating voltage	≥250 V
Operating current	≥10 A

### Current consumption at 230 V AC

When device is switched off with switched-on main switch and fully charged battery	<0.18 A
During mechanical ventilation (PC - CMV, Pinsp = 15 hPa, RR = 8 /min, I:E = 1:2, PEEP = 0 hPa, FG flow = 4 L/min O <sub>2</sub> ) without charging the internal battery	<0.40 A

Maximum	2 A
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### Current consumption at 110 V AC

When device is switched off with switched-on main switch and fully charged battery	<0.38 A
During mechanical ventilation (PC - CMV, Pinsp = 15 hPa, RR = 8 /min, I:E = 1:2, PEEP = 0 hPa, FG flow = 4 L/min O <sub>2</sub> ) without charging the internal battery	<0.84 A

Maximum	4 A
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### Power consumption

When device is switched off with switched-on main switch and fully charged battery	<40 W
During mechanical ventilation (PC - CMV, Pinsp = 15 hPa, RR = 8 /min, I:E = 1:2, PEEP = 0 hPa, FG flow = 4 L/min O <sub>2</sub> ) without charging the internal battery	<95 W

Maximum	400 W
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Peak inrush current	Approx. 8 to 14 A Approx. 6 to 10 A quasi-RMS
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### Internal battery

Type	Lead battery Sealed, maintenance-free
Nominal capacity	7.2 Ah

Nominal voltage	24 V
Fuse	F15A 80V UL248-14, breaking capacity 1000 A, size 19.7 mm x 19 mm x 5 mm
Current	Maximum 15 A
Backup time with fully charged battery	
During mechanical ventilation (VC - CMV, VT = 500 mL, RR = 10 /min, I:E = 1:2, PEEP = 5 hPa, FG flow = 10 L/min O <sub>2</sub> ) and with less than 5 completed battery discharge cycles	90 min or longer Typically 120 min
During mechanical ventilation (VC - CMV, VT = 500 mL, RR = 10 /min, I:E = 1:2, PEEP = 5 hPa, FG flow = 10 L/min O <sub>2</sub> ) and with less than 20 completed battery discharge cycles	45 min or longer
During ventilation in Man / Spon mode and with less than 20 completed battery discharge cycles	90 min or longer
Charging time (to achieve at least 30 minutes backup time)	At least 8 hours
Charging power	Maximum 50 W
<b>Gas supply</b>	
Gas quality requirements	
Oil content	<0.1 mg/m <sup>3</sup>
Dew point	5 °C (41 °F) at ambient temperature
Particle size	Dust-free air (filtered with pore size <1 µm)
Supply pressure for O <sub>2</sub> , Air, N <sub>2</sub> O	2.7 to 6.9 kPa x 100 [bar] 39 to 100 psi 0.27 to 0.69 MPa
Maximum short-term peak inlet flow with electronically controlled gas mixer at 6.9 kPa x 100 [bar] (100 psi or 0.69 MPa) supply pressure	
O <sub>2</sub>	135 L/min (applies only when there is no distribution piece for the central O <sub>2</sub> supply)
Air	
Without bronchial suction system	50 L/min
Including a directly connected bronchial suction system	130 L/min
N <sub>2</sub> O	40 L/min
Distribution piece for central O <sub>2</sub> supply	
Maximum permissible flow	20 L/min
Distribution piece for central Air supply	
Maximum permissible flow	70 L/min
Drive gas	Not needed

Gas supply connection	Depending on configuration: NIST, DISS (CGAV-5/B or CGAV-5/N), French standard (NFS90-116)
Gas cylinders (dimensions)	
Diameter	100 to 140 mm (3.94 to 5.51 in) for devices equipped with upright gas cylinders 100 to 110 mm (3.94 to 4.33 in) for devices equipped with hanger yoke system for gas cylinders with pin-index connections
Maximum height	880 mm (34.64 in) for devices equipped with upright gas cylinders 757 mm (29.80 in) for devices equipped with hanger yoke system for gas cylinders with pin-index connection
<b>Pressure reducer (permanently fitted)</b>	
Version	In accordance with ISO 80601-2-13
Permissible inlet pressure (P <sub>v</sub> )	
Air, O <sub>2</sub>	Up to 200 kPa x 100 [bar] (2900 psi, 20 MPa)
N <sub>2</sub> O	Up to 60 kPa x 100 [bar] (870 psi, 6 MPa)
Opening pressure of the relief valve	7.0 to 9.5 kPa x 100 [bar] (101 to 138 psi, 0.70 to 0.95 MPa)
<b>Pressure reducer (third-party manufacturer)</b>	
Version	In accordance with DIN EN ISO 10524-1
<b>Noise emissions from device</b>	
Measuring method	Free field measurements complying with ISO 3744
Equivalent continuous sound pressure level Leq(A) during ventilation with typical settings	≤42 dB(A)
Sound pressure L(A) of alarm tones at the user's operating location	
Measuring method	In accordance with IEC 60601-1-8
Acoustic alarm signal	
Alarm volume (all priorities)	Adjustable from ≥42 dB(A) to <80 dB(A)
Secondary acoustic alarm signal and mains power supply failure alarm	≥50 dB(A) and ≤80 dB(A)
<b>Dimensions of the device, including breathing system and ventilator</b>	
Information	A tolerance of ±10 mm (0.39 in) applies to all specified dimensions.
Compact version with plug-in connector for 1 vaporizer (may deviate with accessory equipment)	
Width	745 mm (29.3 in)
Height	1403 mm (55.2 in)

Depth	692 mm (27.2 in)
Large version with plug-in connectors for 2 vaporizers (may deviate with accessory equipment)	
Width	933 mm (36.7 in)
Height	1403 mm (55.2 in)
Depth	724 mm (28.5 in)
Work surface of the compact version	
Width	470 mm (18.5 in)
Depth	380 mm (15.0 in)
Work surface of the large version	
Width	710 mm (28.0 in)
Depth	380 mm (15.0 in)
Additional pull-out work surface	
Width	340 mm (13.4 in)
Depth	245 mm (9.6 in)
Additional folding work surface	
Width	300 mm (11.8 in)
Depth	425 mm (16.7 in)

#### **Weight of the compact version**

Nominal configuration consisting of mechanically controlled gas mixer, plug-in connectors for 2 vaporizers, including 1 vaporizer, 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. 135 kg (298 lb) without counterweight
	Approx. 170 kg (375 lb) with counterweight for increased maximum total weight
Permissible total weight without counterweight	270 kg (595 lb)
Permissible total weight with counterweight	330 kg (727 lb)

#### **Weight of the large version**

Nominal configuration consisting of mechanically controlled gas mixer, plug-in connectors for 3 vaporizers, including 1 vaporizer, breathing system, CLIC adapter and CLIC absorber, breathing hoses, central supply hoses (5 m (16.4 ft)) and scavenging hose (5 m (16.4 ft))	Approx. 160 kg (353 lb)
Permissible total weight	330 kg (727 lb)

#### **Touchscreen color screen**

Screen diagonal	Approx. 39 cm (15.3 in)
Background illumination	LED
Resolution	1280 x 768 pixels

#### **RFID system**

Operating frequency	13.56 MHz ± 50 ppm (wideband)
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Transmitter power	≤42 dBµA/m (200 mW ±1 dB)
Modulation	ASK (amplitude shift keying)
<b>Electromagnetic compatibility</b>	Tested in compliance with IEC 60601-1-2
<b>Protection classes</b>	
Device	I, in compliance with IEC 60601-1
Applied parts (connections for breathing hoses)	TYPE BF
Degree of protection	IP11 against vertically falling dripping water under typical conditions of use in accordance with the intended use (with 0° inclination of the device) IP10 at >0° and ≤5° inclination of the device In accordance with IEC 60529, meets ISO 80601-2-13
<b>Classification Medical Device Europe</b>	Class II b
<b>UMDNS code</b>	10-134
<b>Use of latex</b>	The device is made without natural rubber latex.

## 15.19 Interfaces and ports

<b>Serial ports</b>	COM 1 and COM 2
Information	Only connect devices that meet the requirements of IEC 60950-1 / IEC 62368-1 for ungrounded SELV circuits or the requirements of IEC 60601-1 (as of the 2nd edition) for touchable secondary circuits with a maximum nominal voltage of 24 V DC.
Protocol	MEDIBUS.X
Alarm delay time (measured as of the query time)	<3 s for baud rates ≥9600 <10 s for baud rates <9600
Connector	9-way Sub-D
Baud rate	1200, 2400, 4800, 9600, 19200, 38400 baud
Data bits	8
Parity	Even
Stop bits	1
Pin assignment	
Pin 1	Not used
Pin 2	RXD
Pin 3	TXD
Pins 4, 6	Pins 4 and 6 are connected internally
Pin 5	SHLD-GND
Pins 7, 8	Pins 7 and 8 are connected internally

Pin 9	Not used
Housing	SHLD-GND
<b>USB port</b>	Only connect USB mass storage devices that do not have their own power supply. Do not connect any charging cables.
Type	Connector type A; USB 2.0
Supported devices	USB flash drive formatted with FAT16 or FAT32
<b>Network port</b>	
Information	Only for Dräger Remote Service Only connect devices or networks that meet the requirements of IEC 60950-1 / IEC 62368-1 for ungrounded SELV circuits or the requirements of IEC 60601-1 (as of the 2nd edition) for touchable secondary circuits with a maximum nominal voltage of 24 V DC.
Type	RJ45 plug
Transfer speed	100Base-TX, IEEE 802.3 Clauses 24 and 25 (requires at least a CAT5 cable) 10Base-T, IEEE 802.3 Clause 14 (requires at least a CAT3 cable)
<b>Connector for external workplace light</b>	Only for workplace lights approved by Dräger, see list of accessories.

