# Cato® edition

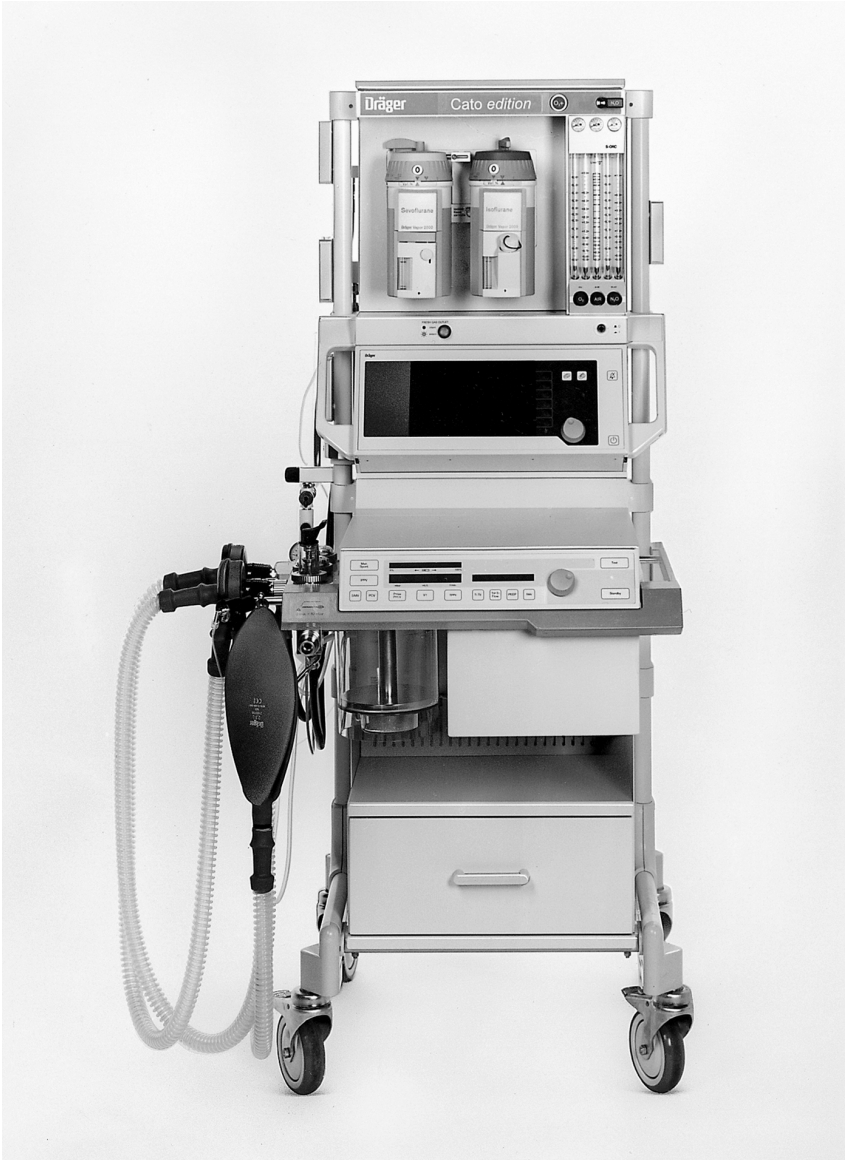
## Anaesthetic Workstation

Instructions for Use

**Software versions:**

Ventilator: ..... 7.n

Monitor: ..... 2.n




MT-438-2000

# Working with these Instructions for Use

**In the header line...**
**the subject of the main section**
The sub-section title is given underneath the main title to help you find your way rapidly through the manual.

**Page body**
**Instructions for Use**
in text-graphic combination. The information is translated directly into physical actions that teach the user in practical steps how to use the apparatus.

**Left-hand column...**
**the text**
contains explanations and guides the user in the operation of the product with concise, clear and unmistakable instructions in ergonomic sequence.
The bullets (dots) indicate separate steps, and, when several steps are described, the numbers indicate details in the illustrations and also specify the order of action.

**Right-hand column...**
**the illustrations**
provide a visual reference for the text and make it easier to locate the various parts of the equipment. Details mentioned in the text are highlighted. Irrelevant details are omitted.

The user is also prompted by screen displays which confirm the operating sequence.



## Manual / Spontaneous

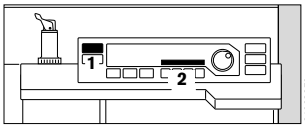
**Before connecting a patient**

- Check workstation with checklist (see page 21).
- – Check that breathing system is complete (see page 20) and
- – perform leakage test (see page 31).

**Select Manual / Spontaneous mode**

1 Press »**MAN/SPONT**« on ventilator for at least one second –

2 Display in dialogue field:
**MAN/SPONT**



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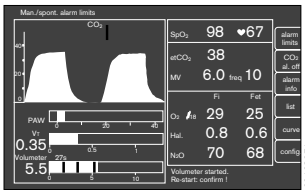
**The standard screen appears with the alarm limits for MAN/SPONT mode.**



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**Spontaneous breathing**

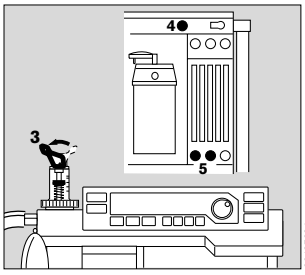
»**PEEP**« and pressure limitation »**Pmax**« are inactive.

3 Set pressure limiting valve APL to »**SPONT**«.
It is now open, regardless of the set pressure.

**To fill system:**

4 Press »**O2 +**« to inflate the breathing bag rapidly –

5 Set fresh gas –
detailed information on setting the fresh gas flow can be found in the Annex on page 130.



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# Contents

# For Your Safety and that of Your Patients

### Strictly follow the Instructions for Use

Any use of the apparatus requires full understanding and strict observation of these instructions. The apparatus is only to be used for purposes specified here.

### Maintenance

The apparatus must be inspected and serviced regularly by trained service personnel at six monthly intervals (and a record kept).
Repair and general overhaul of the apparatus may only be carried out by trained service personnel.
We recommend that a service contract be obtained with DrägerService and that all repairs also be carried out by them. Only authentic Dräger spare parts may be used for maintenance.
Observe chapter "Maintenance Intervals".

### Accessories

Do not use accessory parts other than those in the order list.

### Not for use in areas of explosion hazard

This apparatus is neither approved nor certified for use in areas where combustible or explosive gas mixtures are likely to occur.

### Safe connection with other electrical equipment

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

### Liability for proper function or damage

The liability for the proper function of the apparatus is irrevocably transferred to the owner or operator to the extent that the apparatus is serviced or repaired by personnel not employed or authorized by DrägerService or if the apparatus is used in a manner not conforming to its intended use.

Dräger cannot be held responsible for damage caused by non-compliance with the recommendations given above. The warranty and liability provisions of the terms of sale and delivery of Dräger are likewise not modified by the recommendations given above.

Dräger Medizintechnik GmbH

# Intended use

## Anaesthetic Workstation Cato®

Universally applicable anaesthetic workstation for

- Inhalation anaesthesia in semi-closed systems
- Inhalation anaesthesia in virtually closed systems with »low flow« and »minimal flow« techniques for minimum gas and anaesthetic consumption, with:
- Inhalation anaesthesia in non-rebreathing systems with separate fresh gas outlet for connecting e.g. Kuhn system.
- Automatic ventilation (IPPV)
- Synchronized intermittent mandatory ventilation (SIMV)
- Manual ventilation (MAN)
- Spontaneous breathing (SPONT)

**The workstation must only be used under the supervision of qualified medical staff, so that help is available immediately if any faults or malfunctions occur.**

**Explosive anaesthetic agents, such as ether or cyclopropane, must not be used due to the risk of fire!**

**The equipment cannot distinguish between different anaesthetics. Dräger cannot accept any liability if the wrong anaesthetic is used!**

**Additional electric devices clipped into the top of the unit must be connected to the base unit via an equipotential bonding (earthing) conductor.**

**Do not use mobile phones within a distance of 10 metres from the machine.**
Mobile phones can cause interference to electrical and electronic medical appliances, thereby putting patients at risk.*

**Do not use Cato® for nuclear spin tomography.**
The functioning of the apparatus may be impaired.

Since this equipment is not approved for use with inflammable anaesthetics (ether, cyclopropane, etc.), it is not necessary to use antistatic (conductive) breathing hoses or face masks.

Conductive breathing hoses and face masks may cause burns during high-frequency surgery and are therefore not recommended for this equipment.

The workstation should be moved **using the handles only**.

* Dräger medical appliances comply with the interference immunity requirements of the specific standards for the products or EN 60601-1-2 (IEC 601-1-2). However, depending on the design of the mobile phone and situation of use, field strengths may occur in the immediate environment of a mobile phone that exceed the values of the standards quoted and therefore cause interference.

**Measurement and monitoring functions:**

- Measurement of the ventilation parameters: pressure, flow, $O_2$ concentration (inspiratory and expiratory)
- Continuous measurement of the $CO_2$ concentration and $N_2O$/anaesthetic concentration (halothane, enflurane, isoflurane, sevoflurane, desflurane). The flow rate for sampling the measuring gas can be varied and is returned to the circulation.
- Automatic adjustment of the alarm limits for automatic ventilation IPPV.
- Anaesthetic vaporizer with automatic Vapor recognition[1)].

Optional:

- ❍ Continuous non-invasive measurement of the functional $O_2$ saturation.
- ❍ Measurement of the inspiratory breathing gas temperature.
- ❍ Expiratory $O_2$ value.

**The following values are indicated:**

- Continuous curve for airway pressure, peak and plateau pressure, mean pressure and PEEP.
- Patient compliance.
- Expiratory minute volume, tidal volume and respiration rate.
- Expiratory flow curve.
- Inspiratory and expiratory $O_2$ concentration.
- Inspiratory and expiratory concentration of $N_2O$ and anaesthetic halothane, enflurane, isoflurane, sevoflurane and desflurane.
- Inspiratory and end-expiratory $CO_2$ concentration (in$CO_2$ and et$CO_2$).
- Continuous $CO_2$ curve.
- List entries and trend displays.

Optional:

- ❍ Functional $O_2$ saturation, pulse rate, plethysmogram.
- ❍ Inspiratory breathing gas temperature.
- ❍ Expiratory $O_2$ value.

1) Refer to the separate Instructions for Use for the Vapor!

**The following parameters are monitored:**

- Airway pressure.
- Expiratory minute volume.
- Inspiratory $O_2$ concentration.
- Inspiratory and expiratory $CO_2$ concentration.
- Inspiratory anaesthetic concentration.

Optional:

❍ Functional $O_2$ saturation and pulse.

❍ Inspiratory breathing gas temperature with invariable upper alarm limit.

## Accessories

– **Patient monitoring**

Optional monitor PM 8060 vitara[1)].

Parameter box for patient monitoring and measurement of the haemodynamic patient values.

- ECG/arrhythmia analysis.
- Pulse rate.
- Respiration.
- Invasive (2 channels) and non-invasive blood pressure.
- Functional $O_2$ saturation and pulse.
- Body temperature (2 channels).

– **Aquapor**[1)]
for humidifying and heating the breathing gas.

– **Secretion aspirator**[1)]

– **Vapor**[1)]
Anaesthetic vaporiser for halothane, enflurane, isoflurane and sevoflurane.

– **Connection for two "Vapor" anaesthetic vaporisers**[1)]

– **Devapor**[1)]
Anaesthetic vaporiser for desflurane.

– **Anaesthetic gas scavenging system**[1)]

– **Uninterruptible power supply**[1)]

1) Refer to the separate Instructions for Use for this equipment!

# Quick start in an emergency

- Plug the gas connectors into the gas supply wall sockets.

**1** The $O_2$, AIR and $N_2O$ pressure gauges must be in the green range.

- Plug the power plug into the mains.

**2** Press the master switch.
All the LEDs on the ventilator light up.

**3** Press the key for the desired operating mode on the ventilator –

Recommendation: hold down MAN SPONT for longer than 1 second.

**4** The following message is displayed in the display window of the ventilator:

**Test 3 x discont** (example)

Number of times that the self-test has been interrupted for a quick start since it was last completed successfully.

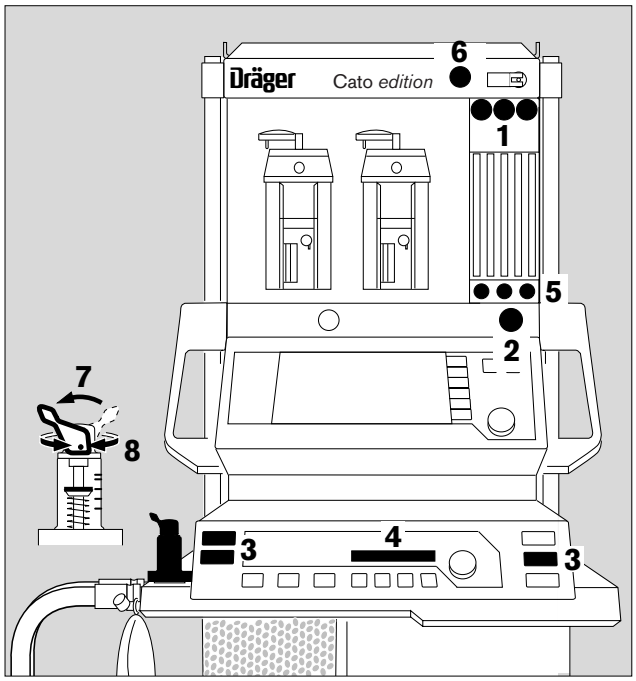
- Set the selector switch to »**$N_2O$**« or »**AIR**«.

**5** Deliver fresh gas.

**6** Press O2 flush – if necessary –
to fill the system and the breathing bag rapidly.

**7** Switch the pressure limiting valve (APL) to »**MAN**«.

**8** Set maximum pressure. Turn the lever of the pressure limiting valve clockwise until the indicator (plate) stands at maximum pressure.




No more than ten consecutive quick-starts are allowed between two complete self-tests. This maximum is only permitted if the previous completed self-test revealed no fault.
After the 10th consecutive quick-start, the following message appears in the ventilator display window:

**last cancel**

If a further attempt is made to cancel the self-test and carry out a quick start, the following message is displayed:

**COMPLETE TEST**

**Quick-start not permitted.**
**A complete self-test must be carried out before start-up is possible.**

However, in all cases, manual ventilation is always possible.

Quick-start can be started at any time, even while a self-test is in progress.

## Power failure (manual ventilation is still possible)

- The master power switch must be pressed. The audible power failure warning is muted after 45 seconds.
- Deliver fresh gas and set the pressure limiting valve (APL). If necessary press the $O_2$ Flush key (»**$O_2$ +**«).

If there is a power failure, the ventilator piston is forced back to its end position by the airway pressure, thereby increasing the system volume by max. 1.4 litre.

## Gas failure

**If AIR** (medical compressed air) **fails**

– Cato automatically switches over to $O_2$.

**If $O_2$ fails**

– Cato automatically switches over to AIR. An audible warning is emitted ($O_2$ shortage warning). $N_2O$ delivery is blocked:

**If $O_2$ and air fail:**

**Ventilate the patient immediately with the separate emergency ventilation bag!**

## Auto-WakeUp

Manual ventilation cannot be performed in standby mode. Any attempt to perform manual ventilation in standby mode is detected by the system on account of the pressure thrust in the breathing bag and it automatically switches to »**MAN/SPONT**« mode in which manual ventilation can then be performed. The background lighting of the flow measuring tubes goes on at the same time.

The system is protected against excess static pressures:

The system pressure is relieved automatically if an excess static pressure of more than 30 mbar is present for more than 60 seconds.

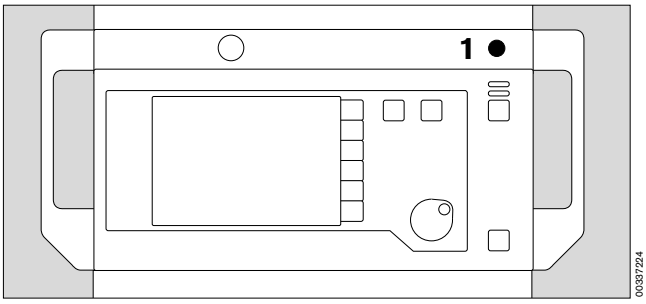
Dräger recommends that manual ventilation should always be started by pressing the »**MAN/SPONT**« key.

# Operating concept

## Contents

# Operating concept, general

## Master switch for electricity supply



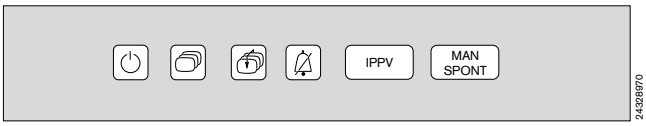

Master switch

**1** Press to switch on

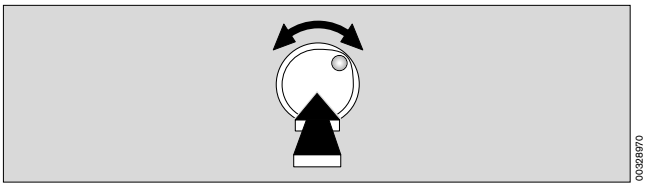
**Dialogue:**
Monitor and ventilator feature a dialogue with the user mediated by:

- keys,
- rotary controls,
- displays and
- beeps.

Basic conditions of the operating state are established by adjusting the delivery valves or pressure limitation (e.g. APL valve).




- **Keys:** For direct command input




- **Rotary control:**
  For selection by ...

  ... **turning**

  This causes a cursor frame (on the screen) to be moved or a variable numerical value (on the display window of the ventilator or on the screen) to be changed.

  ... **pressing**

  The value selected with the rotary control is adopted as a valid parameter or a process is started or ended.

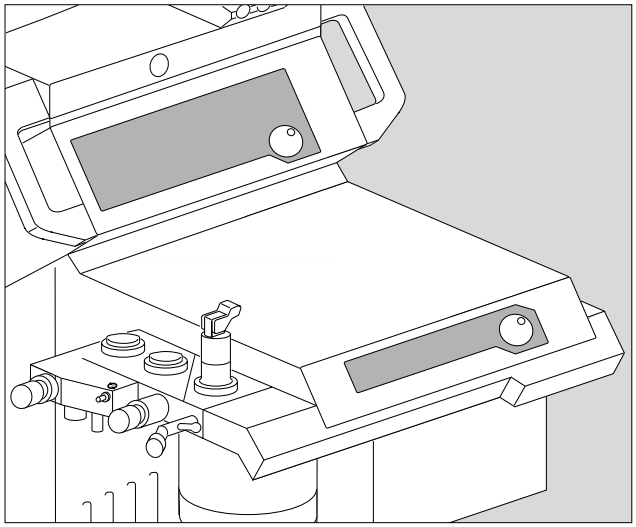
- **Displays:** For presenting all information on the screen and on the display windows of the ventilator.

- **Tone sequences:**
  As an acoustic supplement to the messages. They are coupled with certain sounds or tone sequences, according to priority classes.

  Tone sequences accompanying warnings are output continuously, every 30 seconds with caution messages and only once in conjunction with advisory messages. These are to draw the user's attention to the messages which appear simultaneously in the displays.

  European Standard EN 740 stipulates use of EN tones.
  Alternatively there are tones in keeping with Dräger conventions available.

# Operating concept of the ventilator




## Keys with dedicated function – for setting the operating modes

Left-hand side:

MAN SPONT — Key for manual ventilation or spontaneous breathing.

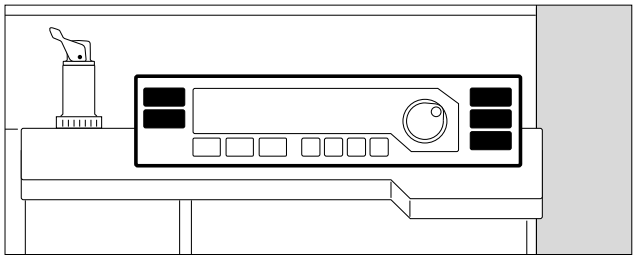
IPPV — Key for IPPV mode.

Right-hand side:

TEST — Key for leakage test and compliance measurement.

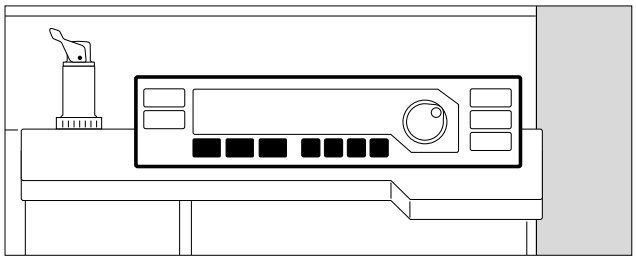
SIMV — Key for SIMV mode.

⏻ — Standby key.




## for setting ventilation parameters

Below the display window:




Pmax — Key for setting the maximum pressure for IPPV and SIMV ventilation.

Vt — Key for setting the tidal volume.

$f_{IPPV}$ — Key for setting the ventilation frequency in IPPV mode.

$T_I : T_E$ — Key for setting the time ratio between inspiration and expiration.

$T_{IP} : T_I$ — Key for setting the relative inspiratory pause.

PEEP — Key for setting the PEEP pressure for IPPV mode.

$f_{IMV}$ — Key for setting the ventilation frequency in SIMV mode.

## Display window without dialogue function

Top left:

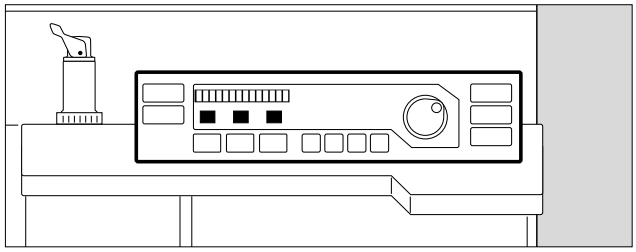
Continuous indication of the relative piston movement (in % referred to the set stroke volume $V_T$)

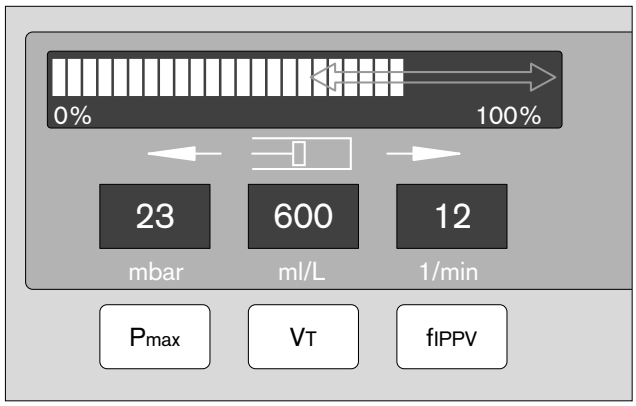
The set operating parameters correspond with the keys below:

– Indication of the maximum pressure $P_{max}$ in mbar.

– Indication of the tidal volume $V_T$ in mL or L.

– Indication of the ventilation frequency $f_{IPPV}$ in breaths per minute.




## Display window with dialogue function
**(in combination with the rotary control)**

Example: adjusting the maximum pressure

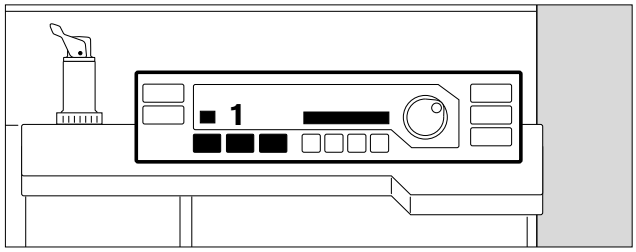
In the black field, beside the rotary control:

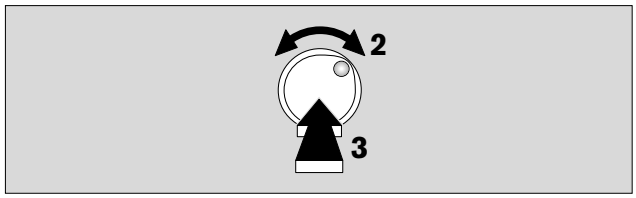
**1** The set value appears on the right and left-hand sides of the field when a parameter key ($P_{max}$, $V_T$, $f_{IPPV}$) is pressed. Here: »**23**«.

**2** The value on the right-hand side is changed by turning the rotary control. Here: »**28**«.
The old and new values are consequently always displayed together.

**3** The value on the right («**28**«) is confirmed as the definitive value by pressing the control.

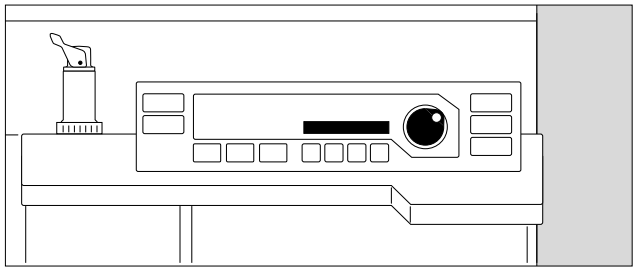
If the rotary control is not pressed and not turned again, the machine is reset after 10 seconds without changing the setting.


● This dialogue window also displays advisory messages (see page 78) –

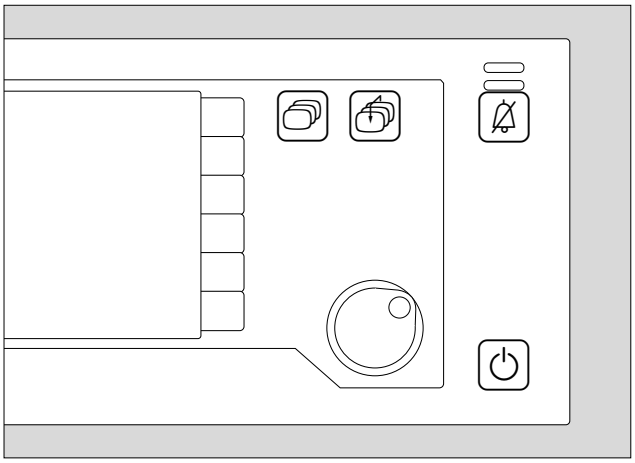
Example: »**Paed. hoses !**«:

# Operating concept of the monitor

## **Keys with dedicated function** (Hardkeys)

The right-hand side is reserved for operating elements, the left-hand side for displays.




This key switches the monitor from standby to measuring mode and vice versa.

**The monitor mode depends on the ventilator mode:**

Standby can only be selected on the monitor if the ventilator is also in standby.
The monitor starts up when the ventilator is started.

This key is used to deactivate the alarm tone for two minutes. It is reactivated by pressing the key again. The yellow LED in the key lights up while alarms are suppressed.

Inside the dark area, there are two keys acting directly on the screen contents:

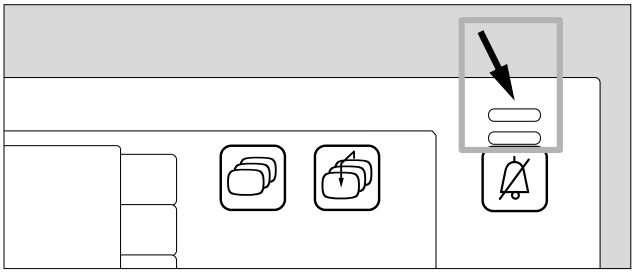
This key is used to switch directly from one screen to the next in succession.

This key is always used to call up the »**Standard screen**« (see page 57).

## Displays


Two bar-shaped indicator lamps are located above the key: these lamps continue to indicate the alarm states even when the acoustic alam is switched off.

| | | |
|---|---|---|
| Red (upper) lamp, flashing: | **Warning** | **!!!** |
| Yellow (lower) lamp, flashing: | **Caution** | **!!** |
| Yellow lamp, constant: | **Advisory** | **!** |




## Measured values with grey numerals

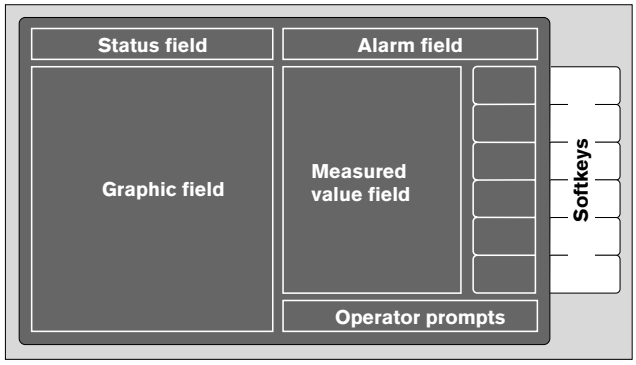
Measured values generated by an uncalibrated sensor are shown in grey type. This may be due to the following causes:

– Self-test has been aborted.

– Automatic sensor calibration is in progress.

– The measuring equipment for the anaesthetic gas composition has not yet reached the required working temperature when the system is started.

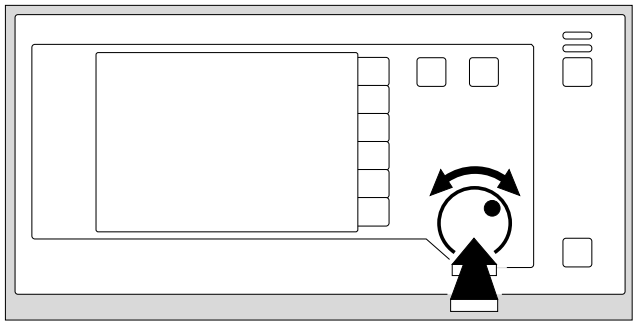
## Screen structure




- **Status field** top:
  contains information on the current alarm mode of the monitor.
- **Alarm field** top:
  indicates any alarms and their priority.
- **Graphic field** left:
  for curves and bar graphs.
- **Measured value field** right:
  for the most important numerical values.
- **Operator prompts** bottom right:
  prompts to guide the operator.
- **Softkeys** right:
  for rapid selection of the functions displayed on the screen.

## Screen saver

If none of the operating elements on the monitor is operated in »**standby**« for approx. 2 minutes, the screen switches off and becomes dark. The yellow LED in the standby key and the word »**standby**« on the ventilator light up. The monitor display is immediately restored as soon as any key is pressed.




## Rotary control

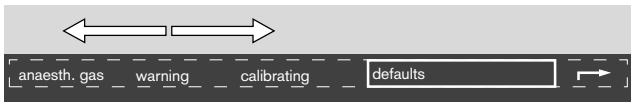
Selection and adjustment with a single control.

**For example:**
**Adjusting the volume of the pulse tone**

after calling up the menu of default values via the softkey »**config**.« in standby (after entering a code).

- Turn rotary control = selection.

  The cursor frame moves horizontally in the dashed area.

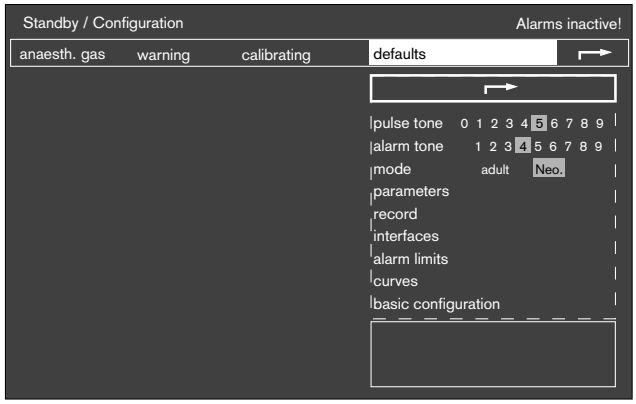


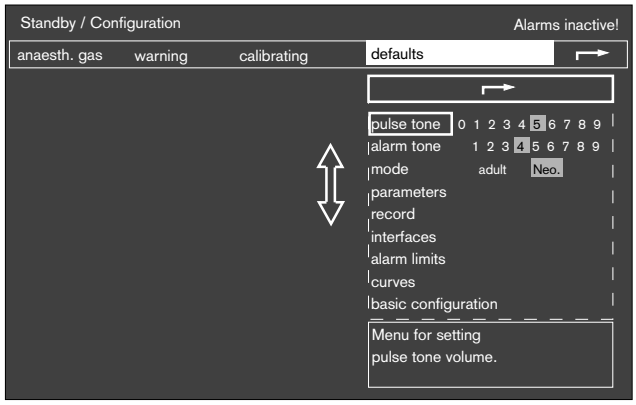

- Press rotary control = confirm selection.

  The selection is confirmed and appears in dark type on a light background. The cursor frame is positioned over the arrow symbol ( ⮡ ) to the next higher menu.

- Turn rotary control = the cursor frame moves vertically inside the dashed area.

  Select pulse tone.



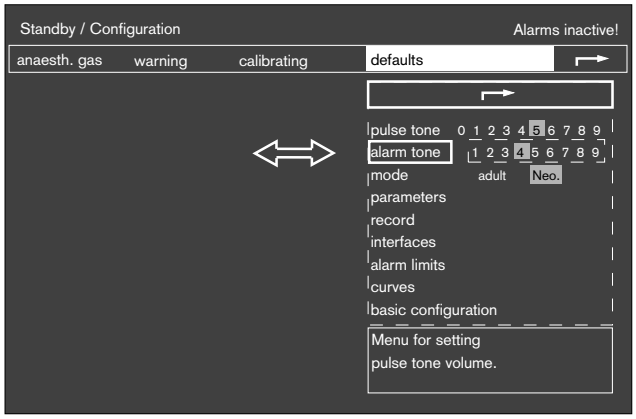



- Press rotary control = confirm selection.

  The selection is confirmed and appears in dark type on a light background.

- Turn rotary control = select new setting.
- Press rotary control = confirm selection.

  The cursor frame is now on the arrow symbol ( ⮡ ) to the next higher menu.



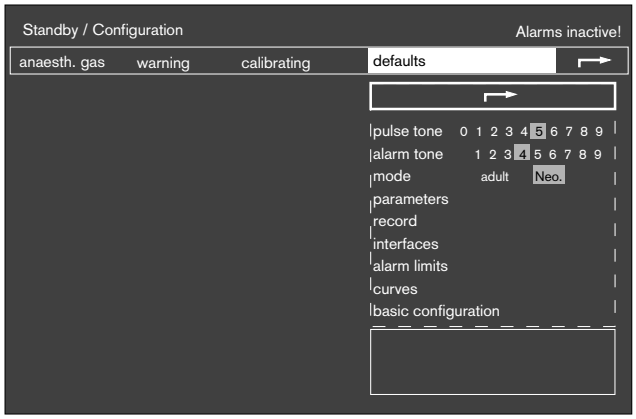

- Turn rotary control = select new setting.

  Or:

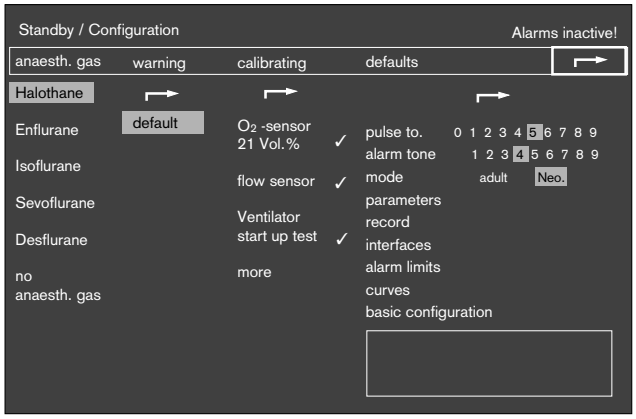
- Press rotary control again = close submenu »**defaults**«.

  The cursor frame is on the arrow symbol ( ⮡ ) to the next higher menu.

The current configuration is indicated by the fields with grey background.



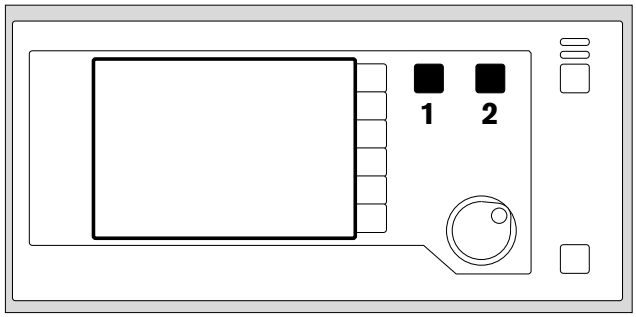

- Press rotary control again = exit menu.



## The various screen displays

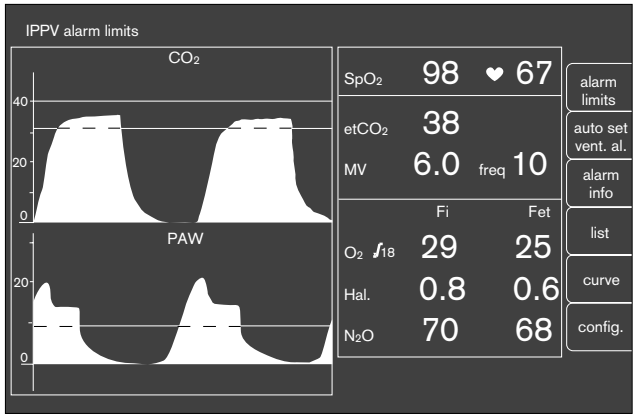
1 The three different screen displays are invoked by pressing .

2 Press to return to the standard screen from any screen display.



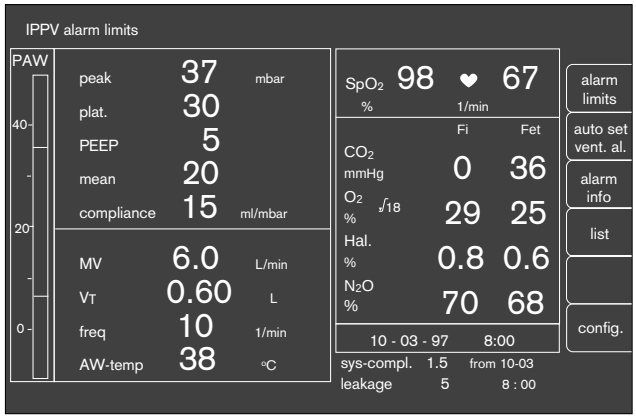

### The standard screen

with the **$CO_2$ curve** and **another** selectable curve. The most important measured values are grouped together on the right.



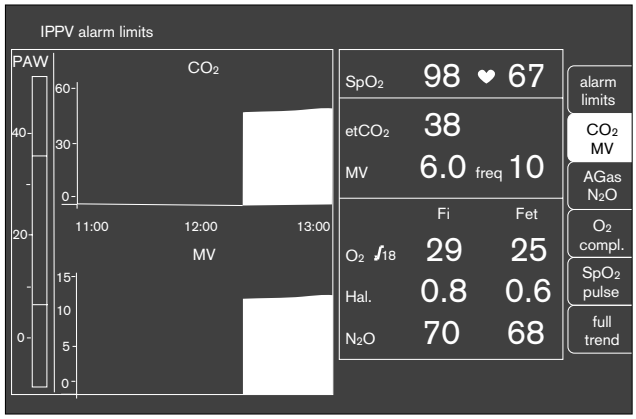

### The data screen

contains **all** measured values with their units of measure; simplifies the completion of the anaesthesia record.




### The trend screen

for displaying the **changes in measured values** since measurement started.
The **current measured values** are shown on the right.



# Preparing for use

## Contents

# Connecting the equipment

The equipment must have been stripped down and tested beforehand!

## Electricity and gas supply

**1** Plug the power cable into the mains socket.

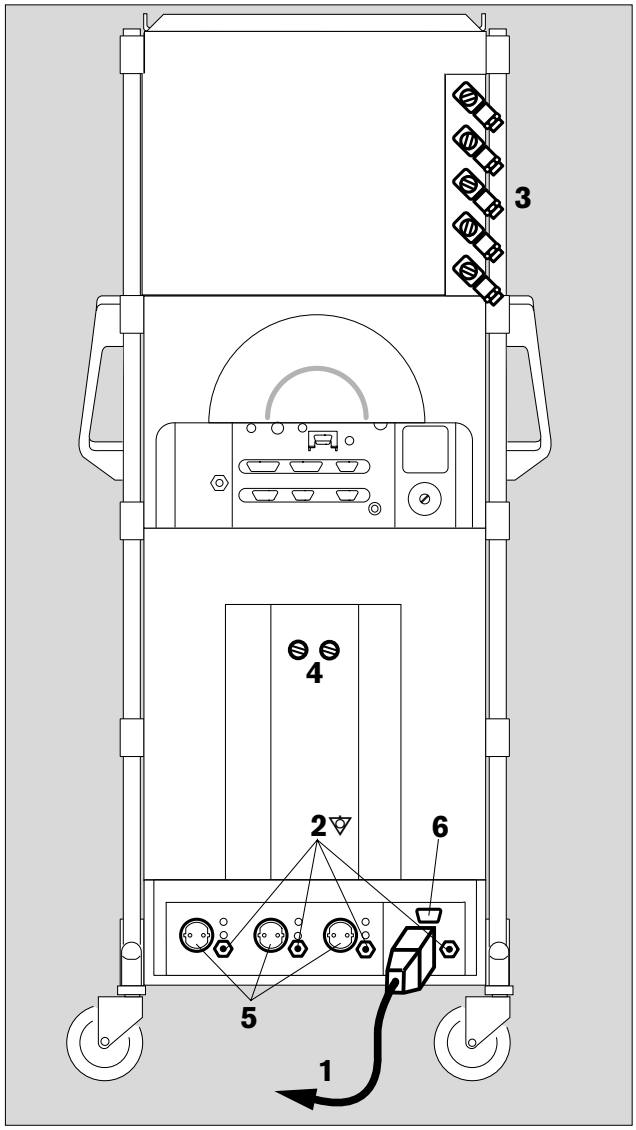
**2** Connect a ground lead for equipotential bonding to one of the four pins on the rear of the workstation when it is used for intracranial or intracardiac surgery.

The other end must be connected to the specified point in the operating theatre.

**3** Screw hoses for $O_2$, AIR and $N_2O$ into the rear of the equipment and plug connectors into the wall sockets.

- Check that the supply pressure is adequate on the pressure gauges on the front (pointers must be in the green area).

**4** Holder for anaesthetic gas scavenging.




## Auxiliary electrical equipment

**5** Connect to the three auxiliary power sockets (max. current per socket: 2 A). The auxiliary power sockets are not controlled by the main switch.

**If there is a power failure, the auxiliary power sockets will be de-energised, because they are not powered by the uninterruptible power supply (UPS).**

**Do not connect high-frequency surgery appliances to the auxiliary power sockets.**

**Do not connect any other multiple sockets, e.g. multiple socket adapters, to the auxiliary sockets.**
The connection of equipment to the auxiliary sockets causes an increase in leakage current.
The total leakage current in the power line must not exceed 500 uA (EN 60601-1).

**6** Sub-D socket for connecting the uninterruptible power supply (UPS), see page 20.
On connection to the Sub-D socket, the UPS can be switched off using the main switch.

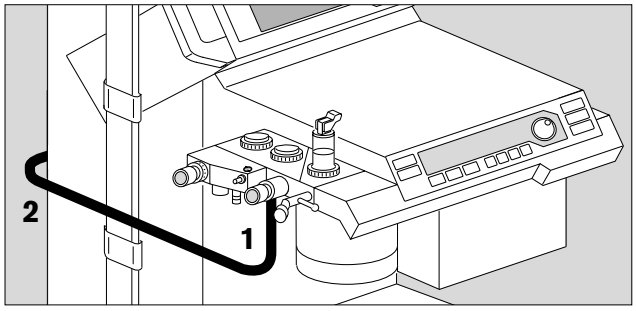
**The auxiliary power sockets and UPS are not installed in the Cato ceiling version.**

## Anaesthetic gas scavenging system (AGS)

- Connect the transfer hose to the scavenging adapter – first time only, it then remains in place.