## 15.20 Relevant standards

<b>Information</b>	In addition to the standards listed here, this medical device also meets various other standards.
IEC 60601-1 Medical electrical equipment	Part 1: General requirements for basic safety and essential performance
IEC 60601-1-2 Medical electrical equipment	Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic disturbances - Requirements and tests
IEC 60601-1-8 Medical electrical equipment	Part 1-8: General requirements for basic safety and essential performance - Collateral standard: Alarm systems - General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
ISO 80601-2-13 Medical electrical equipment	Part 2-13: Particular requirements for basic safety and essential performance of an anaesthetic workstation

ISO 80601-2-55  
Medical electrical equipment

Part 2-55:  
Particular requirements for basic safety and essential performance of respiratory gas monitors

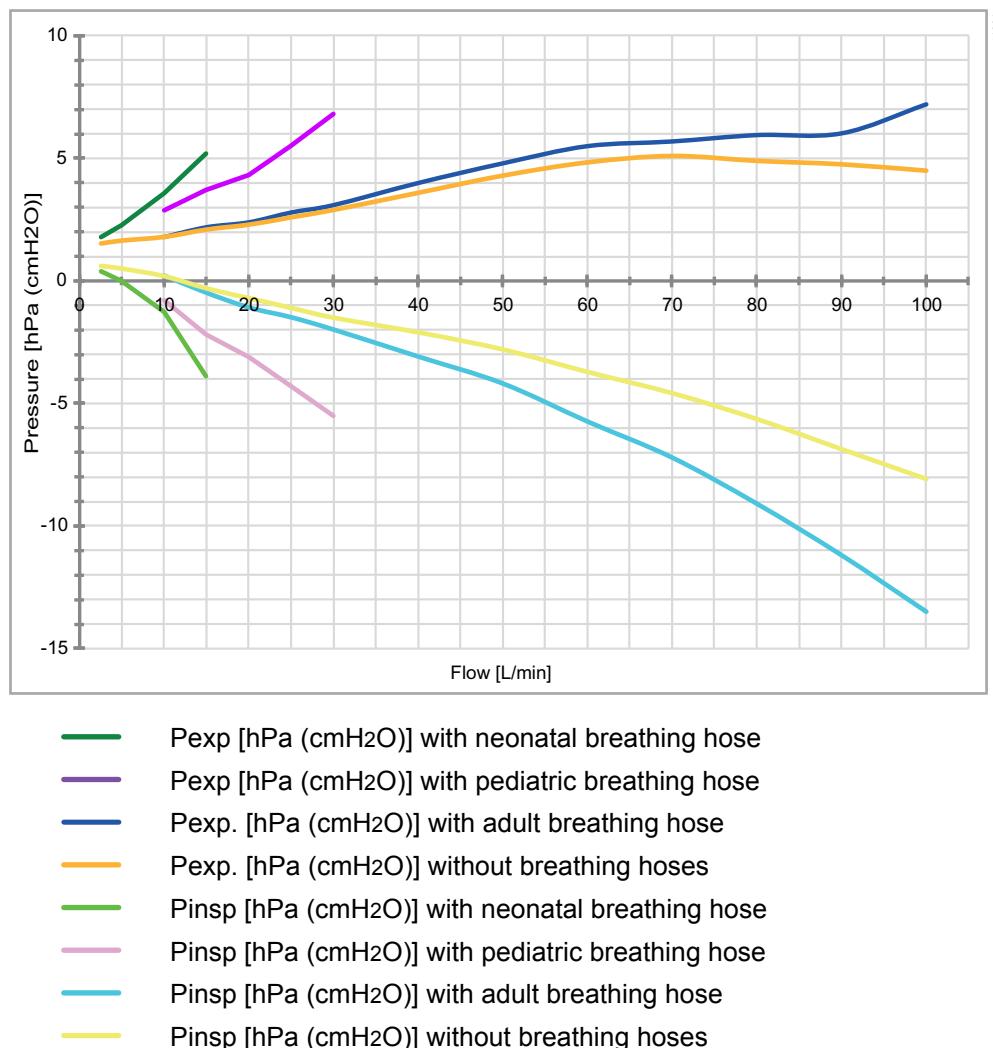
ISO 17664  
Processing of health care products

Information to be provided by the medical device manufacturer for the processing of medical devices

## 15.21 Diagrams

### 15.21.1 Pressure characteristics and flow characteristics of the breathing system

Breathing system with and without breathing hoses and filters (conforming to ISO 8835-2 and ISO 80601-2-13), fresh-gas flow Air, 10 L/min STPD, inspiratory and expiratory flows STPD:



<b>Breathing system, dry, with filled reusable CO<sub>2</sub> absorber</b>	<b>Peak flow in use [L/min]</b>	<b>Resistance [hPa (cmH<sub>2</sub>O)]</b>	
		<b>Man / Spon</b>	
		<b>Inspiratory</b>	<b>Expiratory</b>
<b>Without</b> breathing circuit and inspiratory filter	60	−3.7	4.8
	30	−1.5	2.9
	15	−0.3	2.1
	2.5	0.6	1.5
<b>With</b> breathing circuit for <b>adults</b> MP00301, inspiratory filter MP01730	60	−5.8	5.5
	30	−2.0	3.1
<b>With</b> breathing circuit for <b>pediatric patients</b> MP00331, filter MP01815 on Y-piece	15	−2.2	3.7
<b>With</b> breathing circuit for <b>neonates</b> MP00333, filter MP01815 on Y-piece	2.5	0.4	1.8

## 15.22

### Gas exchange times for concentration changes

Typical gas exchange times (T<sub>0...90</sub>) at the Y-piece of the breathing circuit during an oxygen concentration change from 21 Vol% to 100 Vol% in volume-controlled ventilation at different O<sub>2</sub> fresh-gas flows:

	<b>Gas exchange times [min] at the following O<sub>2</sub> fresh-gas flows</b>			
	<b>2 L/min</b>	<b>4 L/min</b>	<b>8 L/min</b>	<b>2 L/min + O<sub>2</sub> flush</b>
<b>Adults</b> Test lung MP02400, breathing circuit MP00301, VT = 500 mL, RR = 10 /min, I:E = 1:2, PEEP = Off	7:50	3:25	0:48	0:41
<b>Pediatric patients</b> Test lung MP02400, breathing circuit MP00331, VT = 300 mL, RR = 20 /min, I:E = 1:1.5, PEEP = Off	6:05	3:08	0:37	0:24
<b>Pediatric patients</b> Test lung MP02400, breathing circuit MP00331, VT = 100 mL, RR = 20 /min, I:E = 1:1.5, PEEP = Off	2:46	1:27	1:18	0:34
<b>Neonates</b> Test lungs 8409742 (3x), breathing circuit MP00333, VT = 30 mL, RR = 30 /min, I:E = 1:1, PEEP = Off	2:08	1:44	1:37	0:32

**15.23****Declaration of hazardous substances in accordance with Regulation CLP 1272/2008 Appendix VI Part 3**

Certain materials of this product contain the following substances in a proportion exceeding 0.1 % by mass:

- Lead (CAS No. 7439-92-1)

This product is safe to use for patients who are sensitive to the indicated substances.

Dräger is aware of the following residual risks:

- None

**15.24****EMC declaration****15.24.1****General information**

This device was tested for electromagnetic compatibility using accessories from the list of accessories. Other accessories may only be used if they do not compromise the electromagnetic compatibility. The use of non-compliant accessories may result in increased electromagnetic emissions or decreased electromagnetic immunity of the device.

This device may be used in the direct vicinity of other devices only if Dräger has approved this device arrangement. If no approval has been given by Dräger, it must be ensured that this device functions correctly in the desired arrangement before use. The instructions for use for the other devices must be followed.

**15.24.2****Electromagnetic environment**

This device may only be used in environments specified in section "Environments of use" on page 10.

Emissions	Compliance
Radiated emissions	Class A, group 1 (30 MHz to 1 GHz)
Conducted emissions	Class A, group 1 (150 kHz to 30 MHz)

 The emissions characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required), this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.

<b>Immunity against</b>	<b>Test level and required electromagnetic environment</b>
Electrostatic discharge (ESD) (IEC 61000-4-2)	Contact discharge: $\pm 8$ kV Air discharge: $\pm 15$ kV
Fast transient electrical disturbances (bursts) (IEC 61000-4-4)	Power cable: $\pm 2$ kV Longer signal input lines/output lines: $\pm 1$ kV
Impulse voltages (surges) (IEC 61000-4-5)	Voltage, external conductor – external conductor: $\pm 1$ kV Voltage, external conductor – protective ground conductor: $\pm 2$ kV
Magnetic fields at mains frequency (IEC 61000-4-8)	50 Hz: 30 A/m
Voltage dips and short interruptions in the supply voltage (IEC 61000-4-11)	Voltage dips of 30 % to 100 %, 8.3 ms to 5 s, different phase angles
Radiated high-frequency disturbances (IEC 61000-4-3)	80 MHz to 2.7 GHz: 3 V/m
Conducted high-frequency disturbances (IEC 61000-4-6)	150 kHz to 80 MHz: 3 V, ISM bands: 6 V
Electromagnetic fields in the vicinity of wireless communication devices	Various frequencies from 385 MHz to 5785 MHz: 9 V/m to 28 V/m

### 15.24.3 Recommended separation distances from wireless communication devices

To ensure that the technical data of this device can be met, there must be a separation distance of at least 1.0 m (3.3 ft) between this device and wireless high-frequency communication equipment.

## 15.25 Device combinations

This device can be operated in combination with other Dräger devices or with devices from other manufacturers. Follow the accompanying documents of the individual devices.

If a device combination is not approved by Dräger, the safety and the functional integrity 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: 3rd edition (electromagnetic compatibility) or 4th edition (electromagnetic interference)
- IEC 60601-1-8 (alarm systems)

Or:

- IEC 60601-1, 2n 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)

## 15.26 IT networks and cybersecurity

### 15.26.1 Prerequisites

This chapter is intended for the operating organization and users of the device, and the IT representatives and device owners of the health-care facility appointed by the operating organization.

The following information must be noted before connecting the device to a network:

- Accompanying documents of this device

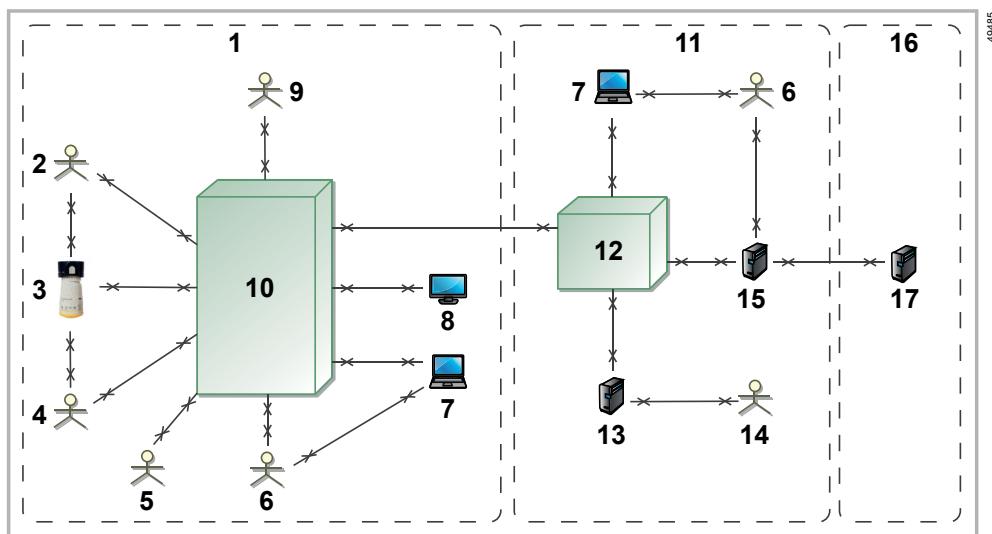
Connecting this device to a network that incorporates other devices or making subsequent changes to that network can lead to new risks for patients, users, and third parties. These risks must be identified, analyzed, and assessed before the device is connected to the network or the network is changed. Appropriate actions must be taken.

The following provides 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

Dräger recommends compliance with IEC 80001-1 (Application of risk management for IT-networks incorporating medical devices) and creation of the following documents:

- Description of the network of the health-care facility
- Description of the network-based alarm systems

**Diagram of the cybersecurity system****No. Designation**

- |    |  |
|----|--|
| 1  | Operating location, e.g., OR                                     |
| 2  | Users  |
| 3  | Infinity ID accessories  |
| 4  | Users with access to the user password                           |
| 5  | Service personnel  |
| 6  | Specialized service personnel                                    |
| 7  | Service laptop   |
| 8  | MEDIBUS device   |
| 9  | Patient  |
| 10 | Anesthesia machine   |
| 11 | Intranet of the health-care facility                             |
| 12 | Local area network of the health-care facility                   |
| 13 | SNMP trap receiver   |
| 14 | IT representative of the health-care facility                    |
| 15 | ServiceConnect Gateway   |
| 16 | Internet<br>No direct communication with the anesthesia machine. |
| 17 | ServiceConnect Server  |

**Procedure in case of a cybersecurity attack**

If a cybersecurity attack on the device is suspected, disconnect the affected interfaces from the device and inform IT personnel.

## 15.26.2 LAN

### Service support

In conjunction with the ServiceConnect Gateway (SCG) or a service laptop, this device supports the following measures for connected maintenance:

Measure	Description
Software installation	Installing device software and firmware. Installation can only be performed if no patient is connected to the device and this has been confirmed in standby mode.
Reading out the technical device data	Downloading the technical device data (e.g., log files) to support the service activities and analyze the device data.
Configuration	Configuring the device parameters using Dräger service tools.

The interface can only be used by specialized service personnel. Authentication and a secure connection protocol are required. The data is transmitted in encrypted form.

Additional licenses, options, and other features can be installed directly on the device by specialized service personnel.

The SNMP protocol is used for communication with the device (e.g., monitoring the service status). The FTPS protocol is used for data transmission (e.g., readout of the technical data).

Further information on networked maintenance and training is available from Dräger, see [www.draeger.com/training](http://www draeger com/training).

The operating organization must ensure that external service providers for Dräger devices adequately protect their service assets (e.g., service software, installation files) against unauthorized access or manipulation. Protection is provided, for example, by encrypting hard disks or physically protecting computers with service software.

The operating organization must ensure that the remote service running on a server-based service infrastructure (e.g., SCG) accepts only authenticated remote desktop connections from other computers.

### Required properties

To prevent unauthorized access and the spread of malware and computer viruses in the network, the LAN must provide effective risk control measures.

For example, the following measures are suitable:

- Restriction of physical access to active network sockets.
- Only integrate the device into networks that have the necessary level of trust in association with all the connected devices.
- The secure separation or segmentation of the network (physical or virtual).
- Only permit communication with other networks via secure gateways.
- Use a network firewall with appropriate settings (e.g., known and fewest possible open ports).
- Introduce patch management for devices in the network.
- Apply the ISO/IEC 27033 standard or the IEC 62443 series of standards.

The IT network enables communication between this device and other devices.

#### Connections between the main device (local) and target (remote)

Function	Protocol	Local port	Direction	Remote port	Remote partner
SNMP V3	UDP	161	↔	>1023	SCG
SNMP V2c (trap)	UDP	>1023	→	162	SCG
DHCP	UDP	68	↔	67	DHCP server
FTPS (command)	TCP	>1023	→	21	SCG
FTPS (command)	TCP	>1023	←	21	SCG
FTPS (data)	TCP	>1023	→	>1023	SCG
FTPS (data)	TCP	>1023	←	>1023	SCG
SNTP	UDP	>1023	↔	123	NTP server

Measure	Typical data volume
Update of the device firmware	20 MB
Download of DSR	3 MB
Renewal of certificates	100 KB
Establishing communication	3 MB
Transmission of therapy-related data (e.g., measured values, set values, waveforms)	2 Mbit/s for every connected device

When using the service functions, the device normally causes an average network load of up to 150 KB/s. The bandwidth used during normal use is negligibly low. The maximum estimated network load is 3 MB/s.

The following dangerous situations can arise if the network does not meet the requirements:

- An overload of the device due to high network load (e.g., caused by denial-of-service attacks) can lead to delayed display of transmitted data when devices are connected.
- In extreme cases (e.g., a large number of data packets), the network port is switched off to protect the device (until the device is restarted). The therapy functions are still ensured.

If more than one medical device in the IT network is affected by the same problem, the operating organization must consider the cumulative effect.

### 15.26.3 COM

#### Functionality

This device supports the interface in accordance with EIA RS-232 (CCITT V.24/V.28) for the following applications:

- MEDIBUS.X
- Connections with medical devices, other devices, or accessories if Dräger has approved the device combinations.

The RS-232 ports support the communication protocols for data exchange between the device and, for example, the following external medical or non-medical devices:

- Hemodynamic monitors
- Data management systems
- Standard RS-232-to-Ethernet converters (with encryption and authorization)

The transmitted data contains the following information, for example:

- Settings
- Measured values
- Waveforms
- Text messages
- Alarm status

Further information on the interface is provided in the MEDIBUS documentation. The documents are only available in English. Before data transmission, note the documentation on the following communication protocols:

#### **MEDIBUS.X**

MEDIBUS.X, Rules and Standards for Implementation	9052607
MEDIBUS.X, Profile Definition for Data Communication V1.n	9052608

MEDIBUS.X is the MEDIBUS standard. If this communication protocol is used, all data can be transmitted. In combination with MEDIBUS.X, the device meets the requirements of the ISO 80601-2-55:2018 standard.

The following data is transmitted over the interface without encryption:

- Therapy data with details of age, weight, and height of the patient

The data can be used to transmit alarm signals to improve the clinical process. Alarm signals are transmitted without confirmation from the receiving device. This data must not be used to replace the medical device as the primary alarm source. Alarm conditions are only transmitted in the network if they are active during an active query from a connected device. An alarm history is not transmitted.

Note: Every connected device must be marked with the following precautionary statement: Alarm signals may not always be received

#### **Required properties**

The RS-232 port is used to establish a point-to-point connection.

A connected device must meet the following requirements:

- Only authorized persons may have access to the data transmitted via the RS-232 port.
- All device interfaces must be protected against malware and computer viruses.
- If commercially available RS-232-to-Ethernet converters are used, the operating organization is responsible for the use and correctness of the data.

## 15.26.4

### USB

#### Functionality

This device supports the following interfaces based on USB 2.0:

- USB mass storage devices

The USB port supports data transmission to external storage media. Existing data on external storage media may be deleted during this process.

The following data is transmitted to the USB mass storage device over the interface unencrypted:

- Logbook with details on weight and height of the patient
- Screenshots with screen contents

The following functions can be performed if no patient is connected to the device:

- Exporting and importing device configurations
- Installing software options

#### Required properties

Only devices that are included in the list of accessories or which correspond to the "mass storage medium" USB device class may be connected. For example, no provision has been made for connecting devices whose battery is to be charged. Dräger recommends the use of storage media with hardware encryption.

USB mass storage devices must be checked for malware and approved before being connected to the device. Checking and approval must be performed by the IT administrator or equipment officer of the health-care facility in accordance with the specifications of the health-care facility.

The following USB devices must not be connected:

- Active USB devices (own power supply)
- Devices that use wireless technology
- Cellular phones

## 15.26.5

### RFID

#### Functionality

This medical device may be equipped with an RFID module (Radio Frequency Identification) to enable wireless communication with Infinity ID accessories.

This medical device has been designed and manufactured to comply with emission limit values for high-frequency energy. These limit values are part of international safety standards, such as IEC 60601-1-2, and standards on radio devices, such as EN 300330, and have been specified by the authorities.

Changes and modifications that have not been expressly approved by Dräger can mean that the user is no longer permitted to operate the device.

Dräger hereby declares that this medical device, including the radio devices, complies with Directive 2014/53/EU. The full EU declaration of conformity can be found at the following website: <http://www.draeger.com/doc-radio>

### Required properties

A connected device must meet the following requirements:

- Only authorized persons may have access to the data transmitted via the RFID port.
- All device interfaces must be protected against malware and computer viruses.

The RFID system of the connected device must comply with section 15 of the FCC guidelines and the royalty-free RSS guidelines of Industry Canada and meet the following conditions:

- The device must not cause any dangerous interference.
- The device must not be susceptible to damage caused by interference reception, including interference causing undesired operating conditions.

## 15.26.6 Security events

 The following description refers to the safety instruction in the "Network security" chapter (see "Security events", page 17).

The device monitors and logs events that may indicate that security has been compromised or a potential security attack. These security events are recorded in the security event log.

The following provides examples of possible security events:

- Failed authentication events
- Software installation events
- Configuration events
- Network anomalies

The number of previous failed authentication attempts is displayed. This indicates unauthorized attempts to access password-protected functions. These access attempts can only be made directly at the device. The persons attempting to access these functions therefore must be potential users.

If security events that require direct action by the IT representative of the health-care facility occur, a message of potential breaches or attacks is immediately sent via SNMP. This message enables further investigations and subsequent measures.

Dräger tools for recording and analyzing SNMP traps are available via ServiceConnect. Alternatively, tools of third-party manufacturers can be used for SNMP monitoring.

Security events of relevance for clinical application are also reported on the device and recorded in the logbook.

Service personnel and specialized service personnel can generate a device status report (DSR) with all entries in the security event log, logbook, and information log. The device status report is encrypted and can be decrypted and automatically analyzed by specialized service personnel.

The list of software components for this device can be requested from Dräger. Dräger will notify the customer with an adequate lead time when the cybersecurity support for the device ends and security patches are no longer provided.

## 15.27

### Open-source software

The Dräger product software contains free software and open-source software. The respective licensing terms for every open-source element take precedence over other licensing terms. In addition to Dräger, the open-source licensor is also entitled to assert claims and rights from the open-source licenses in their own name. A list of the free software and open-source software used, as well as the applicable licensing terms and conditions, reference documents and other information (e.g. source code), can be found at [www.draeger.comopensource](http://www.draeger.comopensource).

## 16

### Principles of operation

#### 16.1

#### Safety instructions

##### Infinity ID components

It is only possible to use the additional functions of Infinity ID accessories if the device has the additional functions for replacement interval monitoring and anti-interchange security.

The use of these additional functions does not ensure the maximum period of use for the accessories and any correctly connected hoses. The user is thus not excused from regularly checking the accessories. If these accessories are not checked, the patient may be put at risk.

- ▶ Use the appropriate Infinity ID accessories to utilize the additional functions.
- ▶ Check the current condition and the period of use of the accessories regularly.
- ▶ Check regularly that the hoses are correctly connected.

There are product-specific data saved on the Infinity ID accessories, which are further processed by the device. If an unused Infinity ID accessory is in the immediate vicinity of the device, values such as those for resistance and compliance may be transferred inadvertently from this accessory. When accessories are added to an Infinity ID breathing circuit, the values for compliance and leakage may deviate from those saved on the breathing circuit.

- ▶ Do not keep unused Infinity ID accessories in the vicinity of the device.
- ▶ To determine the actual values for compliance and resistance, always perform the leakage test before starting the therapy. If the test cannot be performed because the patient is already connected, particular attention is required during ventilation.

#### 16.2

### Description of the ventilation modes

#### 16.2.1

#### Meaning and function of the therapy controls

Therapy controls	Meaning / Function
% Tplat	Plateau time as a percentage of the inspiratory time Ti in volume-controlled modes
RR	Respiratory rate
RRmin	Minimum respiratory rate at which supported breaths are applied in CPAP / PSV mode.