**1** Insert the scavenging adapter in the breathing system from below until it engages.

**2** Route the transfer hose round the equipment to the rear.



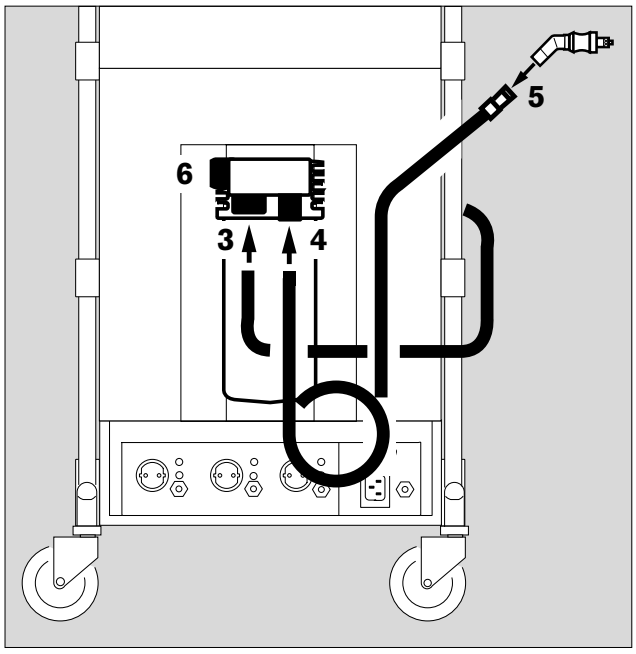

**3** Plug the transfer hose to the port on the collecting system.

**4** Connect the suction hose (sampling hose) to the port on the collecting system.

**5** Connect the anaesthetic scavenging connector to the sampling hose.

**6** Make sure that the second connector on the collecting system is sealed with the screw plug.

- Follow the specific Instructions for Use of the anaesthetic gas scavenging system.




## Anaesthetic agent vaporiser

The illustration shows a Vapor 2000

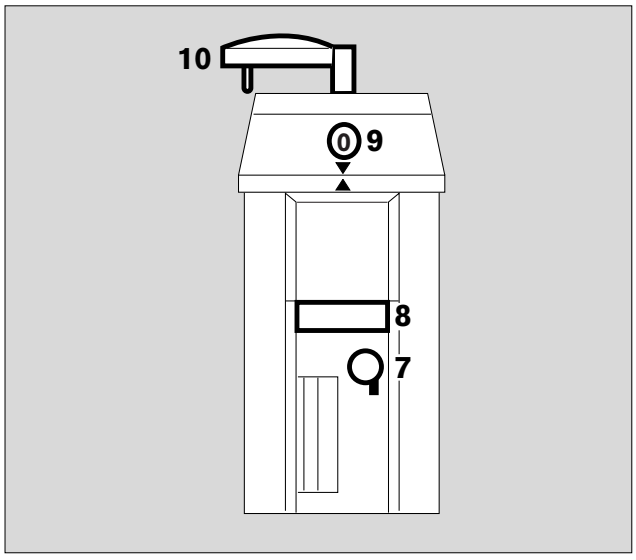
- If using the double connector for two Vapors, the automatic Vapor identification system is disabled.
- Only use Vapors listed in the Order List.
- Follow the specific Instructions for Use of the Vapor.
- For each anaesthetic agent, only use the specified Vapor.

**7** Always insert the sealing plug and

**8** secure with lever.

**9** Engage control dial at **»0«** when no fresh gas is set.

**10** Always secure the Vapor with the locking lever (turn lever to the left as far as it will go).



## Uninterruptible power supply

(optional, see separate Instructions for Use)

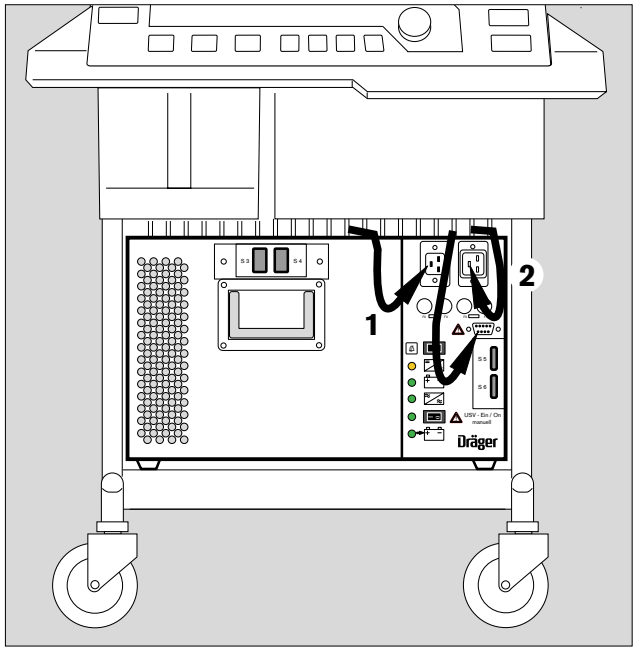
Make sure that the status line is connected, so that the uninterruptible power supply (UPS) is controlled by Cato.

**In the event of power failure, the machine is powered by the battery of the UPS, but the auxiliary mains socket on the back of the Cato will be de-energised.** However, auxiliary equipment powered by the refrigerator connector on the side of the Cato will still be powered.

**1** Plug the power plug of the Cato into the socket of the UPS.

**2** Plug the power plug of the UPS into the mains socket.

The UPS can supply the Cato and connected auxiliaries with electrical energy for about 45 minutes. It is automatically activated in the event of a power failure.




## External equipment

See page 53 for the configuration of the interfaces.

**Connection via the protocol interface**

**3** with data cable for printers with **serial interface**, e.g. Desk-Jet (Hewlett-Packard)

or

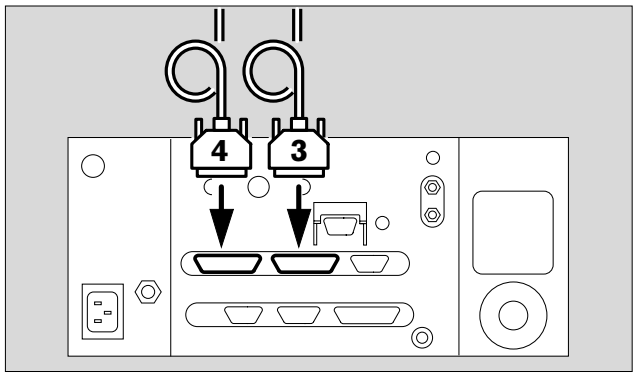
e.g. the PM 8060 Vitara Patient Monitor with the MEDIBUS protocol.
See page 53 for configuration.

**Connection via the Dräger RS 232 C MEDIBUS interface**

e.g. to connect the PM 8060 Vitara Patient Monitor.

**4** Connect with data cable.

- The equipment plugs must be secured with the screws provided.



# Checking readiness for operation with checklist

**It is assumed that the following conditions have been met:**

- The equipment and its accessory parts have been cleaned and disinfected –
  refer to page..... 83 onwards
- The unit is fully equipped for the application in question –
  refer to page..... 89 onwards
- The user has a good knowledge of the Instructions for Use and has been trained to use the equipment.
- An emergency ventilation bag with appropriate mask is available on the equipment.
- A checklist is affixed to the equipment.

**The equipment must always be checked against the checklist before it is used!**

**This check is mandatory as specified by EN 740!**

Duration: approx. 5 minutes (depending on the scope of calibration).

The equipment is subsequently in »standby« mode when ready for use. Anaesthesia ventilation can immediately be started at any time in this mode –
refer to page..... 36 onwards

- Update the checklist by adding or deleting points in accordance with the Instructions for Use, the equipment type and configuration concerned and the various supplementary units connected. It will then contain all the requisite checks.
- Enter the model designation and serial number of the equipment.
- Tick off ✔ the results of the checks in the ACTUAL column.
- Remember to sign and date the checklist!

**Test sequence**

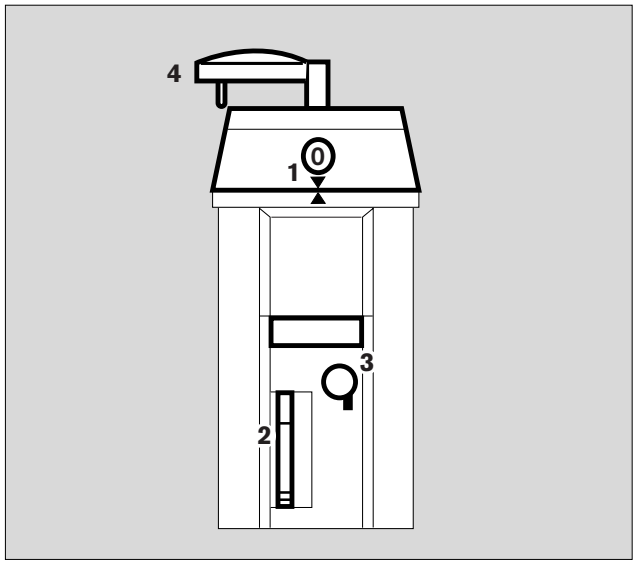
– Note any alterations and additions!

– Note the Instructions for Use of the individual units!

– If the checks do not proceed as planned, restore the required status.

## Vapor

The illustration shows a Vapor 2000




**1** The control dial is engaged at **»0«**.

**2** Filling level OK – check filling level in viewglass.

– Last inspection less than six months ago.

**Safety fill:**

**3** The sealing plug is inserted and secured with the lever.

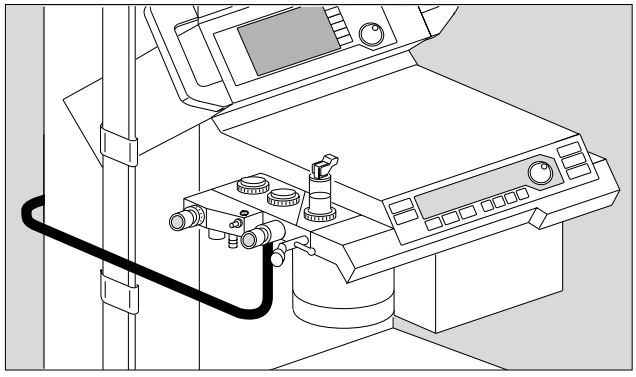
**Plug adapter:**

– The plug adapter lies horizontally and flush all round on the sealing rings of the plug connection.

**Interlock:**

**4** Plug-in system is locked – locking lever turned clockwise until it engages.

## Anaesthetic gas scavenging




– Is indicator in wall socket green? (Only when using Dräger systems; note sounds of gas flow in other cases.)

– Hose connector engaged below breathing system?

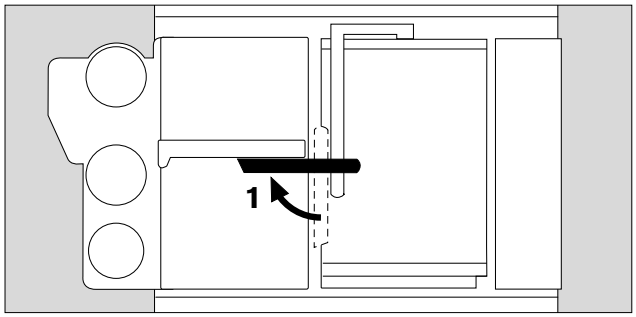
– The auxiliary air holes in the tube below the connector must not be sealed, otherwise the breathing system will be drained!

● Note the separate Instructions for Use for the anaesthetic gas scavenging system.

## Breathing system

Lift off table top:

**1** Lever set to the position shown in black.



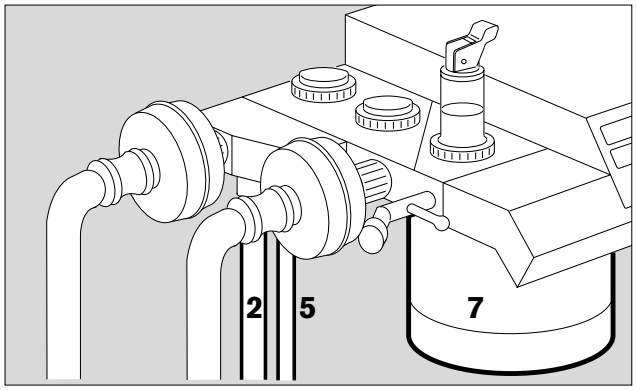

The following are complete:

**2** Hose with manual ventilation bag Symbol:
(Connected from below – not shown)

– Correct breathing hoses installed.
(Adult or infant hoses)

**3** Pressure measuring hose with filter connected.

**4** Measured gas return hose Symbol:
connected.



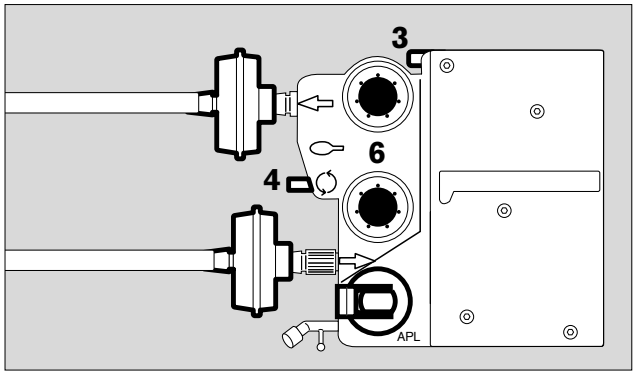

**5** Fresh gas hose plugged in.
(Connected from below – not shown)

**6** Valve discs inserted.

– Pressure limiting valve (APL) present.

– Inspiratory microbial filter. Symbol:

– Expiratory microbial filter. Symbol:




## Soda lime

**7** Lime has not noticeably changed colour (purple).

– Filling level adequate (up to the mark).

– Soda lime container is securely tightened – **up to the end stop** (clockwise).

## Emergency ventilation bag

(not shown)

– Bag is complete with mask and hung from the side of the Cato.

– Bag functions correctly.

✔ Check and tick off.

## Water traps

**1** Water traps are recommended in both the inspiratory and the expiratory lines during prolonged anaesthesia, low-flow anaesthesia and when using humidified breathing gas.

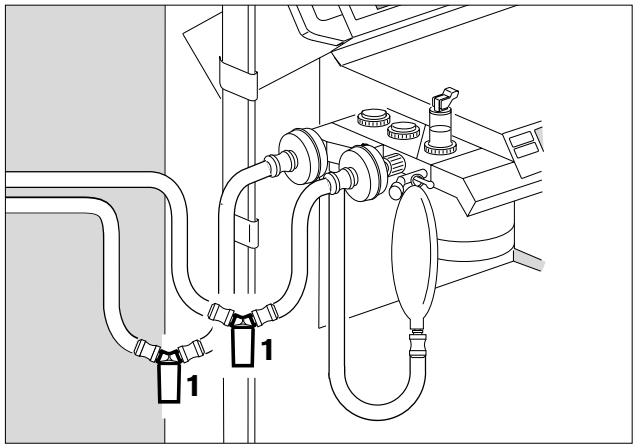
– Water traps must be fitted at the lowest point in the hose and hang downwards.

– Check regularly and drain if necessary.

**Observe hygiene regulations – risk of infection!**

The hose system remains sealed. The container must be replaced securely!

»Tips on reducing condensation« on page 136.




## Reserve gas cylinders (optional)

- Open cylinder valves.

✔ Check and tick off:

- Pressure indicator on $O_2$ cylinder exceeds 50 bar? – Pressure indicator on $N_2O$ cylinder exceeds 30 bar? –

  Replace cylinders if not.

- Close cylinder valves!

## Pipelinie gas supply

- Have connectors been pressed right into the wall sockets for $O_2$, AIR and $N_2O$ (not in holding position!)?

✔ Check and tick off:

**2** Pointers of all three pressure indicators are in the green range.

## Gas delivery

**3** Switch over to AIR.

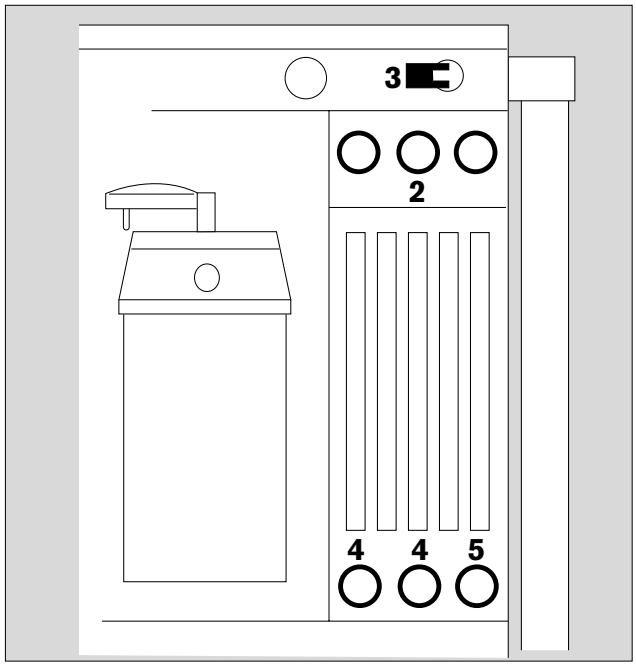
**4** Open $O_2$ and AIR delivery valves until more than 9 L/min are indicated!

**5** Open $N_2O$ delivery valve completely.

✔ Check and tick off:
Does $N_2O$ measuring tube indicate 0?

**3** Switch over to $N_2O$.

✔ Check and tick off:
Does $N_2O$ measuring tube indicate more than 9 L/min?
Does AIR measuring tube indicate 0?



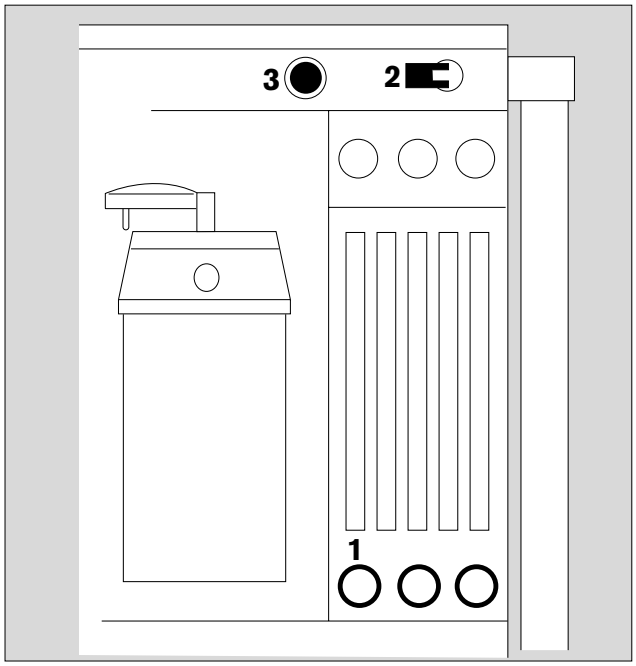
## Oxygen Ratio Control (ORC)

**1** Slowly close $O_2$ delivery valve –

– check:
the $N_2O$ flow decreases to less than 0.8 L/min proportionally with the $O_2$ flow for ORC low-flow,
the $N_2O$ flow decreases to »**O**« proportionally with the $O_2$ flow for S-ORC.

**2** Switch over to »**AIR**«.
$N_2O$ flow decreases to »**O**«.

● Close $N_2O$ and AIR delivery valve.




## O2 flush

**3** Press button »**O2+**« –

– Is there a distinctly audible flow noise?

– Does the manual ventilation bag inflate?

✔ Check and tick off!

## Secretion aspirator (optional)

**4** Open ejector valve –

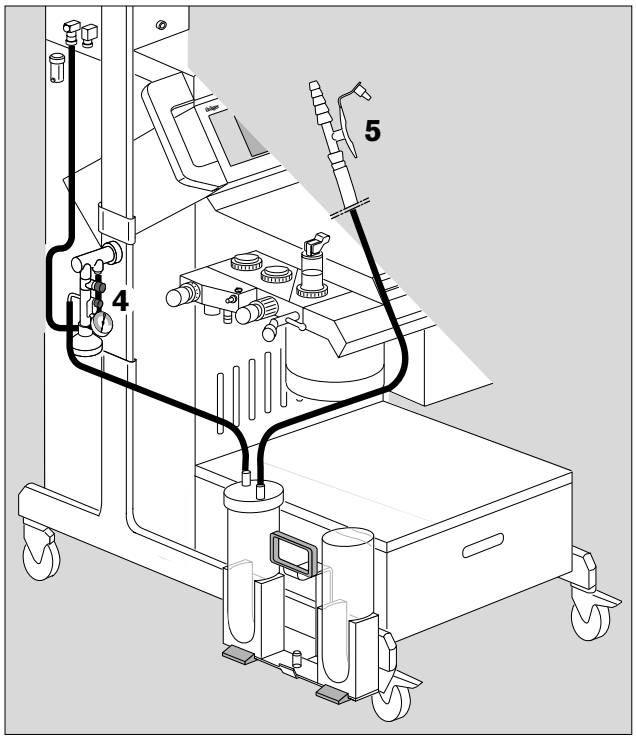
**5** Seal the **aspiration holes** on aspirator hose with your finger (or fold over the hose).

Negative pressure indicated approx. –0.8 bar?

✔ Check and tick off!

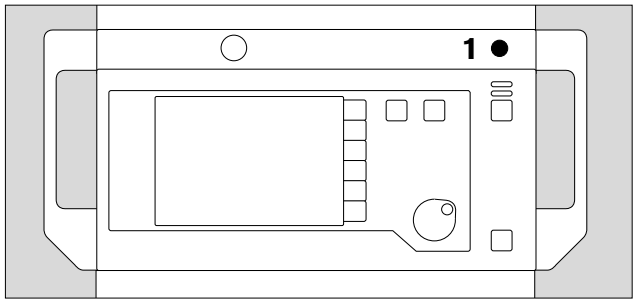
● Close ejector valve.

⚠ **Secretion aspirator may only be used in »MAN/SPONT« mode or with disconnected Y-piece.**



## Power supply

- Equipotential bonding conductor connected?
- Mains plug connected?




**1** Switch on equipment –
Press main switch to I.

## Self-test

✔ Check the signals and tick off the following on the checklist:

- Lamp and alarm test, in succession:

  **Ventilator:**

– Indication of the software version, all indicators light up for approx. 2 seconds while a single tone sounds.

  **Monitor:**

– The machine runs through the self-test:

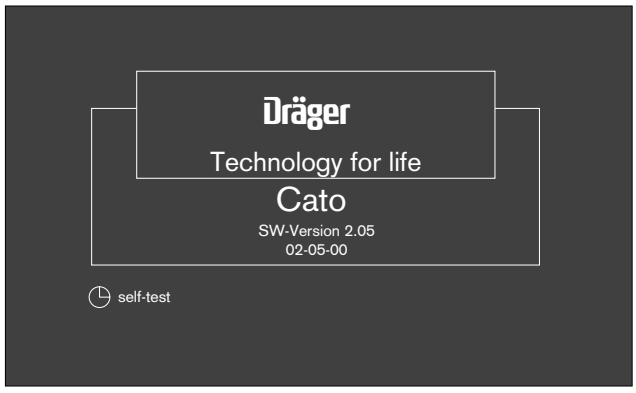
  All LEDs and display elements light up for approx. 2 seconds. The LED in the Standby key ⏻ continues to light up.

– Two alarm tones sound.

– The internal program memories are tested.

– The self-test is completed after approx. 1 minute.

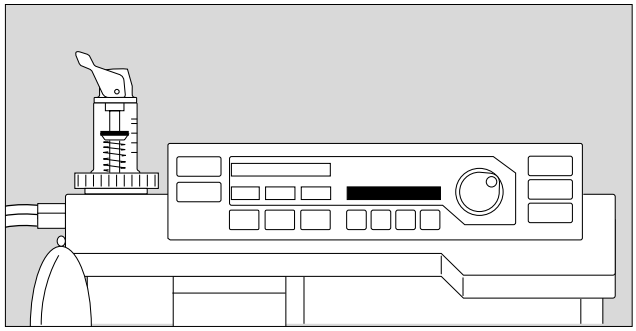
The following display appears on the monitor:




»**Self-test**«

is displayed on the ventilator.

If the self-test reveals a **fault of no relevance to the safety of the equipment** and not affecting any of the measuring functions, the following message appears on the monitor:




»**Ready within limits**«

together with a specific error message (refer to pages 74 onwards). However, the equipment can be operated nevertheless.

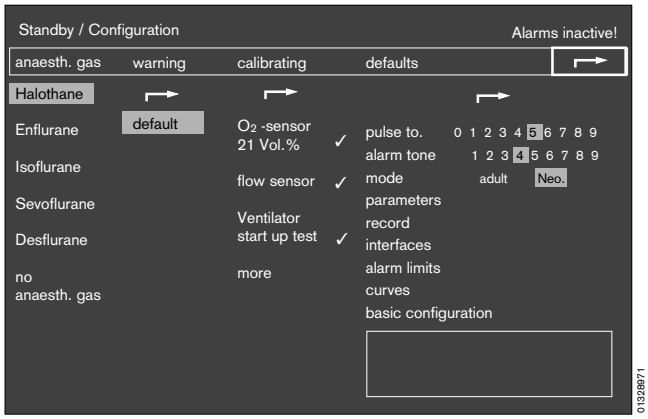
- Press the rotary control.
  Call DrägerService.

If the self-test reveals a **fault impairing the equipment's safety**, the following message appears on the monitor:

»**Not ready**«.

The machine cannot switch to Standby and cannot be switched to measuring mode. DrägerService must be called immediately.

- The configuration menu is displayed after the self-test (example):




## **Fresh gas - External outlet** (optional)

Fresh gas outlet for connecting to semi-open systems.

**1** Fit the hose of the semi-open system to the external fresh gas outlet.

- Make sure the anaesthetic gas scavenging hose is connected.

**2** Set the desired $O_2$ and $N_2O$ flow-rates on the flowmeter block.

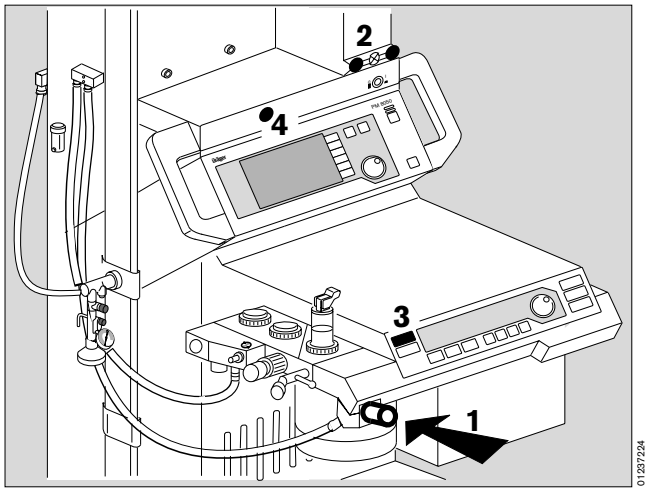
**3** Press »**MAN SPONT**« on the ventilator.

**4** The lamp in the »**FRESH GAS OUTLET**« key does not light up.

- Check that pressure is building up in the circle system.

**4** Switch on the fresh gas outlet –
Press »**FRESH GAS OUTLET**« key.
The lamp in the key lights up.

- Check that pressure builds up in the semi-open system.



## Selecting anaesthetic agent

The machine automatically identifies the newer Vapor models with code for

**halothane, enflurane and isoflurane,**

**sevoflurane** and **desflurane.**

Sevoflurane and desflurane are only identified by equipment built after July 1994 or which has been upgraded.

**Uncoded Vapors** must be selected via the configuration menu on the monitor.

The setting »**no anaesth. gas**« must be selected in the configuration menu for ventilation without volatile anaesthetic. This setting is activated automatically if a Vapor is not connected.

The plug-in system of the new Vapor models features an optical code allowing the machine to identify the Vapor:

– when the equipment is started up
– when the Vapor is changed during operation.

Incorrect anaesthetics are not detected!
However, the user can quite deliberately select a different Vapor instead of that identified automatically. The following advisory message is then displayed in the alarm field on the monitor:

»**AGT NOT SEL !**«

**If the Vapor has not been encoded:**

The message

»**Vapor not identified**«

is displayed in the user advisory field of the configuration menu in »standby« mode.

- Set the appropriate anaesthetic for the Vapor used.

**If a Vapor has not been connected:**

The message

»**Vapor not present**«

is displayed in the user advisory field of the configuration menu in »standby« mode.

The following symbols are used:

**?** = Enquires whether an action has been performed or a setting made.

⏲ = Waiting period. The selected test step is being performed by the machine.

✔ = The action has been completed successfully or is not required.

## Automatic calibration of the $O_2$/flow sensors

Sidestream calibration of the $O_2$ measurement ($O_2$ sampling) and flow measurement are performed automatically.

Automatic flow calibration is performed during the first breaths after starting ventilation. There is therefore no cause for panic if the measured values for the minute ventilation still appear in grey (i.e. uncalibrated values, see page 13) immediately after the self-test.

$CO_2$ measurement must function correctly before automatic flow calibration can be performed, otherwise the flow sensor must be calibrated by hand.

## Manual calibration of the $O_2$ sensor

The $O_2$ sensor must be calibrated by hand if $O_2$ measurement has been set in the inspiratory line (see “Parameters“ on page 53).

**Calibrate $O_2$ sensor with 21% $O_2$ by volume = air**

– The $O_2$ sensor can be calibrated while flow calibration is still in progress.

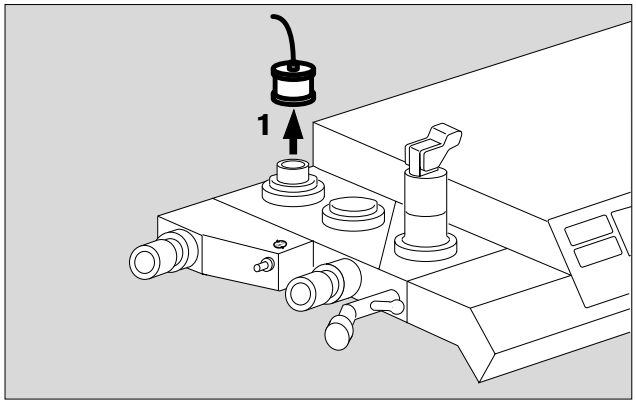
**1** Remove the sensor from the inspiratory valve and expose it to the ambient air – place it on the table and wait at least two minutes.

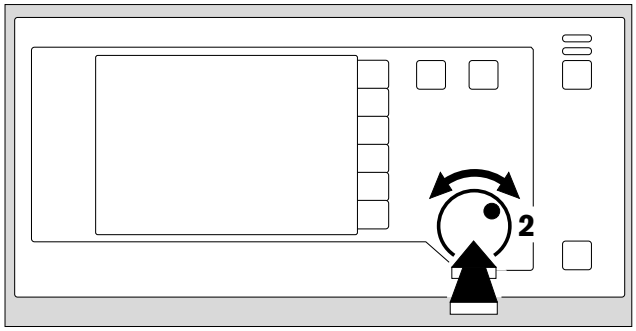
**2** Use the rotary control to select »**calibrating**« in the »**Standby/Configuration**« menu and press to confirm.

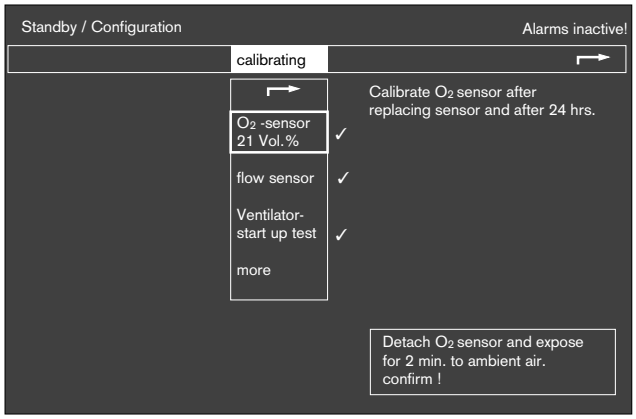
- Move the cursor frame to »**$O_2$ sensor 21Vol.%**« by means of the rotary control.
- Press rotary control to confirm: calibration starts.

**1** Then plug $O_2$ sensor onto the inspiratory valve again.

✔ Tick off in checklist.

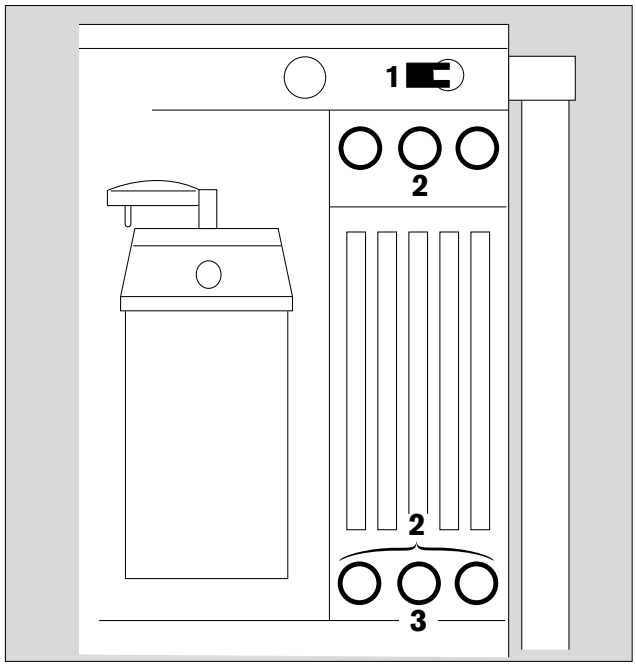


## Manual calibration of the flow sensor

– The flow sensor can be calibrated by hand while $O_2$ calibration is still in progress, either in the machine or after being removed from the machine.




**Without removal**:

On the anaesthetic unit:

**1** Set AIR/$N_2O$ selector to »AIR«.

**2** Close the delivery valves for $O_2$ and $N_2O$, open the delivery valve for air and thoroughly flush the breathing system with air.

**3** Close the delivery valve for air.

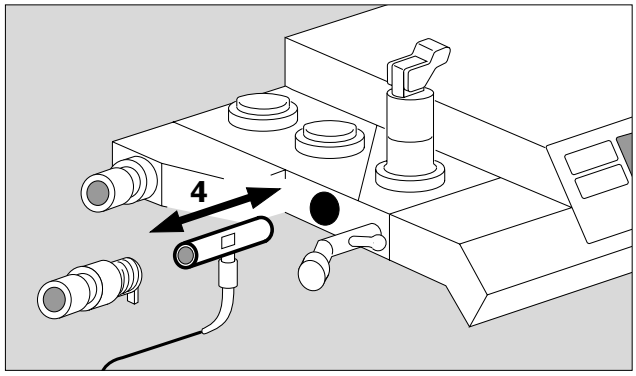
● Press the rotary control on the monitor to start calibration.

The question mark (?) disappears and is replaced by a timer icon ( ⏲ ) on the screen.

A tick ( ✔ ) appears on the screen when calibration has been completed correctly.

✔ Tick off in checklist.

The cursor frame has automatically jumped to »Ventilator start-up test«.




**With removal:**

**4** Remove flow sensor:

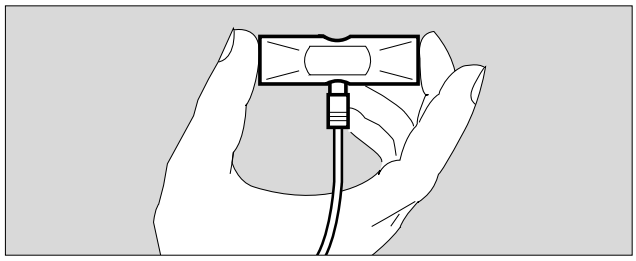
– Unscrew expiration nozzle

– Remove flow sensor

– Briefly swing it to flush with ambient air

– Hold it horizontally with the cable connection pointing downwards (calibration in installation position improves the measuring accuracy)

– Seal off one or both sides as shown on the right, preferably with your thumb or palm.




● Press the rotary control on the monitor to start calibration; continue as above.

**4** Replace flow sensor!

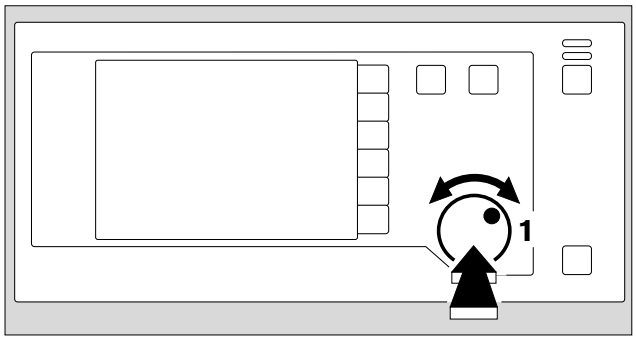
## Ventilator start-up test

**The ventilator must not be connected to the patient during this test!**

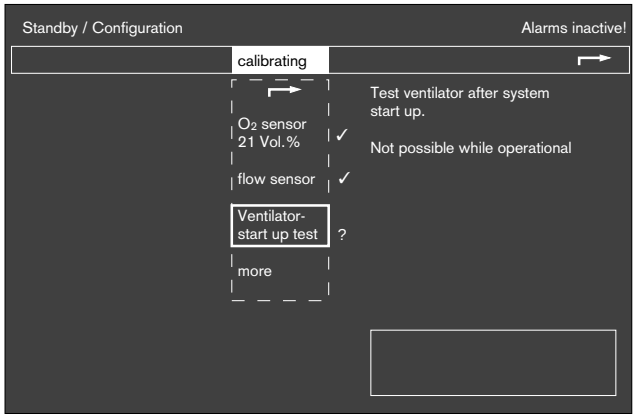
Quantitative test to establish the integrity of the anaesthetic system.

The test cannot be performed until $O_2$ and flow calibration is complete and the relevant sensors have been installed in the anaesthetic system.

**1** Use the rotary control to select
**«Ventilator start-up test«**
under »Calibrating« in the »Standby/Configuration« menu and press to confirm. (If this has not already been done automatically after $O_2$ and flow calibration).



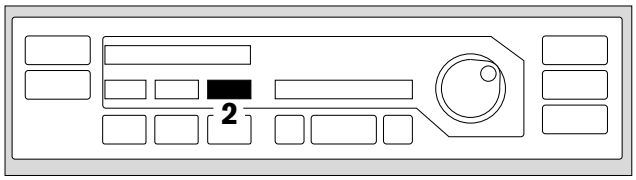

- Screen display:




On ventilator:

**2** Display: Digits 1 to 10 = test blocks during the self-test –

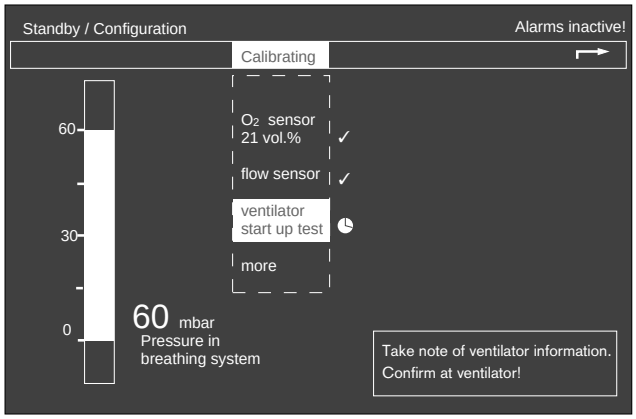
refer to the flow chart on pages 124/125 for further details.




Messages in the display are accompanied by a brief advisory tone which is repeated every 15 seconds if the operator does not undertake some kind of action on the equipment.

The test pressure is displayed as an analog and digital value.

Display (example):



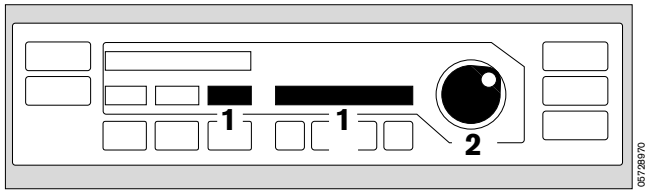
The dialogue continues on the ventilator:

**1** Test block No. 3 and display:

**Fresh gas occl?**

**3** Close all three delivery valves!
Confirm:

**2** Press rotary control on ventilator!

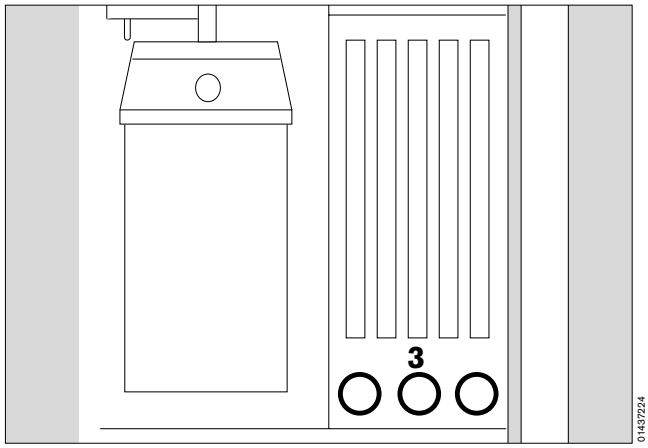



**1** Display:

**APL = 30 mbar?**

**4** Set pressure limiting valve to »MAN« and 30 mbar!
Confirm:

**2** Press rotary control on ventilator!




**1** Display:

**Y-piece open?**

**5** Remove Y-piece from cone or exercise thorax!
Confirm:

**2** Press rotary control on ventilator!

**1** Display:

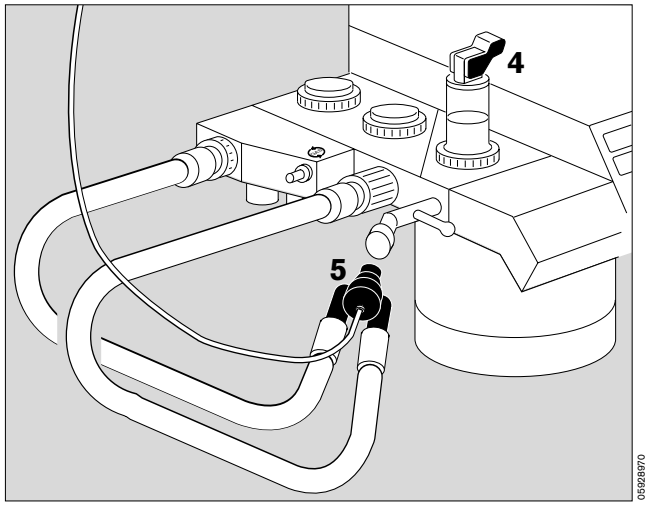
**Self-test**

**1** Display:

**Ypiece occluded?**

**5** Plug Y-piece onto cone!
(The sampling line is connected to the Y-piece and the water trap.)
Confirm:

**2** Press rotary control on ventilator!




**1** Display with test block No. 4:

**Self-test**

The test then continues automatically, block by block:

- wait – approx. 1 minute!

**1** Display:

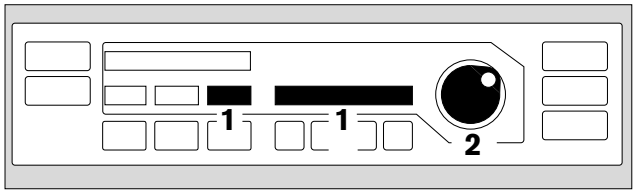
**Leaktest IPPV**

**1** Display:

**Leak IPPV = xxx mL**

If greater than 175 mL/min:
Repair leak, particularly for low-flow, or continue if not problematical –

Confirm:




**2** Press rotary control on ventilator!

**1** Display with test block No. 9:

**Leaktest MAN**

**1** Display:

**Self-test**

- Wait – approx. 1 minute!

A tick (✔) appears on the screen when the ventilator test has been completed successfully.

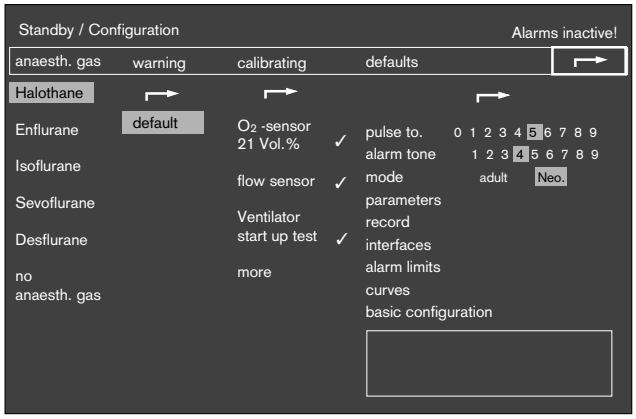
The prompt »Confirm« appears.

- Press rotary control on monitor.

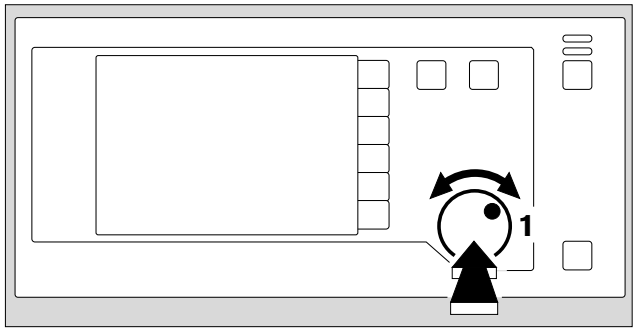
The cursor jumps to the arrow symbol on the configuration menu and the vertical pressure indication disappears.

- Press the rotary control on the monitor again to confirm and exit the configuration menu. Configuration is now complete.

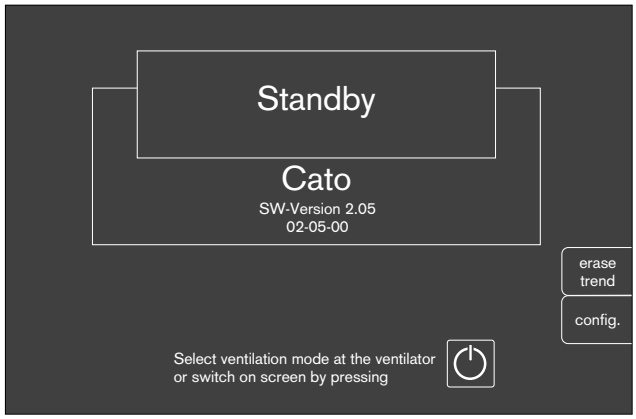
✔ Tick off the ventilator self-test and monitor self-test on the checklist.



**1** Press rotary control on monitor –

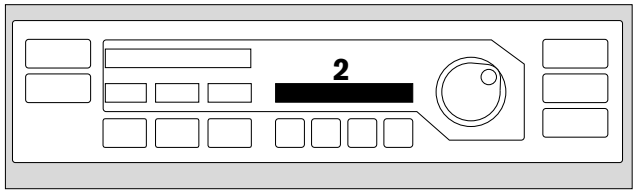



The machine changes to »standby« mode and the following display appears (example):




**2** On the ventilator:

**Standby**




»Standby« means that:

– the system can immediately be switched to any operating mode;

– gas consumption is zero (neither drive gas nor anaesthetic gas);

– power consumption is marginal;

– the piston cylinder unit is in withdrawal position.

**Manual ventilation is not possible in standby mode!**

Any attempt to undertake manual ventilation in »standby« mode is immediately detected and causes the system to start operation in MAN/SPONT mode. (»**Auto-WakeUp**« function, see page 8).

**The equipment is now ready for operation!**

The monitor and ventilator self-tests have been completed successfully.

✔ Tick off in checklist, select the settings required for the patient and

✔ tick off in checklist.

● Remember to sign and date the checklist!

# Operation

## Contents

# Manual / Spontaneous

**Before connecting a patient**

- Check workstation with checklist (see page 21 onwards).

– Check that breathing system is complete (see page 23) and

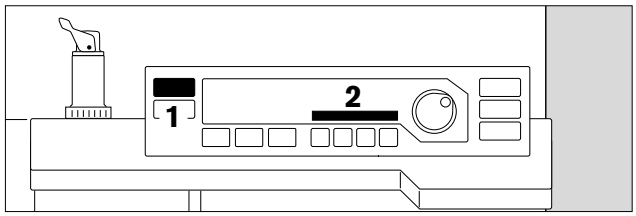
– perform leakage test (see page 31 onwards).

## Select Manual / Spontaneous mode

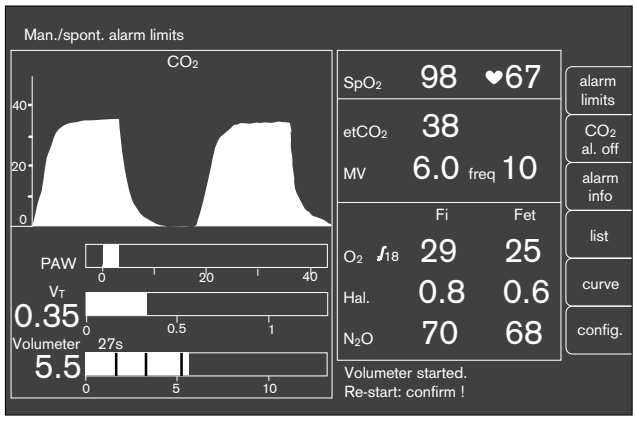
**1** Press »**MAN SPONT**« on ventilator for at least one second (or press »**MAN SPONT**« and confirm with the rotary control. Setting by Dräger Service).

**2** Display in dialogue field:

**MAN/SPONT**




The standard screen appears with the alarm limits for MAN/SPONT mode.




## Spontaneous breathing

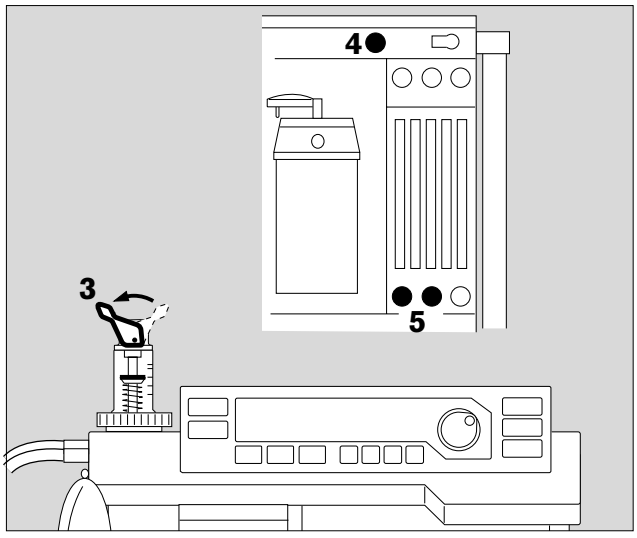
»**PEEP**« and pressure limitation »**Pmax**« are inactive.

**3** Set pressure limiting valve APL to »**SPONT**«. It is now open, regardless of the set pressure.

**To fill system:**

**4** Press »**O2 +**« to inflate the breathing bag rapidly.

**5** Set fresh gas –
detailed information on setting the fresh gas flow can be found in the Annex on page 128.



## Manual ventilation

with breathing bag

»**PEEP**« and pressure limitation »**Pmax**« are inactive. The airway pressure is limited via the pressure limiting valve APL.

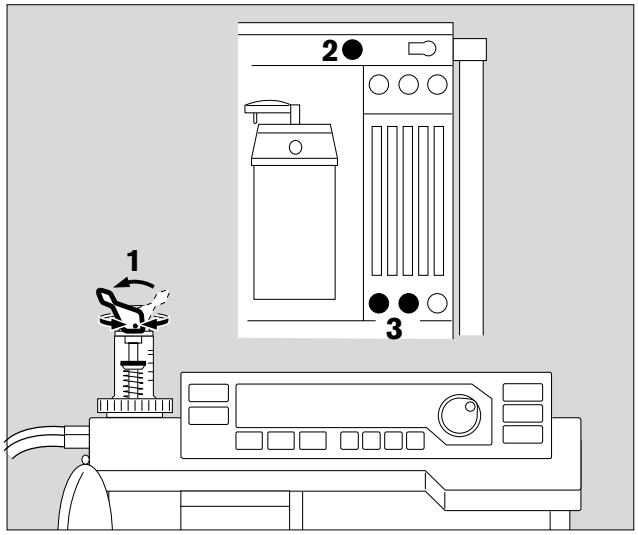
**1** Set pressure limiting valve APL to »**MAN**« and set required ventilation pressure: turn valve head.

**To fill system:**

**2** Press »**O2 +**«.

**3** Set fresh gas with O2, N2O or AIR delivery valve –

- start manual ventilation.




## Manual ventilation following a power failure

with breathing bag

(Only relevant if the machine is not equipped with an uninterruptible power supply).

In the event of a power failure, the airway pressure pushes the ventilator piston into its limit position, thus increasing the system volume by up to 1.4 litres!

**To compensate this:**

**1** Set pressure limiting valve APL to »**MAN**« –

**3** temporarily increase fresh gas flow
or

**2** press »**O2 +**«.

**3** Set fresh gas with O2, N2O or AIR delivery valve –

- start manual ventilation.

## Emergency ventilation following a gas failure

AIR changeover

The ventilator drive and ejector generating a negative pressure in the secretion aspirator are normally supplied with gas from the compressed air supply (AIR). If AIR fails, the system automatically switches over to O2.

N2O lock and O2 shortage alarm

If O2 fails, an O2 shortage is signalled and the supply of N2O disabled. The measuring tube block automatically switches to AIR, regardless of the lever setting.

⚠ **The patient must immediately be ventilated with the separate emergency ventilation bag if both O2 and AIR fail.**

## **Fresh gas - External outlet** (optional)

**Only available in "MAN/SPONT" mode**

**1** Connect the anaesthetic gas scavenging hose, see page 92.

**2** Press »**MAN SPONT**« on the ventilator.

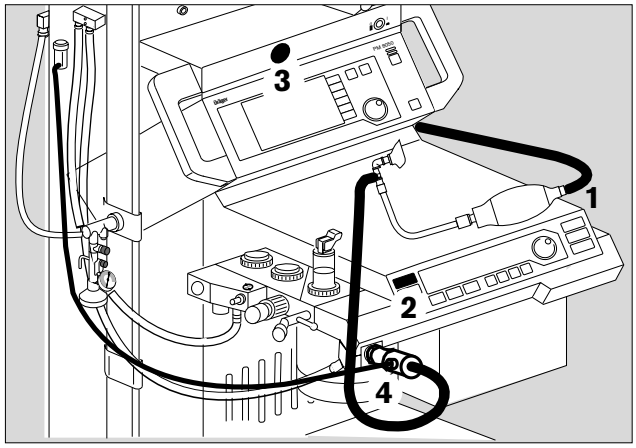
**3** Switch on the external fresh gas outlet –
Press »**FRESH GAS OUTLET**«
The lamp in the key lights up.
The circle system is switched off.

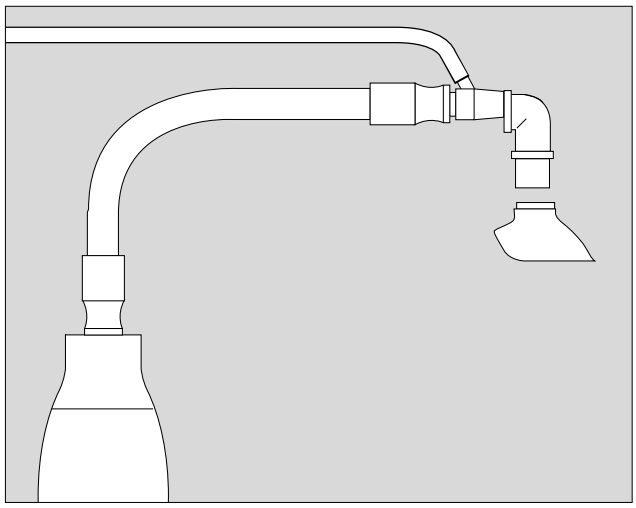
- Perform anaesthesia ventilation using the external fresh gas outlet.
- When switching over to another mode, e.g. IPPV, the circle system is automatically switched on again. The external fresh gas outlet is then disabled.

**4** Monitoring the breathing gas ($O_2$ and anaesthetic gases) in semi-open mode with aspiration measurement at the fresh gas supply connector of the semi-open system, and with the screen in HLM mode.

⚠ Intake measurement is performed without connection to the breathing phase. There is no pressure monitoring.

When switching on and in the event of a power failure lasting longer than 2 minutes, Cato switches automatically to the internal fresh gas outlet.



# IPPV

## Selecting IPPV mode

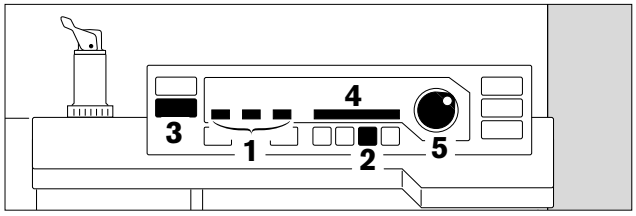
**Secretion aspirator may only be used in »MAN/SPONT« mode or with disconnected Y-piece.**

After switching on, the ventilation parameters set prior to delivery or subsequently programmed by DrägerService are active in IPPV mode.

**1** Set the values required for the patient.

Default settings upon delivery of new equipment: (may be altered by DrägerService if requested by customer)

| | | |
|---|---|---|
| $V_T$ | Tidal volume | 0.6 L |
| $f_{IPPV}$ | IPPV frequency | 12 breaths/min. |
| $P_{max}$ | Maximum ventilation pressure | 25 mbar |
| $T_I$:$T_E$ | Inspiration/expiration time ratio | 1 : 1.7 |
| $T_{IP}$:$T_I$ | Inspiration pause/inspiration time ratio | 10 % |




**2** Set PEEP – if necessary.

**3** Press **»IPPV«**.

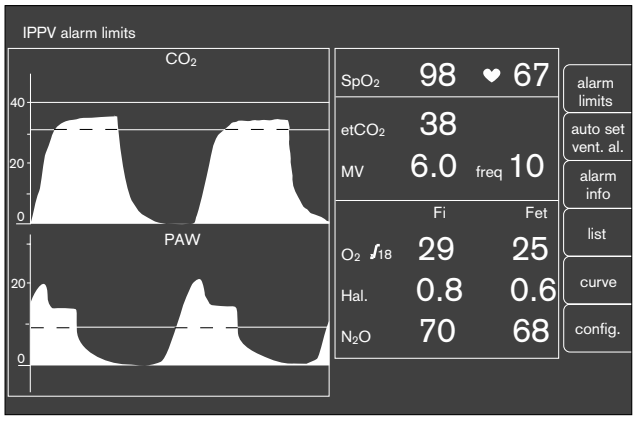
**4** Display in dialogue field:

**IPPV Mode ?**

**5** Press rotary control to confirm – ventilation starts.

The parameters Pmax, $V_T$, $f_{IPPV}$, PEEP and piston movement are displayed on the ventilator.

The monitor is also started and the IPPV alarm limits are activated.




**Adjusting ventilation parameters ($P_{max}$ for example):**

**6** Press **»Pmax«**.

**1** The set value appears in the window above, while

**4** the set value (left), the parameter and its unit of measure (middle) and the value to be adjusted (right) appear in the dialogue window.

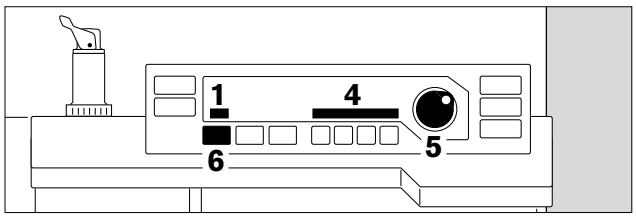
**5** Turn rotary control:

**4** the value on the right changes –

**5** continue turning until the required maximum pressure is reached. Press rotary control to confirm this value –

**1** the new value is displayed –

if the new value is not confirmed, it will not be adopted by the system and the display disappears after approx. 10 seconds.




- $f_{IPPV}$, $V_T$, $T_I$:$T_E$, $T_{IP}$:$T_I$, PEEP and fIMV are adjusted like $P_{max}$ after pressing the corresponding parameter key.

### Automatic compliance correction

Only set the effective tidal volume!

The compliance of the breathing system and of the hoses used is established by the equipment during the self-test or if a leakage test is started manually. The reduction in tidal volume due to system compliance is then corrected automatically during ventilation so that the patient actually receives the set tidal volume.

The leakage test should therefore be repeated whenever changes have been made in the hoses.

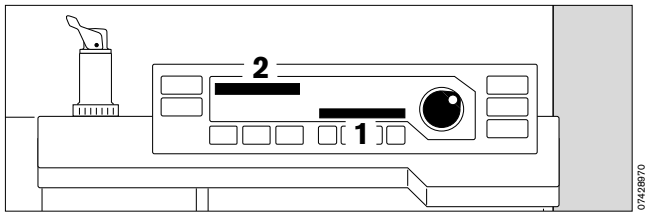
**The patient must always be disconnected and the system set to »standby« before starting the leakage test!** (see page 48 onwards)

A detailed description of automatic compensation of the system compliance can be found in the Annex on page 129.

### Ventilation with pressure limitation

When the set maximum ventilation pressure $P_{max}$ has been reached, the inspiratory stroke is adjusted so that the pressure remains constant up to the end of inspiration.

The set tidal volume is not fully applied in this case!




**1** Display on ventilator:

**Pressure limit**

**2** The bar graph on the ventilator does not reach 100%.

If the pressure increases by more than 5 mbar above the maximum ventilation pressure $P_{max}$, e.g. because the patient coughs, inspiration is immediately stopped and expiration starts.

### Limit settings

– **$P_{max}$, PEEP**

The minimum difference between $P_{max}$ and PEEP equals 10 mbar. Settings resulting in a smaller pressure difference are not accepted by the system.

– **Max. inspiratory flow**

The tidal volume, frequency, I:E ratio and inspiratory pause time cannot be set to values resulting in an inspiratory flow of more than 75 L/min.

– **Max. minute volume**

The tidal volume and frequency cannot be set to values resulting in a minute volume of more than 25 L/min.

# SIMV

## Selecting SIMV mode

**Secretion aspirator may only be used in »MAN/SPONT« mode or with disconnected Y-piece.**

In order to prevent the mechanical mandatory ventilation stroke from being applied during the expiratory spontaneous breathing phase, a special trigger ensures that the mandatory ventilation stroke is controlled by the patient and consequently synchronized with spontaneous breathing (this is described in detail on page 133).

**PEEP is not active in SIMV mode!**

After switching on, the ventilation parameters programmed upon delivery are active in SIMV mode.

The ventilation parameters of the preceding mode remain active when changing from IPPV to SIMV mode and vice versa!

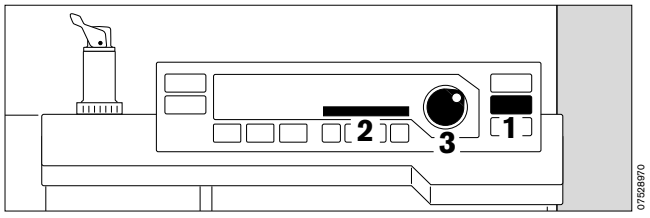
Settings upon delivery of new equipment:

| | | |
|---|---|---|
| $V_T$ | Tidal volume | 0.6 L |
| $f_{IMV}$ | IMV frequency | 12 breaths/min. |
| $P_{max}$ | Maximum ventilation pressure | 25 mbar |
| $T_I$:$T_E$ | Inspiration/expiration time ratio | 1 : 1.7 |
| $T_{IP}$:$T_I$ | Inspiration pause/inspiration time ratio | 10 % |

If the ventilation frequency is equal to or greater than 6 breaths per minute in »**SIMV**« mode, the IPPV alarm limits become active and the alarm mode »**IPPV alarm limits**« is automatically displayed on the monitor.

If the ventilation frequency is less than 6 breaths per minute in »**SIMV**« mode, special SIMV alarm limits become active and the advisory message »**SIMV alarm limits**« flashes in the status field of the monitor for five seconds. This message does not require confirmation.

When setting frequencies of **more than 5 breaths per minute**, the system **automatically** reverts to the IPPV alarm limits and indicates this on the monitor.
The ventilation parameters are adjusted in the same way as in IPPV mode:




1 Press »**SIMV**«.

2 Display in dialogue field:

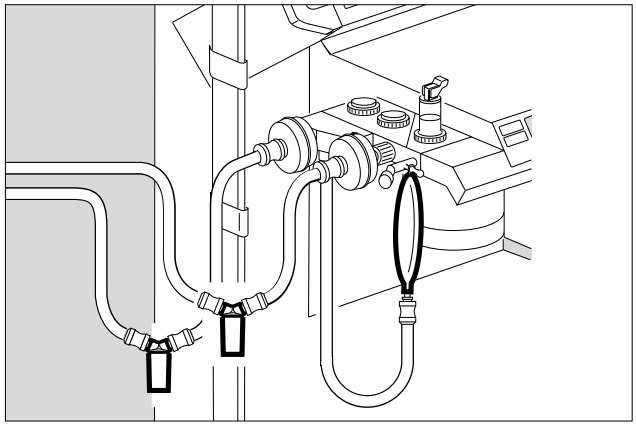
**SIMV Mode ?**

3 Press rotary control to confirm – ventilation starts.

The parameters $P_{max}$, $V_T$, $f_{IMV}$, PEEP and piston movement are displayed on the ventilator –

the monitor is also started and the alarm limits for SIMV are activated.
Refer also to the chapter describing the »**Alarm concept**« on page 65.

# Paediatric use




### Infant hose set

Infant hoses must be used for ventilation volumes of less than 200 mL.

If a breathing gas humidifier is used, water traps must be installed at the lowest points of the breathing hoses on both the inspiratory and the expiratory side.

### Avoid pressure peaks

The fresh gas is stored in the breathing bag during inspiration. The pressure built up in the breathing bag when working with high flow rates and long inspiration times may be higher than the end-inspiratory pressure in the patient, particularly when using a 0.5 L breathing bag.

Even at a fresh gas flow of 4 L/min, a pressure peak may arise at the beginning of the expiration phase as fresh gas streams out of the breathing bag. This is particularly possible in combination with long inspiration times and can be avoided by reducing the fresh gas flow or using a 1.5 L breathing bag.

The adjustment intervals and metering accuracy for the tidal volume VT depend on the selected range.

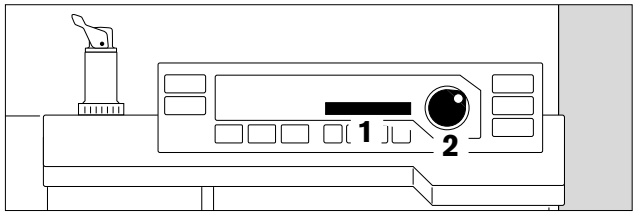
| Range | Interval | Metering accuracy |
|---|---|---|
| < 20 mL | 1 mL | ± 30% or ± 6 mL |
| 20 to 50 mL | 2 mL | ± 10% or ± 10 mL |
| 50 to 100 mL | 5 mL | ± 10% or ± 10 mL |
| 100 to 990 mL | 10 mL | ± 5% or ± 15 mL |
| 1 L to 1.4 L | 0.01L | ± 5% or ± 15 mL |

The system must calculate its new system compliance following a change of hoses.

**The patient must be disconnected for this purpose and the leakage test started!**
(see overleaf)

The ventilation parameters are adjusted in the same way as in IPPV mode.

If a tidal volume of less than 200 mL is selected from a higher setting, the system automatically generates the



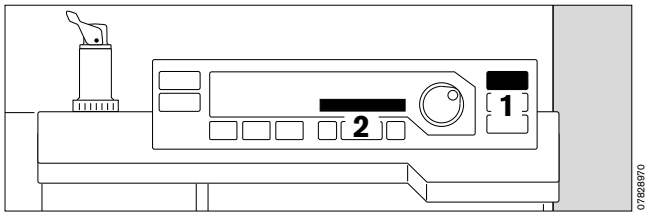

**1** display:

**Paed. hoses !**

- Fit infant hoses –

**2** press rotary control to confirm.

Then switch to »**standby**« (see page 48) and call up the leakage test so that the new compliance can be calculated.




**Invoking the leakage test**

1 Press »**TEST**« on the ventilator for at least three seconds.

2 Display in dialogue field on ventilator:

**Leaktest IPPV**

followed by:

**Leak IPPV = xx mL**

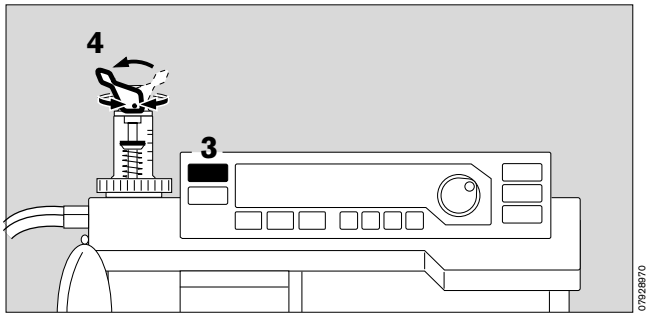
The calculated leakage and compliance values are saved and displayed on the data screen.

The manual ventilation bag and its hose are not included in the test!

The system switches back to »**standby**« after the test.

## Anaesthesia ventilation with the Kuhn system

If the machine does not have an external fresh gas outlet (optional - see page 38), anaesthesia ventilation with the Kuhn system is performed as follows.:




- Prepare the Kuhn set in accordance with separate Instructions for Use –
- connect anaesthetic gas scavenging hose (see page 92).

3 Press »**MAN/SPONT**« on ventilator for at least one second –

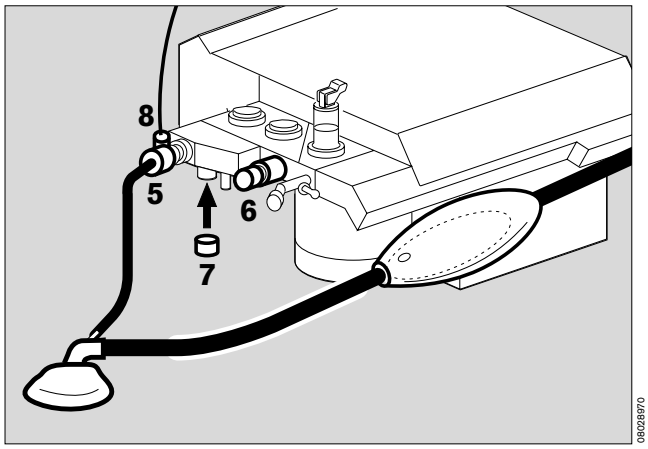
4 set pressure limiting valve APL to »**MAN**«.

- Connect inspiration hose via

5 connecting sleeve – Symbol: 

6 Expiration connector remains open – Symbol: 

7 Seal manual ventilation connector with cap. Symbol: 




The pressure indicated on the monitor is not identical with the actual airway pressure. Reason: higher flow resistance of the fresh gas hose in the Kuhn system. The higher the fresh gas flow, the greater the difference.

8 The anaesthetic and $O_2$ concentration must be monitored by means of intake measurement with the monitor in HLM mode.

## Monitoring with reduced alarm limits

The »**IPPV alarm limits**« are automatically activated on the monitor when a ventilation frequency **equal to or greater than** 6 breaths per minute is set in »**IPPV**« and »**SIMV**« modes.

The »**SIMV alarm limits**« are automatically activated on the monitor if a ventilation frequency of less than 6 breaths per minute is set in »**SIMV**« mode.

The »**MAN/SPONT alarm limits**« are automatically activated on the monitor in »**MAN/SPONT**« mode. This prevents false alarms (see »**Alarm concept**«, page 65 onwards).

## Checking water traps

**WaterLock**
(refer also to the separate Instructions for Use)

When fouled
or
if **$CO_2$ LINE ? !** is output although the sample line is clear.

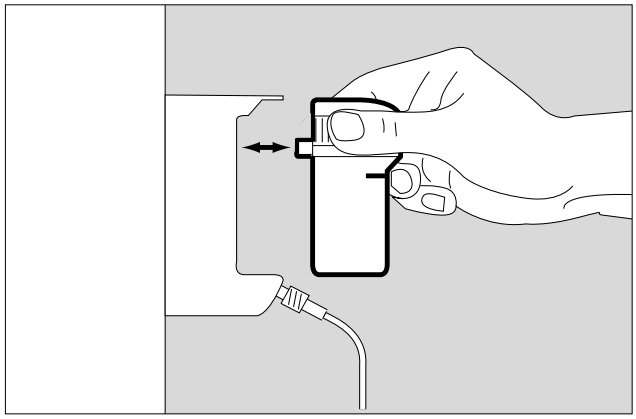
- Replace water trap:

– when severely fouled,

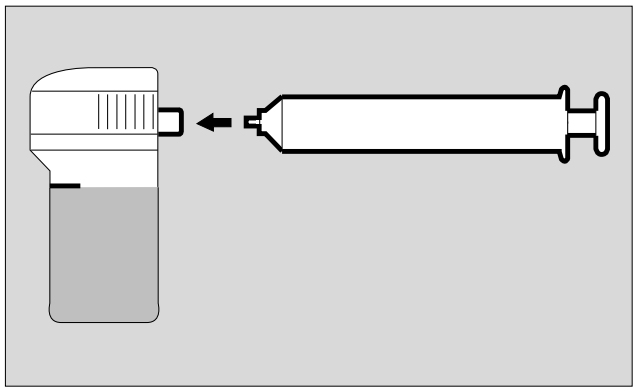
– if the error message persists even after draining the water trap,

– when the maximum service period of four weeks is exceeded.

- Grasp the ribbed sides of the water trap and draw it out.
- Remove a new water trap from the package.
- Enter the date in the field provided on the water trap.
- Grasp the ribbed sides of the water trap and slide it into the holder – until it tangibly engages.




- Empty water trap:
- Insert an empty syringe without cannula, at least 20 mL, into the connector.
- Extract the water, remove syringe and dispose of the full syringe as ordinary domestic waste.
- Push water trap back into holder – until it tangibly engages.




Disposal:

- Water traps which have been dismantled must be disposed of as ordinary commercial waste. Waste code number 91101.

**in the breathing hoses**

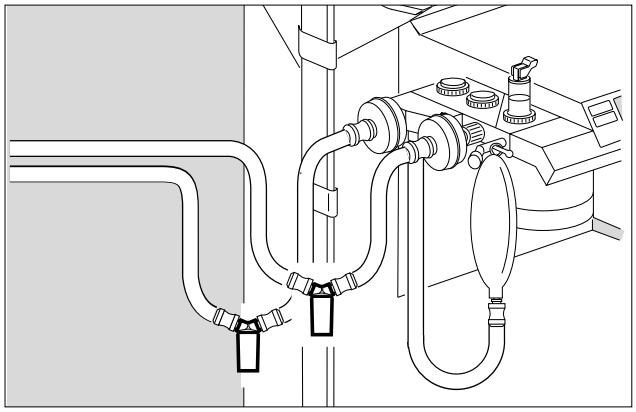
– Water traps must be fitted at the lowest point in the hose and hang downwards.

– They must be checked regularly and drained if necessary.

**Note hygiene regulations – risk of infection!**

The hose system remains sealed. Container must be replaced securely.

"Tips on reducing condensation“, see page 136.




## Checking the soda lime

The soda lime turns purple from the bottom upwards when saturated with $CO_2$. To monitor $CO_2$ absorption, the $FiCO_2$ value is displayed in "data screen" mode. An alarm limit of 5 mmHg is set for monitoring $CO_2$ absorption.
The soda lime must be changed when two-thirds of the charge has changed colour! The colour may also fade again due to drying out after prolonged breaks.

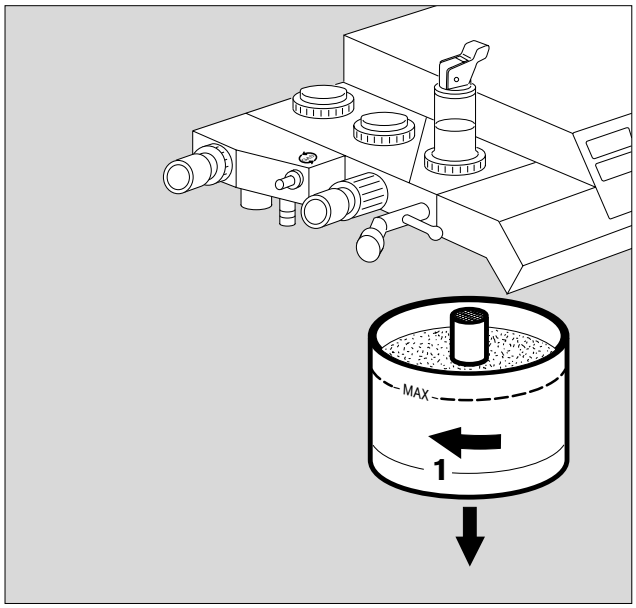
**Changing soda lime during operation**
(see also page 91)

- Prepare a replacement soda lime container.
- Occlude the Vapor and stop $N_2O$ delivery.
- Set ventilator to »**MAN/SPONT**« and the pressure limiting valve to »**SPONT**«.

1 Briefly turn the soda lime container anticlockwise and pull it downwards.

- Insert the replacement soda lime container from below and turn clockwise as far as possible.
- Gas and machine settings may be cancelled.
- Remove spent soda lime from the container.

**Note hygiene regulations when dealing with infectious patients – risk of infection!**



## Anaesthetic vaporiser

The illustration shows a Vapor 2000.

– Control dial with scale in % anaesthetic agent by volume.

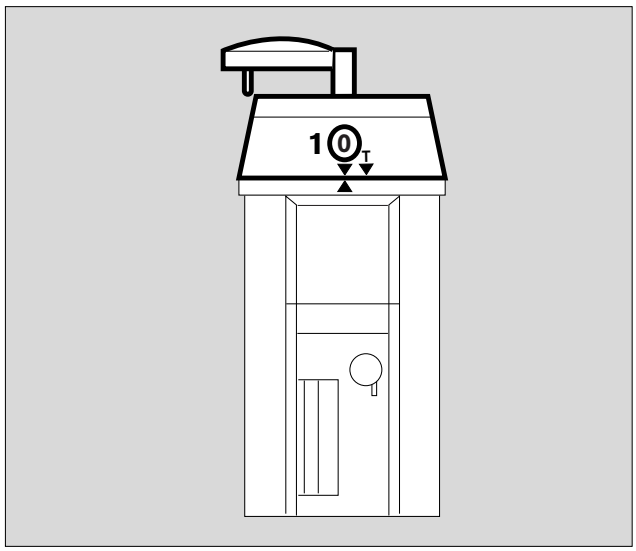
– **»0«** button – engages in zero position **»0«**.

– Locking lever – Vapor is locked onto the plug adapter.

**Metering anaesthetic agent:**

**1** Press **»0«** button and turn control dial anticlockwise – until required setting is reached.

If Vapor has to be removed – turn control dial to **»T«**. Swing locking lever forwards – Vapor can now be removed.



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## Secretion aspirator (optional)

**To prevent negative pressures in the breathing system and in the patient's lungs, we recommend that you only carry out suction with the Y-piece disconnected from the patient tube.**

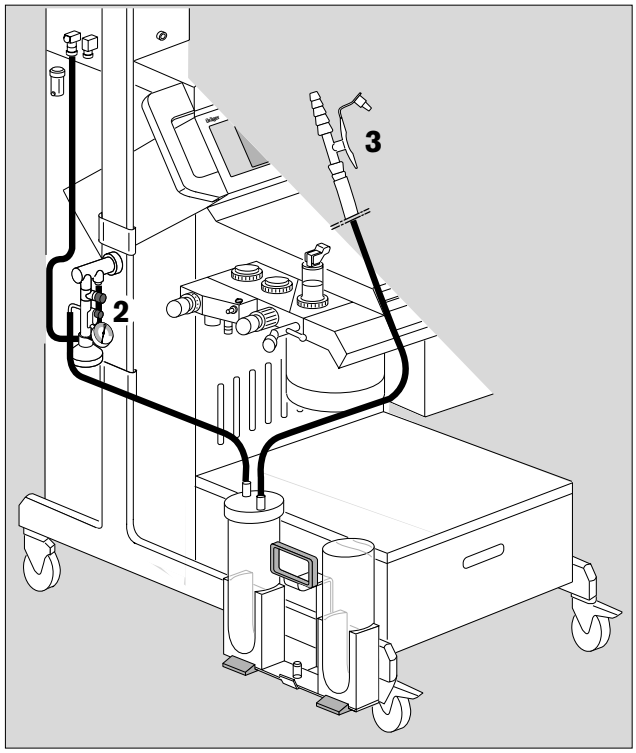
**2** Open ejector valve –

**3** cover the »**Fingertip**« with your index finger.

● The aspiration capacity can be adjusted very accurately with the aid of auxiliary air on this surface.

– Check filling level of aspiration vessel regularly and drain if necessary.

**Note hygiene regulations – risk of infection!**



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## Changing patients

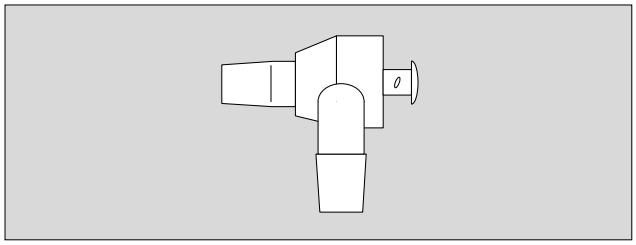
### Changing parts

Refer to page 83 onwards for a schematic overview and description of methods for cleaning and disinfection.

Maintenance intervals: page 106.

- Machine in »standby« mode –
- Vapor: control dial set to »**0**« = Off.

**The T-piece and filter are not required when using a Y-piece with Luer lock.**




### After treating an infectious patient

the entire machine must be cleaned, disinfected and sterilized.

**Note hygiene regulations – risk of infection!**

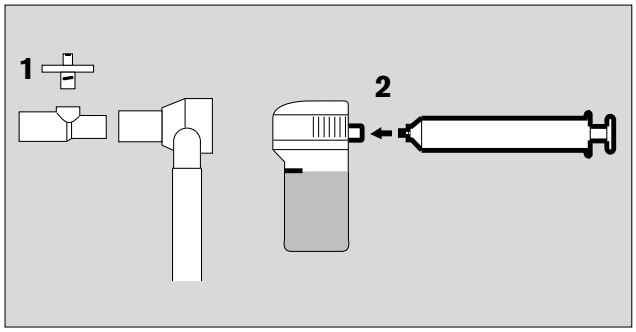
### After treating a non-infectious patient

the following parts must be replaced before continuing with the next patient:

- Tube or mask
- Y-piece
- Both breathing hoses
- Temperature sensor and cable if applicable

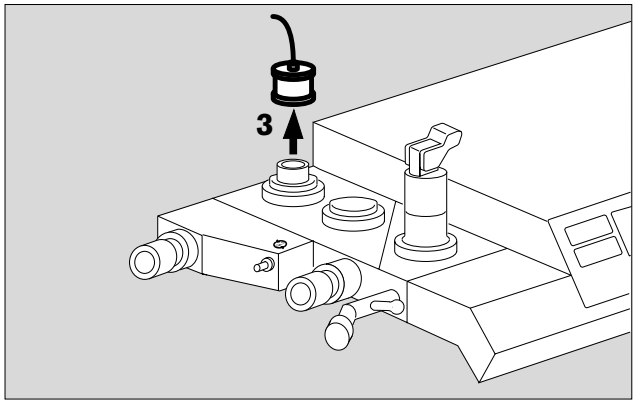
**1** T-piece of the measured gas hose and filter, if used (disposable articles, household refuse)

**2** Drain:
Insert an empty syringe without cannula, at least 20 mL, into the connector.




- Extract the water, remove syringe and dispose of the full syringe as ordinary domestic waste.
- Push water trap back into holder – until it tangibly engages.

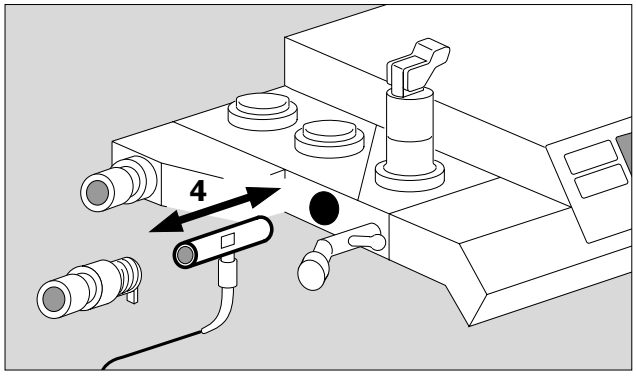
  **An overfull container or a faulty water trap could lead to failure in sidestream measurement.**




**The following must also be changed when working without microbial filter:**

**3** $O_2$ sensor with connecting lead, if used.

**4** Flow sensor.
Disconnect lead from flow sensor, it remains on the machine.




- Breathing bag with hose
- Breathing system:
  Disconnect fresh gas hose, it remains on the machine.
- Pressure measuring hose and filter: must be replaced. Hose connector remains on the machine.
- Soda lime container – turn anticlockwise and pull down – must be replaced.
- Anaesthetic gas scavenging hose – release (latch in front of connector) and pull off, also at the central supply point.

## Set machine to »standby«

In »**standby**« mode,

– the system can immediately be switched to any operating mode,

– gas consumption is zero,

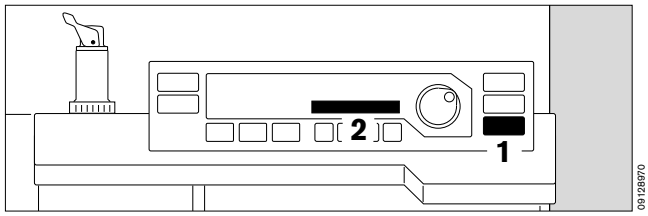
– power consumption is marginal and

– the piston cylinder unit is in withdrawal position.

**1** Press ⏻ on the ventilator for at least three seconds.

**2** Display

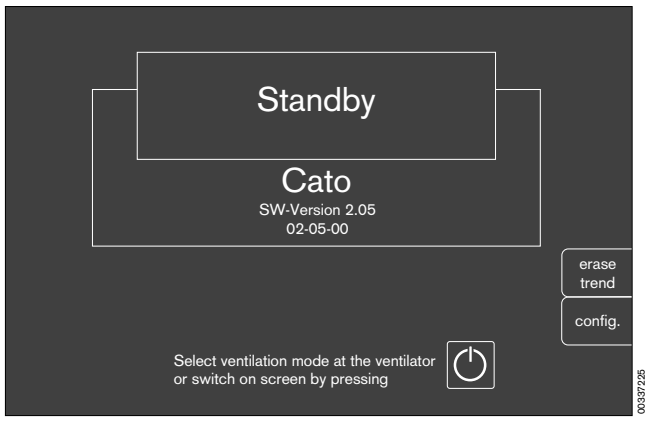
**Standby**




The flow tubes are no longer lit up.

The monitor remains operational and should be set to »standby« by pressing ⏻ if not required.

**The monitor can only be switched to standby if the ventilator is already in standby!**




**During breaks:**

- Set fresh gas flow to »**O**«.
- On Vapor: set control dial to »**0**«.

## After use

If operation is interrupted for several hours, we recommend that you do not leave the Cato in »Standby« mode but switch it off completely.

- Turn the master switch to »**O**« = Off – the switch symbol is no longer white. After switching off, an OFF delay displays the message »**Power off**« in the Ventilator display for about 10 seconds.
- Disconnect the gas hoses from the wall sockets, or close the cylinder valves of the gas cylinders.
- Roll up hoses and hang them over the holder at the back of the machine.
- Disconnect the mains plug.