Therapy controls	Meaning / Function										
Insp term	When the flow falls below this flow value (in % of the measured peak flow), a supported breath is interrupted.										
PEEP	Positive end-expiratory pressure Pressure that is always maintained.										
ΔPsupp	Pressure difference of an assisted breath between PEEP level and inspiratory pressure This pressure support is only available if synchronization of spontaneous breathing (SIMV and in PSV mode) is switched on. When pressure support is switched on, the naming of the following ventilation modes changes:										
	<table border="1"> <thead> <tr> <th>Without pressure support</th> <th>With pressure support</th> </tr> </thead> <tbody> <tr> <td>PC - SIMV</td> <td>PC - SIMV / PS</td> </tr> <tr> <td>VC - SIMV</td> <td>VC - SIMV / PS</td> </tr> <tr> <td>VC - SIMV / AutoFlow</td> <td>VC - SIMV / PS / AutoFlow</td> </tr> <tr> <td>CPAP / PSV</td> <td>CPAP / PSV</td> </tr> </tbody> </table>	Without pressure support	With pressure support	PC - SIMV	PC - SIMV / PS	VC - SIMV	VC - SIMV / PS	VC - SIMV / AutoFlow	VC - SIMV / PS / AutoFlow	CPAP / PSV	CPAP / PSV
Without pressure support	With pressure support										
PC - SIMV	PC - SIMV / PS										
VC - SIMV	VC - SIMV / PS										
VC - SIMV / AutoFlow	VC - SIMV / PS / AutoFlow										
CPAP / PSV	CPAP / PSV										
Pinsp	Inspiratory pressure										
Pmax	Upper pressure limit in volume-controlled ventilation. When this pressure is reached, the breath is held at this level until the set inspiratory time Ti is reached.										
Trigger	Flow that, when exceeded, triggers a supported breath.										
Ti <sup>1)</sup>	Inspiratory time										
I:E <sup>1)</sup>	Ratio of inspiratory time to expiratory time										
Slope	Period of time during which a pressure rise from the PEEP or CPAP pressure to the inspiratory pressure or PSV pressure takes place. This time determines the steepness of the rise in pressure from the lower to the upper level.										
VT	Tidal volume										
SIMV/CMV	Switching spontaneous breathing support on/off Switching the synchronization on or off causes the following change to the ventilation mode:										
	<table border="1"> <thead> <tr> <th></th> <th>Pressure-controlled</th> <th>Volume-controlled</th> </tr> </thead> <tbody> <tr> <td>SIMV</td> <td>PC - SIMV</td> <td>VC - SIMV</td> </tr> <tr> <td>CMV</td> <td>PC - CMV</td> <td>VC - CMV</td> </tr> </tbody> </table>		Pressure-controlled	Volume-controlled	SIMV	PC - SIMV	VC - SIMV	CMV	PC - CMV	VC - CMV	
	Pressure-controlled	Volume-controlled									
SIMV	PC - SIMV	VC - SIMV									
CMV	PC - CMV	VC - CMV									
	When synchronization is switched on, mandatory breaths are synchronized with the patient's inspiratory effort. In doing so, the respiratory rate RR is held constant by adapting the mandatory breaths and the expiratory time. At the end of the expiratory phase, an inspiratory trigger window is activated so that the mandatory breath can be initiated prematurely by up to 5 seconds (patient category Adult) or 1.5 seconds (patient categories Ped and Neo). If the spontaneous inspiratory flow reaches the set value of the flow trigger Trigger during this trigger window, a premature mandatory breath is triggered. If no spontaneous breathing is detected within the inspiratory trigger window, a mandatory breath will be triggered immediately afterwards.										
FG O <sub>2</sub>	Oxygen concentration in the fresh gas (only with electronically controlled gas mixer)										
FG flow	Fresh-gas flow (only with electronically controlled gas mixer)										
Air / N <sub>2</sub> O	Carrier gas Air or N <sub>2</sub> O (only with electronically controlled gas mixer)										

1) Whether the ventilation settings are based on Ti or the I:E ratio can be defined in the system setup.

### 16.2.2 Degree of breathing support

Breathing support	Ventilation mode
None	Standby, Pause, Monitoring, Ext. FGO
Low	Man/Spon, CPAP, CPAP / PSV with $\Delta P_{supp} < 5 \text{ hPa}$ ( $\text{cmH}_2\text{O}$ )
Medium	CPAP / PSV with $\Delta P_{supp} \geq 5 \text{ hPa}$ ( $\text{cmH}_2\text{O}$ )
High	Volume-controlled modes Pressure-controlled modes

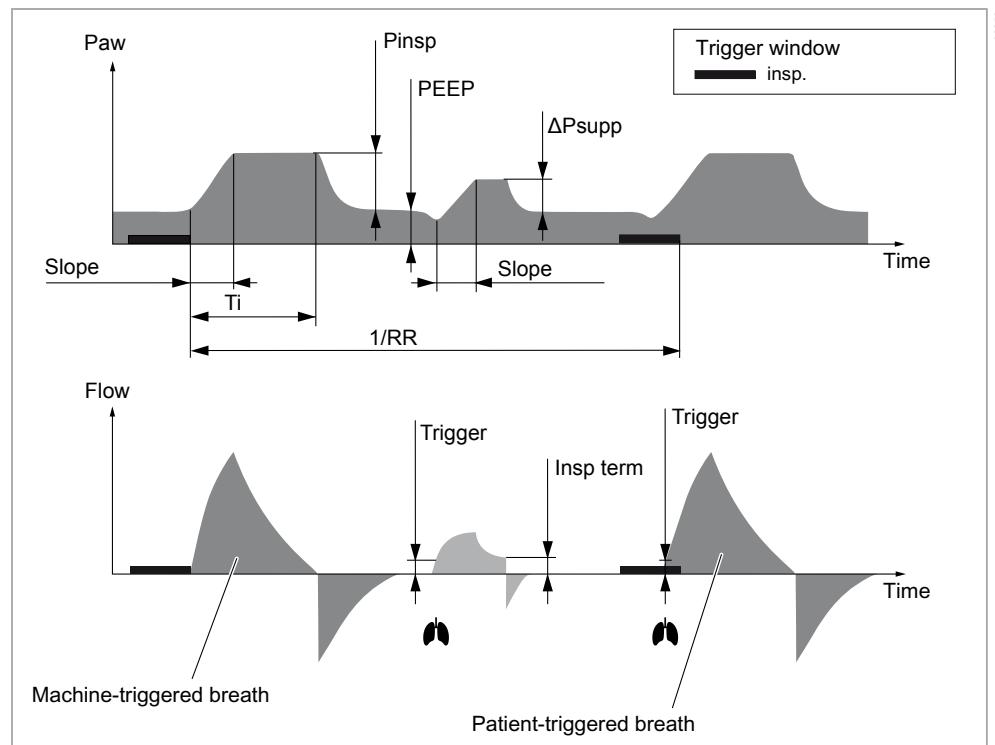
### 16.2.3 Ventilation modes and effective parameters

Group	Tabs	Ventilation mode	Basic parameter (normal therapy bar)	Additional parameters (expanded therapy bar)
Manual ventilation/spontaneous breathing	Man/Spon	Manual / Spontaneous	---	

<b>Group</b>	<b>Tabs</b>	<b>Ventilation mode</b>	<b>Basic parameter (normal therapy bar)</b>	<b>Additional param- eters (expanded therapy bar)</b>
Volume-con- trolled ventilation	VC - AF	VC - CMV / Auto- Flow	Pmax VT RR PEEP Ti <sup>1)</sup> I:E <sup>1)</sup> CMV	Slope
		VC - SIMV / Auto- Flow	Pmax VT RR PEEP Ti <sup>1)</sup> I:E <sup>1)</sup> SIMV	Trigger ΔPsupp = Off Slope
		VC - SIMV / PS / AutoFlow	Pmax VT RR PEEP Ti <sup>1)</sup> I:E <sup>1)</sup> SIMV	Trigger ΔPsupp >0 Insp term Slope
		VC	VC - CMV	% Tplat
		VC - SIMV	Pmax VT RR PEEP Ti <sup>1)</sup> I:E <sup>1)</sup> SIMV	Trigger ΔPsupp = Off % Tplat
		VC - SIMV / PS	Pmax VT RR PEEP Ti <sup>1)</sup> I:E <sup>1)</sup> SIMV	Trigger ΔPsupp >0 Insp term Slope % Tplat

<b>Group</b>	<b>Tabs</b>	<b>Ventilation mode</b>	<b>Basic parameter (normal therapy bar)</b>	<b>Additional param- eters (expanded therapy bar)</b>
Pressure-con- trolled ventilation	PC	PC - CMV	Pinsp RR PEEP Ti CMV	Slope
		PC - SIMV	Pinsp $\Delta P_{supp} = \text{Off}$ RR PEEP Ti SIMV	Trigger Slope
		PC - SIMV / PS	Pinsp $\Delta P_{supp} > 0$ RR PEEP Ti SIMV	Trigger Insp term Slope
Assisted ventila- tion	PSV	CPAP / PSV	Trigger $\Delta P_{supp}$ RRmin PEEP Slope	Insp term

- 1) Whether the ventilation settings are based on Ti or the I:E ratio can be defined in the system setup.

**16.2.4****Pressure-controlled ventilation****16.2.4.1****PC****16.2.4.2****PC - CMV**

- Pressure-controlled
- Time-controlled
- Machine-triggered

The mandatory breaths are machine-triggered and are not triggered by the patient.

**16.2.4.3****PC - SIMV**

- Pressure-controlled
- Time-controlled
- Machine-triggered or patient-triggered
- Synchronized inspiration

In PC - SIMV, the patient can breathe spontaneously at any time, while the number of mandatory breaths is predefined. When synchronization is switched on, the breaths are adapted to the spontaneous breathing efforts of the patient. If spontaneous breathing effort by the patient is detected during the inspiratory trigger window, a patient-triggered breath will be initiated.

**16.2.4.4****PC - SIMV / PS**

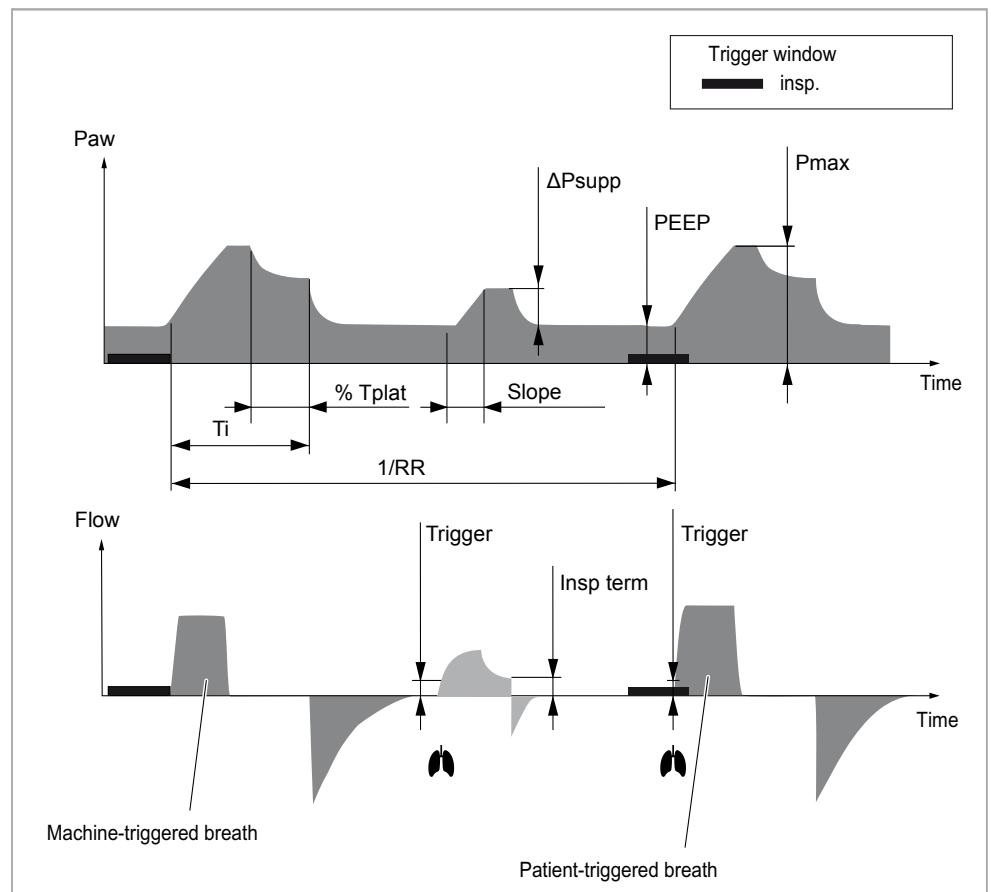
This mode is similar to PC - SIMV, except that the patient's spontaneous breathing at the PEEP level during the expiratory phase is pressure-supported with  $\Delta P_{supp}$  when outside the trigger window.