# Monitor functions

## Contents

## Screen saver

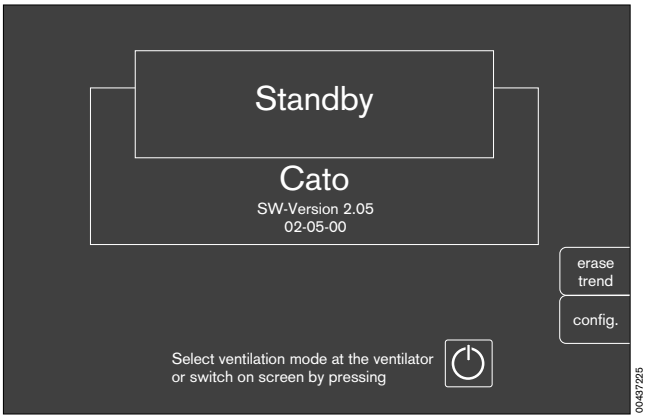
If none of the operating elements on the Cato is operated in »**standby**« for approx. 2 minutes, the screen switches off and becomes dark. The yellow LED in the standby key and the word »**Standby**« on the ventilator light up. The monitor display is immediately restored as soon as any key is pressed.

## Standby screen

The »**standby**« screen contains two softkeys with which to invoke menus for

– erasing the trend and list memory,

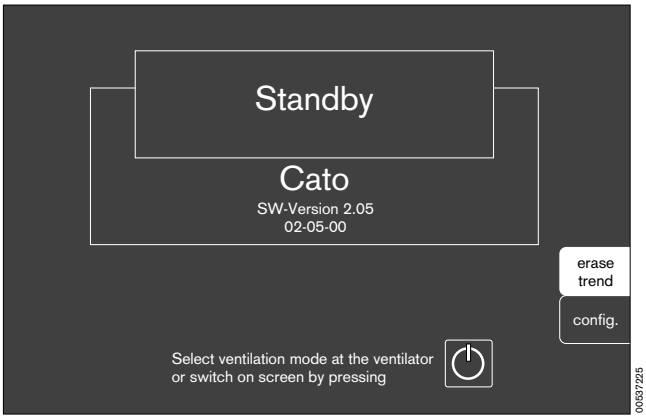
– monitor configuration.




### Erase trend

e.g. for a new patient:
The trend memory and list are erased together! This is only possible in »**standby**«!

- Press ⏻ on the screen in order to switch to »standby«. This is only possible if the ventilator is also on »**standby**«!

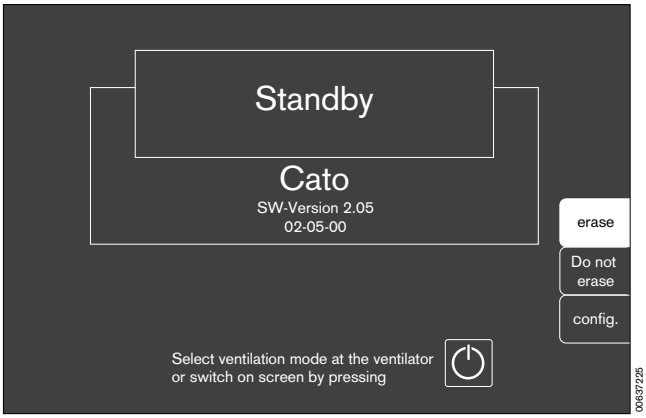



- Press the softkey »**erase trend**«.

  The system enquires again whether the trend is indeed to be erased.

- Press the softkey »**erase**« to confirm.

  The former screen is restored without change if the softkey »**Do not erase**« is pressed.




**The saved anaesthetic concentration trend is erased when changing the anaesthetic vaporizer!**

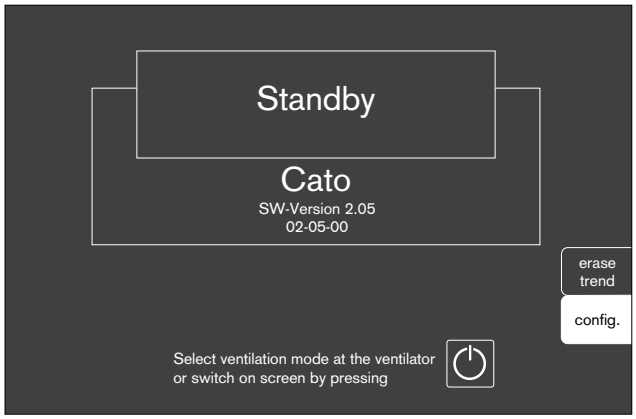
# Configuring monitor functions in »standby«

## Invoking the configuration menu

- The configuration menu is called up by pressing the softkey »**config**«.

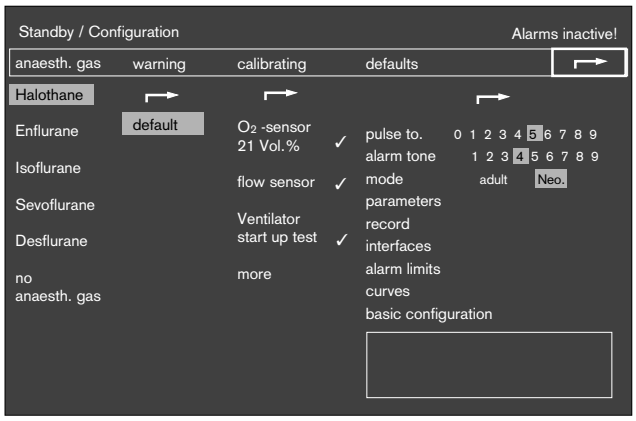
Configurations which are set under »**defaults**« in »**standby**« mode remain active whenever the machine is switched on again.

All other configurations, on the other hand, only apply temporarily.




The screen shown alongside appears on the monitor:

The
– **defaults**,
– **calibration**,
– **alarms** and
– **anaesthetic gas**
can be altered with this menu.



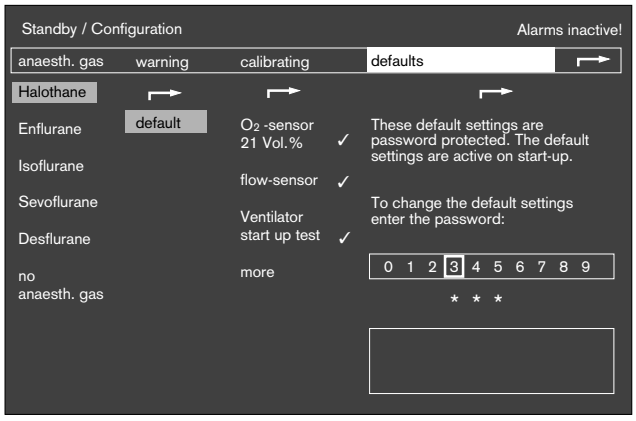

These settings are always called up and changed in the same way:

- **Turn rotary control**
  to displace the cursor frame.
- **Press rotary control**
  to confirm the selection made with the cursor frame.
- **Fields with grey background**
  represent the currently valid settings.
- **Fields with white background**
  show the menu steps via which the momentary field was reached.
- **The arrow ( ↱ )**
  means return to the preceding menu level.

## Changing default values

- Turn rotary control on monitor until the cursor frame is located over »**defaults**«.
- Press rotary control.

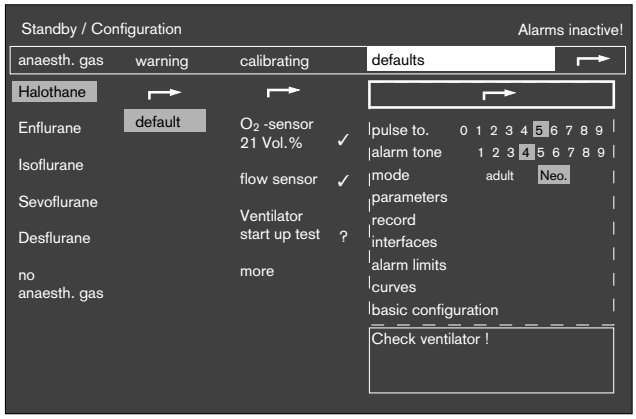
  The operator is then prompted to enter a four-digit password (specified during the initial training) in order to prevent unauthorized changes to the basic functions. This function can be deactivated by DrägerService.
- Use the rotary control to select and confirm individual numbers from the line displayed below. The password is represented by asterisks ( * * * ) below the line. When the correct password has been entered, the cursor frame jumps to the selection field for the default values.



The vertical selection area is displayed.

The menu for configuring the defaults appears with settings:

- **pulse tone** for setting the volume of the pulse tone.
- **alarm tone** for setting the volume of the alarm tone.
- **mode** for changing over between adult and neonate mode.
- **parameters** for setting the measuring functions.
- **record** for setting the list entries and printer output.
- **interfaces** for setting the parameters for data transfer.
- **alarm limits** for selecting the alarm limits.
- **curves** for selecting the curve display.
- **basic config.** for setting the date, time, language and tone.

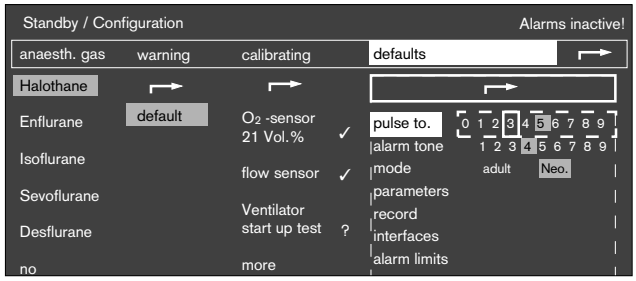



## Pulse tone

The volume of the pulse tone is set here.

»**0**« corresponds to **OFF**, »**1**« is the lowest volume and »**9**« the highest volume.

The tone is generated at the corresponding volume as it is adjusted.

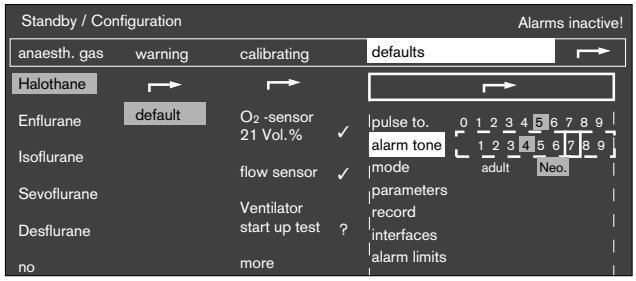



## Alarm tone

The volume of the alarm tone is set here.

»**1**« is the lowest volume and »**9**« the highest volume.

The tone is generated at the corresponding volume as it is adjusted.

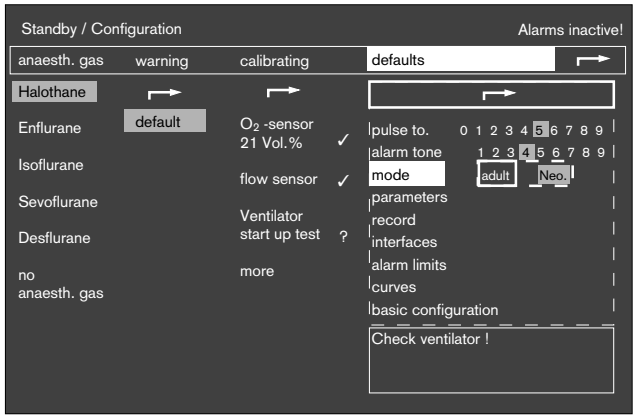



## Mode

This function is used to change over between adult and neonate mode:

- **adult** Adult mode
- **neo** Neonate mode

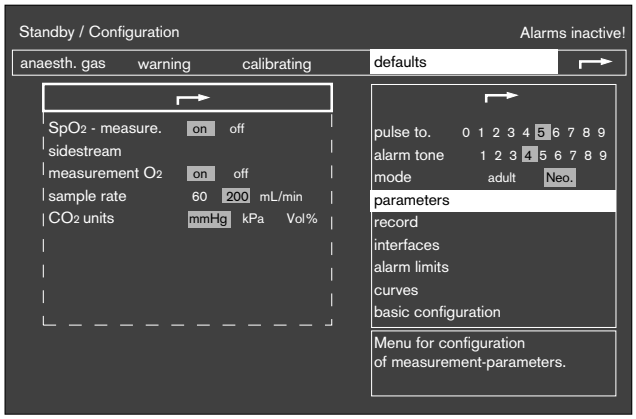
The volumeter functions and trend displays are scaled at the same time.



## Parameters

The settings for the following parameters are defined via this menu:

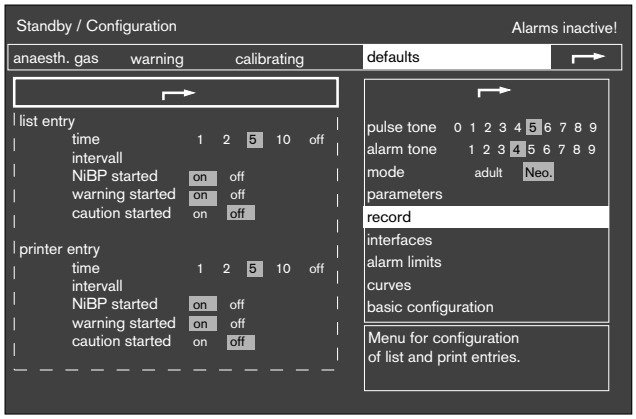
- **$SpO_2$-measurement** on • off
- **sidestream measurement $O_2$** on • off
- **sample rate** 60 • 200 mL/min
- **$CO_2$ units** mmHg • kPa • % by volume




## Record

This menu is used to define which event triggers an **automatic** entry in the record list or printout on the on-line printer:

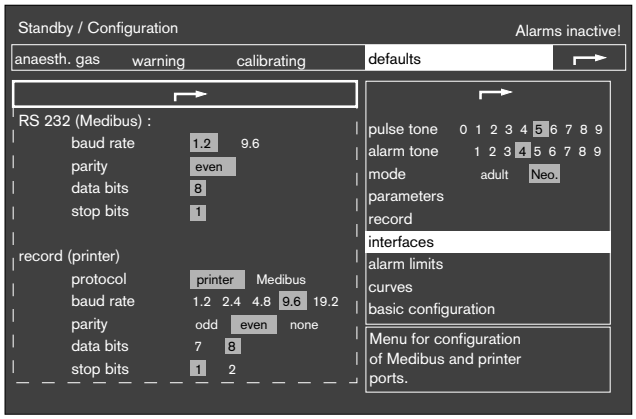
- **time intervall** Entry upon expiry of a fixed time interval in minutes.
- **NiBP started** Entry after every NiBP measurement with new results.
- **warning started** Entry is made whenever a warning has been triggered.
- **caution started** Entry is made whenever a caution has been triggered.




## Interfaces

The interface for data transfer (Dräger MEDIBUS RS 232) and the printer port are configured here:

- **baud rate** Transmission rate (can be varied, see Instructions for Use of the device to be connected)
- **parity** Cannot be changed in MEDIBUS and is merely displayed for information.
- **data bits** Cannot be changed in MEDIBUS and is merely displayed for information.
- **stop bits** Cannot be changed in MEDIBUS and is merely displayed for information.
- **protocol** Allows the printer port to be used as a second MEDIBUS interface.



## Alarm limits

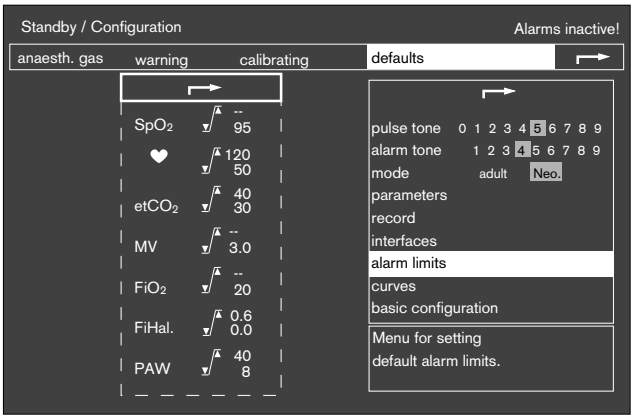
This menu is used to specify the standard alarm limits.

These alarm limits are automatically active after

– switching on the Cato,

– selecting »**default**«.

Two dashes (– –) in the table mean that this alarm limit is inactive and not monitored. It can be activated by turning the rotary control beyond the maximum or minimum value possible and confirming it.

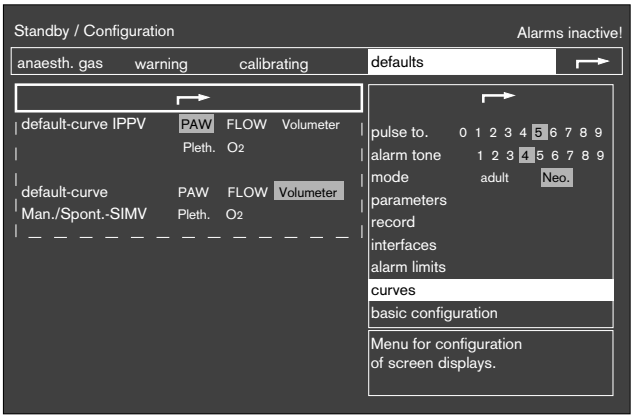



## Curves

This menu is used to specify the standard curves.

These curves are automatically active after

– switching on the Cato.




## Basic configuration

The basic configuration comprises four items:

– **time** for the current time

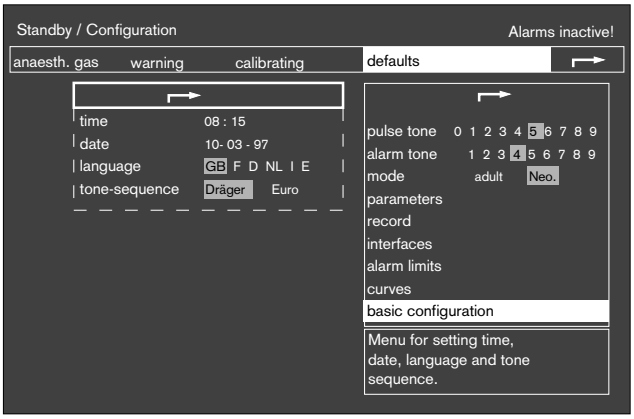
– **date** for the current date

– **language** for the language version
The same language version is also used by the ventilator.

The following languages are available:

| | |
|---|---|
| English | **GB** |
| French | **F** |
| German | **D** |
| Dutch | **NL** |
| Italian | **I** |
| Spanish | **E** |

– **tone-sequence** for selecting the tone sequences for warnings, cautions and advisories.



## Calibration

This menu is used for the following tests and calibrations:

- Calibrate **$O_2$-sensor with 21 Vol.% $O_2$**
- Calibrate **flow sensor**
- Perform **Ventilator start up test**
- **more**

  The following can be realized under »**more**«:

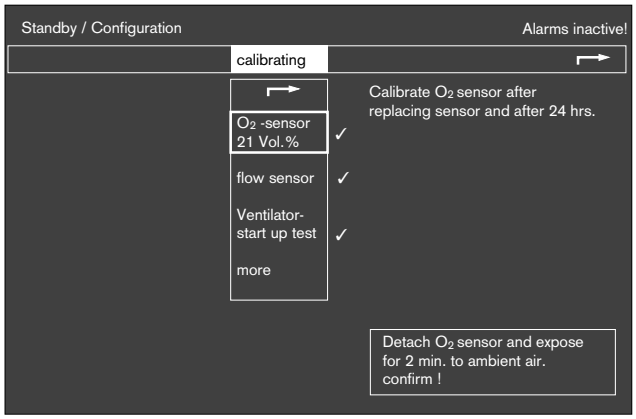
  - $O_2$ sensor calibration with 100% $O_2$ by volume,
  - linearity check of the $O_2$ sensor and
  - calibration of the $CO_2$ sensor.

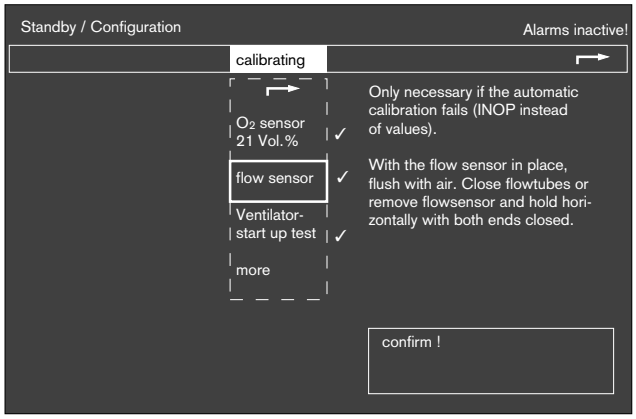
The significance of the symbols is as before:

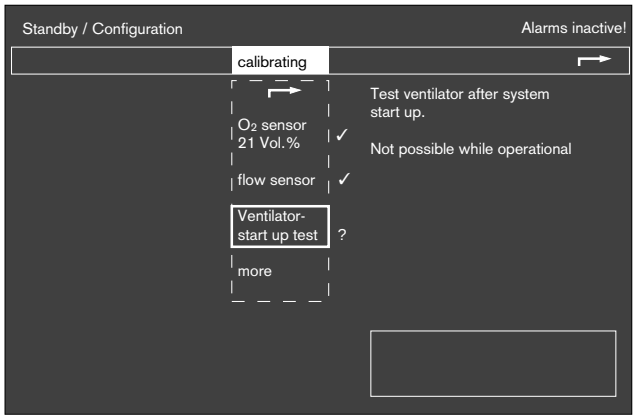
**?** = Enquires whether an action has been performed or a setting made.

⏲ = Waiting period. The selected test step is being carried out by the system.

✔ = The action has been completed successfully or is not required.

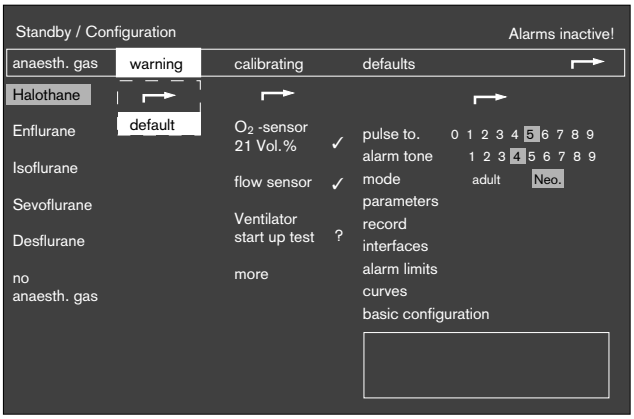


## Alarms

The standard alarm limits are activated by selecting and confirming the field »**defaults**«. The individual settings in the »**limits**« menu are then overwritten.




## Anaesthetic agent

The anaesthetic vaporizer is automatically recognized by the Cato on account of an optical code. However, sevoflurane and desflurane vaporizers are only recognized by equipment built after July 1994 or which has been converted by DrägerService. The anaesthetic agent concerned is then highlighted by a grey background.

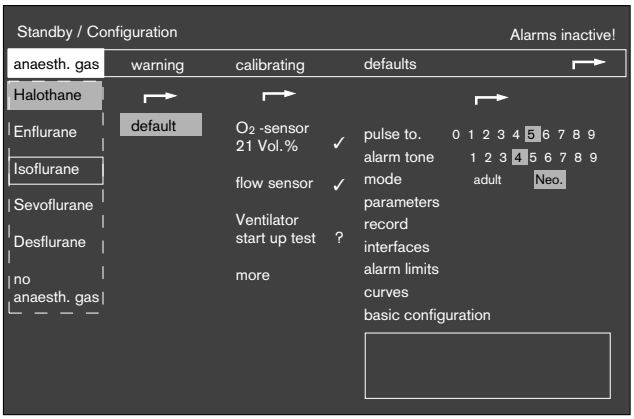
**The machine can only recognize the Vapor, but not the anaesthetic agent!**

**The user is responsible for ensuring that the correct agent is used!**

If the anaesthetic vaporizer does not feature an optical code which can be read electronically (older models can be upgraded by DrägerService on request), the anaesthetic agent must be selected by hand:

- Move the cursor frame to the required anaesthetic agent with the aid of the rotary control.
- Press the rotary control to confirm.

**The stored trend for the anaesthetic agent concentration is automatically erased when changing the anaesthetic vaporizer!**



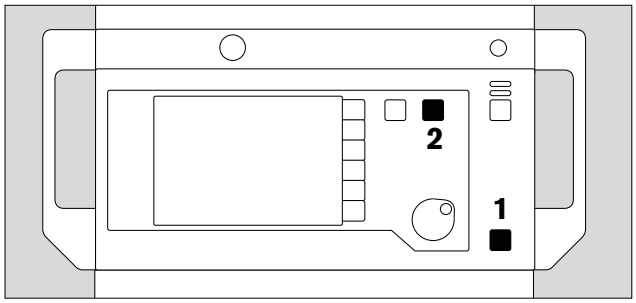
# Monitor functions during operation

## Changing to measuring mode from »standby«

- The monitor automatically changes to measuring mode when »standby« mode is deactivated on the ventilator or a ventilation pattern is set (»**IPPV**«, »**SIMV**«) or »**MAN/SPONT**«.

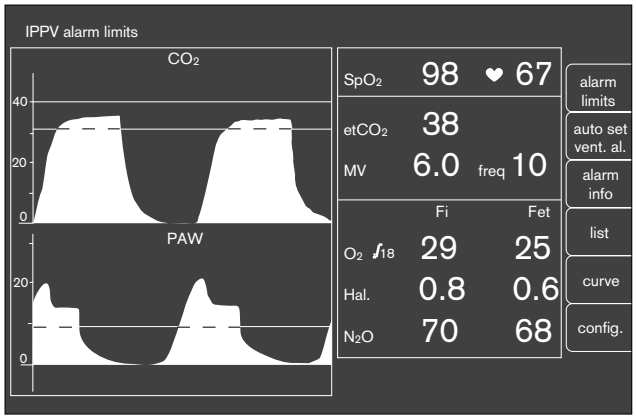
**or**

**1** Press »standby« on the monitor; the yellow LED goes out.




- The **standard screen** with the basic parameters of importance for anaesthesia ventilation is displayed on the monitor.

  The **data screen** and the **trend screen with zoom function** can also be selected. These screens are described below.




## Select standard screen

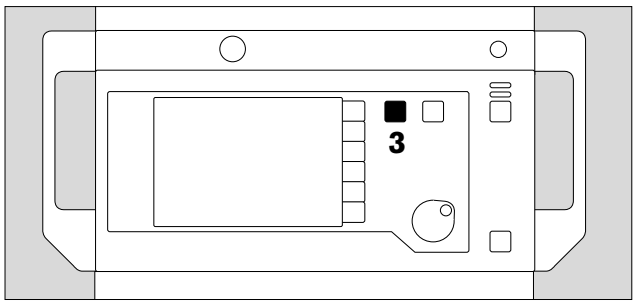
The standard screen can be selected at any time:

**2** Press on the monitor.

## Select data screen

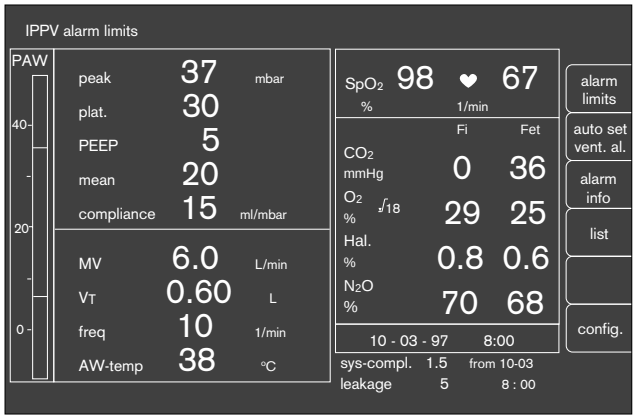
to display all measured values.

**3** Press (repeatedly) until the **data screen** is displayed.




- Display (example):

  The airway pressure $P_{aw}$ is continuously indicated by the bar graph on the left-hand side of the screen.



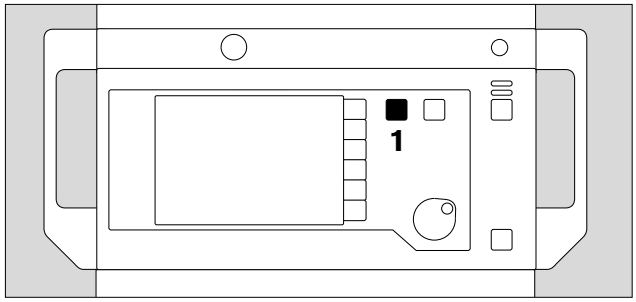
## Select trend screen with zoom function

This screen presents the development of measured values over time since measurement commenced.

Values can be saved for a maximum of eight hours.

The following combinations can be displayed:
– $CO_2$ / AMV
– Agas / $N_2O$
– $O_2$ / Compliance
– $SpO_2$ / Pulse rate

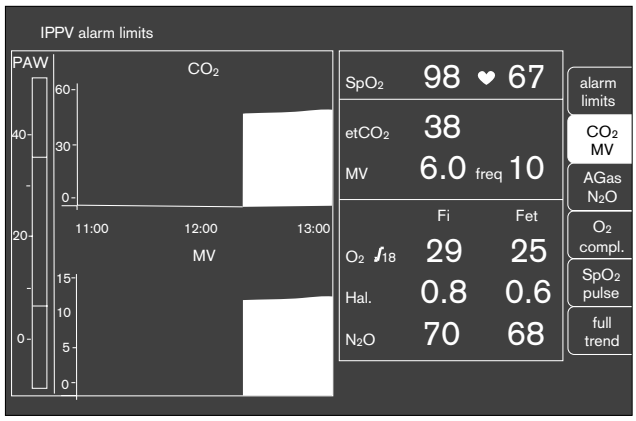
**1** Press  (repeatedly) until the trend screen is displayed.




02437224

**Example:**
(The bottom softkey »**full trend**« is only available here)

The zoom function can also be called up when the equipment has been in operation for more than 30 minutes. This function makes it possible to magnify part of the time range (possibly several times). The magnified section is marked by a dashed border. The past is on the left.



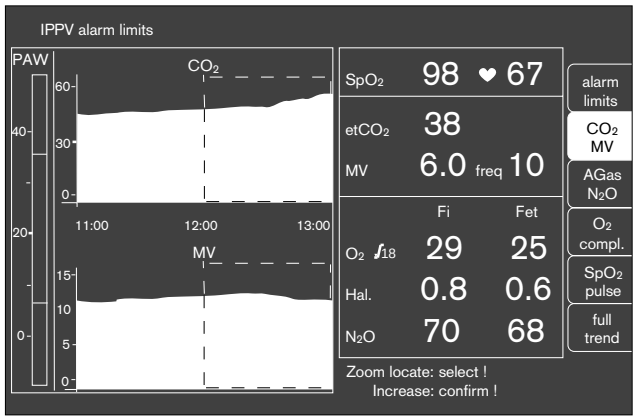

04028971

**Example:**

- Turn rotary knob – the dashed area moves until it includes the interval of interest.
- Press rotary knob – the dashed area is enlarged to the full display width.

  When the monitor has been in operation for a sufficiently long time, a new dashed area appears and can be extended as described above.

  The maximum has been reached when no new dashed border appears.

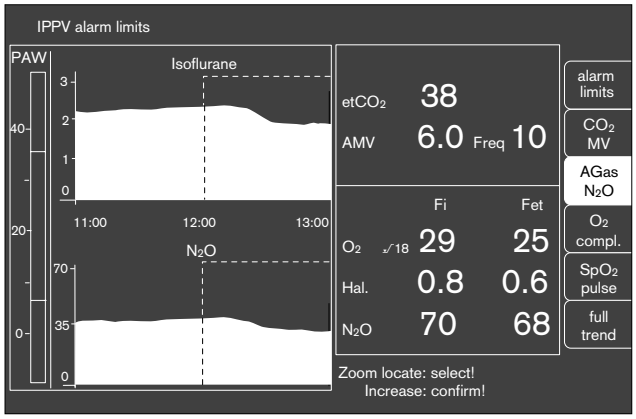



04028971

### Show other trend combinations

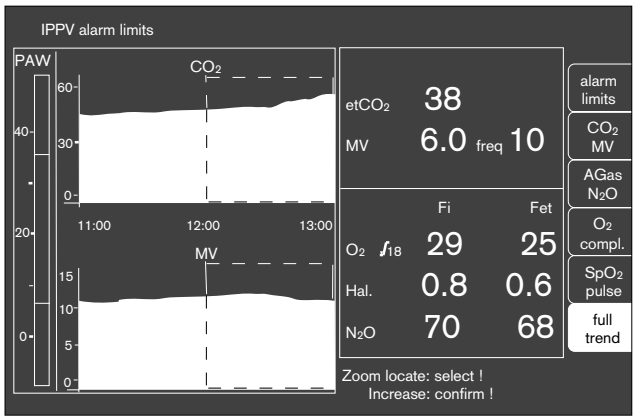
- Press the corresponding softkey, in this case »**Agas/N2O**«; the combination is then set against a light background and the new trend curves appear on the screen.

  The softkey remains blank if a measuring function (e.g. SpO2 measurement) is not available.




### Return to full trend

- Press the softkey »**full trend**« in order to restore the complete trend display.



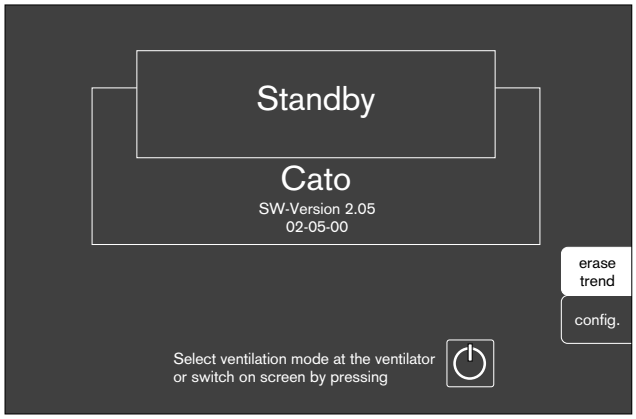

### Erase trend memory

The trend memory and list are erased together! This is only possible in »**standby**« mode!

- Press ⏻ on the monitor in order to switch to »standby«. This is only possible if the ventilator is already on »standby«!

- Press the softkey »**erase trend**«.

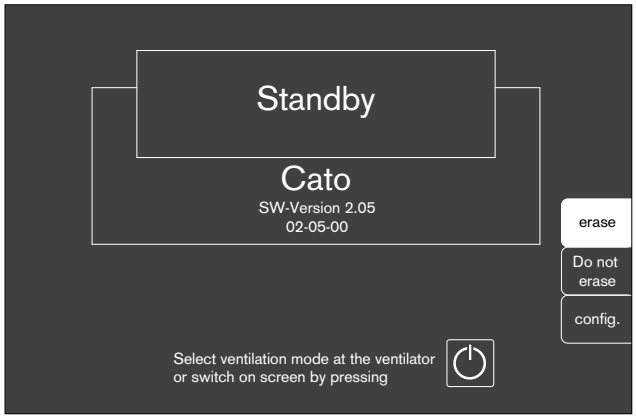
  The system enquires again whether the trend is indeed to be erased.




- Press the softkey »**erase**« to confirm.

  The former screen is redisplayed without changes if the softkey »**Do not erase**« is pressed.

**The saved anaesthetic concentration trend is erased when the anaesthetic vaporizer is changed!**



# Softkeys

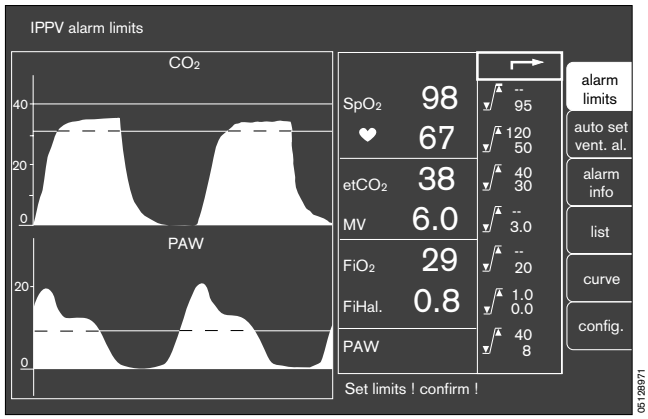
## Displaying and setting alarm limits during operation

This can be done in all screens.

– So that measured values can be displayed together with their associated alarm limits.

– So that alarm limits can be corrected in line with changed values.

- Invoked via the softkey »**alarm limits**«.




The display comprises the designation of the measured value (etCO2 in this example), the value actually measured on the patient in large numerals (38 in this example) and the set upper and lower alarm limits as small numerals following the symbol for alarm limits ( ▼/▲ ).


A deactivated alarm limit is indicated by two dashes in the numbers field.


The set limit values only apply temporarily! They are overwritten by the standard alarm limits when

– the Cato is switched off;

– the setting »**default**« is selected and confirmed under »**warning**«.

**To change alarm limits:**

- Move the cursor frame to the value for the required alarm limit with the rotary control and press to confirm.
- The value can then be altered by turning the rotary control until the required value has been obtained.
- The value is confirmed by pressing the rotary control – this value now represents the active limit.

The active alarm limits are shown as a dashed line in the graphs displayed on the monitor.

See page 65 for information on adjusting alarm limits.

## Activate and deactivate $CO_2$ alarms

In »**MAN/SPONT**« monitoring mode, the alarm limits for inspiratory and expiratory $CO_2$ are deactivated; only the $CO_2$-apnoea alarm is active. This alarm can also be deactivated by pressing the »**$CO_2$ al. on/off**« key.

**In this case, there will be no $CO_2$ monitoring at all.**

The $CO_2$-apnoea alarm can be reactivated by pressing the key again.

The $CO_2$ alarms are automatically activated on changing to »**IPPV**« or »**SIMV**« monitoring mode with a ventilation rate above 6 breaths/min.

The alarms remain deactivated when changing to »**HLM**« mode or »**SIMV**« with a ventilation rate of up to 6 breaths per minute.

When the $CO_2$ alarm is activated, the inspiratory $CO_2$ concentration of the breathing air is monitored with an invariable upper limit of 5 mmHg.


## Auto set/Ventilation alarm

Prerequisite:
The ventilator must be in »**IPPV**« mode

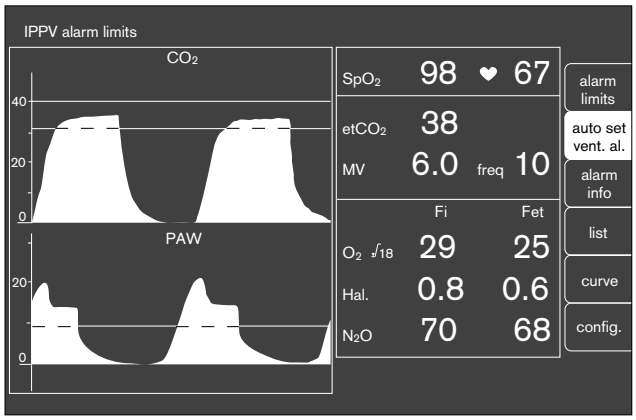
The ventilation alarms with new alarm limits can be automatically adjusted to the current ventilator settings by pressing the softkey »**auto set vent. al.**«.

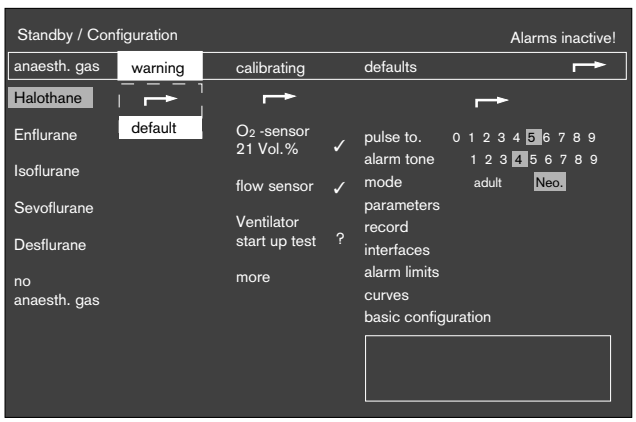
The alarm limits previously set in the »**limits**« menu are erased and cannot be reactivated! See also »**Alarm concept**« on page 65.

The new tolerance ranges generated for the current measured values depend on the parameter in question:

| Parameter | New measured value tolerance | | Unit |
|---|---|---|---|
| | Lower | Upper | |
| $P_{aw}$ | PEEP + ($P_{max}$- PEEP) / 4 | $P_{max}$ + 10 | mbar |
| AMV | $V_T$ * f * 0.6<br>but always:<br>over 0.5 | $V_T$ * f * 1.4<br><br>over 2.0 | L/min |

The default alarm limits are not affected by Auto set and can be reactivated at any time via the functions »**config**«, »**warning**« and »**defaults**«.
Deactivated alarm limits (– –) are not activated by Auto set!

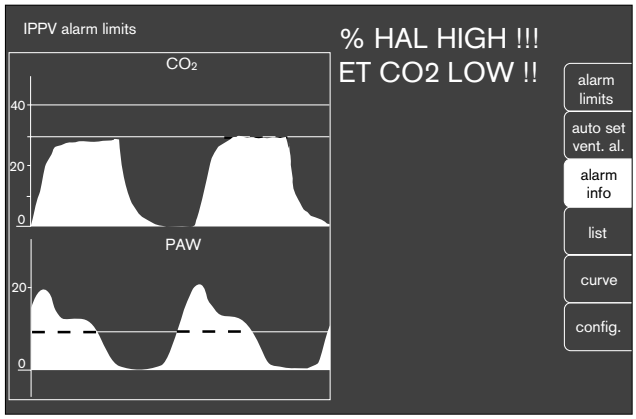


## Alarm information

- The measured value field is erased and all active alarms listed when this softkey is pressed.

  The display can only be viewed as long as the key is pressed.

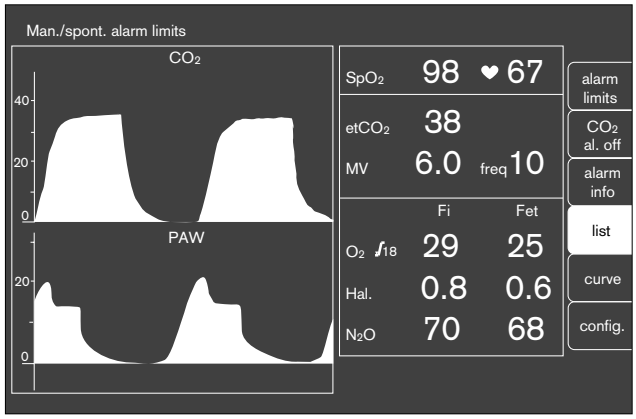



## Select list screen

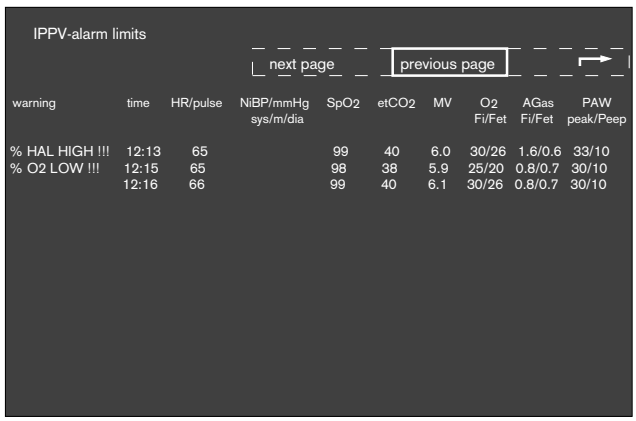
For retrospective documentation of former measured values and alarms. Generation of list entries is described in the section »**record**« on page 53.

On the standard screen,

- press the softkey »**list**«.




- The display changes and the list appears on the screen (example):




**Return to previous page:**

- Select »**previous page**« and confirm.

**Move to next page:**

- Select »**next page**« and confirm.

**Erase list:**

- Press »standby« key ⏻ and softkey »**erase trend**«. Press new softkey »**erase**« in response to system enquiry.