## 16.2.5 Volume-controlled ventilation

### 16.2.5.1 Compliance compensation

The applied VT is corrected by the determined breathing hose compliance, i.e., an additional volume is delivered in order to ensure the application of the volume to the patient. If the device is equipped with the integrated patient-gas measurement module, the applied VT is corrected by the amount of suction flow as soon as CO<sub>2</sub> respiratory phases are detected.

### 16.2.5.2 VC



### 16.2.5.3 VC - CMV

- Volume-controlled
- Pressure-limited
- Time-controlled
- Machine-triggered
- Constant inspiratory flow

In this volume-controlled ventilation mode, the patient receives the set tidal volume VT with each mandatory breath.

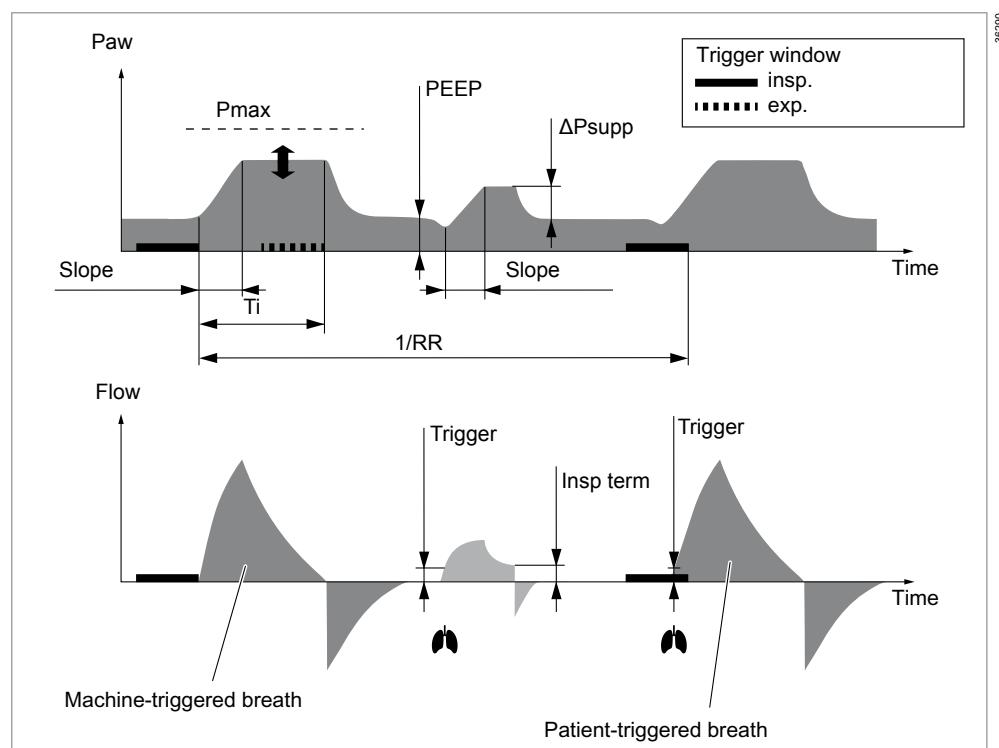
**16.2.5.4****VC - SIMV**

- Volume-controlled
- Pressure-limited
- Time-controlled
- Machine-triggered or patient-triggered
- Constant inspiratory flow
- Synchronized inspiration

In VC - SIMV, the patient can breathe spontaneously at any time, while the number of mandatory breaths is predefined. When synchronization is switched on, the breaths are adapted to the spontaneous breathing of the patient. If inspiratory effort by the patient is detected during the inspiratory trigger window, a patient-triggered breath will be initiated.

**16.2.5.5****VC - SIMV / PS**

This mode is similar to VC - SIMV, except that the patient's spontaneous breathing at the PEEP level during the expiratory phase is pressure-supported with  $\Delta P_{supp}$  when outside the trigger window.

**16.2.5.6****VC - AF**

For volume-controlled mandatory breaths with AutoFlow, the set tidal volume VT is applied with the lowest required pressure. The pressure patterns and flow patterns of the mechanical inspiratory breaths correspond to those of pressure-controlled ventilation.

Due to the patient's inspiratory effort or compliance changes in the lungs, the tidal volume in an individual breath may deviate from the set tidal volume VT. However, averaged over time a tidal volume corresponding to the set volume VT is applied.

If no mechanical ventilation has previously taken place, a volume-controlled test breath with constant inspiratory flow is performed first when starting a ventilation mode with AutoFlow in order to estimate the lung parameters. The inspiratory pressure required at the start is determined from this test breath. Each additional breath-related readjustment of the inspiratory pressure is limited to  $\pm 3$  hPa (cmH<sub>2</sub>O). The pressure difference (inspiratory pressure - PEEP) is at least 5 hPa (cmH<sub>2</sub>O) and the upper inspiratory pressure limit is set by Pmax. If the set value for VT is reduced, the inspiratory pressure will be reduced by a greater amount if necessary.

#### 16.2.5.7

##### **VC - CMV / AutoFlow**

- Volume-controlled
- Pressure-limited
- Time-controlled
- Machine-triggered
- Decelerating inspiratory flow

The mandatory breaths are machine-triggered and are not triggered by the patient.

#### 16.2.5.8

##### **VC - SIMV / AutoFlow**

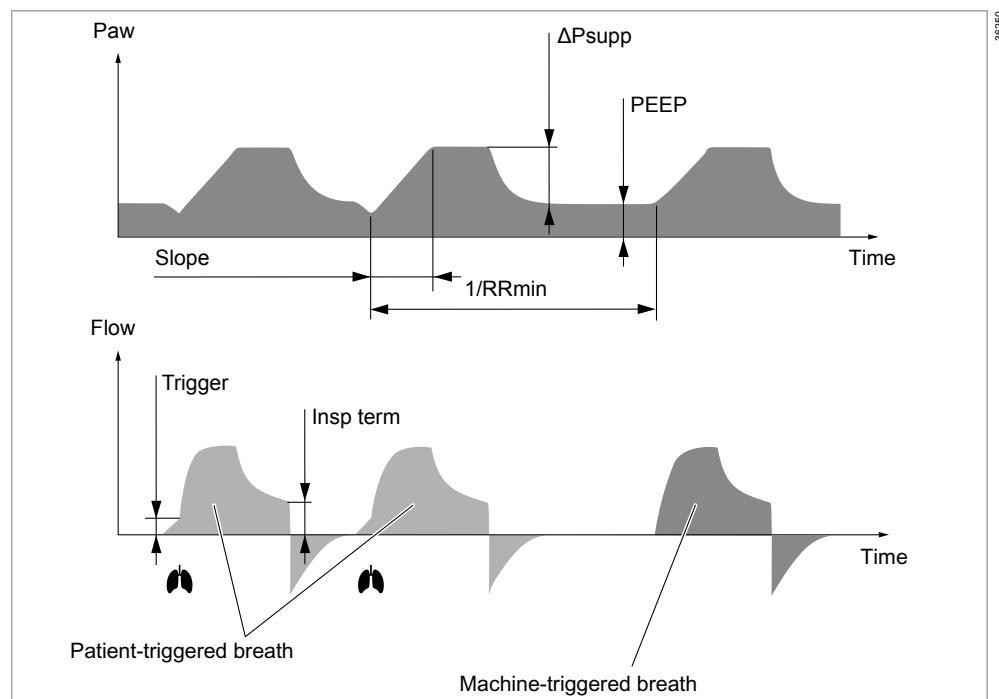
- Volume-controlled
- Pressure-limited
- Time-controlled
- Machine-triggered or patient-triggered
- Decelerating inspiratory flow
- Synchronized with inspiration and expiration

In VC - SIMV / AutoFlow, the patient can breathe spontaneously at any time, while the number of mandatory breaths is predefined. When synchronization is switched on, the breaths are adapted to the spontaneous breathing efforts of the patient. If spontaneous breathing effort by the patient is detected during the inspiratory trigger window, a mandatory breath will be initiated. If an exhalation by the patient is detected during the expiratory trigger window, the expiration will be initiated.

#### 16.2.5.9

##### **VC - SIMV / PS / AutoFlow**

This mode is similar to VC - SIMV / AutoFlow, except that the patient's spontaneous breathing at the PEEP level during the expiratory phase is pressure-supported with  $\Delta P_{supp}$  when outside the trigger window.

**16.2.6****Assisted ventilation with pressure support****16.2.6.1****PSV****16.2.6.2****CPAP / PSV**

- Spontaneous breathing
- Spontaneous breathing with continuous positive pressure level with or without pressure support

Each detected inspiratory effort at CPAP level induces a patient-triggered, flow-controlled, and pressure-supported breath. Point in time, number, and duration of pressure-supported breaths are controlled by the patient. When no inspiratory effort is detected, mandatory breaths are delivered at the set minimum respiratory rate RRmin and with pressure support  $\Delta P_{supp}$ .

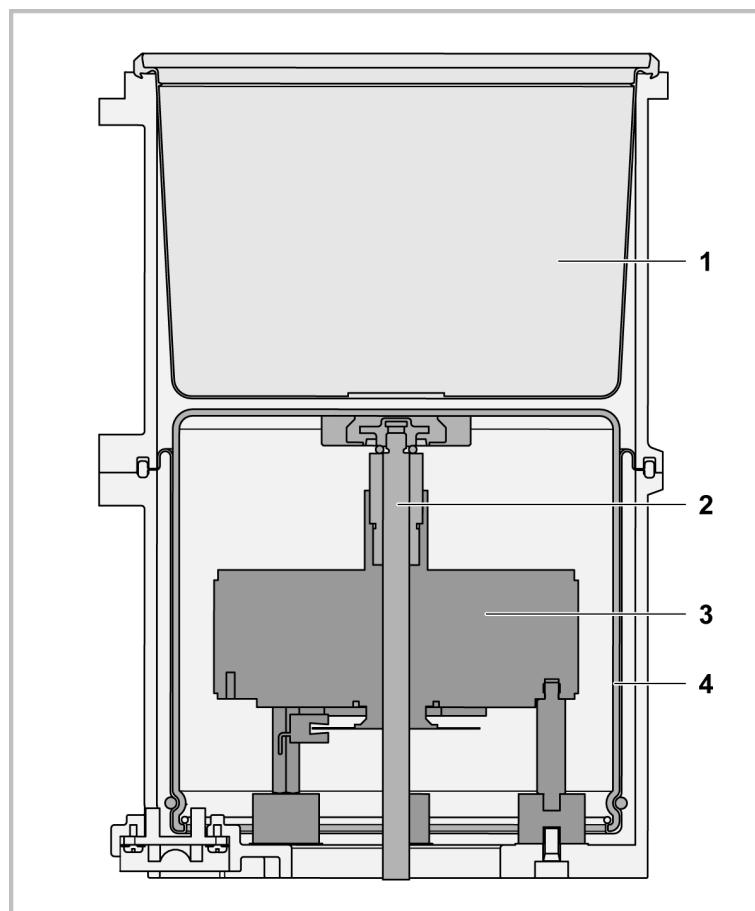
Patient-triggered breaths are ended as soon as the inspiratory flow falls below the flow defined by the Insp term setting. The duration of a machine-triggered breath is additionally defined by the patient category and the set minimum respiratory rate RRmin.

Purely spontaneous breathing at CPAP level can be achieved by setting  $\Delta P_{supp}$  to Off. In this case, the patient does not receive any more pressure-supported breaths and RRmin does not trigger any more mandatory breaths.

## 16.3 Description of the ventilation drive

### 16.3.1 Principle of operation

The device has a piston drive.



40162

#### No. Designation

- |   |                  |
|---|------------------|
| 1 | Piston diaphragm |
| 2 | Spindle          |
| 3 | Electric motor   |
| 4 | Piston           |

The piston drive is connected directly to the breathing system. The electric motor (3) moves the piston (4) by means of a spindle (2). Thus, the fresh gas is moved out of the piston diaphragm and through the breathing system to the patient.

The user can check through a viewing window whether the piston is moving. During inspiration, the ventilator applies the tidal volume with the required pressure and at a defined respiratory rate.

This principle of operation enables the following characteristics, for example:

- Precise application of the set tidal volume, regardless of the inspiratory and expiratory flow measurement.
- No drive gas is required, i.e., no medical gases are consumed in operating the ventilator.
- Mechanical ventilation remains available if the gas supply fails, see page 54.

### 16.3.2

### Detection of condensed water

This device has a humidity detection function to detect condensed water during the system test and the leakage test.

Condensed water can occur in two typical locations.

- Piston diaphragm
- Breathing circuit

The test for water in the piston diaphragm is performed by moving the piston to the top position. If a significant amount of water is present in the piston diaphragm, this water drains off and is detected by the inspiratory flow sensor.

To test for water in the breathing circuit, the piston generates a steady air flow. If a significant amount of water is present in the breathing circuit, this leads to pressure fluctuations. These pressure fluctuations are detected by the pressure sensors.

### 16.3.3

### Fresh-gas decoupling

In certain ventilation situations with anesthesia machines, operation of the O<sub>2</sub> flush can lead to undesired pressure fluctuations at the patient port, particularly if the breathing hoses have small volumes.

This device is equipped with a fresh-gas decoupling function. This function is particularly important during the ventilation of neonates and pediatric patients, as airway pressures and tidal volumes that are too high are thus avoided.

The function decouples the mechanical ventilation from the fresh-gas flow and the O<sub>2</sub> flush. Consequently, changes to the fresh-gas flow and operation of the O<sub>2</sub> flush have no influence on the applied tidal volume and the ventilation pressures.

Furthermore, the fresh-gas decoupling valve passes excess fresh gas to the breathing bag.

Proceed as follows for a better understanding of the device behavior with the fresh-gas decoupling function:

1. Connect the breathing circuit to the device.
2. Fit the Y-piece on the circuit plug of the breathing system.
3. Start a ventilation mode. Observe the measured waveforms on the screen.
4. Press the O<sub>2</sub> flush for at least 5 seconds. Observe the effect on the applied tidal volume and ventilation pressures.

#### 16.3.4

#### Minimization of the fresh-gas consumption

If the ratio between the set fresh-gas flow and the patient's minute volume is low (low-flow operation), the piston is moved back during expiration at a speed that corresponds to the patient's expiratory flow. The volume exhaled by the patient is therefore almost completely captured by the breathing system. The portion of gas disposed of via the anesthetic gas scavenging system is minimized. This has the following advantages:

- Minimization of the fresh-gas losses due to optimized utilization of the delivered fresh-gas flow
- Optimization of the breathing gas climate control by capturing the largest possible amount of humid expiratory gas in the breathing system
- Minimization of the dynamic resistance and easier exhalation for the patient
- Earlier availability of the pressure support in synchronized ventilation modes due to earlier reaching of the piston start position

With larger set fresh-gas flows, the behavior described above is restricted. More fresh gas and less exhaled patient gas is taken up by the breathing system. This shortens the gas exchange times in the breathing system.

#### 16.3.5

#### Compliance compensation

The volume delivered into the breathing circuit is not the same as the volume that the patient ultimately receives. The determining factors for this difference in volume are the elasticity of the breathing circuit and the compressibility of the gas contained within it.

When the pressure in the breathing hose rises during inspiration, there is also expansion of the hose material. The expanding breathing hose can hold a greater volume, with the result that a lesser volume reaches the patient.

This device is equipped with dynamic compliance compensation, which compensates for this volume difference during each breath. Volume is also fed to the entire system so that the set tidal volume actually reaches the patient.

The basis for the compliance compensation is the breathing hose compliance determined in the system test or in the leakage test.

#### 16.3.6

#### Dynamically adjusted breathing system compliance

The required bottom start position of the piston is calculated based on the tidal volume to be delivered plus a reserve volume for compliance compensation.

In mechanical ventilation modes, the higher the expected tidal volume, the lower the start position of the piston. In Manual / Spontaneous mode, the piston start position for the "Adults" patient category is also lower than for pediatric patients or neonates. This enables the first automatic breath to be delivered without delay when switching to a mechanical ventilation mode.

If the reserve volume is reduced at the end of the inspiration (e.g., due to leakage, uptakes, or spontaneous breathing of the patient), the piston start position is automatically lowered further in the mechanical ventilation modes.

The dynamic adjustment of the piston position reduces the dead space for the ventilation to the minimum. This increases the ventilation precision and minimizes the gas exchange times.

**16.3.7****Pressure regulation and PEEP compensation**

In mechanical ventilation modes, the set PEEP is actively adjusted during ventilation. This enables compensation for small leaks at the tube or in the breathing circuit.

In pressure-controlled ventilation modes, the pressure is controlled as described during the entire respiratory cycle.

**16.3.8****Variable PEEP for improved CO<sub>2</sub> measurement**

To improve the CO<sub>2</sub> measurement, a variably controlled PEEP ensures that the patient's expiratory gas is supplied to the sampling site during the entire expiration.

Expiration starts with a slightly increased PEEP which is lowered to a value slightly below the set value during the expiration.

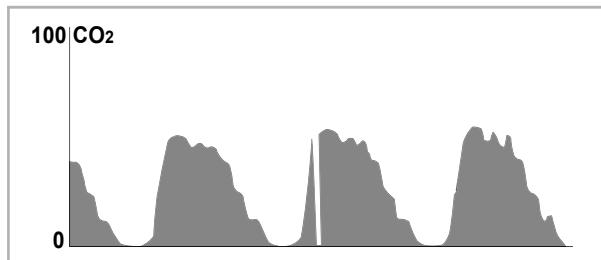
This minimizes effects such as cardiogenic oscillations in the CO<sub>2</sub> waveform and improves the measurement accuracy.

**16.4****CO<sub>2</sub> measurement with pediatric patients and neonates****16.4.1****Influence of the dead space**

To enable effective gas exchange even with small tidal volumes, the dead space has to be as small as possible when ventilating smaller pediatric patients ( $VT < \text{approx. } 30 \text{ mL}$ ) and neonates. Components between the Y-piece and the endotracheal tube, e.g., filters, present an additional dead space. These components should be avoided or be as small as possible.

Depending on the sampling site, ventilation influences such as turbulence at the Y-piece can result in unusual waveform shapes during the CO<sub>2</sub> measurement.

As a consequence, the CO<sub>2</sub> waveform, for example, may fall at the end of the expiration before the inspiration is executed, in contrast to the normal course of the waveform. In addition, cardiogenic oscillation can occur.



37888

Generally, the measured etCO<sub>2</sub> values are still valid, as these measured values correspond to the maximum expiratory values and do not follow the course of the CO<sub>2</sub> waveform.

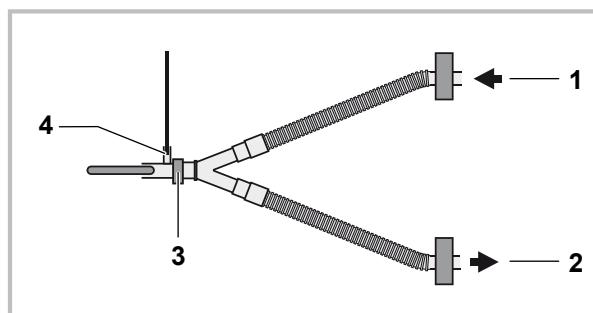
In the case of stronger influences, the measured etCO<sub>2</sub> values may be distorted.

### 16.4.2 Optimization of the sample gas quality

In the case of an unusual waveform shape or if distortion of the measured etCO<sub>2</sub> values is suspected, changing the sampling site and using a heat and moisture exchanger (HME) can be helpful.

Use only pure HMEs with a small volume for this which are listed in the list of accessories.

Do not use fine-pored filters or HME filters, as undesired blockages (e.g., caused by sputum) occur more abruptly with these than with pure HMEs. These blockages would immediately cause negative pressure in the lungs.



49569

#### No. Designation

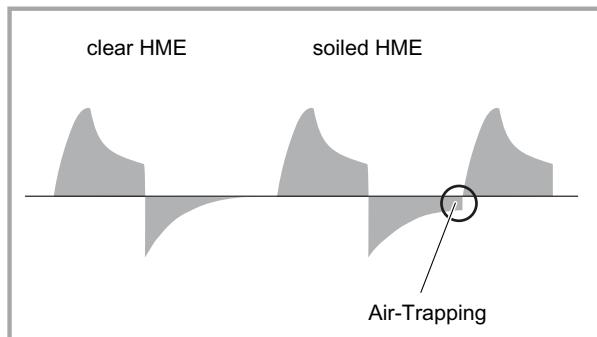
- | No. | Designation  |
|-----|--------------|
| 1   | Inspiration  |
| 2   | Expiration   |
| 3   | HME          |
| 4   | Gas sampling |

Taking the gas sample as close to the patient as possible and using an HME if necessary has the following advantages (among others):

- Optimization of the sample gas quality due to reduction of ventilation influences, e.g., turbulence at the Y-piece
- Less distortion of the CO<sub>2</sub> waveform
- Less distortion of the measured etCO<sub>2</sub> values
- The undesired influence of the dead space between the Y-piece and the sampling site is reduced. At the end of the expiration, the dead space already contains fresh inspiratory gas for the next breath.