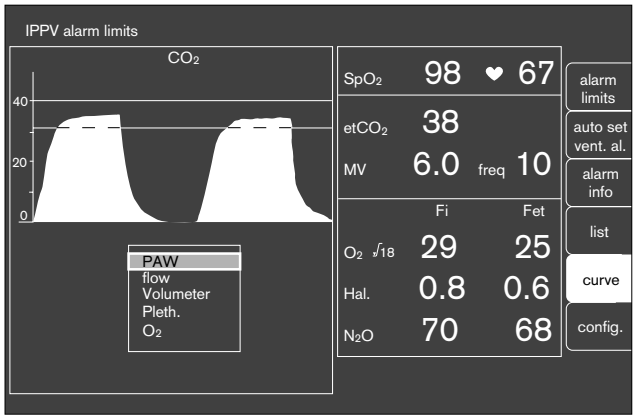
## Curve selection

Only possible in the standard screen!

A second curve for the bottom half of the screen can be selected from the menu presented here to complement the $CO_2$ concentration curve ($CO_2$) which is always displayed.

The following can be selected:

– **PAW** Airway pressure
– **flow** Expiratory flow
– **Volumeter** Display showing the minute ventilation plus Paw and $V_T$ as a bar graph. See below.
– **Pleth.** Plethysmogram (optional)
– **$O_2$** Oxygen concentration of the breathing gas (optional).




- Press the softkey »**curve**«.
  A selection menu appears. The option with grey background is currently set.
- Use the rotary control to move the cursor frame to the designation of the required curve.
- Press rotary control. The selected curve is shown on the screen.

### Volumeter function

Depending on mode, the length of the bar represents a maximum measured value:

| Mode | Tidal volume $V_T$ | Minute ventilation |
|---|---|---|
| Neonate | 0.2 L | 2 L/min |
| Adult | 1.0 L | 10 L/min |

**Pressure indication:**

– The airway pressure is shown in the upper bar graph.

**Tidal volumeter:**

– The expiratory volume of a breath ($V_T$) is indicated graphically by the middle bar and numerically on the left.

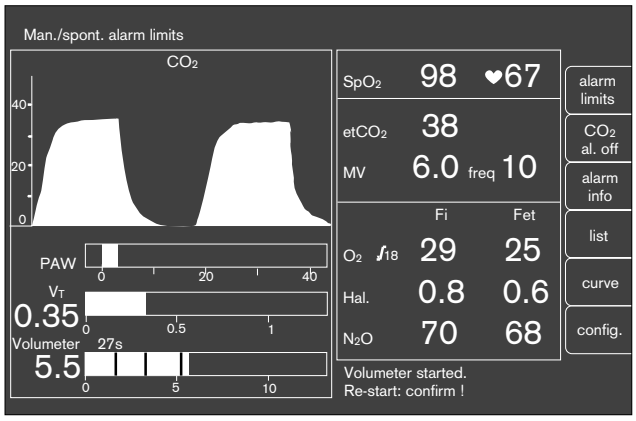
**Minute volumeter:**

– The minute volume represented by the bottom bar runs for 60 seconds, during which the tidal volume is summed.

The time expired is shown in seconds above the bar, the total volume appearing on the left. The individual breaths are separated by segments in the bar graph. The volumeter automatically stops and outputs an advisory tone after 60 seconds. The measured values are displayed for 4 minutes and are then erased.

**To start volumeter:**

- Press rotary control. If the rotary control is pressed again during the 60 seconds, the values will be erased and the volumeter restarted.



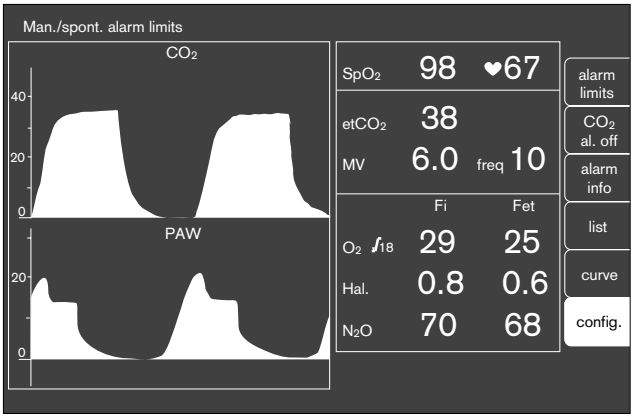
## Configuration during operation

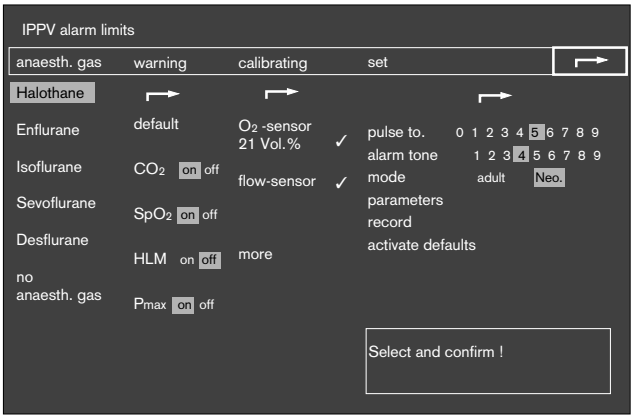
The menu displayed during operation shows the functions required for measuring mode. The functions are selected as described for other menus. The settings made here only apply for the present operation.

- Press the softkey »**config.**«

  The configuration menu is displayed. The values shown against a grey background currently apply.

- Turn the rotary control to move the cursor frame as in the standby configuration menu. Refer to the description of that menu for further details (page 51 onwards).




**set**

– **pulse tone** For setting the volume.

– **alarm tone** For setting the volume.

– **mode** Change over between adult and neonate modes.

– **parameters** For setting the parameters, see page 53.

– **record** For determining which event triggers an entry in the record list or printout on the printer, see page 53.

– **activate defaults** Activates the configured default settings (see page 51 onwards).

**calibrating**

– **calibration** $O_2$ and flow sensor, as well as others.

**warning**

– **default** Activates all default alarm limits configured in »**standby**«.

– **$CO_2$** Activates/deactivates all $CO_2$ alarms (including »Apnoea«).

– **$SpO_2$** Activates/deactivates all $SpO_2$ alarms.

– **HLM mode** Activates/deactivates the heart/lung machine monitoring mode. See page 68.

– **$P_{max}$** »**on**« Ventilator pressure limitation generates a caution message.

»**off**« Ventilator pressure limitation generates an advisory message.

The »**off**« setting is recommended for ventilation with intentional pressure limitation.

– **anaesth. gas** see »Configuring monitor functions in « standby »« on page 56.

# Alarm concept

## Alarm priority

The monitor alarms are combined with those of the ventilator, arranged in order of priority and assigned to certain tones or tone sequences.

This information is presented in keeping with the situation, in separate fields for:

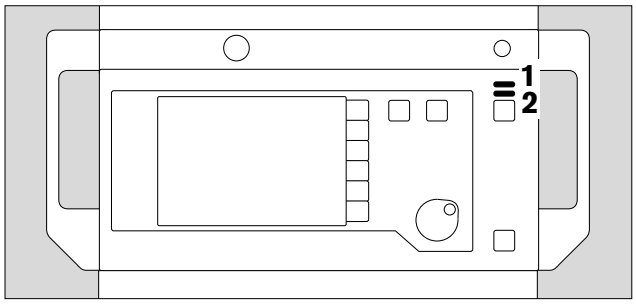
**Warning** marked »**!!!**«
**Caution** marked »**!!**«
**Advisory** marked »**!**«

Warnings are accompanied by a continuous tone, caution messages by a tone at 30 second intervals and advisory messages by a single tone. All tones are output at the same time as the messages appear in the displays.

European Standard EN 740 stipulates use of EN tones. Alternatively there are tones in keeping with Dräger conventions available.

Whenever a warning or caution message occurs, the corresponding LED lights up above the key:

**1** Warning Red, flashing
**2** Caution Yellow, flashing
**2** Advisory Yellow, continuous




The summary of alarm limit settings appears on the screen. The parameters which have been exceeded are shown in inverted form.

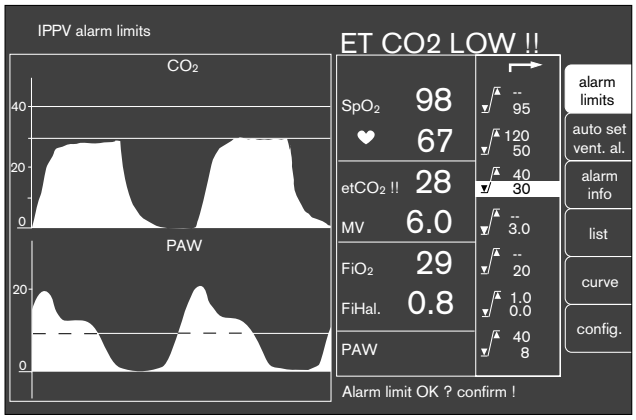
**Example:**

The lower alarm limit for $etCO_2$ is set at 30 but the actual value is lower. A value of 28 is measured.

– The settings menu appears automatically. The violated alarm limit is shown in inverted form.
– The symbol for the lower alarm limit ⌟ and the parameter designation »**$etCO_2$**« appear in the advisory field for caution messages.
– The yellow LED lights up.
– The corresponding tone is heard.

The value can be altered by turning the rotary control and confirmed by pressing the control.

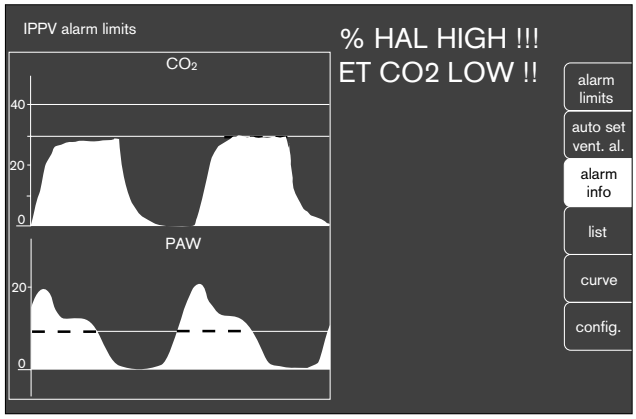
The alarm limit can be confirmed directly if it is to remain unchanged. The limit value menu is always closed whenever a value is confirmed.




If several alarms occur simultaneously, the alarm limits which have been exceeded are shown against a grey background. When the first alarm has been confirmed (by pressing the rotary control on the monitor), the alarm limit of the alarm with the next lower priority is activated and displayed.
All alarms received are recorded for the anaesthesia record if list entry has been configured accordingly.

### Displaying all alarms

- Press the softkey »**alarm info**« and keep pressed. The alarm texts of all warning, caution and advisory messages are displayed in order of priority.
- Release the softkey »**alarm info**«. The alarm texts disappear.



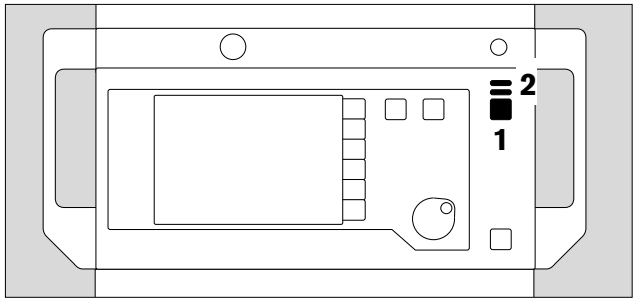

### Suppressing the alarm tone

1 Press 🔔 on the monitor for which the yellow LED lights up. The alarm tone is then suppressed for **two minutes**. Any new messages occurring during this time, however, are indicated once with their appropriate specific tone.

2 The red (upper) or yellow (lower) LED continues to light up and the text remains on display.

**To reactivate the alarm tone during the 2 minutes:**

1 Press 🔔 again and the corresponding yellow LED goes out.



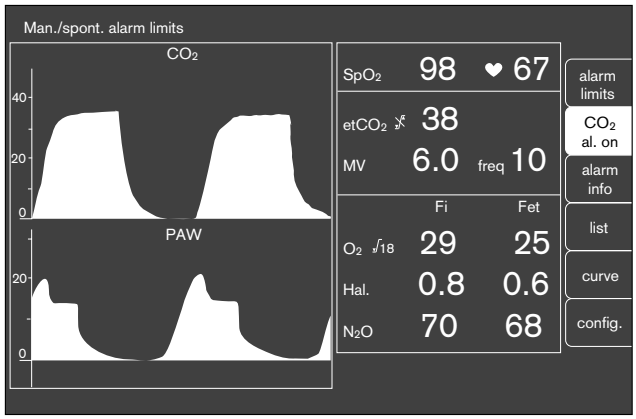

## $CO_2$ alarm on/off

The $CO_2$ alarms can be deactivated by the »**$CO_2$ al. on/off**« key.

**In this case, $CO_2$ is not monitored.**

Press the key again to reactivate the alarm.

When the $CO_2$ alarm is on, the inspiratory $CO_2$ concentration in the breathing air is monitored with a fixed maximum limit of 5 mmHg!



## Adjusting to the ventilation mode

**For »IPPV", »MAN/SPONT« and »SIMV« ventilation modes**

The alarm limits are switched over automatically with the change of ventilation mode.

In »**IPPV**« and »**SIMV**« modes, the »**IPPV alarm limits**« alarm mode is automatically activated on the monitor if the ventilation rate is equal to or greater than 6 breaths per minute.

The MAN/SPONT alarm limits are automatically activated for »**MAN/SPONT**« and the SIMV alarm limits for »**SIMV**« mode with a ventilation frequency of less than 6 breaths per minute.

The currently active alarm mode at any time is displayed in the status field and flashes for the first five seconds.

The full range of alarms (»**IPPV alarm limits**« alarm mode) can be reactivated by selecting IPPV mode or by setting the ventilation frequency to a value equal to or greater than 6 breaths per minute.

| **Alarm limits in ventilation mode** | | | **MAN/ SPONT** | **SIMV** with $f_{IMV} < 6$ | **SIMV** with $f_{IMV} \geq 6$ and **IPPV** | **MAN/SPONT HLM** | **IPPV/SIMV HLM** |
|---|---|---|---|---|---|---|---|
| Minute ventilation | AMV | ↓/↑ | off | on | on | off | on |
| | | | off | on | on | off | on |
| Insp. anaesthetic gas | | ↓/↑ | on | on | on | on | on |
| | | | off | on | on | off | on |
| Airway pressure | Paw | ↓/↑ | on | on | on | on | on |
| | | | off | on | on | off | on |
| Exsp. $CO_2$ concentration | et $CO_2$ | ↓/↑ | on | on | on | on | on |
| | | | on | on | on | on | on |
| Insp. $CO_2$ concentration | in $CO_2$ | ↑ | on | on | on | on | on |
| Insp. $O_2$ concentration | $FiO_2$ | ↓/↑ | off | on | on | off | on |
| | | | on | on | on | on | on |
| Apnoea pressure | alarm activated after | | off | 30 s | 15 s | off | off |
| Apnoea flow | alarm activated after | | off | 30 s | 15 s | off | off |
| Apnoea $CO_2$ | alarm activated after | | 1 min. | 30 s | 30 s | off | off |
| Functional oxygen saturation | $SpO_2$ | ↓/↑ | on | on | on | off | off |
| | | | on | on | on | off | off |
| | HR | ↓/↑ | on | on | on | off | off |
| | | | on | on | on | off | off |

## Heart/lung mode (HLM)

A special alarm mode can be activated during operation for the function »**warning**« in the »**Configuration**« menu for operation with a heart/lung machine (»**HLM**« mode).

All apnoea alarms are deactivated in this mode and the gas values are displayed continuously without connection to the respiratory phase.

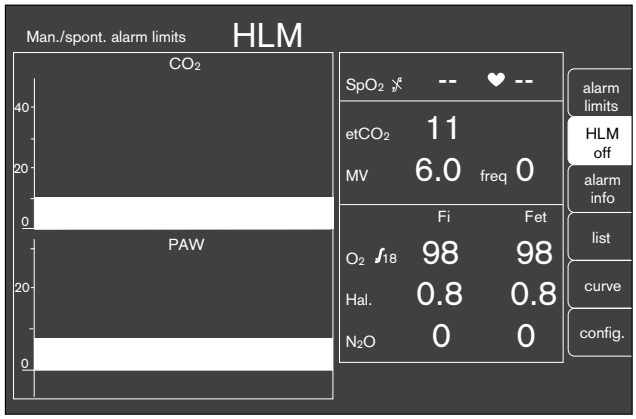
SpO2 alarms are deactivated in HLM mode. They are automatically reactivated when pulsations are detected again after ending HLM mode.

In this alarm mode, the parameters are monitored with the same limits as are set in the ventilation mode from which »HLM« was selected.

Heart/lung mode can be deactivated either

– via the »**Configuration**« menu or

– via the softkey »**HLM off**«.



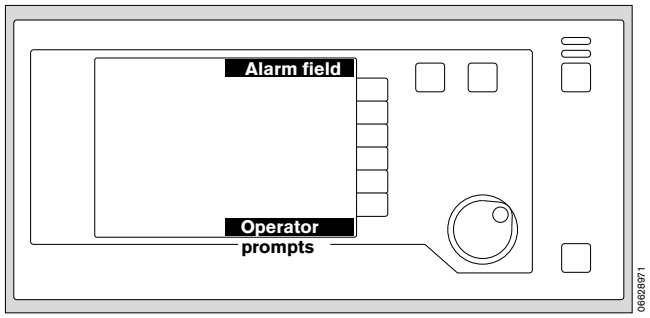
# Messages, cause and remedy

## Contents

## Where messages occur

### Warning, caution and advisory messages

These are the three types of message output by the system and displayed in the alarm field.
They are classified in order of priority and listed alphabetically in the following tables.



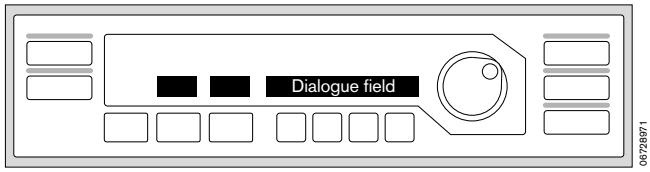

### User prompts

appear in the bottom right-hand corner of the screen.

### Messages on the ventilator

These are always output during operation. Refer to the chapter entitled »Anaesthesia ventilation«.

In exceptional cases, messages may also appear in the dialogue field during operation and the self-test. Refer to the table on page 78.




### Malfunctions and system faults

Eliminate the cause where possible as indicated by the user prompt on the screen. Inform DrägerService if necessary, specifying the malfunction number and software number.

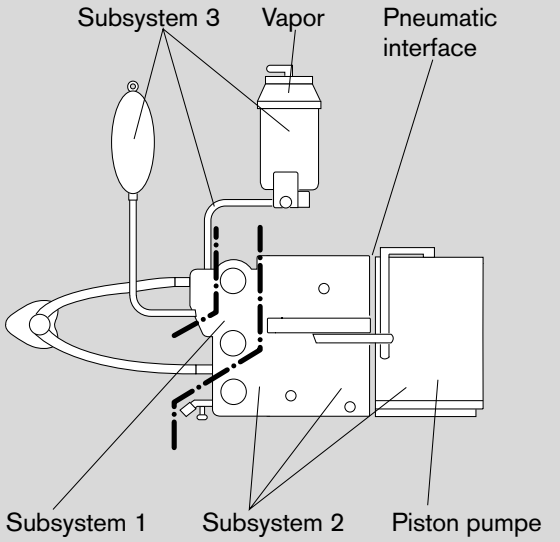
Call DrägerService if the malfunctions and/or advisory messages cannot be remedied in accordance with the descriptions or by repeatedly switching off and on again (with a delay of approx. 5 seconds in between) via the master power switch and repeating the self-test!

All malfunctions are signalled acoustically.

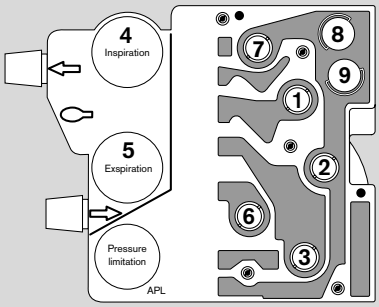
In the event of particularly serious problems, e.g. »**Control pressure low**«, it is possible that when manual ventilation is attempted no pressure will be generated in the breathing system. Simultaneous failure of the compressed air and compressed oxygen supply would be such a serious fault.

**In these cases, immediately ventilate the patient with the separate emergency breathing bag.**

## Location of the subsystems:

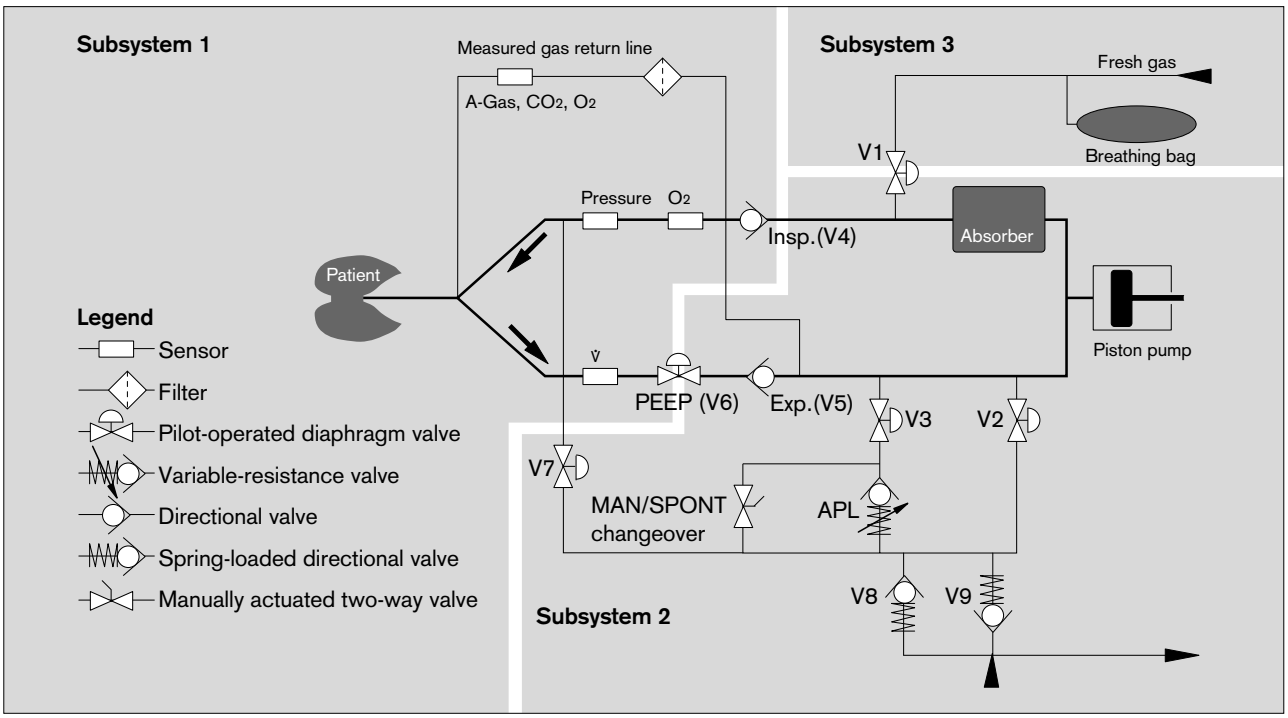



## Location of valves in the breathing system:




The valves are numbered as shown in the following schematic – V1, V2, ...

## Simplified pneumatic schematic showing valves and subsystems:

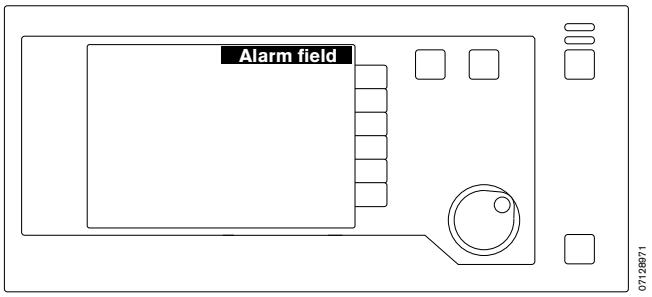


## Messages on the monitor

Alarm messages are assigned to three priority classes (alarm priority) on the monitor of the Cato:

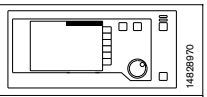
– Warning !!!
– Caution !!
– Advisory !

**The patient's condition must be checked first, before the machine is examined on account of a possible measuring error!**



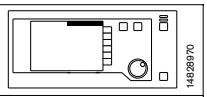

| Messages | | Cause | Remedy |
|---|---|---|---|
| % HAL HIGH<br>% ISO HIGH<br>% ENF HIGH<br>% DES HIGH<br>% SEV HIGH | !!!<br>!!!<br>!!!<br>!!!<br>!!! | The inspiratory anaesthetic concentration exceeds the upper alarm limit in each case.<br>The upper alarm limit has been exceeded for at least two breaths. | Check setting of anaesthetic vaporizer. |
| % HAL LOW<br>% ISO LOW<br>% ENF LOW<br>% DES LOW<br>% SEV LOW | !!<br>!!<br>!!<br>!!<br>!! | Applicable inspiratory anaesthetic concentration below lower alarm limit.<br>Value below lower alarm limit for at least two breaths. | Check setting of anaesthetic vaporizer. |
| % O2 ERR | ! | Sensor for inspiratory $O_2$ measurement incorrectly calibrated?<br>Sensor changed and/or not calibrated? | Calibrate sensor. |
| | | Sensor exhausted?<br>Sensor not plugged in?<br>Sensor lead defective?<br>Dräger sensor cell not used? | Replace and calibrate cell.<br>Plug in sensor connector.<br>Replace sensor housing.<br>Use original sensor cell. |
| % O2 HIGH | !! | Inspiratory $O_2$ concentration exceeds upper alarm limit. $O_2$ flush used? | Check $O_2$ concentration in fresh gas flow. |
| % O2 LOW | !!! | The inspiratory $O_2$ concentration is below the lower alarm limit. | Check $O_2$ supply.<br>Check setting on $O_2$ flow meter. |
| AGT ERR | ! | Anaesthetic gas measurement faulty. | Call DrägerService. |
| AGT NOT SEL | ! | Anaesthetic agent not selected or selection differs from that detected by Vapor identification. | Check and select anaesthetic agent. |
| APNOEA CO2 | !!! | Breathing/ventilation at a standstill. No breath detected by expiratory $CO_2$ for 30 seconds.<br>(No breath has been detected for 60 seconds in alarm mode »Man/Spont alarm limits«.) | **Patient must immediately be ventilated by hand!**<br>Check patient's spontaneous breathing ability.<br>Check hoses, tube and ventilator. |

## Messages on the monitor



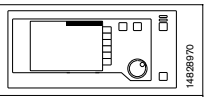
| Messages | | Cause | Remedy |
|---|---|---|---|
| APNOEA PRES | !!! | Ventilation at a standstill.<br>No change of pressure detected for 15 seconds; 30 seconds in the case of SIMV alarm limits.<br>Inadequate supply of fresh gas.<br>Leak in hose system. | **Patient must immediately be ventilated by hand!**<br>Check fresh gas setting on anaesthetic unit.<br>Check hoses and tube.<br>Check ventilator. |
| APNOEA VOL | !!! | Ventilation at a standstill. No expiratory tidal volume for 15 seconds; 30 seconds in the case of SIMV alarm limits.<br>Inadequate supply of fresh gas.<br>Tube kinked. Leak in hose system. | **Patient must immediately be ventilated by hand!**<br>Check ventilator.<br>Check fresh gas setting on anaesthetic unit.<br>Check tube and hose system. |
| AW-TEMP HIGH | !!! | Inspiratory breathing gas temperature over 40 °C. | Disconnect breathing gas humidifier. Set lower heating level when temperature has dropped to 37 °C. |
| CO2 ERR | ! | Sidestream measurement is faulty. | Call DrägerService. |
| CO2 LINE BLK | ! | Sample line blocked. | Replace sample line and water trap if necessary.<br>Check sample line is not kinked.<br>Examine measuring gas return line for stenosis, replace microbial filter if necessary. |
| CO2 OFF ( ) | ! | $CO_2$ alarm deactivated. | |
| COM VENT ERR | !!! | Communication between ventilator and monitor interrupted or faulty. | Alarm limits do not change over automatically. Set alarm limits by hand if necessary.<br>Call DrägerService.<br>Valve discs in the breathing system defective.<br>Set the sampling rate to 200 mL/min due to the high frequency and time constant of the $CO_2$ sensor. |
| COOLING 8050 ? | ! | Temperature inside machine too high. | Clean filter at rear.<br>Call DrägerService. |
| ET CO2 HIGH | !! | Upper alarm limit for end-expiratory $CO_2$ concentration has been exceeded for at least two breaths. | Check ventilation. |

## Messages on the monitor



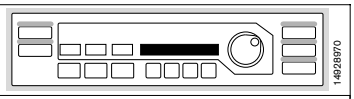
| Messages | | Cause | Remedy |
|---|---|---|---|
| ET CO2 LOW | !! | End-expiratory $CO_2$ concentration below lower alarm limit for at least two breaths. | Check ventilation. |
| EXP-VALVE ? | !! | Fault in expiration valve. Measured value for minute ventilation may be excessive. | Check expiration valve.<br>This message can be deactivated until the next leak test by pressing the key for muting the audible alarmtone. |
| FRESH GAS ? | !! | Too little gas in manual ventilation bag. | Increase fresh gas flow. Repair any leaks in hose system. |
| INSP CO2 HI | ! | Inspiratory $CO_2$ concentration is above upper alarm limit of 5 mmHg. | Replace the soda lime in the circle system of the anaesthetic workstation. |
| MIN VOL HIGH | !! | Minute volume exceeds upper alarm limit. | Correct tidal volume or respiration rate on ventilator. |
| MIN VOL LOW | !! | Minute volume below lower alarm limit.<br>Tube clogged / kinked?<br>Leak in breathing system?<br>Ventilation volume limited by pressure limitation? | Check tube and hoses.<br><br>Seal breathing system.<br>Correct ventilation pattern. |
| N2O ERR | ! | $N_2O$ gas measurement faulty. | Call DrägerService. |
| NO SPO2 PULS | !!! | No pulse signal detected by $SpO_2$ measurement for approx. 10 seconds. | Check $SpO_2$ sensor (dropped off? NiBP measurement on same arm?). |
| O2 ⌿ xx % | ! | The alarm limit appears after the parameter designation if the alarm limit for the inspiratory $O_2$ concentration is below 21%. | |
| PAW HIGH | !!! | Airway pressure exceeds the upper alarm limit.<br>Ventilation hose kinked? Stenosis?<br>Pulmonary problem? Cough? | **Check patient's condition!**<br>Check hose system, tube and fresh gas flow. |
| PAW NEGATIVE | !!! | Negative airway pressure measured. | Check hose system and tube on ventilator. |
| PRESS ERR | ! | Pressure sensor defective. | Call DrägerService. |
| PRESS EXP HI | !!! | End-expiratory pressure more than 10 mbar over PEEP. | Extend expiration period.<br>Check hose system and microbial filter.<br>Empty water traps. |

## Messages on the monitor



| Messages | | Cause | Remedy |
|---|---|---|---|
| PRESSURE LTD | **!!, (!)** | Ventilator operating with pressure limitation.<br>Change in lung compliance? Tube kinked? Microbial filter in inspiratory line soiled? | Check tube/filter.<br>Increase Pmax or decrease VT if necessary.<br>If pressure-limited ventilation is intentional:<br>Press softkey »**Config**«, select »**Alarms**« and switch »**Pmax**« »**off**«. |
| RS232COM ERR | **!** | RS 232 communication interrupted. | Check plug connection. |
| SPEAKER FAIL | **!** | No alarm sound, loudspeaker defective. | Call DrägerService. |
| SPO2 ERR | **!** | $SpO_2$ measurement faulty. | Call DrägerService. |
| SPO2 HIGH | **!!** | Oxygen saturation exceeds set upper alarm limit. | Check $O_2$ concentration in fresh gas.<br>Check ventilator. |
| SPO2 LOW | **!!!** | Oxygen saturation is below the set lower alarm limit. | Check $O_2$ concentration of fresh gas.<br>Check ventilation. |
| SPO2 OFF ( ) | **!** | $SpO_2$ alarm deactivated. | |
| SPO2 PULS LO | **!!!** | Pulse rate has dropped below the set alarm limit. | **Check patient's condition!** |
| SPO2 PULSE HI | **!!** | Pulse rate exceeds upper alarm limit. | **Check patient's condition!**<br>Correct alarm limit if necessary. |
| SPO2SEN DISC | **!** | No pulse detected by pulsoxymeter although heart is clearly beating. | Check patient's condition (disturbed circulation?).<br>Check $SpO_2$ sensor positioned correctly. |
| VENT ERR | **!!!** | Fault in ventilator pressure sensor.<br>Filter in pressure measuring hose blocked (water absorption!)<br>Control pressure in ventilator too low.<br>Hardware fault in ventilator.<br>**Machine not operational!** | **Patient must immediately be ventilated by hand!**<br>If no pressure build-up in the breathing system: **immediately ventilate the patient with the separate emergency breathing bag.**<br>Check pressure gas supply.<br>Replace filter in pressure measuring hose. If not possible:<br>Switch off machine, call DrägerService. |
| VOL ERR | **!** | Flow sensor calibrated incorrectly?<br>Flow sensor / flow sensor lead defective? Flow sensor not plugged in? Flow sensor soiled? | Calibrate sensor.<br>Replace lead / sensor and calibrate sensor.<br>Plug in sensor connector. |

## Messages on the ventilator




| Messages | Cause | Remedy |
|---|---|---|
| ???? | Internal electronic fault. | Call DrägerService. |
| compliance test | The hose compliance is being tested during the leakage test in »standby« mode. | |
| Equipment fault | Attempt to cancel self-test when<br>– a malfunction has been signalled beforehand or<br>– self-test has already been broken off 10 times! | Acknowledge to cancel alarm tone. Restart. |
| | (Mechanical ventilation is only possible when self-test has been completed successfully!) | For information. |
| | This message precedes the message »Malfunction No. XXX«. | Note malfunction number and call DrägerService. |
| GB. Version .... | Message displayed at the beginning of the self-test. | Software version number is indicated when switching on. Inform DrägerService of version number when reporting malfunctions. |
| Leak test IPPV | The IPPV leakage rate is being determined during the leakage test in »standby« mode. | |
| Paed. hoses ! | When changing the $V_T$ setting from values above 200 mL to less than 200 mL. | Use infant hoses. Run leakage test to measure new compliance, otherwise limited accuracy! Press rotary control to confirm! |
| piston test | The system occasionally runs a self-test to detect major leaks and faults in the inspiration valve. | |
| Pressure release | A static excess pressure continued for too long after AutoWakeUp. The system is relieved. | Switch ventilator to »**standby**«. Disconnect fresh gas. |
| Restart | Transient system fault.<br>Power supply briefly interrupted. | Manual ventilation is not possible for approx. 10 seconds while the message »Warmstart« is displayed; wait for 10 seconds, the ventilator then continues with the former settings. Check parameter settings. Set up a substitute system if warmstart is repeated. Call DrägerService. |
| Self-test | Self-test has been started. | |
| Self-test ... x discont | Message displayed after cancelling the self-test.<br>Only possible 10 times!<br>A complete self-test **must** then be performed. | Operating mode can be selected. Skipping calibration functions and internal alignment procedures can impair the accuracy of measurements! |
| Standby | Machine on standby. | |
| Supply pressure? | Pressure supply inadequate. | Correct pressure supply.<br>Use spare cylinders if necessary. |

# Care

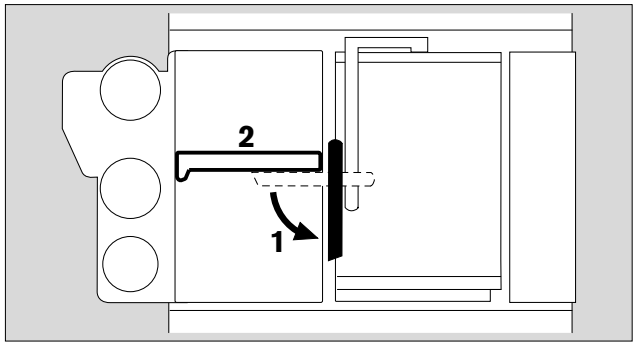
## Contents

# Stripping down machine

Swing up table top to remove piston pump:
**(only possible in »standby«)**

**1** Swing lever as far as possible to unlock.

**2** Hold breathing system by handle and lift out.
Do not damage flat seals – avoid contact with sharp edges. It must be put down so that the sealing elements are not subject to constant pressure!

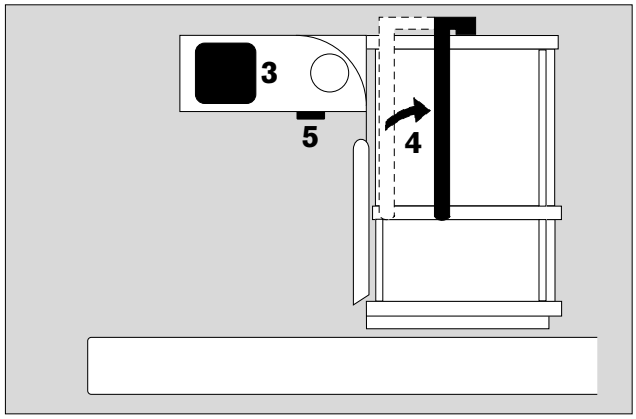



**3** Caution!

Temperature of hotplate for breathing system equals approx. 60 °C.

**4** Handle pointing up – lift out piston pump
**– do not use force –**
Do not damage flat seals – avoid contact with sharp edges. It must be put down so that the sealing elements are not subject to constant pressure!

**1** Swing lever back to original position, otherwise table top cannot be reclosed.

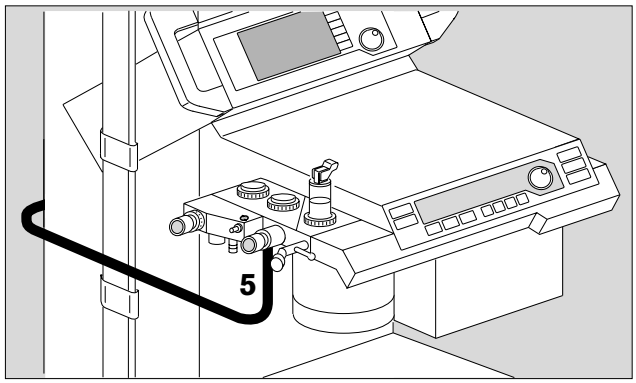



## Remove anaesthetic gas scavenging system

Refer to separate Instructions for Use for anaesthetic gas scavenging system.

- Unplug anaesthetic gas scavenging hose from anaesthetic gas scavenging system.

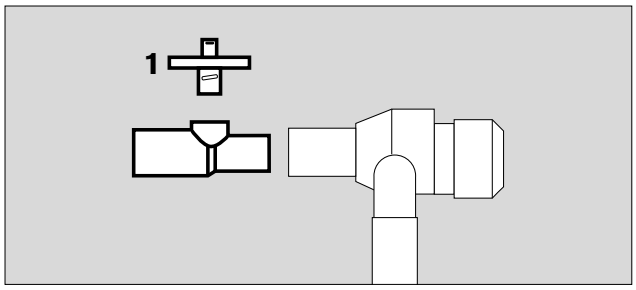
**5** Press button to unlock hose connector and pull downwards. Hose remains on connector.



# Dismantling parts

## T-piece of measured gas hose (if used)

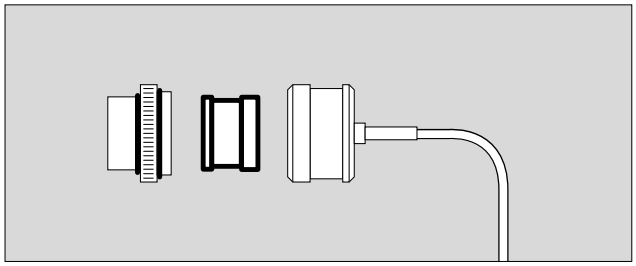
**1** Remove filter.




## Inspiratory O2 sensor (if used)

- **Must not be disinfected in liquid or autoclaved!**
- Wipe any dirt off housing or lead with damp disposable cloth.
- Unscrew O2 sensor and remove O2 cell. Do not touch wire mesh of O2 cell, otherwise it loses its water-repellent property and measurement becomes inaccurate.

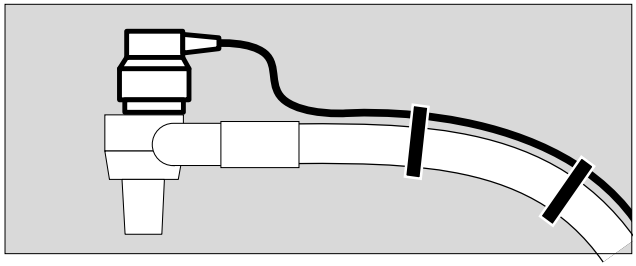
  Dirt on wire mesh of sensor cell is simply wiped off with a disposable cloth moistened with distilled water.




## Temperature sensor (breathing gas) (optional)

- Draw temperature sensor out of Y-piece, remove Y-piece from ventilation hoses.

  Prise lead out of hose clips.
- Pull connector out of socket.
- Wipe dirt off with damp disposable cloth.

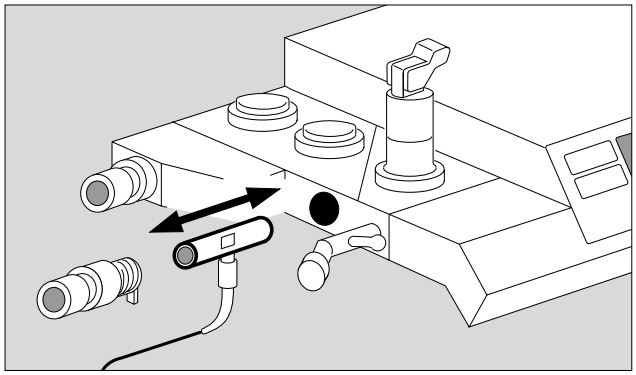



## Flow sensor

The flow sensor cannot be disinfected or sterilized.

Contamination by infectious patients: dispose of as directed!

If contamination is unlikely, the flow sensor can be reused as long as it can be calibrated correctly.

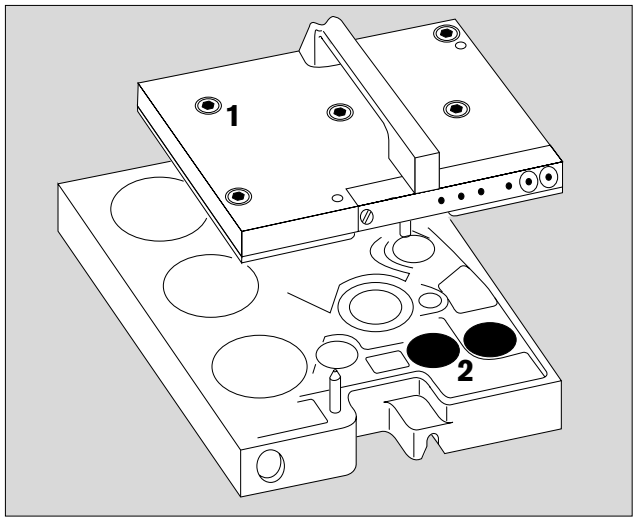


## Breathing system

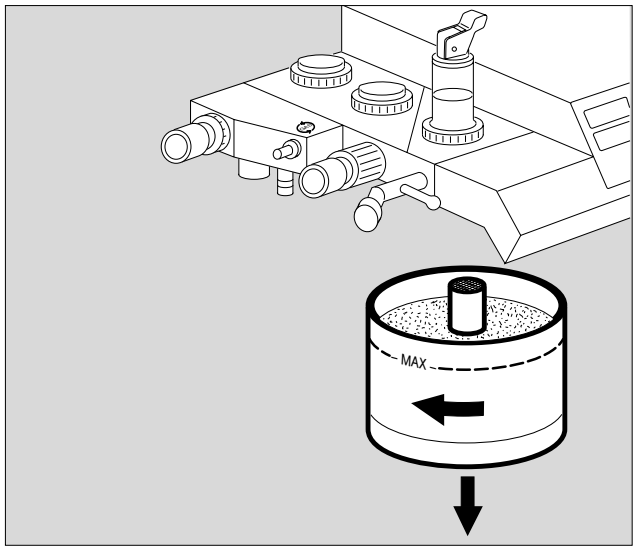
- Remove flow sensor.
- Unscrew pressure limitation valve APL.
- Dismantle breathing valves –
  valve discs must be handled with care.
- Replace measured gas return hose if contamination is possible.