A blockage or soiling of the HME (e.g., caused by sputum) can have the following effects in the previously described configuration:

- Increase of the HME resistance
- Negative pressure in the patient's lungs
- Increasing air trapping (detectable in the flow waveform as an incomplete expiration before the start of the next inspiration)



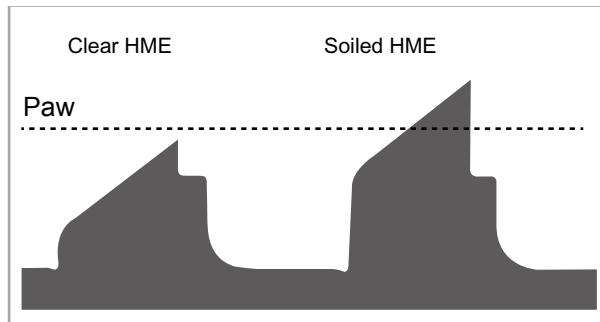
To detect any soiling of the HME as early as possible, observe the following:

- Visually check the HME with its transparent housing on a regular basis, e.g. for sputum.
- If there are signs (alarm, air trapping, visual check) that suggest a blockage of the HME, check the HME and replace it if in doubt.
- Set the alarm limits for MV low and Paw to suitable values if the HME is clear.

#### **Suitable alarm limits in volume-controlled ventilation modes (also for AutoFlow)**

If the HME is clear, set the alarm limit for Paw closely above the peak inspiratory pressure (PIP). If the HME becomes blocked or soiled, its resistance and thus the airway pressure increases. This will trigger the **Airway pressure high** alarm.

The following graphic illustrates the Paw alarm limit as a suitable indicator in the event of a soiled filter:



#### **Suitable alarm limits in pressure-controlled ventilation modes**

If the HME is clear, set the expiratory MV low alarm limit closely below the measured MV. If the HME becomes clogged or soiled, its resistance increases. As a consequence, the applied and measured expiratory tidal volume VT is reduced and the **Minute volume low** alarm is triggered.

**16.5****Breathing gas climate control when using the internal breathing system**

The patient's expiratory gas is fed back into the breathing system and the majority of it is guided through the CO<sub>2</sub> absorber, where the CO<sub>2</sub> is eliminated in a chemical reaction which also produces heat and water. During the further procedure, the patient gas heated and humidified in this way is enriched with the fresh-gas flow set at the gas mixer and used for inspiration. For further information see: "Breathing system and adjacent gas-carrying components", page 56.

In addition, the device is equipped with a breathing system warmer. The breathing system warmer reduces the condensation of water in the breathing system and compensates for the heat loss caused by the added fresh gas.

When the breathing system warmer is switched on, its heat output is based on the measured ambient temperature. The lower the ambient temperature, the higher the heat output.

The breathing system warmer can be switched off manually in the system setup.

In standby and in operation modes without fresh-gas supply via the breathing system, the heat output is reduced.

In the following situations, the breathing system warmer is switched off automatically:

- In battery operation
- In standby outside of the configured OR working hours

**16.6****Minimum O<sub>2</sub> delivery (SORC)**

Devices with 3-gas mixers are equipped with a minimum O<sub>2</sub> delivery function (SORC) which ensures that a minimum quantity of oxygen is delivered when nitrous oxide is delivered at the same time.

With electronically controlled gas mixers, the minimum O<sub>2</sub> delivery is controlled via the software. With mechanically controlled gas mixers, the minimum O<sub>2</sub> delivery is controlled via the integrated SORC.

<b>Gas mixer</b>	<b>Minimum FG O<sub>2</sub> concentration</b>		<b>Minimal O<sub>2</sub> flow</b>
	<b>Carrier gas Air</b>	<b>Carrier gas N<sub>2</sub>O</b>	
Electronically controlled	21 %	25 %	<p>Configurable for each patient category, see chapter "Vertical tab "Fresh gas" (only with electronically controlled gas mixer)"</p> <p>When the minimum O<sub>2</sub> delivery switches on, the FG O<sub>2</sub> therapy control is selected in addition to the selected therapy control. When the active set value is changed, FG O<sub>2</sub> automatically changes with it.</p>

Gas mixer	Minimum FG O <sub>2</sub> concentration		Minimal O <sub>2</sub> flow
	Carrier gas Air	Carrier gas N <sub>2</sub> O	
Mechanically controlled	21 %	21 %	<p>Continuously adjustable with flow control valves</p> <p>The SORC interrupts the N<sub>2</sub>O flow in the following cases:</p> <ul style="list-style-type: none"> <li>– N<sub>2</sub>O flow control valve open and O<sub>2</sub> flow control valve closed</li> <li>– O<sub>2</sub> flow less than 200 mL/min O<sub>2</sub> will continue to be delivered in the event of an N<sub>2</sub>O failure.</li> </ul>

## 16.7 Influence of patient category, weight, and age on device behavior

### 16.7.1 Influence of patient category

- Alarm limits and start settings for therapy
- Volumeter scale
- Flow measurement and software algorithms to suppress artifacts
- Maximum duration of a pressure-supported breath

### 16.7.2 Influence of ideal body weight and body height

Ideal body weight describes the portion of the body that is relevant to setting the ventilation parameters (body weight of the patient minus assumed excess fat).

In the Adult and Ped patient categories, the ideal body weight is calculated from the entered body height.

In the Neo patient category, the ideal body weight is equal to the entered body weight.

The calculated ideal body weight affects the following:

- Start settings for tidal volume VT
- Start settings for respiratory rate RR
- Start settings for alarm limits for VT and MV
- Ventilation algorithms
- Trigger threshold (insp. synchronization of the mandatory breaths)
- Sensitivity and resolution of the volume monitoring
- Rate of concentration changes affecting the patient

 For neonates, the patient category and the ideal body weight must be set with particular care.

VT and RR are only dependent on the ideal body weight when the ***Ideal body weight*** function has been selected in **System setup > Therapy**, see page 210.

Changing the body weight during mechanical ventilation has no effect on the current ventilation settings.

### 16.7.3 Influence of patient age

During operation, the set age influences the following:

- Calculation of MAC value

## 16.8 Support of Infinity ID accessories

The following accessories can be used if the device has the appropriate options:

- Infinity ID breathing circuit
- Infinity ID WaterLock 2 water trap
- Infinity ID flow sensors
- Infinity ID CLIC absorber

The Infinity ID functionality can be configured, see page 221.

### 16.8.1 Infinity ID functionality

#### 16.8.1.1 Replacement interval monitoring

Automatic monitoring of the period of use is available for Infinity ID products. An exceeded period of use is signaled during the system test.

The replacement interval for the connected Infinity ID accessories can be adjusted. This interval must be specified in accordance with the applicable infection prevention regulations or the requirements stated in the instructions for use for the corresponding accessory.

#### 16.8.1.2 Anti-interchange security

When Infinity ID breathing hoses and Infinity ID breathing bags are used, the incorrect connection of breathing hoses and the breathing bag is detected and reported. Hoses that are incorrectly connected with the breathing system trigger an automatic alarm.

## 16.9 Schematic illustration of the acoustic signals

### 16.9.1 Alarm signal for various alarm priorities

Alarm priority	Standard (according to IEC 60601-1-8)	Repeated
High		Yes
	Depending on the overall alarm situation, this acoustic alarm signal may also be played as only a 5-tone sequence due to the timing of the individual alarms.	
Medium		Yes
Low		No

The described acoustic alarm signals are handled by a backup loudspeaker if the primary acoustic alarm system fails. It plays the acoustic alarm signals of the high and medium alarm priorities at a constant tone frequency and unchanged volume.

### 16.9.2

### Tone signals during operation

When	Signal
Therapy start or change of ventilation mode	—●—
Timeout	●●●●●

## 17

## Annex

### 17.1

### Abbreviations

Abbreviation	Explanation
%, Vol %	Percentage gas ratio, related to total volume
A	Ampere
<b>Add. O<sub>2</sub></b>	Emergency O <sub>2</sub> delivery
AGS	Anesthetic gas receiving system
AGSS	Anesthetic gas scavenging system
Air	Medical compressed air
APL	Adjustable Pressure Limitation, adjustable pressure limitation
ASA	American Society of Anesthesiologists, american society of anesthesiologists
ATPD	Ambient Temperature and Pressure, Dry Ambient temperature and ambient pressure, dry gas
ATPS	Ambient Temperature and Pressure, Saturated Ambient temperature and ambient pressure, 100 % relative humidity
<b>Aux. O<sub>2</sub></b>	O <sub>2</sub> insufflation
BMI	Body mass index
BTSP	Body temperature, pressure, saturated 37 °C (98.6 °F) body core temperature, ambient pressure, 100 % relative humidity
CAL	Display when a measurement value is calibrated.
CBM mode	Cardiac bypass mode
<b>Cdyn</b>	Dynamic compliance (patient)
CISPR	Comité International Spécial des Perturbations Radioélectriques International special committee on radio interference
cmH <sub>2</sub> O	Centimeters of water
CMV	Controlled Mandatory Ventilation
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide

<b>Abbreviation</b>	<b>Explanation</b>
COM	Serial port
<b>CPAP</b>	Continuous Positive Airway Pressure, continuous positive air-way pressure
CSA	Canadian Standards Agency
dB(A)	Sound pressure level, A-weighted
<b>Des</b>	Desflurane
DHCP	Dynamic Host Configuration Protocol; communication protocol for assigning the network configuration to clients by a server
DSR	Device Status Report
$\Delta O_2$	Difference between inspiratory and expiratory O <sub>2</sub> concentration
<b><math>\Delta P_{supp}</math></b>	Pressure support above <b>PEEP</b>
EMC	Electromagnetic compatibility
<b>Enf</b>	Enflurane
ERR	Display when a measured value cannot be determined.
ESD	Electrostatic discharge
FG	Fresh gas
<b>FiO<sub>2</sub></b>	Inspiratory oxygen fraction
FTP	File Transfer Protocol
FTPS	File Transfer Protocol Secure
GPL	General Public Licence
<b>Hal</b>	Halothane
HF	High-frequency
HME	Heat and moisture exchanger
HMEF	HME filter
hPa	Hectopascal
Hz	Hertz
<b>I:E</b>	Ratio of inspiratory time to expiratory time
ID	Identification
<b>Insp term</b>	Inspiration termination criterion in % based on peak inspiratory flow
<b>Iso</b>	Isoflurane
kg	Kilogram
kPa	Kilopascal
L	Liter
LAN	Local Area Network
lb	Pound, unit of mass
LED	Light-emitting diode
LGPL	Lesser General Public Licence
MAC	Minimum Alveolar Concentration

Abbreviation	Explanation
<b>Man / Spon</b>	
<b>Manual / Spontaneous</b>	Manual ventilation / Spontaneous breathing
mbar	Millibar
MEDIBUS.X	Communication protocol for medical devices with uniform data definition for all devices
min	Minute
mL	Milliliter
mmHg	Millimeter of mercury
MPa	Megapascal
<b>MV</b>	Minute volume
<b>N<sub>2</sub>O</b>	Nitrous oxide
NTP	Network Time Protocol, standard for synchronizing clocks
<b>O<sub>2</sub></b>	Oxygen
<b>O<sub>2+</sub></b>	<b>O<sub>2</sub></b> flush
<b>Pa</b>	Pascal; unit of pressure
<b>Paw</b>	Airway pressure
<b>PEEP</b>	Positive end-expiratory pressure
PGM	Patient-gas measurement module
<b>Pinsp</b>	Inspiratory pressure
<b>PIP</b>	Peak inspiratory pressure
<b>Pmax</b>	Maximum pressure
<b>Pmean</b>	Mean pressure
png	Graphics format
<b>Pplat</b>	Plateau pressure
ppm	Parts per million
QR code	Quick Response Code
<b>R</b>	Resistance
RFID	Radio Frequency Identification, radio frequency identification
<b>RR</b>	Respiratory rate
<b>RRmin</b>	Minimum respiratory rate
SCG	ServiceConnect Gateway
<b>Sev</b>	Sevoflurane
<b>Slope</b>	Pressure rise time
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SORC	Sensitive Oxygen Ratio Controller, minimum O <sub>2</sub> delivery
STAPD	Standard Temperature, Ambient Pressure, Dry 20 °C (68 °F), ambient pressure, dry gas