**1** Release the five quick-release screws by turning through a quarter-turn with a 6 mm hexagon key. Remove upper part.

**2** The two valves are only unscrewed if soiled.




- Empty soda lime container (see page 45).
  Dispose of with household refuse (but not when treating infectious patients!).




## Piston pump

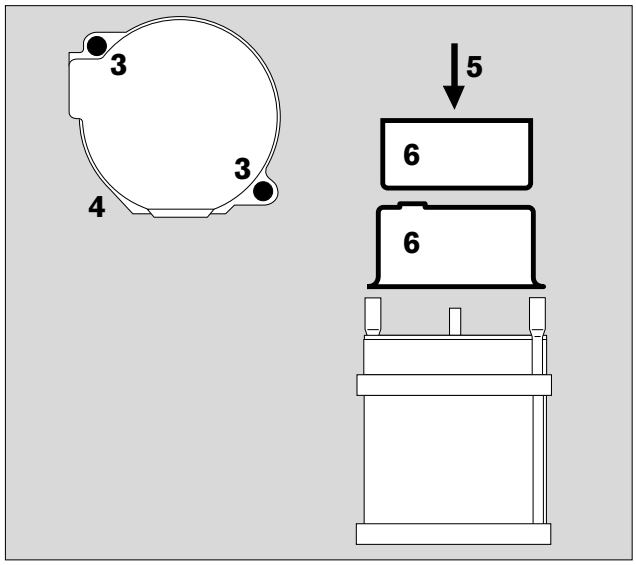
**3** Release the two quick-release screws by turning through a quarter-turn with a 6 mm hexagon key.

**4** Remove cylinder head.

**5** Completely unscrew the central screw on the piston (no quick-release).

**6** Remove piston and roller diaphragm.

- The remainder of the piston pump does not come in contact with breathing gas and does not require sterilization!



# Disinfection – cleaning – sterilization

## Agents and methods for disinfection, cleaning and sterilization

Only products from the list of surface disinfectants may be used for disinfection. Products based on

– aldehydes,

– alcohols and

– quaternary ammonium compounds

(e.g. **Buraton 10 F**® or **Terralin**® diluted as specified. Both are registered trademarks of Messrs. Schülke & Mayr, D-22846 Norderstedt.)

may be used to ensure material compatibility.

**The following are not suitable:**

– phenols,

– compounds liberating halogen,

– strong organic acids and

– compounds liberating oxygen.

Users in the Federal Republic of Germany are advised to use disinfectants specified in the current list published by the German Society for Hygiene and Microbiology (DGHM). The list also specifies the active agent in each disinfectant.

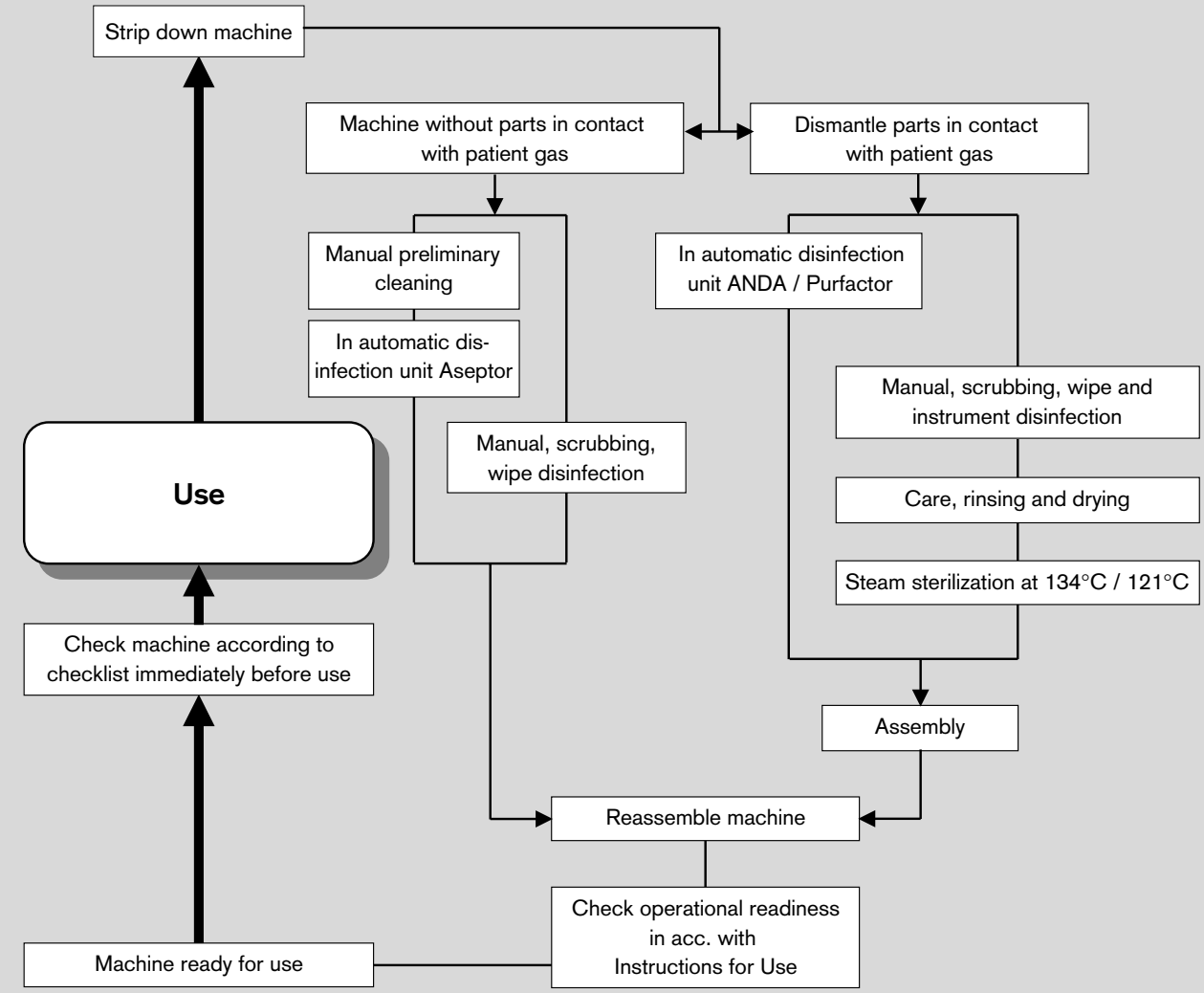
Users in countries in which the DGHM list is not available are advised to use the agents mentioned above.

**Alcohol and agents containing alcohol must not be allowed to seep into the sample line!**

Alcohol results in incorrect results when measuring the anaesthetic agent!

# Care methods

## Care schematic




## Care intervals

A number of steps can be omitted if microbial filters are used in the inspiratory and expiratory lines.
The following table is intended as a guide; it does not replace the directions of the hospital's hygiene officer!

| | **Non-infectious patients** | | **Infectious patients** |
|---|---|---|---|
| Component: | with microbial filters: | without microbial filters: | with or without microbial filters: |
| Tube, mask | after every patient | after every patient | after every patient |
| Y-piece | after every patient | after every patient | after every patient |
| Both breathing hoses | after every patient | after every patient | after every patient |
| Temperature sensor with lead | after every patient | after every patient | after every patient |
| T-piece and filter of measured gas sampling system | after every patient | after every patient | after every patient |
| Flow sensor downstream of expiration nozzle | daily | after every patient | after every patient |
| Breathing bag with hose | daily | after every patient | after every patient |
| Breathing system | weekly | after every patient | after every patient |
| Soda lime container | daily | after every patient | after every patient |
| Anaesthetic gas scavenging hose | weekly | weekly | after every patient |
| Piston pump | weekly | after every patient | after every patient |

## Disposal of consumable articles

Consumable articles are listed at the bottom of page 87. Consumable articles and articles with limited service life (e.g. microbial filters, soda lime) can be disposed of as household refuse if used for treating non-infectious patients. **Infectious waste must be disposed in accordance with regulations!**

## Wipe cleaning

Cato parts which can be wipe-cleaned are listed in the table on page 87.

Use a disposable cloth moistened with disinfectant cleaner.

Note effective time –
parts must only be wiped, not immersed –
do not allow liquid to seep inside the machine!

## Cleaning and disinfection in automatic cleaning and disinfection machines

Cato parts which can be cleaned and disinfected in this way are listed in the table on page 87.

Set »**Disinfection with moist heat**«
(at least 93 °C, at least 10 minutes).

Alkaline or chlorinated cleaning and disinfectant agents must not be added due to the risk of corrosion!

## Disinfection with formaldehyde vapour

Cato parts which can be treated in this way are listed in the table on page 87.

Parts in contact with breathing gas (breathing hoses, breathing bag, breathing system, soda lime container, piston pump) must **not** be disinfected with formaldehyde vapour!

Parts containing water, such as the humidifier or water traps, should be removed since formaldehyde accumulates here to a particularly large extent.

The machine can be disinfected with the supplementary Dräger units in place when using formaldehyde vapour. Electrical devices not made by Dräger and which may not be resistant to formaldehyde must be removed first.

After disinfection in formaldehyde vapour, the machine must be rinsed in fresh gas as specified in the Instructions for Use of the disinfection equipment in order to eliminate all formaldehyde residues (two rinses: $O_2$ / AIR and then $O_2$ / $N_2O$)! The rinsing effect can be verified by measuring the formaldehyde concentration at the fresh gas outlet (e.g. using Dräger formaldehyde test tubes 0.2/a).

## Sterilization with ethylene oxide

Only the sensor cell of the $O_2$ sensor can be sterilized in this way – **no other parts!** Maximum temperature: 50 °C.

**Flash-off time**: at least 24 hours at 50 °C with 60-fold exchange of air. This impairs the service life of the $O_2$ cell!

## Steam sterilization at 121 or 134 °C

Cato parts which can be sterilized in this way are listed in the table on page 87.

Steam sterilization must be preceded by sterilization with moist heat and/or wipe cleaning. All parts must be dry! Steam sterilization is only required after treating an infectious patient!

Minimum exposure times: 20 minutes at 121 °C and 10 minutes at 134 °C. Parts should preferably be sterilized at 134 °C since less time is required for the procedure.

## Tabular summary

| Machine components | Method | | | | |
|---|---|---|---|---|---|
| | Disinfection by wiping or immersion | Cleaning with automatic cleaners | Formaldehyde vapour | Steam sterilization at 121 °C | Steam sterilization at 134 °C |
| Stripped down basic machine | Wipe | | ● | | |
| Parameter box (optional) | Wipe | | | | |
| **Rubber parts:** | | | | | |
| Tube / mask | ● | ● | | ● | ● |
| Y-piece | ● | ● | | ● | ● |
| Breathing hoses | ● | ● | | ● | ● |
| Breathing bag | ● | ● | | ● | ● |
| Breathing bag hose | ● | ● | | ● | ● |
| Roller diaphragm of piston pump | ● | ● | | ● | ● |
| Anaesthetic gas scavenging system | ● | ● | | ● | ● |
| Pressure measuring hoses | ● | ● | | ● | ● |
| Connecting hoses for measured gas return system | ● | ● | | ● | ● |
| **Metal parts:** | | | | | |
| Cylinder head of piston pump | | ● | | ● | ● |
| Piston of piston pump | | ● | | ● | ● |
| Parts of breathing system | | ● | | ● | ● |
| Valves of breathing system | | ● | | ● | ● |
| **Plastic parts:** | | | | | |
| Housing of piston pump | ● | ● | | ● | ● |
| Soda line container with screen | ● | ● | | ● | ● |
| T-piece for sidestream gas measurement | ● | ● | | ● | ● |
| Water trap for measured gas | ● | ● | | ● | ● |
| Water traps for airway | ● | ● | | ● | ● |
| **Filters:** | | | | | |
| Microbial filter | | | | | 24 times |
| **Sensors:** | | | | | |
| Temperature sensor (airway temperature) | ● | | | | |
| Temperature sensor (skin/rectal/oesophagus) | ● | | | | |
| $O_2$ sensor (housing) | ● | | | | |
| Flow sensor | externally | | | | |

**The following parts cannot be processed and prepared:**
(must be replaced if damaged or possibly contaminated)

| | |
|---|---|
| Filter of pressure measuring hose: | Change every 6 months or when resistance increases (e.g. water absorption). The warning message **P-Sensor fault** resp. **VENT ERR !!!** is output. |
| Filter of measured gas return hose: | Replace every 6 months. |
| for sidestream gas measurement: | |
| Water separator: | Replace, depending on degree of contamination |
| Connecting hoses: | Replace after each patient |
| Filter in T-piece: | Replace after each patient |

## Disposal of used batteries and O2 sensors

Batteries and O2 sensors:

- must not be thrown in the fire. Danger of explosion.
- must not be forced open. Risk of chemical burns.
- batteries must not be recharged.

Used batteries must be treated as special waste:

- Dispose of used batteries in accordance with local waste disposal regulations.

Used O2 sensors can be returned to Dräger.

## Disposal of apparatus

– at the end of its useful life.

Cato can be returned to Dräger for disposal in accordance with environmental regulations.

# Reassembling system

**Reassemble cleaned, disinfected and sterilized parts**

## Assemble the piston pump

- Check individual parts:

  Gaskets: pressure marks? cracks?
  Diaphragm: cracks? holes? deformation?

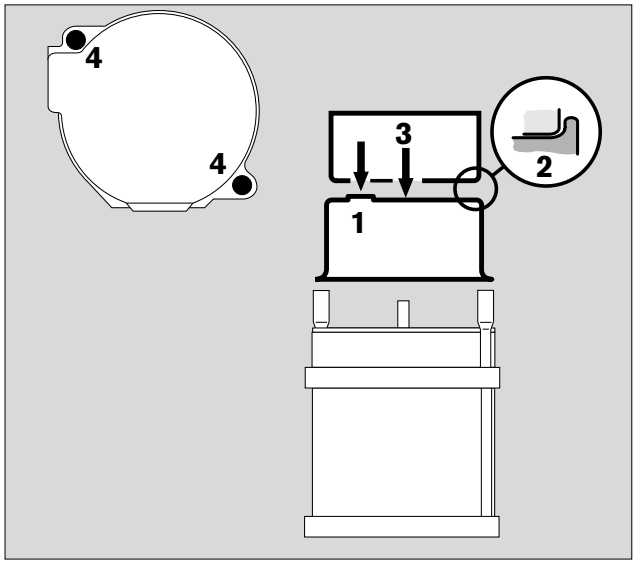
  **Defective parts must be replaced!**

**1** Fit roller diaphragm –
production mark visible at the outside (arrow).

**2** Insert piston – carefully place the rolled edge round the edge of the piston.

**3** Screw piston into position (no quick-release catch).

**4** Fit cylinder head and secure in position (two quick-release catches).



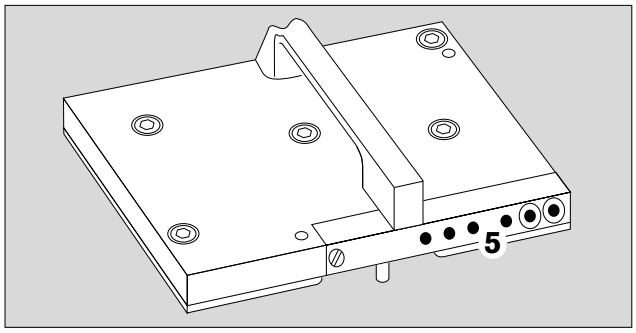

## Assemble the breathing system

- Check individual parts:

  Gaskets: pressure marks? cracks?
  Diaphragms: cracks? holes? deformation?
  Valve discs: chipped?

  **Defective parts must be replaced!**

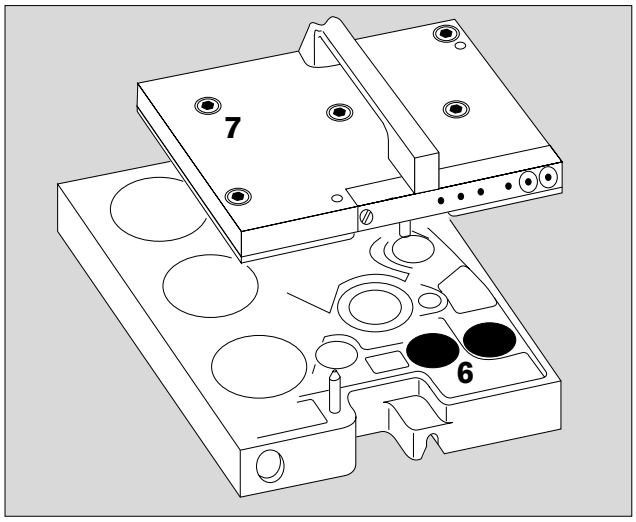
**5** The six holes must be clear!




**6** Fit valves if necessary.

- Place upper and lower parts of breathing system on top of one another.

**7** Secure the five quick-release catches.
(6 mm hexagon key).



## Fit the piston pump

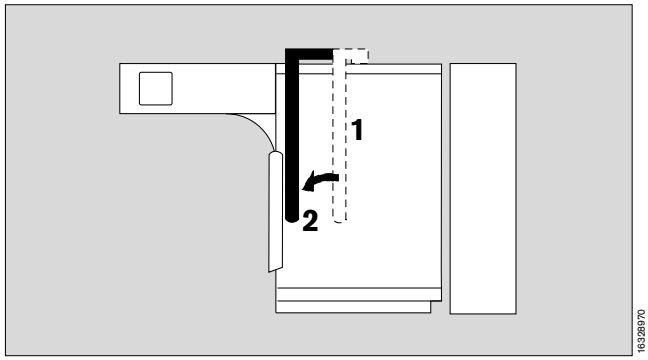
- Swing up table top

**1** Handle in starting position.

**Do not damage gaskets when fitting pump!**

- Hold piston pump by its handle and insert in machine **– do not use force –**

**2** Swing handle as far as possible to the left (black).



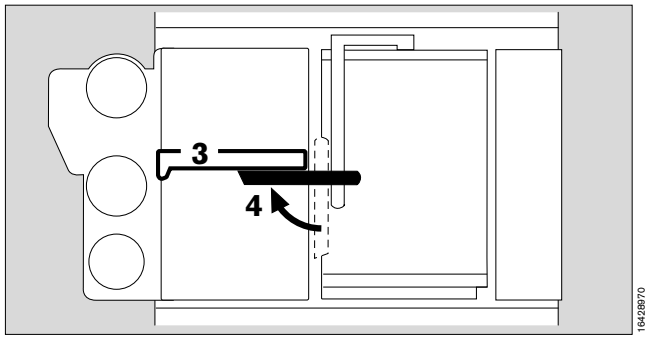

## Fit the breathing system

Hold breathing system by its

**3** handle and insert in machine –

**4** lock in direction of arrow – swing as far as possible (black).

**Do not damage gaskets when fitting breathing system!**




## Replace $O_2$ sensor for gas sampling system

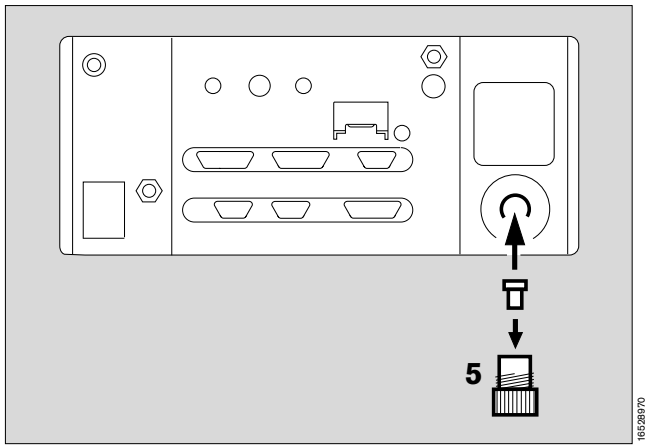
(if the measuring cell is worn)

**5** Unscrew the knurled screw on the back of the machine (behind the monitor) by turning anticlockwise.

- Draw used sensor or blank out of the knurled screw and insert new sensor.
- Screw knurled screw back into place.

When operating **without** sidestream $O_2$ sensor:

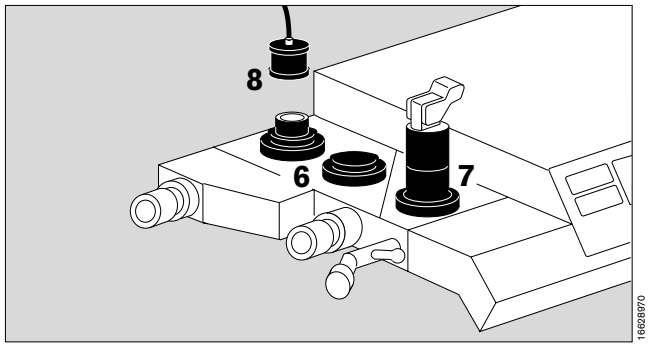
- Insert blank instead of $O_2$ sensor to seal the measuring system.




## Fit valves

**6** Fit valve discs in expiration and inspiration valves – screw on valve caps.

**7** Screw on pressure limitation valve APL – scale facing the front.

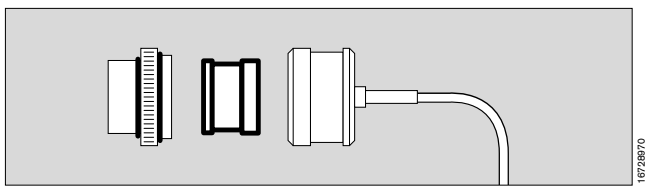



## Assemble and fit the inspiratory $O_2$ sensor

(if used)

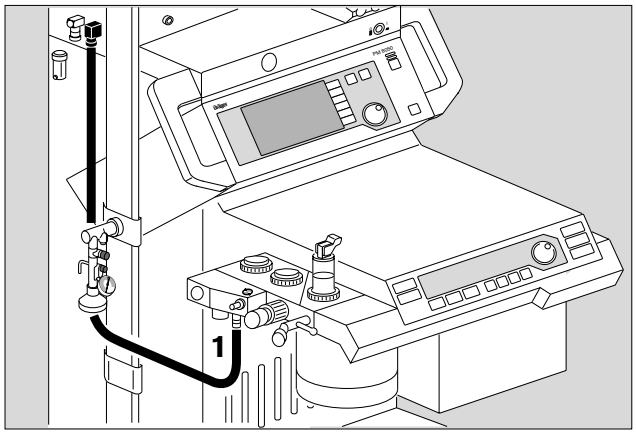
- Do not touch wire mesh on cell! Insert cell with conductors facing wiring –
- screw sensor housing together –

**8** plug sensor onto inspiration valve.



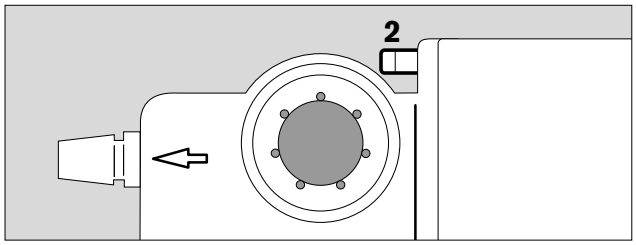
## Connect fresh gas hose

**1** to breathing system from below with plug connector.




## Connect pressure measuring line with filter

**2** Plug pressure measuring line into coupling – until it engages.




## Fill soda lime container

The container can hold approx. 1.5 L soda lime »**Drägersorb 800**« (see separate Instructions for Use). This is sufficient to bind approx. 150 L $CO_2$ or for a period of approx. 6 hours.

The soda lime should be replaced daily, at the latest when two-thirds of the charge has changed colour.

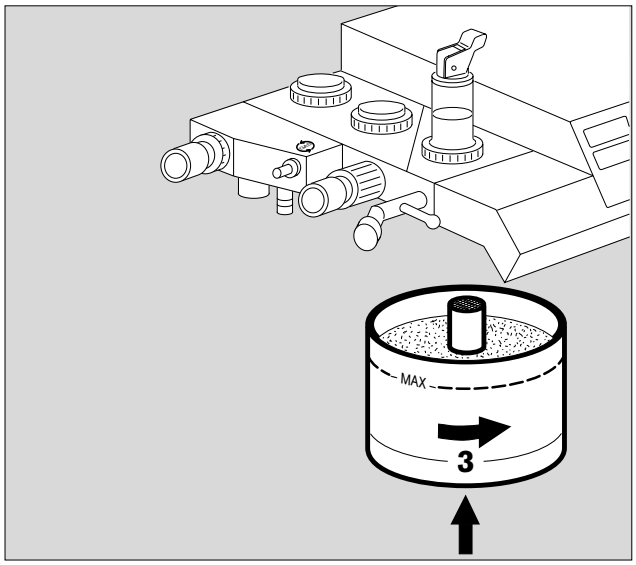
The indicator colour **changes back as it dries** although the absorption capacity is exhausted!

- Place the chain on the bottom of the container.
- Insert mesh – **must not be forgotten! Absolutely essential for absorption!**
- Uniformly fill the container with fresh soda lime all round, until the

  **– MAX –**

  mark is reached (approx. 3 cm below top edge).
- Gently shake the container or knock against the table to settle the contents.
- Remove any dust and granulated material on the edge of the container.

**3** Fit the soda lime container into the breathing system from below and turn clockwise as far as it will go.



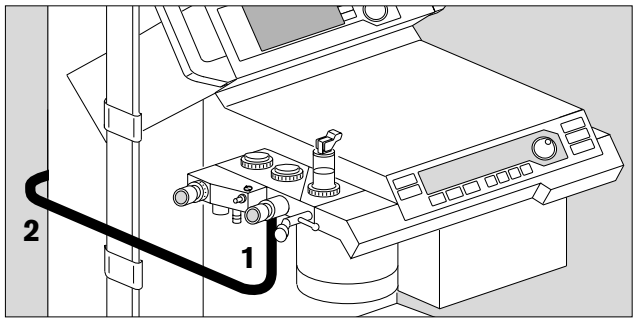
## Connecting anaesthetic gas scavenging system (AGS)

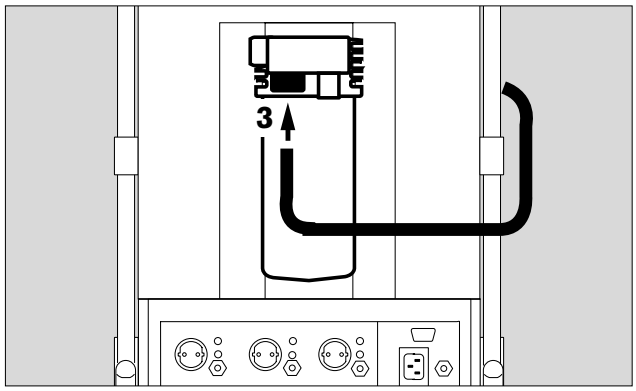
**1** Insert the transfer hose, complete with scavenging adapter, into the breathing system from underneath until it engages, or connect the hose to the scavenging adapter of the semi open system.

**2** Route the extractor hose round the equipment to the rear and

**3** connect it to the connector on the collecting system.

- Refer to the separate Instructions for Use of the AGS anaesthetic gas scavenging system.



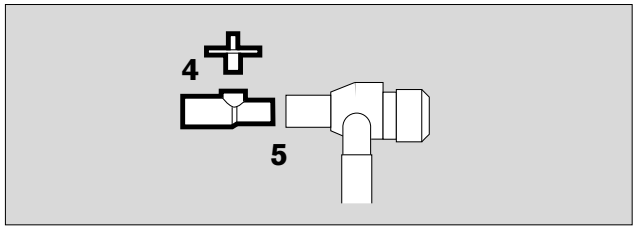




## Connect sample line

For sampling $CO_2$, anaesthetic agent and $O_2$.

**4** Screw filter into T-piece.

**5** Insert T-piece into the patient connection of the Y-piece – filter facing upwards to prevent congestion by droplets of liquid.

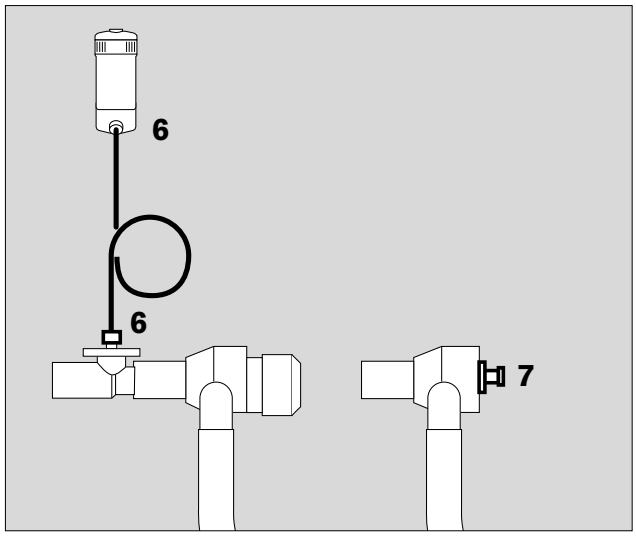



**6** Securely screw sample line onto filter and water trap.

**Only use original sample lines, others may lead to changes in the machine's technical specifications!**

**7** The Y-piece with direct connection for the sample line can also be used instead of the T-piece and filter.

**Alcohol or agents containing alcohol must not be allowed to enter the sample line!**
Alcohol will result in incorrect measurement of the concentration.

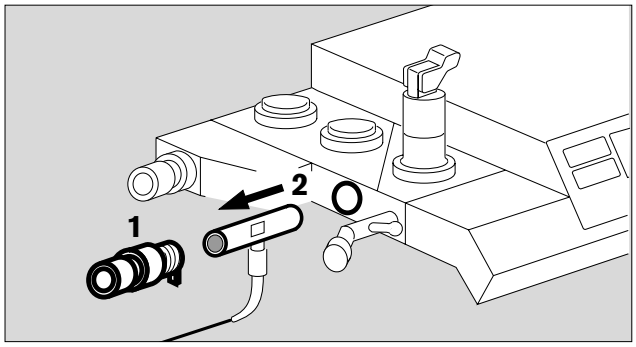


## Fit flow sensor

**1** Unscrew expiration nozzle.

**2** Slide flow sensor into housing.

**1** Screw expiration nozzle back into place.




## Fit microbial filter

- Fit a microbial filter with ISO nozzle on both the inspiration and expiration legs.

## Fit temperature sensor

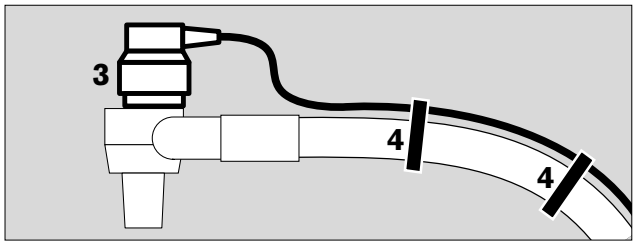
(Optional) with: Y-piece M 30 543 and hose clips 84 04 047.

The T-piece must be used for anaesthetic gas measurement in this case!

**3** Insert temperature sensor 84 05 371 as far as possible into the hole in the Y-piece.

After securing the Y-piece, align the sensor to face upwards so that it remains free from condensation.

**4** Route the sensor lead back to the machine with hose clips along the inspiration hose of the anaesthetic system.




## Install secretion aspirator

- Position the secretion aspirator on the mount on the frame with two secretion collecting vessels.

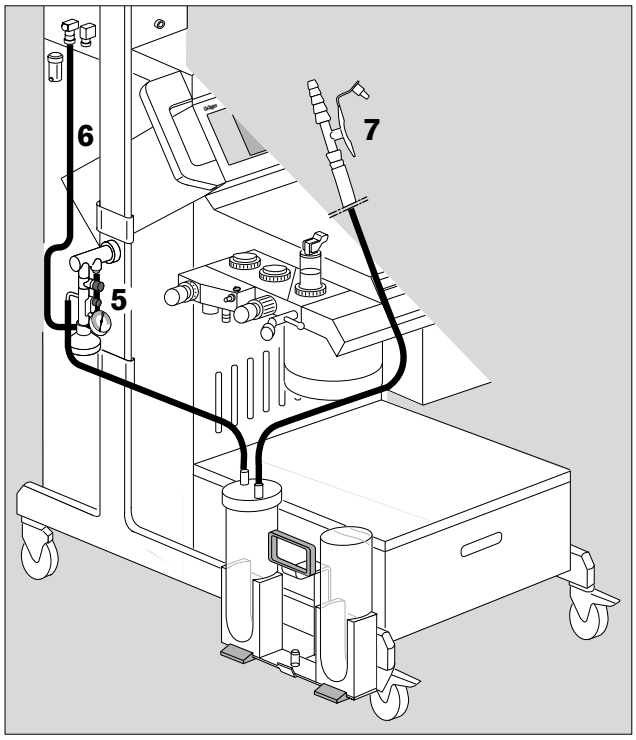
**5** Install hose between negative pressure outlet and secretion collecting vessels.

**6** Connect the gas outlet on the Cato to the ejector.

**7** Plug the aspiration hose with handpiece onto the inlet.

- Secure the aspiration hose in the clamp.

**Secretion aspirator may only be used in »MAN/SPONT« mode or with disconnected Y-piece.**



## Connecting external equipment

Configuration of the interfaces is described on page 53.

**Connection via the protocol interface**

**1** with data cable for printers with **serial interface**, e.g. Desk-Jet (Hewlett-Packard)

or

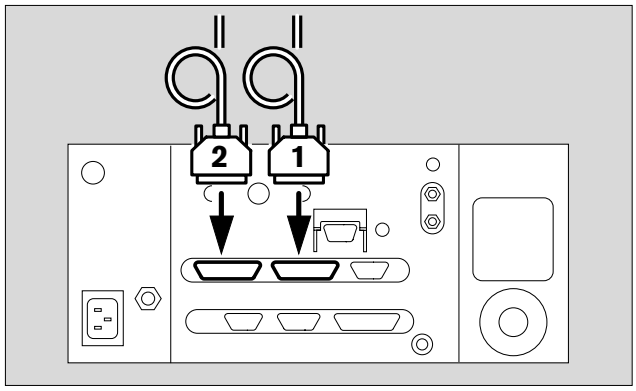
for e.g. the PM 8060 Vitara Patient Monitor with the MEDIBUS protocol.
See page 53 for configuration.

**Connection via the Dräger RS 232 C MEDIBUS interface**

e.g. to connect the PM 8060 Vitara Patient Monitor.

**2** Connect with data cable.

- The equipment plugs must be secured with the screws provided.




## Connecting equipotential bonding

e.g. for intracardiac or intracranial operations.

**3** Connect one end of the grounding cable to the pin at the rear.

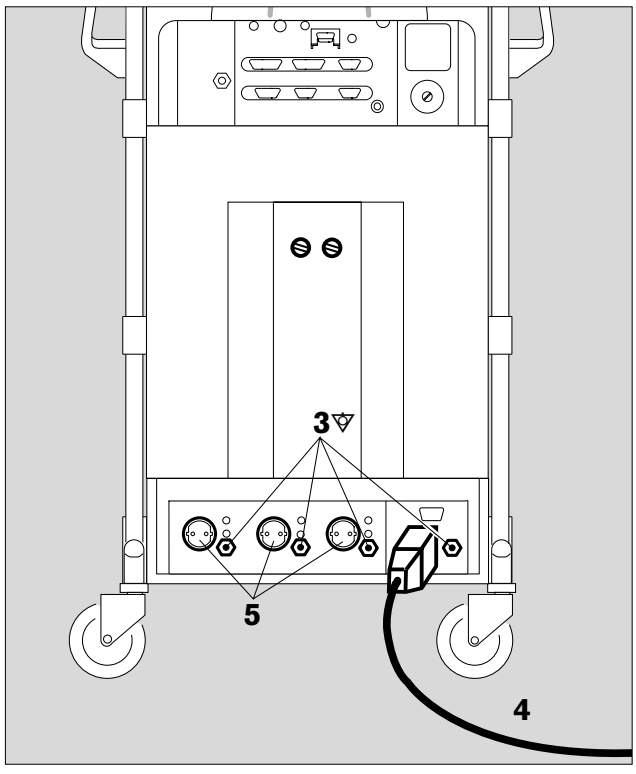
- Connect the other end to the equipotential bonding pin on the operating table or ceiling pendant.

## Connecting to electricity supply

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

**4** Plug the mains plug into the wall socket.

**5** The auxiliary power sockets are always switched on.



# SpO2 measurement (optional)

## Safety and precautions

- The sensor must not be applied to limbs together with an arterial catheter, infusion or sphygmomanometer cuff.
- Blood circulation must not be impeded during application of the sensor. If possible, the site should be changed from time to time in order to avoid pressure necroses at the measuring point.
- The sensor should be protected against bright light (covered).
- Nellcor sensors should be used exclusively and applied as described below.
- Damaged sensors must not be used.
- The adhesive strip of the Oxiband sensor must be discarded after use. It should not be stretched unduly. Never use two strips together.

## Choice of sensor

Nellcor sensors must be used exclusively. Note the Instructions for Use of the sensors. Tissue damage may result if they are positioned or used incorrectly.

The choice of sensor should be based on the following criteria:
- Patient's weight
- Mobility of the patient
- Possible application site
- Perfusion of the patient
- Period of use

The following table listing the various sensors available and their specific characteristics may prove useful here.

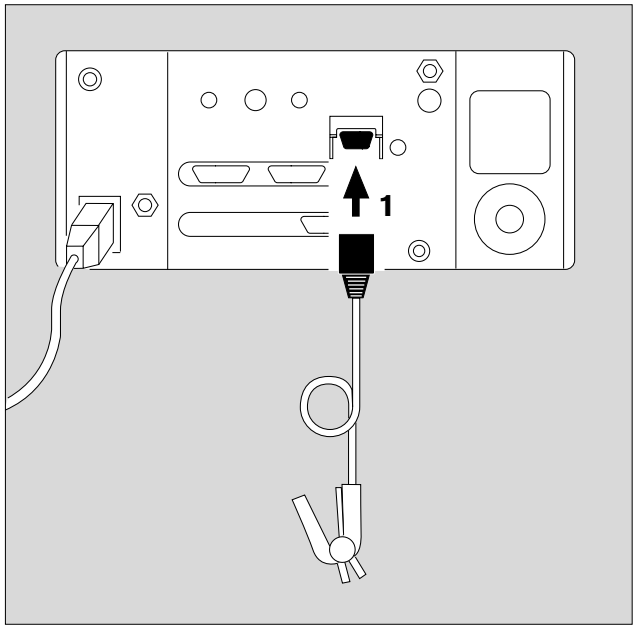
| **Type of sensor** | **OXISENSOR I-20** | **OXISENSOR D-20** | **DURASENSOR DS-100A** | **OXISENSOR D-25** | **OXISENSOR R-15** |
|---|---|---|---|---|---|
| Age group | Infants | Children | Adults | Adults | Adults |
| Weight of patient | 1 to 20 kg | 10 to 50 kg | > 40 kg | > 30 kg | > 50 kg |
| Period of use | Short and long-term monitoring | Short and long-term monitoring | Short-term monitoring | Short and long-term monitoring | Short and long-term monitoring |
| Mobility of patient | Limited activity | Limited activity | Inactive patients only | Limited activity | Inactive patients only |
| Preferred site | Toe | Finger | Finger | Finger | Nose |
| Sterility[1)] | In sterile packaging | In sterile packaging | ____ | In sterile packaging | In sterile packaging |

OXISENSOR ™ I-20, OXISENSOR ™ D-20, DURASENSOR ™ DS-100A, OXISENSOR ™ D-25 and OXISENSOR ™ R-15 are registered trademarks.

1) in undamaged, unopened packaging.

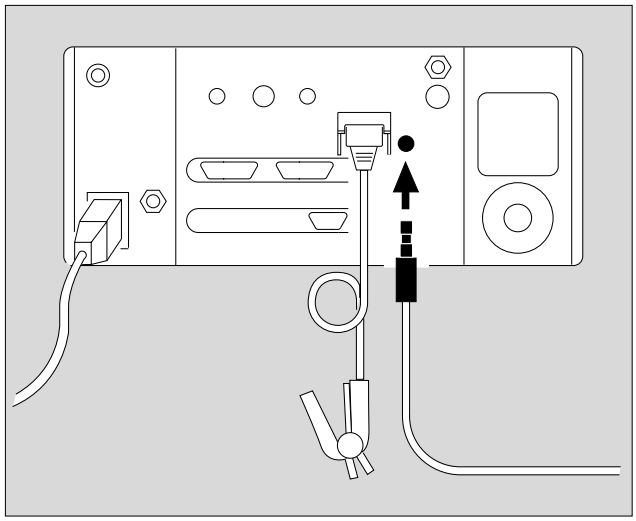
**1** Choose the appropriate sensor.
Plug the sensor connector into the rear of the monitor.

**Do not let the sensor lead hang over the monitor, as it may impair $SpO_2$ measurement!**




## C-Lock ECG synchronization (optional)

If the patient is extremely mobile or has a very low arterial flow, the signals from the $SpO_2$ measurement can be amplified with the aid of C-Lock ECG synchronization. In this case, the monitor receives two separate signals reflecting the cardiac activity:
an optical signal from the $SpO_2$ sensor
and
an electrical signal from the ECG monitor.
The monitor uses the R-wave of the ECG signal to detect the pulse and for synchronization with the $SpO_2$ measurement.




- Connect the ECG signal from the ECG monitor to the rear of the monitor by means of a lead and pawl-type plug.
  Prerequisites for the electrical signal and pin assignment can be found in the »Technical Data« on page 121.

### In the event of a delayed ECG signal

Synchronization may be impaired if the ECG signal is delayed by more than 40 milliseconds relative to the QRS complex.
The monitor must be operated without C-Lock ECG synchronization whenever there is any suspicion of such a fault existing.

## Tips to avoid artefacts

Nellcor sensors must be used exclusively and positioned correctly in order to avoid the risk of measuring errors and tissue damage.

Damaged sensors with exposed electric wires must not be used – risk of electric shock.

Adhesive strips of the Oxiband OXI-A/N and OXI-P/I sensors must not be reused: they may not adhere properly.
The strips must not be stretched unduly.
Never use two strips together, as this may lead to venous pulsation and failure of the pulse signal.

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

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

The sensor must be covered in bright light (e.g. surgical lamps and direct sunlight), otherwise the pulse signal may fail or inaccurate results may be obtained.

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

Major concentrations of dyshaemoglobins, such as carboxyhaemoglobin or methaemoglobin, can make the measurement inaccurate.

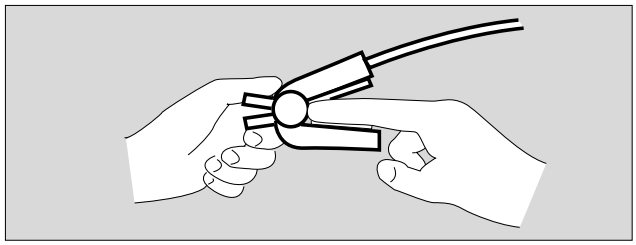
Intravascular dyes, such as methylene blue, may similarly result in inaccurate measurement.

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

Sensor performance may be impaired if the patient moves violently, thus leading to inaccurate results. The sensor should be applied to a different site in such cases in order to reduce the risk of artefacts due to movement.

## Applying the sensors

### Durasensor DS-100 A

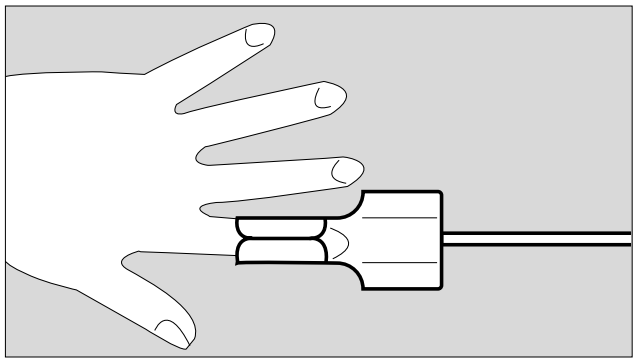



Reusable sensor for short-term monitoring of relatively quiet patients weighing over 40 kg.

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

- Open the clip slightly and slide the sensor onto the finger. The tip of the finger must touch the end, the soft padding resting on the nail and tip of the finger. The lead should be on top of the finger.
- Ensure that the finger is not compressed or hurt by the clip.

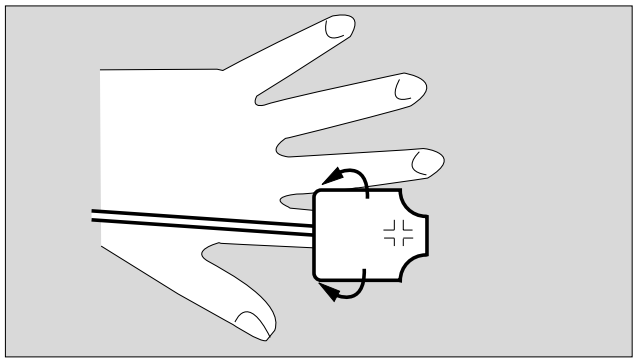
### Oxisensor D-25 und D-20




Adhesive sensors for short and long-term monitoring of patients with limited mobility and weighing from 15 to more than 50 kg.

Long nails make application of the sensor more difficult and coloured nail varnish impairs the accuracy of measurement.

- Cut the nail if necessary.
- Remove nail varnish if necessary.
- Draw the protective film off the adhesive strip.
- Place the sensor on a flat surface with the adhesive side facing upwards.




- Place the tip of the index finger onto the middle of the optical element on the side of the sensor opposite the lead and wrap the adhesive strips round the finger.

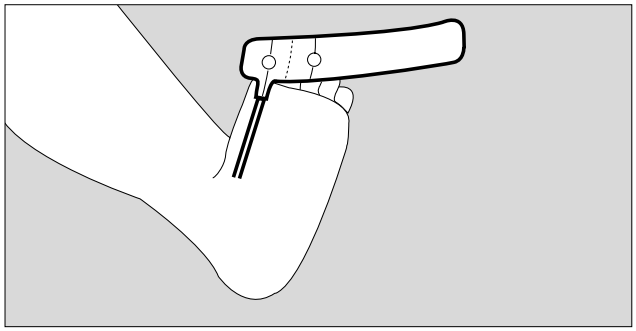
- Fold the other side of the sensor over the tip of the finger and align it on the underside so that the markings are lined up correctly. Press the sensor into place and wrap the adhesive strips round the finger.

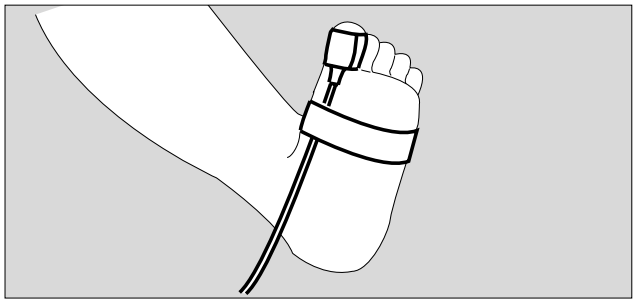
  A thinner finger should be used instead of the index finger if the patient is very obese.

**Oxisensor I-20**

Adhesive sensor for short and long-term monitoring of patients with limited mobility and weighing between 3 and 15 kg.

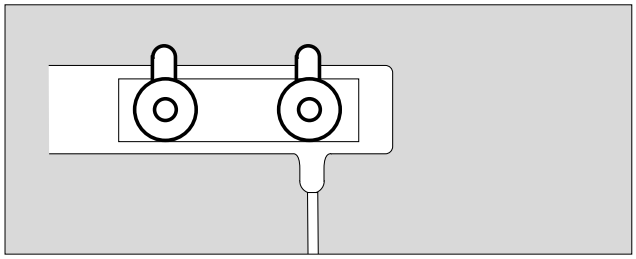
- Peel the protective film off the adhesive strip.
- Place the sensor underneath the big toe so that the dotted line corresponds to the inner edge of the toe and the marking is in the middle of the toe.
- Wrap the sensor round the toe so that the other marking rests exactly on top of the toenail.
- Secure the sensor lead to the foot with the additional adhesive tape.



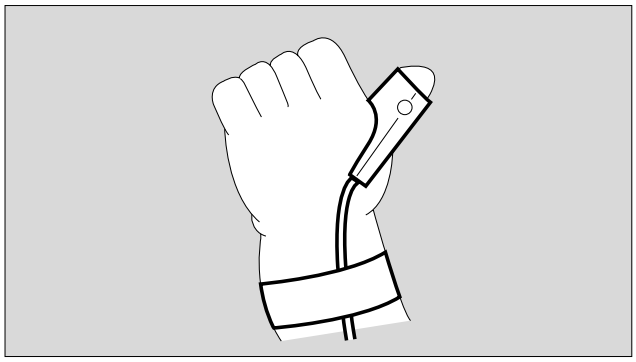

**Reusing the sensor:**
The sensor can be reused if the tape is still tacky. Adhesion is improved by small additional adhesive spots.

- Hold the adhesive spots by the blue tags, peel them off the backing paper and remove the protective film.
- Affix one spot to the middle of each optical element.
- Position the sensor as described above.

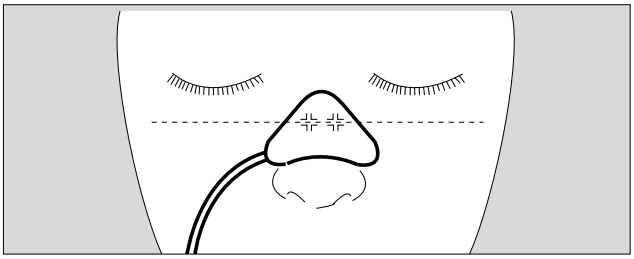



**Other measuring point:**
The sensor is preferably applied to the big toe because it moves less than the patient's hand. If the big toe is not available, however, the sensor can also be applied to the thumb.

- Peel off the protective film on the adhesive strip.
- Position the sensor under the thumb so that the dotted line corresponds with the edge of the thumb and the marking is in the middle of the thumb.
- Wrap the sensor round the thumb so that the other marking lies exactly on top of the thumb nail.
- Secure the sensor lead to the hand with the additional adhesive tape.



### Oxisensor R-15




Disposable adhesive sensor for short and long-term monitoring of **inactive** patients weighing more than 50 kg. Preferably used for patients possibly suffering from severe vasoconstriction or poor circulation.

- Clean the bridge of the nose with the liquid in the enclosed ampoule – keep away from the eyes.
- Peel off the protective film on the sensor.
- Align the sensor symmetrically on the bridge of the nose: the two symbols should lie on the bone/cartilage boundary.
- Press the sensor firmly into place and hold for 10 seconds to ensure good adhesion.
- The R-15 sensor must not be used on patients with nasal intubation or a mask.

# Check operational readiness

## Contents

Operational readiness of the machine must be restored and checked whenever it has been cleaned, disinfected, sterilized, repaired or serviced!

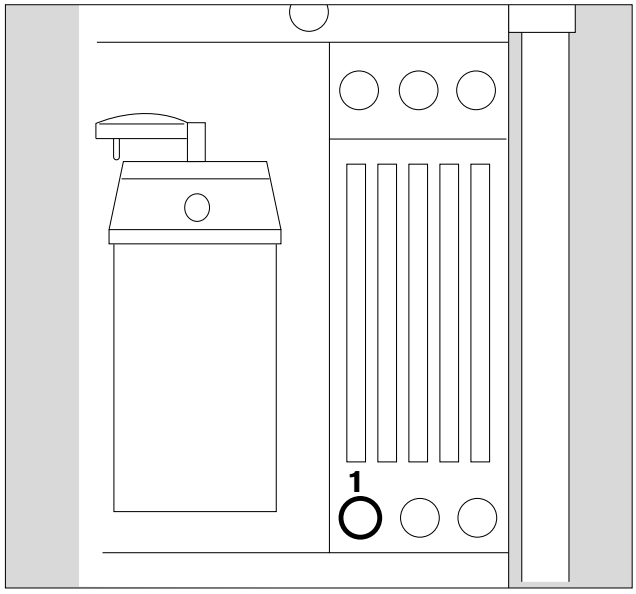
Supplementary equipment must be checked in accordance with the respective Instructions for Use. Note the applicable time limits for filters, maintenance and calibration, e.g. in conjunction with equipment for measuring blood pressure or body temperature.

Checking operational readiness includes the check based on the checklist (page 21 onwards), the self-test (page 31 onwards) and the following:

## $O_2$ shortage signal

**1** Open $O_2$ delivery valve.

- Interrupt $O_2$ supply.
- $O_2$ shortage signal must be given after approx. 3 seconds: continuous tone for at least 7 seconds.



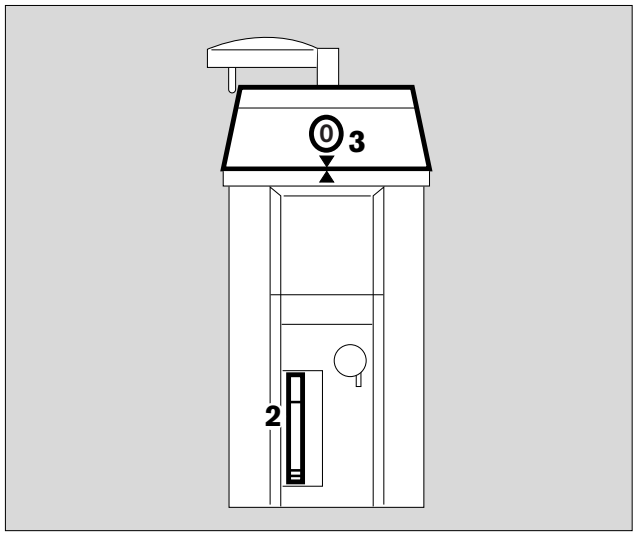

## Supply of anaesthetic agent

**2** Check filling level –
top up anaesthetic agent if necessary – in accordance with separate Instructions for Use of the anaesthetic agent vaporiser.

– If the last inspection was more than 6 months ago (sticker on Vapor):

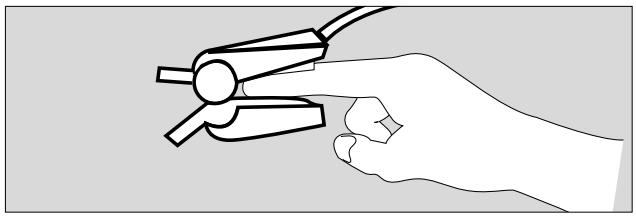
- Change Vapor!

**3** Lock control dial in »**0**« position.




## Temperature measurement (optional)

- Remove temperature sensor from Y-piece and place in a water bath (21 to 49 °C) –
compare measured value on screen with that of a second thermometer of known accuracy.



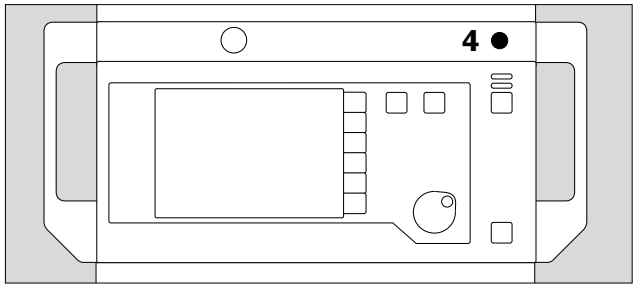

## $SpO_2$ measurement (optional)

- Apply Durasensor DS 100 A to own finger.
- Indication must be plausible.

## Power failure alarm (only if no UPS fitted)

- Interrupt power supply, e.g. disconnect plug from socket.

**4** Switch on machine –
press power switch, turn to »**I**«. Power failure alarm is given.



Continuous tone – volume must remain constant for 30 seconds.
If not, reconnect to mains and leave machine on for 24 hours so that battery can recharge. Repeat test!

- Switch off machine. Press power switch again and turn to **O**. Alarm goes out.
- Reconnect to power supply.

## Self-test

The self-test must be completed successfully in order to establish readiness for operation!
Supplementary equipment must not be switched on until after the self-test.
Start self-test:

- Switch on machine: press power switch.

  Test proceeds as described from page 31 onwards.

## Calibrate flow sensor, see page 30

## Calibrate inspiratory O2 sensor with 100% O2

This is only necessary if sidestream O2 measurement is not used.

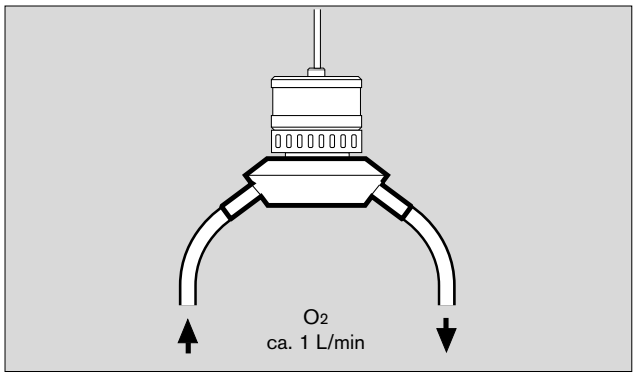
- Remove O2 sensor and place test adapter 68 01 349 on sensor.
- Allow an O2 flow of approx. 1 L/min to flow over the O2 sensor for approx. 2 minutes.
- Select »**more**« with the rotary control.
- Select »**O2 sensor 100 Vol.%**« with the rotary control.
- Display:

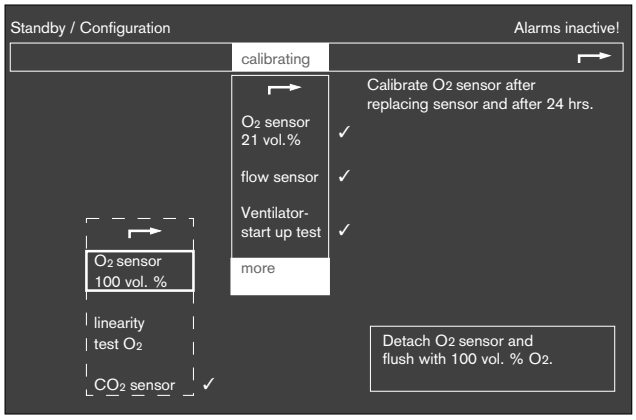
When the O2 sensor has been flushed with O2 for approx. 2 minutes:

- Press rotary control to confirm; calibration is then started and continues automatically.

The clock icon is replaced by a tick (✓) when calibration is complete.

- Replace the O2 sensor in its mount.



## Calibrate $O_2$ sensor for sidestream measurement with 100% $O_2$

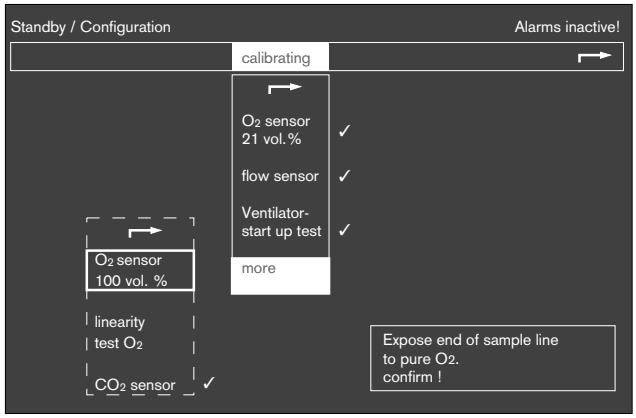
This is necessary for the monthly linearity check.

Prepare a substitute sampling line:

- Cut the sampling hose through the middle.
- Unscrew the original sampling hose from the water trap and screw on the slit sampling hose.

On Cato:

- Disconnect fresh gas hose from breathing system.
- Set an $O_2$ flow of 1 L/min $O_2$ at the $O_2$ flow tube and slide the sampling hose into the fresh gas hose.
- Use the rotary control to select »**calibrating**« and then »**more**«.
- Select »**$O_2$ sensor 100 Vol.%**« with the rotary control.
- Display:
- Allow $O_2$ to flow for approx. 2 minutes.
- Press rotary control to confirm; calibration is then started and continues automatically. The clock icon (✓) is then replaced by a tick ( ⏲ ).
- Screw the original sampling hose back onto the water trap.
- Plug the fresh gas hose back into the breathing system.




## Check linearity

– Must be checked every month.

First calibrate the $O_2$ measurement used (inspiratory or sidestream) with 100% $O_2$ (see above).

Then:

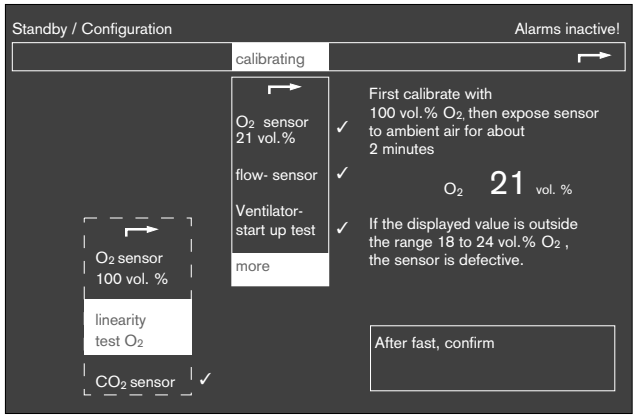
- Expose the inspiratory $O_2$ sensor to ambient air for approx. 2 minutes or,

in the case of the $O_2$ sensor for sidestream measurement:

- unscrew the sampling hose from the water trap and allow it to take in air for approx. 2 minutes.

Display on screen should show between 18 and 24 vol.% $O_2$.

If value displayed is outside 18 to 24 vol.% $O_2$ sensor capsule is faulty.



Then:

- Put inspiratory $O_2$ sensor back and calibrate

  or

- Put $O_2$ sensor for sidestream $O_2$ measurement back and calibrate.
- Put $O_2$ sensor back,

  and

- screw sampling hose back onto water trap.

## Manual ventilation function

Machine in Manual/Spontaneous mode:

**1** Press »**MAN/SPONT**«.

**2** Pressure limiting valve (APL) set to MAN.

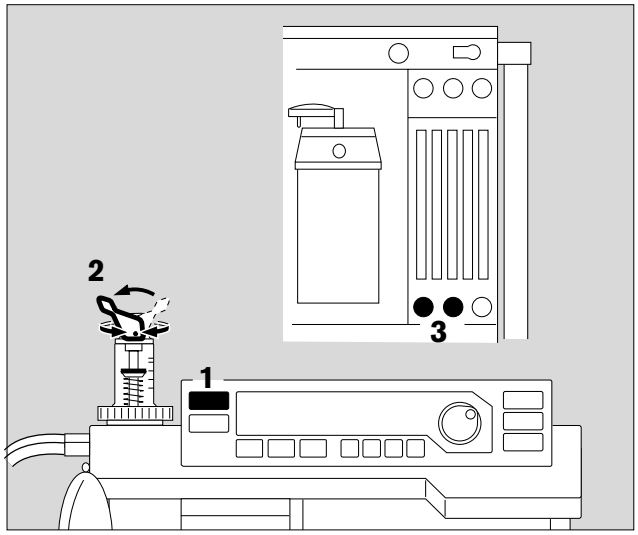
- Connect lung simulator, exercise thorax or breathing bag to Y-piece.

**3** Set fresh gas flow.

**2** Set maximum ventilation pressure between 5 and 70 mbar on APL valve – turn valve head for this purpose.

- Compress breathing bag.
- Compare pressure indication on monitor with setting on pressure limiting valve.
  If excess pressure has to be relieved quickly:

**2** Press vertically down on the lever of the pressure limiting valve.




## Automatic ventilation function

- Connect lung simulator, exercise thorax or breathing bag to Y-piece.

**4** Set fresh gas.

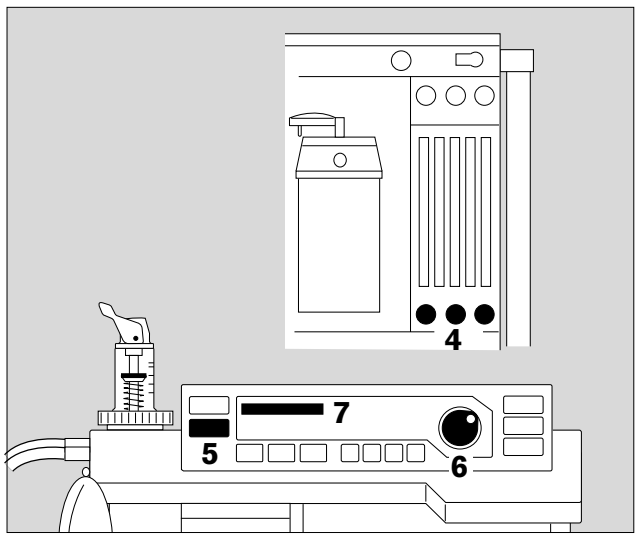
**5** Press »**IPPV**«.

**6** Press rotary control.

**7** Piston movement is indicated on the bar graph.

The machine starts with the ventilation parameters set upon delivery (or programmed to customer's requirements by DrägerService) (see page 39).

- Lung simulator inflates regularly.
- Pressure profile is displayed on the monitor.
- Volume measurement yields plausible values.



# Maintenance intervals

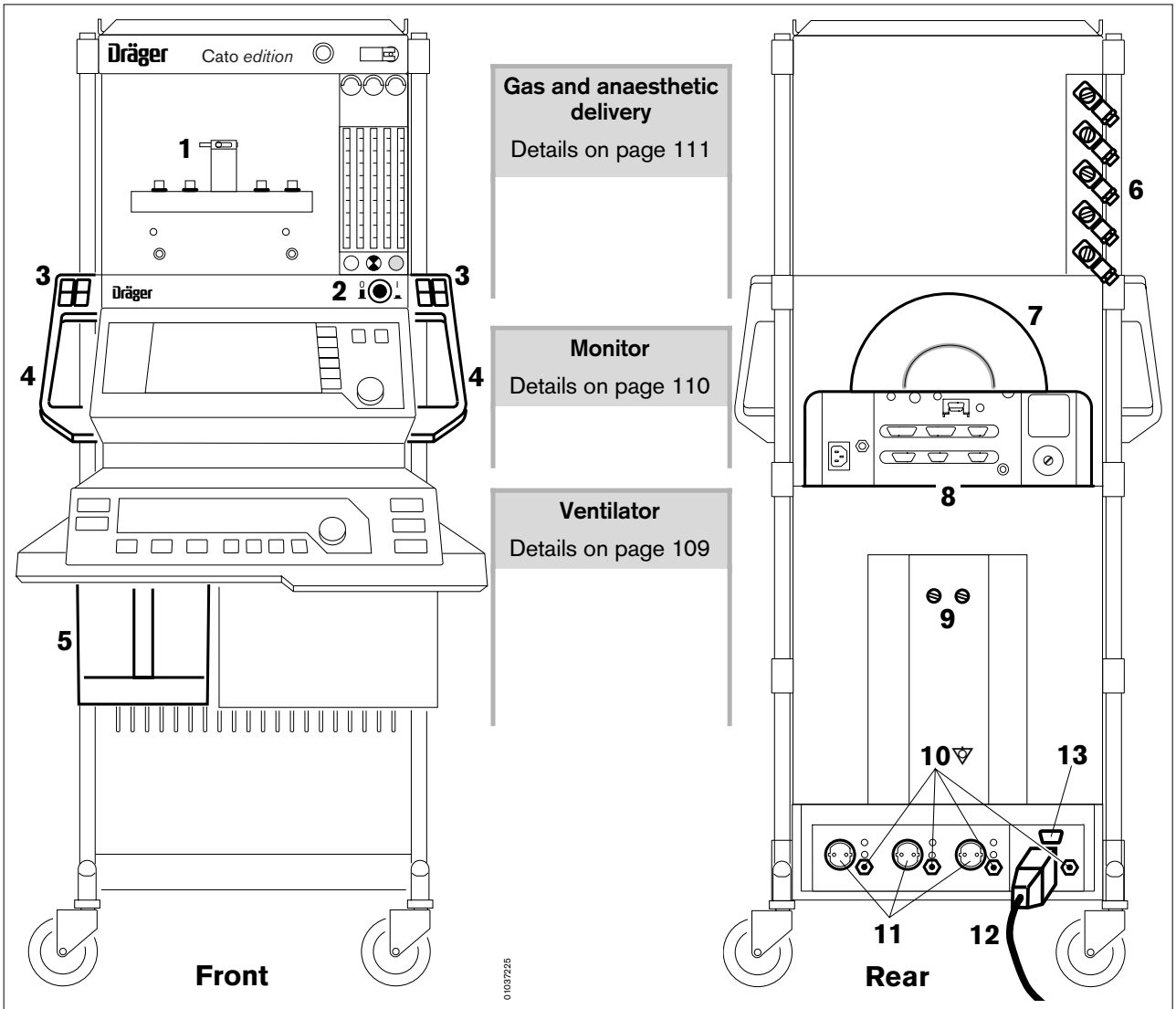
**The machine and machine parts must be cleaned and disinfected before starting any maintenance work and before returning to the manufacturer for repair.**

| | |
|---|---|
| "WaterLock" water trap | See separate Instructions for Use. |
| $O_2$ sensor | Replace if calibration is no longer possible or if the message **FIO2 INOP!** is displayed.<br>Disposal: see page 88. |
| Flow sensor | Replace if calibration is no longer possible or if the message **FLOW INOP!** is displayed.<br>Can be incinerated at temperatures above 800 °C with low pollutant emissions. |
| Bacterial filter in the secretion aspiration line | Replace after 14 days.<br>Disposal: as infectious special waste.<br>Can be incinerated at temperatures above 800 °C with low pollutant emissions. |
| Bacterial filter in measured gas return line | Replace every 6 months.<br>Can be incinerated at temperatures above 800 °C with low pollutant emissions. |
| Bacterial filter in pressure measuring line | Replace every 6 months.<br>Can be incinerated at temperatures above 800 °C with low pollutant emissions. |
| Cooling air filter | Clean monthly and dry well, or replace filter.<br>Replace after 1 year at the latest.<br>Disposal: as domestic waste. |
| Lithium battery for data storage | Must be replaced by qualified personnel after 2 years.<br>Disposal: see page 88. |
| Optical test bench for measuring anaesthetic gas concentration | Must be inspected every 6 months by qualified personnel. |
| Time Keeper RAM | Must be replaced after 3 years by qualified personnel.<br>Disposal: in conformity with local waste disposal regulations. |
| Inspection and servicing | Every 6 months by qualified personnel. |

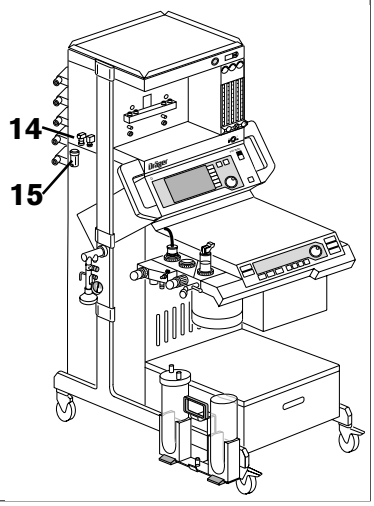
# What's what

## Contents

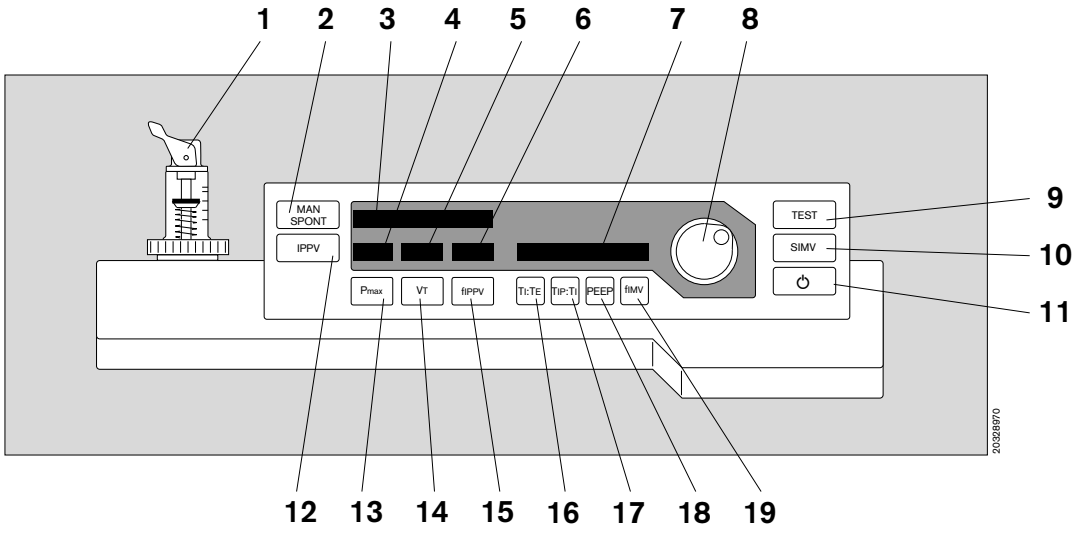
## Overall view of the machine




1 Vapor connection
2 Master switch
3 Push-buttons for ceiling pendant (optional)
4 Transport handles
5 Soda lime container
6 Gas supply ports for $O_2$, AIR, $N_2O$ and gas cylinder ports for $O_2$ and $N_2O$ (from top to bottom)
7 Holders for cables and hoses
8 Rear of monitor
9 Fixing bolts of the anaesthetic gas scavenging system
10 Grounding pin (equipotential bonding)
11 Sockets for supplementary equipment
12 Power cable
13 Sub-D socket for connecting the uninterruptible power supply (UPS)
14 AIR connector for secretion aspiration and fresh gas port for the ventilator
15 Water separator with water trap in the gas sampling line



## Operating elements and displays on ventilator




**1** Pressure limiting valve (APL) with Manual/Spontaneous changeover

**2** MAN/SPONT key for manual ventilation/spontaneous breathing

**3** Bar graph of relative piston movement [%]

**4** Indication of the set maximum pressure ($P_{max}$)

**5** Indication of the set tidal volume ($V_T$)

**6** Indication of the ventilation frequency ($f_{IPPV}$)

**7** Window for interactive settings and selection

**8** Rotary control for settings and selection (confirmation)

**9** Key for leakage test and compliance measurement

**10** Key for mechanically-aided spontaneous breathing (SIMV)

**11** Key for invoking »standby« mode

**12** Key for automatic ventilation (IPPV)

**13** Key for setting the maximum pressure ($P_{max}$)

**14** Key for setting the tidal volume ($V_T$)

**15** Key for setting the ventilation frequency ($f_{IPPV}$)

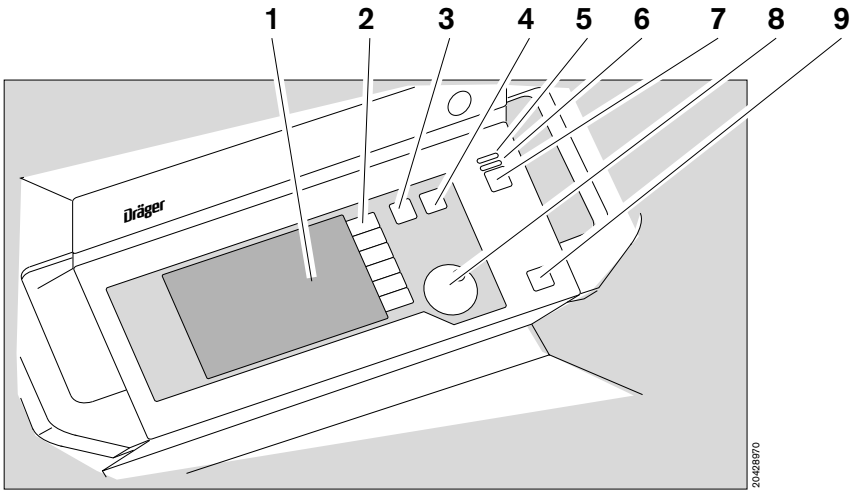
**16** Key for setting the ratio of inspiration time to expiration time ($T_I$:$T_E$)

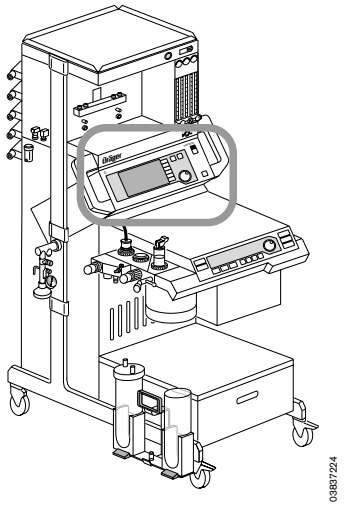
**17** Key for setting the ratio of inspiration pause time to inspiration time ($T_{IP}$:$T_I$)

**18** Key for setting the positive end-expiratory pressure (PEEP). Only possible with IPPV!

**19** Key for setting the frequency for mechanically-aided spontaneous breathing ($f_{IMV}$)

## Operating elements and displays on monitor




**Front panel of monitor:**

**1** Screen

**2** Softkeys

**3** Key for successively calling up the standard screen, data screen and trend screen

**4** Key for calling up the standard screen

**5** Red warning LED

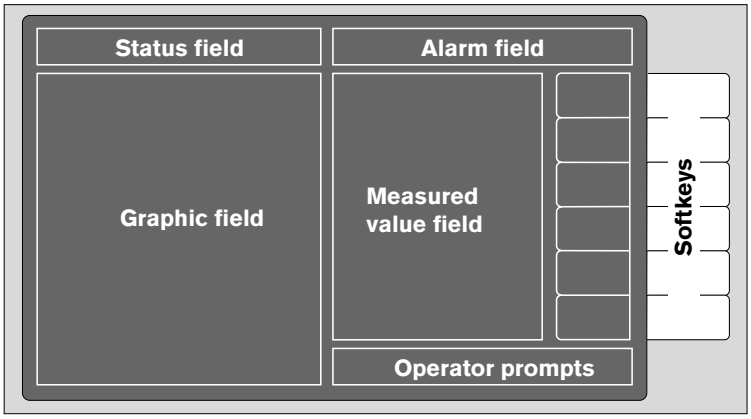
**6** Yellow caution/advisory LED

**7** Keys for deactivating the alarm tone for two minutes and for reactivating it

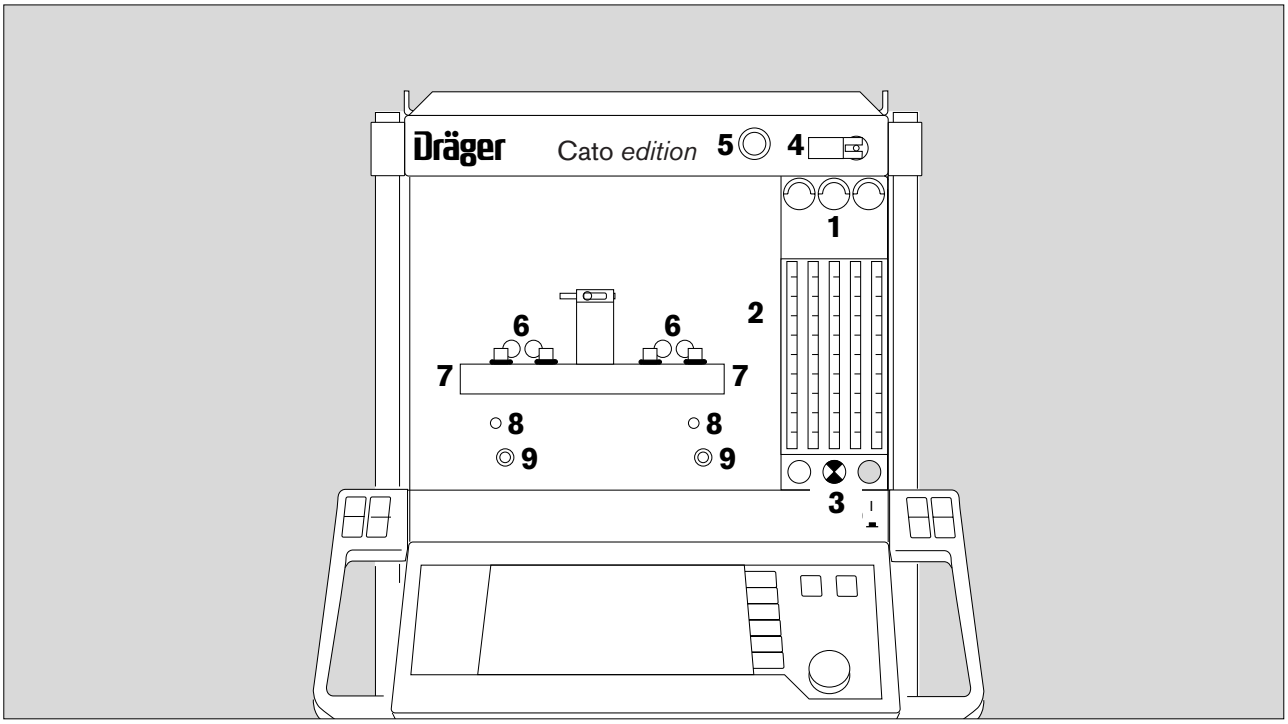
**8** Rotary control for selecting = turn and confirming = press menu items

**9** Key for standby or measuring mode. The yellow LED lights up in standby mode

**Screen layout:**



## Operating elements and displays on the gas and anaesthetic agent measuring tube bank




**1** Pressure gauge for $O_2$, AIR, $N_2O$

**2** Flow measuring tubes for $O_2$, AIR, $N_2O$

**3** Delivery valves for $O_2$, AIR, $N_2O$

**4** $N_2O$ / AIR changeover

**5** Key for $O_2$

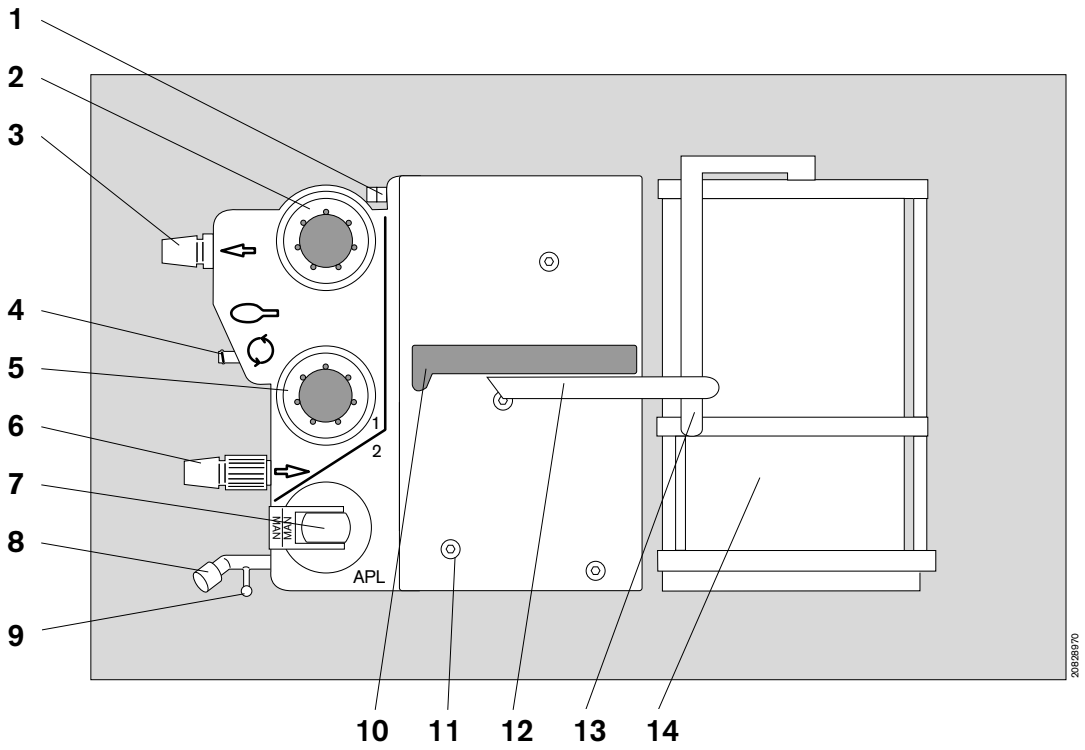
**6** Optical code reader for Vapor recognition

**7** Vapor connection

**8** Supporting pin

**9** Whistle for $O_2$ shortage signal

## Elements on breathing system




**1** Plug-in connection for pressure measurement ($P_{aw}$)

**2** Inspiration valve (with mount for $O_2$ sensor, optional)

**3** Inspiration port (ISO cone 22)

**4** Quick-release coupling for measured gas return line

**5** Expiration valve

**6** Expiration port (ISO cone 22) with mount for flow sensor (screwed in)

**7** Pressure limiting valve (APL) with pressure setting (turn), MAN/SPONT changeover (two-way switch) and pressure relief (press)

**8** Plug to seal Y-piece for leakage test

**9** Support for manual ventilation bag

**10** Handle of breathing system

**11** Quick-release catches for dismantling breathing system (5 units)

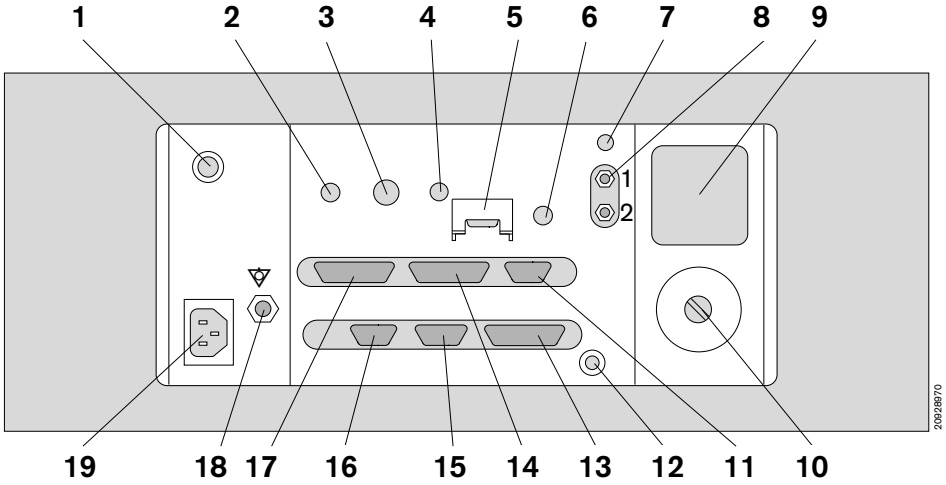
**12** Release lever for breathing system and piston pump

**13** Release lever and handle of piston pump

**14** Piston pump

See also page 73 for
- position of subsystems
- gas flow chart and
- position of valves in breathing system.

## Connections on the rear of the monitor




**1** Master switch

**2** Connection for $O_2$ sensor

**3** Connection for flow sensor

**4** Connection for temperature sensor

**5** Connection for $SpO_2$ sensor lead

**6** Input for ECG/$SpO_2$ synchronization

**7** Connection for anaesthetic gas return or scavenging

**8** Connection for sidestream $CO_2$ / $O_2$ / anaesthetic gas measurement (leads to water trap on the left-hand side of the Cato as seen from the front. The sampling line is connected to the water trap.)