Abbreviation	Explanation
STPD	Standard Temperature and Pressure, Dry 20 °C (68 °F), 1013 hPa, dry gas
<b>TC</b>	Time constant
TCP	Transmission Control Protocol
<b>Ti</b>	Inspiratory time
TLS	Transport Layer Security (encryption protocol)
UDP	User Datagram Protocol
UMDNS	Universal Medical Device Nomenclature System Nomenclature for medical devices
USB	Universal Serial Bus
<b>V</b>	Volt
<b>VT</b>	Tidal volume
<b>xMAC</b>	Accumulated multiple of the MAC values of anesthetic agents and N <sub>2</sub> O

## 17.2 Symbols

Additional information about the symbols is available on the following web page:  
[www.draeger.com/md-symbols](http://www.draeger.com/md-symbols)

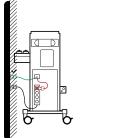
Symbol	Explanation
	Manufacturer
	Date of manufacture
	The product is a medical device (CE conformity assessment procedure)
	Disposal of electrical and electronic devices in accordance with the WEEE Directive
	Follow the instructions for use
	Follow the instructions for use
	Caution
	General warning
	Risk of tipping over! Do not grasp the device above this sign to push it or pull it.
	Group <b>Views...</b>
	Group <b>Trends/Data...</b>
	Group <b>Alarms...</b>

Symbol	Explanation
	<b>Procedures...</b> group
	Group <b>System setup...</b>
	Group <b>Start.../Standby...</b> Device on/ <b>Standby</b>
	Key: Start/Standby
	Main switch on
	Main switch off
	Patient category <b>Neo</b>
	Patient category <b>Ped</b>
	Patient category <b>Adult</b>
	Acoustic alarm signal is temporarily suppressed.
	Alarm silence
	Alarm inactive
	Alarm temporarily inactive
	Mains power
	Mains power unavailable
	Battery
	Battery completely charged
	Battery empty
	Central supply connected and pressure within specified range
	Central supply not connected or pressure not within specified range
	Gas cylinder full
	Gas cylinder empty or gas cylinder valve turned off
	Gas cylinder pressure sensor not connected
	Symbol for programmed Auto On

Symbol	Explanation
	Oxygen cylinders on this side of the device only
	No oxygen cylinders on this side of the device
	Key for switching on and off and dimming the workplace illumination
	Emergency O <sub>2</sub> delivery ( <b>Add. O<sub>2</sub></b> )
	Applied part of type BF (body floating)
	Potential equalization connector
	Closes the dialog
	Upper alarm limit
	Lower alarm limit
	No alarm limit
	Spontaneous breathing activity by the patient
	In lists: One line up
	In lists: One line down
	In lists: One page up
	In lists: One page down
	Risk of crushing
	Devices sensitive to electrostatic discharge Observe the information on electromagnetic compatibility.
	Devices sensitive to electrostatic discharge Observe the information on electromagnetic compatibility.
	Locked
	Unlocked
	Inspiration Labeling on breathing system and breathing system cover
	Expiration Labeling on breathing system and breathing system cover
	Breathing bag

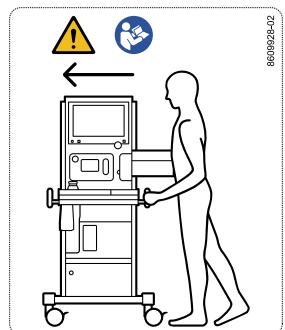
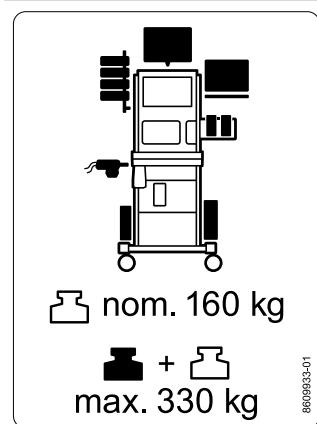
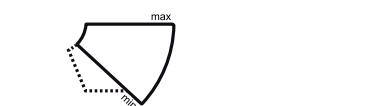
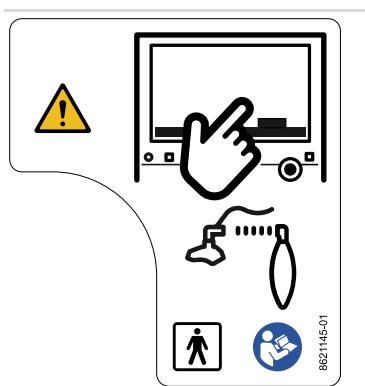
Symbol	Explanation
	Vaporizer plug-in system, "fixed" position
	Auto Exclusion Plug-in connection
	Part number
	Serial number
	Lot number
	Use by: YYYY-MM-DD Expiration date
	Warning of hot surfaces
	Do not touch the device
	Store protected against sunlight
	Storage temperature range
	Relative humidity range
	Ambient pressure range
	The product contains hazardous substances
	Do not use if the packaging is damaged
	Information on packaging material (for numbering, see 97/129/EC)
	Not for reuse
	Spare part
	LAN connection
	USB port
	Connector for workplace light
	External fresh-gas outlet
	CO <sub>2</sub> absorber bypass
	Enter key
*	Indicates a changed view which has not yet been saved
	Identifies the tabs that lead to the page with the language settings.
	Read the flow at the center of the float.

Symbol	Explanation
	Advanced Cylinder Support
	Identifies N <sub>2</sub> O cylinders. The color code conforms to the locally applicable standard.
	Identifies O <sub>2</sub> cylinders. The color code conforms to the locally applicable standard.
	Identifies Air cylinders. The color code conforms to the locally applicable standard.
	Maintain the correct minimum distance between electrical connectors and gas cylinders, see product label on the device.
	Electrical connector on the device
	When connecting auxiliary devices, be aware of the leakage current. Observe chapters "Assembly and preparation" and "Technical data".
	Gas outlet
	Gas inlet
	Manually screw or unscrew the pneumatic connection nozzles into/from the breathing system mount. The corresponding positions are indicated by arrows on the breathing system mount. For further information, please refer to the reprocessing instructions supplied with the product.
<b>Total</b>	Display on the total flow tube indicating the cumulative value of the individual flows
	Do not use this device in the vicinity of MRI scanners.
	Example representation of the weight distribution of the nominal weight and the maximum total weight, see "Technical data".
	Weight: Main device
	Weight: Load
	Do not place or attach any weight.
	Activate backup manual mode.
	Switch to "Add. O <sub>2</sub> ".

Symbol	Explanation
	Set fresh gas on O <sub>2</sub> flowmeter.
	Set fresh-gas flow.
	Set fresh-gas flow.
	Ventilate manually.
	Check vaporizer setting.
	Backup manual mode
	Direct connection from mains supply to device

## 17.3

## Product labels

Product label	Explanation
	Transport instructions (see "Intrahospital transport", page 75)
 <p>nom. 160 kg + max. 330 kg</p>	Observe the weight of the nominal configuration and the permissible total weight (see "Technical data", page 272).
	Ensure that the control dial of the vaporizer is correctly positioned. Do not leave the control dial in the "T" position while the vaporizer is connected to the medical device.
	Observe the correct flow of the anesthetic gas receiving system (see "Anesthetic gas receiving system", page 133).
	If a non-rebreathing system is connected, make sure that the operation mode <b>Ext. FGO</b> is used. For more information, see "Special forms of therapy" in the chapter "Operation".

## 17.4

## Overview of the menu structure

The following tables list the buttons of the main menu bar with the resulting dialogs of the same name and the tabs. For further information see: "Operating concept", page 97. The structure of the main screen and the dialogs is illustrated on pages 97 and 98.

<b>Group </b>			
<b>Button in main menu bar</b>	<b>Horizontal tab</b>	<b>Vertical tab</b>	<b>Description</b>
Alarms...	Limits		Display or change alarm limits.
	Current alarms		Display information on active alarms.
	Logbook		View alarm logbook.
	Settings		Set the alarm volume. Activating or deactivating CO <sub>2</sub> alarms <sup>1),2)</sup> . Switch CBM mode on or off <sup>1)</sup> .
CO <sub>2</sub> alarms off <sup>1),2),3)</sup>			Deactivate CO <sub>2</sub> alarms.
Autoset limits <sup>1),4)</sup>			Automatically adapt alarm limits to current measured or set values.
Exit CBM <sup>1),5)</sup>			Exit CBM mode.

1) Only during operation, not in Standby mode

2) Only available for the device equipped with integrated patient-gas measurement module

3) Only in the modes: Manual / Spontaneous, Ext. FGO, Pause, Monitoring

4) Only in the modes: PSV, PC, VC - CMV / AutoFlow, VC - CMV

5) Only in CBM mode

<b>Group </b>			
<b>Button in main menu bar</b>	<b>Horizontal tab</b>	<b>Vertical tab</b>	<b>Description</b>
Views... <sup>1)</sup>			Switch to other configured views. Reset current view to start setting. Display alarm limits, units, mini-trends, and loops.
 View <sup>1)</sup>			Switching between the 3 configured views.
 View <sup>1)</sup>			
 View <sup>1)</sup>			
Export screenshot			Export screenshot to a USB mass storage device.

1) Only during operation, not in Standby mode

<b>Group</b> 			
<b>Button in main menu bar</b>	<b>Horizontal tab</b>	<b>Vertical tab</b>	<b>Description</b>
Trends/Data...	Graphical trends	Overview	Display graphical trend of measured values.
		Vent. 1	
		Vent. 2	
		Anesthesia	
	Tabular trends	Overview	Display tabular trend of measured values.
		Vent. 1	
		Vent. 2	
		Anesthesia	
	Values	Ventilation 1)	Display overview of current measured values.
		Gases 1)	
		Device	
	Logbook		Display the logbook.
	Export 2)		Export data to a USB mass storage device.

1) Only during operation, not in Standby mode

2) Only in Standby mode

<b>Group</b> 			
<b>Button in main menu bar</b>	<b>Horizontal tab</b>	<b>Vertical tab</b>	<b>Description</b>
Procedures... <sup>1)</sup>	Insp./Exp. hold		Starts a maneuver during ventilation.

1) Only during operation, not in Standby mode

<b>Group</b> 			
<b>Button in main menu bar</b>	<b>Horizontal tab</b>	<b>Vertical tab</b>	<b>Description</b>
System setup...			Configure device functions and start settings, see page 203.
Tests... <sup>1)</sup>			Display test results. Test the system.

1) Only in Standby mode

<b>Group</b> 			
<b>Button in main menu bar</b>	<b>Horizontal tab</b>	<b>Vertical tab</b>	<b>Description</b>
Start... <sup>1)</sup>			Begin or continue a case.
Standby... <sup>2)</sup>			End the case.

1) Only in Standby mode

2) Only during operation, not in Standby mode

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