**9** Cooling air filter

**10** Sensor for sidestream $O_2$ measurement

**11** Analog output

**12** Connection for pressure measuring line

**13** Connection for ventilator

**14** RS 232 interface (printer); can also be configured as RS 232 C interface (MEDIBUS)

**15** Connection for identification of the anaesthetic vaporizer

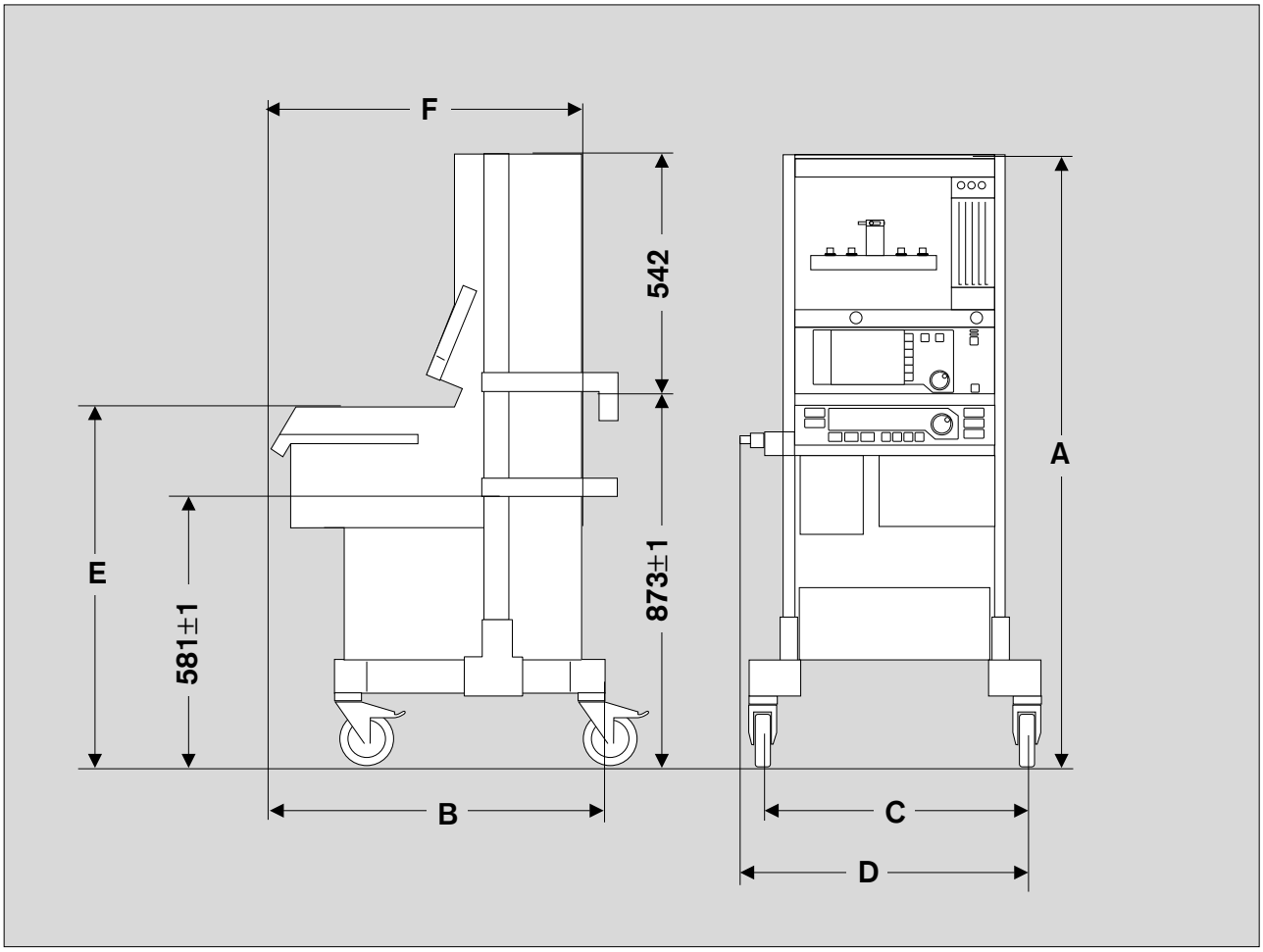
**16** Not used

**17** RS 232 C interface (MEDIBUS; only type-tested equipment and cables may be connected via this interface)

**18** Equipotential bonding pin

**19** Mains power socket

## Dimensions




**Standalone machine:**

A = 1480 mm
B = 785 mm
C = 530 mm
D = 730 mm
E = 830 mm

**Ceiling version:**

A = 1415 mm
B = 785 mm
C = 530 mm
D = 730 mm
E = 760 mm
F = 900 mm

## Weight

Cato basic machine approx. 140 kg
Cato with two Vapors and monitor approx. 180 kg

# Technical data

## Contents

**Where tolerances are given in percent and as absolute values, the higher value applies in each case!**

## General

Identification .....: The Serial No. and Article No. are located on the rating plate (nameplate) on the back of the machine. The Article No. also specifies the equipment level of the machine.

Weight .....: Cato basic machine approx. 140 kg
Cato with two Vapors and monitor approx. 180 kg

Dimensions.....: See dimensional drawings on page 114

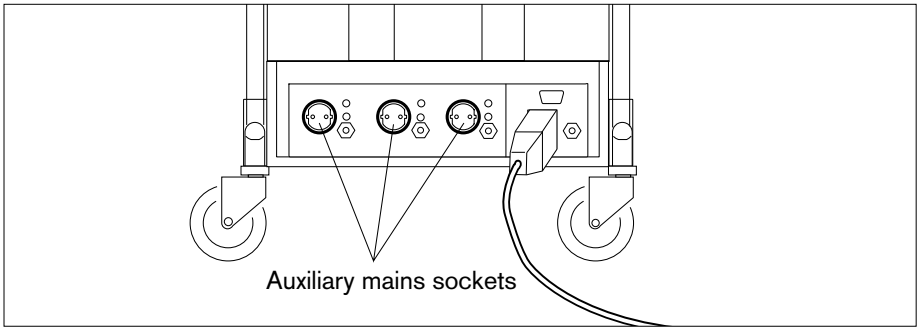
## Power supply

Rated operating voltages .....: depending on power adapter
100 VAC +10 %, –15 %, 50/60 Hz
120 VAC ±10 %, 50/60 Hz
127 VAC ±10 %, 50/60 Hz
230 VAC ±10 %, 50/60 Hz
240 VAC ±10 %, 50/60 Hz
Conversion only by specially trained personnel.

Power input .....: Max. 280 W (without auxiliary power sockets and without accessories)

Fuses .....: The fuses in the power adapter and master switch on contactor are only accessible to qualified personnel with special tools.
Auxiliary power sockets (3x): 2 fuses installed per socket (2A DIN 41 622, 230/240 VAC)

Auxiliary mains sockets .....: Do not connect any HF surgery devices to the auxiliary mains sockets!
The connection of devices to the auxiliary mains socket may result in increased risk of electric shock in the event of earthing failure!




## Ambient conditions

| | | |
|---|---|---|
| Temperature .....: | +15 to +35 °C | (operation) |
| | –20 to +50 °C | (storage / transport) |
| Humidity .....: | 20 to 80 %, no condensation | (operation) |
| | 0 to 98 %, no condensation | (storage / transport) |
| Air pressure.....: | 80 to 106 kPa | (operation) |
| | 50 to 110 kPa | (storage / transport) |

## Medical gas supply

Pneumatic connections: Piped medical gas supply – $O_2$, $N_2O$, AIR
Spare gas cylinders 11 L or 3 L for $O_2$ and $N_2O$ (optional)
Anaesthetic gas scavenging

Required pressures (piped supply): $O_2$ : 2.7 to 5.5 bar
$N_2O$ : 2.7 to 5.5 bar
AIR : 2.7 to 5.5 bar

Maximum gas consumption: $O_2$ : 100 L/min at 5 bar ±10%, including 50 L/min at 5 bar ±10% for $O_2$ flush
$N_2O$ : 20 L/min at 5 bar ±10%
AIR : 50 L/min at 5 bar ±10%

$O_2$ shortage signal: Whistling signal tone.

Triggered: at latest when $O_2$ pressure drops below 170 kPa (1.7 bar)
Stops: at latest when $O_2$ pressure rises above 260 kPa (2.6 bar)

## Breathing system

Gas volume: Approx. 3 L total enclosed gas volume

Compliance: Approx. 3 mL/mbar
Approx. 4 mL/mbar with absorber

Absorber volume: 1.5 L soda lime Drägersorb 800
Binds approx. 150 L $CO_2$, sufficient for approx. 6 hours of operation

Pressure relief: 90 ±10 mbar

Pressure limiting valve: Variable between 5 and 70 mbar, ±15% of set value

Patient connections: ISO cone 22 mm ♂

Anaesthetic gas scavenging: Nominal socket diameter 27 mm or ISO cone 30 mm ♂ (≙ EN 1281-1)

Leakage ventilation system: < 120 mL/min at 30 mbar

Maximum pressure in breathing system: 10 to 80 mbar ±20%
or +3 mbar, but at least 10 mbar over PEEP

Expiratory and inspiratory resistance: ≤4 mbar with a flow of 60 L/min (according to EN 740)

## Ventilator

Drive gas consumption: 2 L/min $O_2$ or AIR in operation
0 L/min in »standby« mode

Tidal volume ($V_T$):

| | |
|---|---|
| < 20 mL | ±30 % or ±6 mL |
| 20 to 100 mL | ±10 % or ±10 mL |
| 100 to 1400 mL | ±5 % or ±15 mL |

Frequency ($f_{IPPV}$): 6 to 80 per minute

Minute volume ($\dot{V}_E$): to 25 L/min

$T_I$:$T_E$: 1:3 to 2:1 ±5 %

$T_{IP}$:$T_I$: 0 to 60 % ±5 %

Inspiratory flow $\dot{V}_E$ max: max. 75 L/min

Frequency ($f_{IMV}$): 3 to 80 per minute ±5 % ($f_{IMV} < f_{IPPV}$)

PEEP: 0; 2 to 20 mbar ±10 % or ±2 mbar ($P_{max}$ – PEEP > 10 mbar)

Trigger pressure: –1 mbar ± 0.5 mbar (invariable)

## Gas delivery

Low-flow measuring tubes .....: (Calibrated for 20 °C, 1013 mbar)

| | | |
|---|---|---|
| $O_2$: | 0.02 to 0.5 L/min | ±10 % |
| | At minimum scale: | +20 %, –10 % |
| | At minimum scale: | ±5 % |
| $O_2$: | 0.55 to 10.0 L/min | ±10 % |
| | At minimum scale: | +20 %, –5 % |
| $N_2O$: | 0.02 to 0.5 L/min | ±10 % |
| | At minimum scale: | –20 %, +10 % |
| | At minimum scale: | ±5 % |
| $N_2O$: | 0.55 to 10.0 L/min | ±10 % |
| | At minimum scale: | +20 %, –5 % |
| AIR: | 0.2 to 14.0 L/min | ±10 % |
| | At minimum scale: | +15 %, –5 % |

Delivery output.....: $O_2$, $N_2O$, AIR: at least 9 L/min each

## Monitor

### Pressure measurement

Airway pressure.....: –10 to 80 mbar

Resolution .....: 1 mbar

Accuracy .....: at least 1 mbar or better than ±4% of the measured value

### Flow-Messung

Tidal volume $V_T$.....: Range: 0.01 to 9.99 L
Resolution: 0.01 L
Accuracy: better than 0.01 L or ±8%[1)] of the measured value (under calibration conditions and 1013 hPa)

Minute ventilation AMV .....: Range: 0 to 99.9 L/min
Resolution: 0.1 L/min
Accuracy: better than 0.2 L/min or ±8%[1)] of the measured value under calibration conditions and BTPS (BTPS = Body Temperature, present atmospheric Pressure, 100% humidity Saturated)

Respiration rate .....: Range: 0 to 80 per minute
Resolution: ±1 per minute
Accuracy: ±1 per minute

1) When using an microbial filter on the expiratory side, the tolerance increases to ±15%.

### $O_2$ measurement in main stream (inspiration line)

Range.....: 5% to 100% by volume

Resolution .....: 1% by volume

Accuracy .....: calibrated with air: ±3 % by vol. in 5 to 50% by vol. measuring range
±5 % by vol. in 50 to 100% by vol. measuring range

calibrated with 100 % $O_2$: ±3% in the 5 to 100% by vol. measuring range

Response time $t_{10...90}$.....: better than 15 seconds

### $O_2$, $CO_2$ and anaesthetic agent measurement in sidestream (sampling)

Sampling rate (selectable).....: 200 mL/min
60 mL/min

### $O_2$ measurement

Range.....: 5% to 100% by volume

Resolution for $FiO_2$ and $FeO_2$...: 1% by volume

Resolution for $\Delta O_2$.....: 0.1% by volume

Accuracy .....: calibrated with air: ±3 % by vol. in 5 to 50% by vol. measuring range
±5 % by vol. in 50 to 100% by vol. measuring range

calibrated with 100 % $O_2$: ±3% in the 5 to 100% by vol. measuring range

Response time $t_{10...90}$.....: At 200 mL/min: better than 500 ms
At 60 mL/min: better than 1 s

### $CO_2$ measurement

Special feature .....: When the $CO_2$ alarm is activated, the inspiratory $CO_2$ concentration in the breathing air is measured with a fixed upper limit of 5 mmHg)

Measuring range.....: 0 to 9.9% by volume (corresponding to 0 to 9.9 kPa or 0 to 80 mmHg)

Accuracy .....: ± 0.2 % by volume or 5% of the measured value

Resolution .....: 0.1% by volume (0.14 Pa or 1 mmHg)

Response time $t_{10 ...90}$.....: at 200 mL/min: 300 ms
at 60 mL/min: 1 s

Warm-up phase.....: 4 minutes (to achieve ISO/DIS 11196 accuracy level)
2 minutes (for first measured values)

Zero drift .....: Within the specified accuracy, without limitation in time

### Anaesthetic agent measurement

Display range for $N_2O$ .....: 0% to 100% by volume
Accuracy: 0 to 40% better than ±2.5% by volume absolute
41 to 100% better than ±6.0% by volume absolute
Resolution: 1 % by volume absolute

Display range for halothane.....: 0% to 7.5% by volume
Accuracy: 0 to 5% better than ±0.2% by volume absolute
5 to 7.5% better than ±0.3% by volume absolute
Resolution: 0.1 % by volume absolute

Display range for
enflurane and isoflurane.....: 0% to 7.5% by volume
Accuracy: 0 to 5% better than ±0.2% by volume absolute
5 to 7.5% better than ±0.3% by volume absolute
Resolution: 0.1 % by volume absolute

Display range for desflurane.....: 0% to 20% by volume
Accuracy: 0 to 10% better than ±0.4% by volume absolute
10 to 20% better than ±0.8% by volume absolute
Resolution: 0.1 % by volume absolute

Display range for sevoflurane....: 0% to 11% by volume
Accuracy: 0 to 5% better than ±0.2% by volume absolute
5 to 9% better than ±0.4% by volume absolute
Resolution: 0.1 % by volume absolute

Response time $t_{10\ ...90}$.....: At 200 mL/min: 450 ms
At 60 mL/min: 1.2 s

Warm-up phase.....: 8 minutes

Zero drift .....: Within the specified accuracy, without limitation in time

**SpO2 measurement**

Display range.....: 0 to 100% $SpO_2$
Accuracy (adults): 70 to 100% $SpO_2$, better than ±2% $SpO_2$
50 to 70% $SpO_2$, better than ±3% $SpO_2$
0 to 50% $SpO_2$ not specified

Accuracy (neonates): 70 to 95% $SpO_2$, better than ±3% $SpO_2$
0 to 70% $SpO_2$ not specified
95 to 100% $SpO_2$ not specified
Resolution: 1 % $SpO_2$

Pulse rate .....: 20 to 250 per minute
Accuracy: ±2 per minute
Resolution: 1 per minute

Sensors.....: Type compatible with Nellcor sensors Oxisensor, Oxiband and Durasensor
Wavelengths: 660 nm (red), 920 nm (infrared)

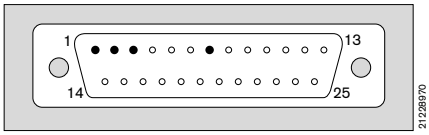
Acoustic pulse signal .....: A tone is generated for each pulse beat detected.
Pitch proportional to oxygen saturation.

**Data communication**

Data interface .....: RS-232-C (MEDIBUS)

Connector .....: 25-pin sub-D, electrical isolation 1.5 kV

Pin assignment .....: 1 ≙ shield, 2 ≙ TxD, 3 ≙ RxD, 7 ≙ GND



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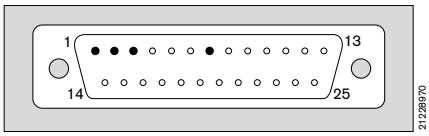
Record (printer):
(can also be configured as RS 232 C (MEDIBUS))

Connector .....: 25-pin sub-D, electrical isolation 1.5 kV

Pin assignment .....: 1 ≙ shield, 2 ≙ TxD, 3 ≙ RxD, 7 ≙ GND



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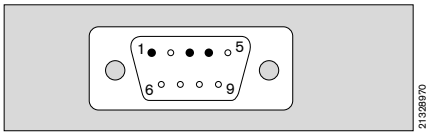
Analog outputs:

$CO_2$ .....: 0 to 10 kPa ≙ 0 to 10 V

Connector .....: 9-pin sub-D, electrical isolation 1.5 kV

Pin assignment .....: 1 ≙ shield, 3 ≙ positive (+), 4 ≙ negative (–)



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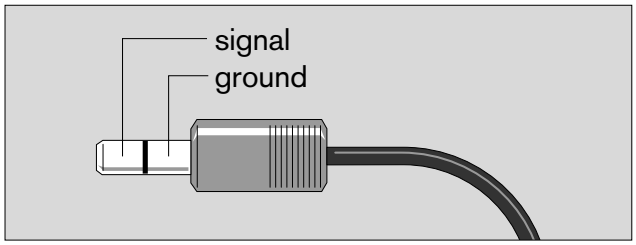
**C-Lock™ ECG synchronization** (optional)

Prerequisite for the
ECG synchronization signal .....: Pos. pulse with > 4.5 V and > 10 ms duration to drive 2 mA.

Max. permitted signal delay
in relation to the current
QRS complex .....: 40 ms

Signal isolation from
remaining electronics .....: Dielectric strength > 4 kV

Socket for 2-pin pawl-type
connector, dia. 3.5.....: Pin assignment:




## Operating parameters

Noise emission ..... : Max. 56 dB(A) (as determined in a free field over a reflecting surface)

Protection classes:

$SpO_2$ sensor ..... : Type BF ⊣  ⊢ electrically isolated from protective earth conductor

Electromagnetic compatibility ..... : Tested to EN 60601-1-2

**Classification** ..... : Class II b
as per Directive 93/42/EEC
Annex IX

**UMDNS-Code** ..... : 10-134
Universal Medical Device
Nomenclature System

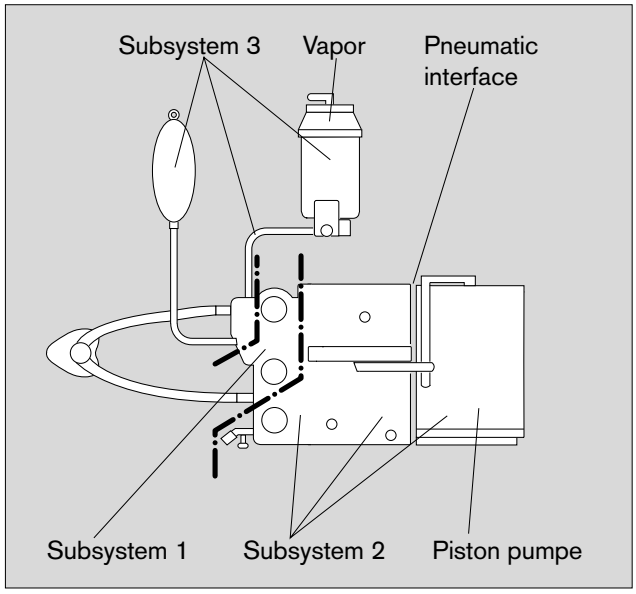
**Technical documentation available on request**

# Descriptions

## Contents

## Flow chart of self-test

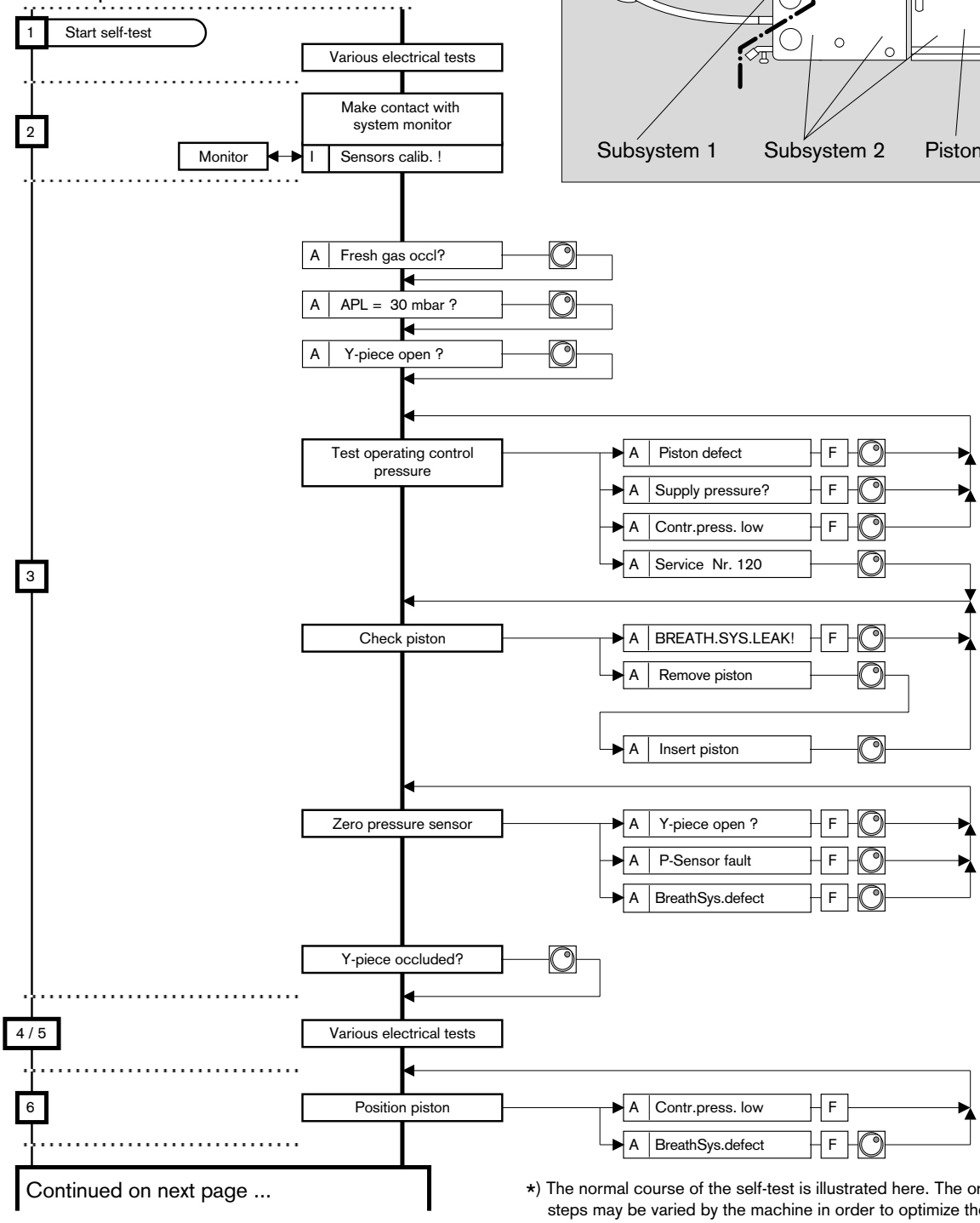
Flow chart of self-test in ventilator




Legend:

- A — Display in dialogue window of ventilator
- F — Indicated faults must be remedied, instructions and advisories observed.
- I — Information in dialogue window of ventilator
- Press rotary control
- # — Correspondingly numbered test blocks in VT window

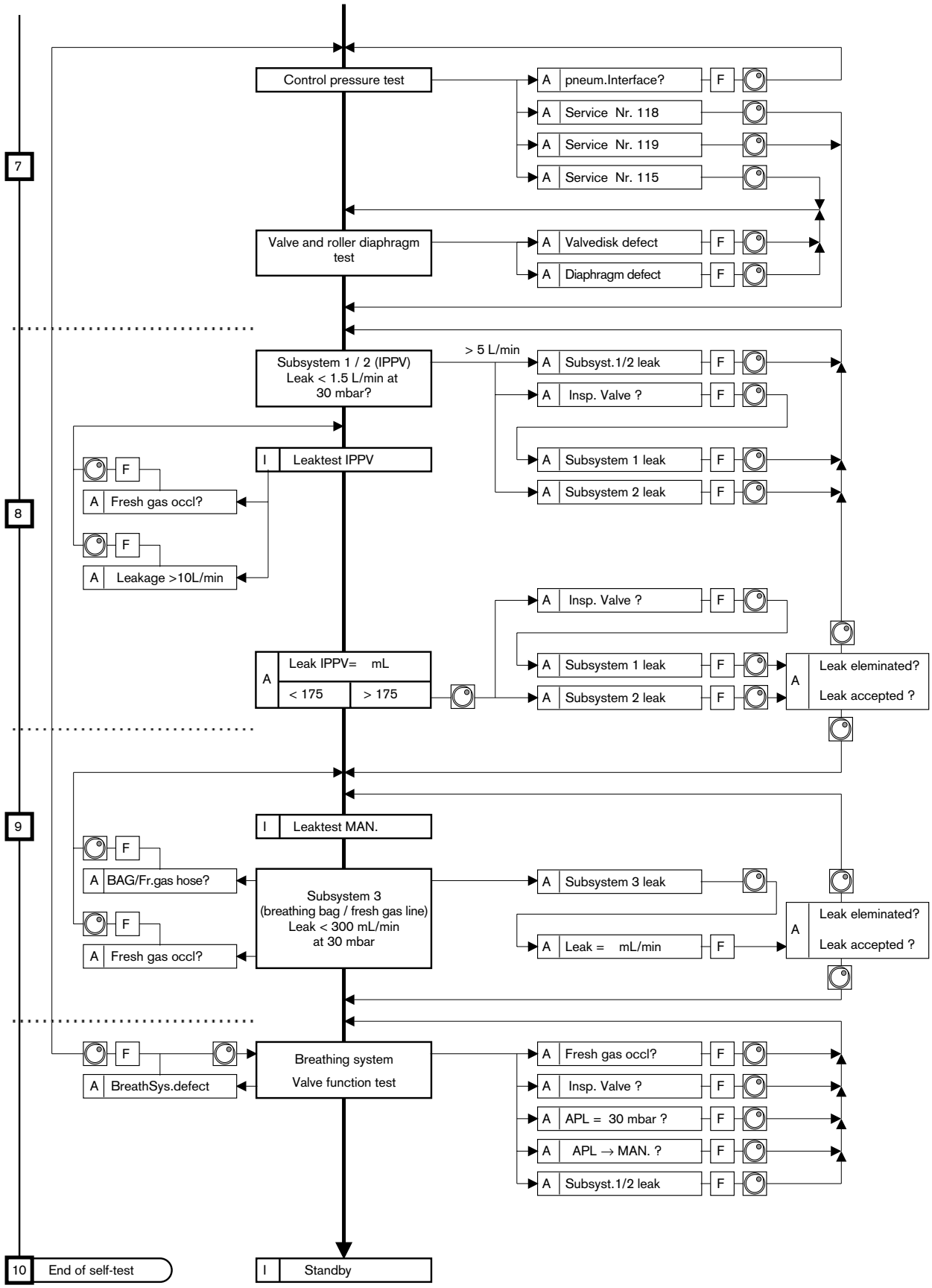
Test sequence *):




*) The normal course of the self-test is illustrated here. The order of test steps may be varied by the machine in order to optimize the test time.

Flow chart of self-test in ventilator (cont.)

Test blocks:



## Ventilation with automatic adjustment of rebreathing to match fresh gas flow

Most of the breathing systems used for anaesthesia today are based on the rebreathing principle. Part of the expired gas is redelivered to the patient after absorbing $CO_2$ and enriching with anaesthetic gases and anaesthetic agent. The excess anaesthetic is scavenged, the amount of scavenged anaesthetic gas essentially depending on the set fresh gas flow.

Administration of anaesthetic gas with reduced fresh gas flow (low-flow technique) yields a number of major advantages: lower consumption of anaesthetic gases and agents, more effective humidification and heating of the inspiratory gas, lower environmental burden and good manual ventilation properties.

The design of the breathing system is an aspect of essential importance for low-flow anaesthesia. The high degree of fresh gas utilization is a major prerequisite. Systems suitable for low-flow techniques should be designed so that it is impossible, firstly, for too much expiration gas to disappear in the anaesthetic scavenging line without building up a constant pressure and, secondly, for fresh gas to escape without first having been administered to the patient.

In closed anaesthesia systems, anaesthetic gas cannot escape from the breathing system and no more fresh gas is delivered than is actually required by the patient. However, closed systems must also meet additional requirements:

the breathing system must be absolutely tight and must feature additional monitoring and control elements.

The breathing system implemented in the Cato automatically matches its degree of openness to the fresh gas flow.

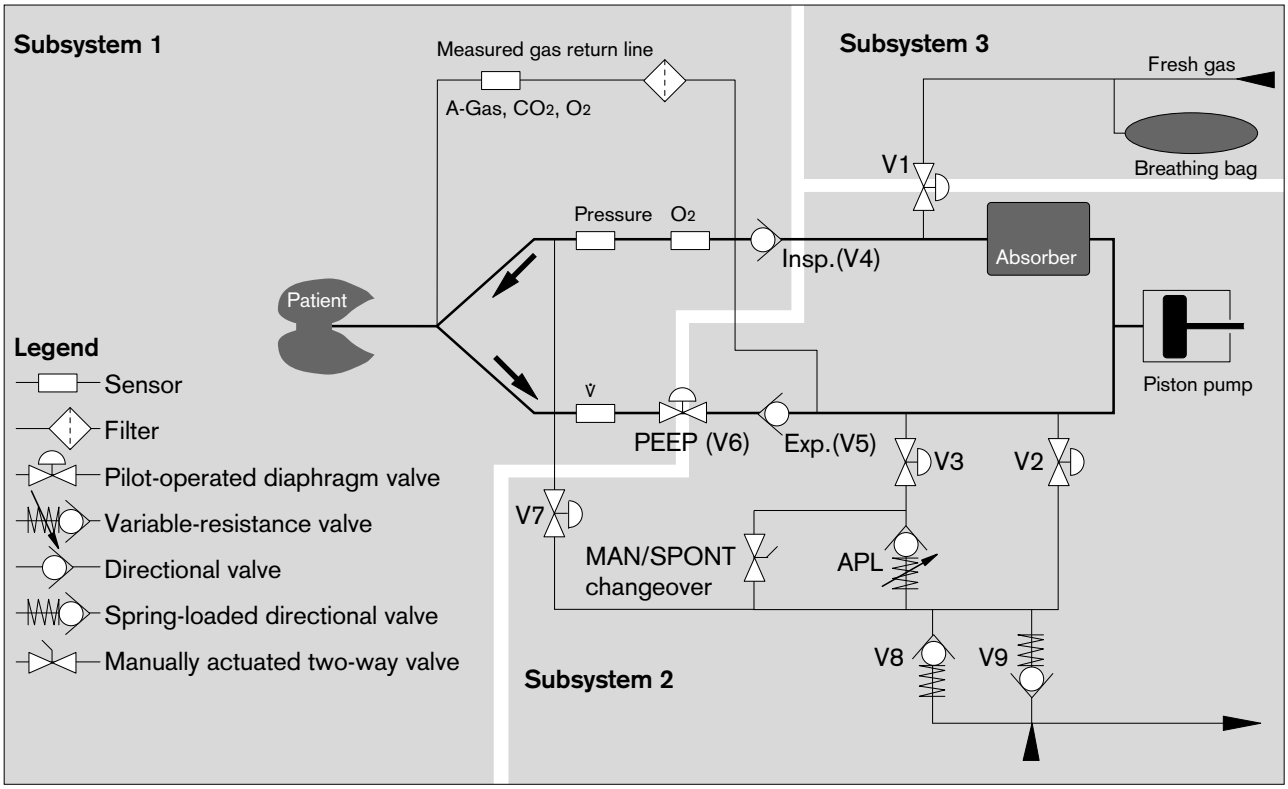
During inspiration, breathing gas streams from the piston pump to the patient. Valve V2 of the excess gas outlet and the fresh gas shutoff valve V1 are closed. Expiration is initiated when the fresh gas shutoff valve V1 is opened.

Expired gas from the patient's lungs streams into the breathing bag which serves as a reservoir and also into the retracting piston pump. The excess gas outlet valve V2 is closed.

Unlike the case with conventional semi-closed breathing systems, the valve opening time for discharging excess gas is controlled as required. The system remains open longer for anaesthesia with high fresh gas flow.

If the fresh gas flow is inadequate in closed anaesthesia systems, the pressure measuring function will detect that the patient's expiratory pressure has dropped below approx. –3 mbar.

This shortage of fresh gas is signalled by the Cato and the piston pump stops in order to avoid a negative pressure in the patient.



## Automatic leakage test IPPV

This leakage test identifies any leaks of relevance for automatic ventilation in subsystems 1 and 2 of the Cato ventilation system. It also encompasses the breathing hoses up to the Y-piece, as well as the measured gas sampling and return lines if installed. The overall system compliance is determined at the same time.

The IPPV leakage test and the leakage test started in »standby« mode is carried out by building up a constant pressure of 30 mbar. The piston movement necessary to compensate the gas escaping through leaks is measured and calculated and indicated as a volume per unit time.

The effective leakage over the complete ventilation cycle is lower than the value indicated, since the effective mean pressure Pmean in IPPV ventilation mode is considerably lower than the test pressure.

The relationship depends on the rate of pressure increase, the plateau time and the ratio $T_I$:$T_E$. The effective leakage value varies with the value measured in the leakage test as $P_{mean}$ : $P_{test}$.

Example:

| | |
|---|---|
| **Test leckage** | **= 30 mL/min** |
| $P_{test}$ | = 30 mbar |
| $P_{mean}$ | = 6 mbar |
| Effective leakage | = Test leakage x $P_{mean}$ / $P_{test}$ |
| **Effective leakage** | **= 6 mL/min** |

## Automatic MAN leakage test

This leakage test is also part of the self-test and locates any leaks of relevance for manual ventilation in subsystem 3 of the Cato ventilation system. The breathing bag, fresh gas hose, Vapor and internal connections up to the bank of measuring tubes are tested for leaks.

The test is normally carried out at a pressure of 30 mbar. If the leakage value remains below 300 mL/min, this is not indicated and the self-test continues. This subsystem contributes only marginally to the overall leakage, since the mean pressure is normally below 5 mbar.

## Automatic compliance correction

The stroke volume applied by a ventilator not only ventilates the patient's lungs, but also the hose system connecting the patient to the ventilator.

This means that only part of the stroke volume is effectively used to ventilate the lungs, the rest remaining in the compressible hose volume. This compressible volume must be known for ventilation to be effective.

Example:

A patient with a lung compliance of 3 mL/mbar requires a tidal volume of $V_T$ = 60 mL.

Disregarding the compressible hose volume, this would yield an effective airway pressure of

$$P = \frac{V_T}{C1} = \frac{60\ mL}{3\ mL / mbar} = 20\ mbar.$$

The actual compressible hose volume (hose system) equals 3 L, however, which corresponds to a compliance of C2 = 3 mL/mbar.

The actual airway pressure is therefore:

$$P = \frac{V_T}{C1 + C2} = \frac{60\ mL}{(3 + 3)\ mL / mbar} = 10\ mbar$$

In other words, 30 mL stroke volume ventilate the lungs, the other 30 mL remaining in the hoses.

The compliance of the breathing system (breathing gas block, soda lime container, hoses, etc.) is determined during the leakage test and saved by the Cato.

This calculated compliance value is used to calculate the volume stored in the breathing system and hoses for each ventilation pressure. In order to correct it, the Cato starts with the set tidal volume and reaches the correct volume after three to six breaths. The corrected volume is constantly verified automatically.

The measured value must be limited to plausible ranges for safety reasons. This limit is set at 3.9 mL/mbar when using adult hoses (tidal volumes greater than 200 mL) and at 0.8 mL/mbar when using infant hoses (tidal volumes less than 200 mL). The maximum length of the breathing hoses should therefore not be exceeded (see table below).

Table of maximum hose lengths:

| **Hose** | **Maximum length with filter** | **without filter** |
|---|---|---|
| Adults; black | 3.0 m | 3.5 m |
| Adults; blue | 6.5 m | 7.0 m |
| Infants; black | 2.2 m | 4.4 m |
| Infants; blue | 2.2 m | 4.4 m |

## Notes on setting the fresh gas flow

The fresh gas delivered must

– cover the patient's consumption (uptake) and

– any leaks in the system.

– It must also compensate the gas sampled by the system monitor if the measured gas return line is not connected.

This is particularly important when setting a low fresh gas flow.

The patient's uptake of gas depends on the anaesthesia and primarily comprises the consumption of $O_2$ and nitrous oxide. The consumption of $O_2$ can be calculated approximately using Brody's equation:

$O_2$ flow = $10 \times BW^{0.75}$ in mL/min

BW = Body weight in kg

This corresponds to an $O_2$ uptake of roughly 3.5 mL/min per kg body weight.

Higher $O_2$ consumption results in a lower inspiratory $O_2$ concentration due to rebreathing when a low fresh gas flow is set.

– The uptake of nitrous oxide varies with time and can be approximated by the following rule of thumb:

$$\frac{1}{\sqrt{t}}$$

Approximate steady state value: 1.5 mL/min $N_2O$ per kg body weight.

– The leakage from the ventilation system depends on the airway pressure (mean value) and can be determined with the aid of the automatic leakage test.

– The measuring gas sampled to measure the $CO_2$, $N_2O$ and anaesthetic agent can be set on the system monitor (60 or 200 mL/min).

– The gas is returned to the breathing circulation via the measured gas return line. This would reduce the required fresh gas by 200 mL/min in the following example.

Example

for estimating the minimum fresh gas flow required in the steady state:

| | | | | |
|---|---|---|---|---|
| **Body weight** | **=** | **70** | **[kg]:** | |
| $\dot{V}$ $O_2$ | = | 240 | [mL/min] | |
| $\dot{V}$ $N_2O$ | = | 100 | [mL/min] | + |
| Leakage | = | 10 | [mL/min] | + |
| Sampled gas | = | 200 | [mL/min] | + |
| **Fresh gas required** | **≥** | **550** | **[mL/min]** | |

This example shows that the fresh gas flow ($O_2$ and $N_2O$) must be set to at least 550 mL/min.

## Relationship between fresh gas flow and gas concentration in breathing system

The inspiratory concentration differs from the set fresh gas concentration due to rebreathing and the $O_2$, $N_2O$ and anaesthetic agent uptake by the patient. The lower the fresh gas flow, the larger the concentration gradient between fresh gas, inspiratory and expiratory gas concentration becomes.

Since the concentration of the fresh gas flow in this flow range bears little resemblance to the concentration at the patient, it is important to measure the anaesthetic agent concentration as close to the inspiration tube as possible in this mode!

The measuring system is integrated into the system monitor.

## Relationship between fresh gas flow and time constants in breathing system

The response time following a change of concentration of $O_2$, $N_2O$ or anaesthetic agent in the fresh gas depends on the set fresh gas flow.

The inspiratory concentration in the breathing system corresponds more and more accurately with the fresh gas concentration as the fresh gas flow increases. At a low fresh gas flow, a change of concentration takes effect in the breathing system very slowly. This process can be speeded up by increasing the fresh gas flow abruptly.

**Rule of thumb for estimating the system response over time:**

$T = VC / \dot{v} FG$

where:

T = Time constant of the system in minutes
VC = System volume in litres (breathing system, ventilation hoses, residual volume of the lungs)
$\dot{v}$ FG = Fresh gas flow in L/min

**Example**

for estimating the time constant of the system (comprising breathing system and hoses):

VC = 6 [L]
$\dot{v}$ FG = 3 [L/min]
T = 2 [min]

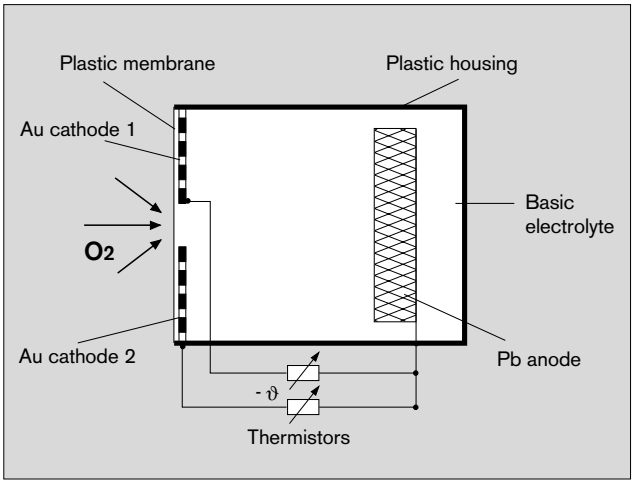
In this example, the change of concentration in the breathing system would have reached roughly 60% of the change in fresh gas concentration after approx. 2 minutes.

## Principles of measurement

### O2 measurement (Measuring principle of the galvanic cell

The $O_2$ sensor is based on the principle of a galvanic cell.

Oxygen molecules from the gas mixture to be measured diffuse through a plastic membrane into the electrochemical cell and are reduced on precious metal electrodes.




A base electrode is oxidized at the same time. It is depleted by the oxidation process and essentially determines the service life of the sensor.

The current flowing through the cell is proportional to the partial oxygen pressure in the gas mixture to be measured.
At constant pressure and constant temperature of the gas mixture to be measured, the measured value is directly proportional to the partial oxygen pressure.

### Flow measurement

**Measuring principle and signal processing:**
The sensor is based on the principle of a constant-temperature hot-wire anemometer. The breathing gas flows round a very thin, electrically heated platinum wire in a measuring tube. The wire is heated to a constant temperature of 180 °C which is controlled by a control circuit. Heat is dissipated when gas flows past this wire. The larger the volume of gas flowing past per unit time, the more heat will be dissipated.

The heating current required to maintain a constant wire temperature is taken as an indicator for the gas stream.

**Gas type compensation:**
The effect of the various types of gas contained in the breathing gas is compensated by a second heated platinum wire. The heat dissipated by the second wire in the stationary gas column in the measuring tube is determined during a period in which there is no gas flow (i.e. during inspiration when the sensor is positioned on the expiration side). The gas composition is determined on the basis of the specifically different thermal conductivity of the types of gas present in the breathing gas.
Linearization is performed with the aid of internal calibration tables for the gas mixtures $O_2/N_2O$, air and 100% $O_2$.

### Measurement of $CO_2$ and anaesthetic agent

$CO_2$ and anaesthetic agent absorb infrared light. A pump entrains a small amount of breathing gas through a measuring cuvette irradiated with infrared light. Different filters make it possible to select a frequency band in which only one of the gases to be identified is absorbed. All gases can be measured quasi continuously by changing filters rapidly.

The absorption reflects the gas concentration in the cuvette. The gas concentrations in the breathing gas can be calculated by simultaneously measuring the temperature and absolute pressure in the cuvette.

Cross-sensitivity of the anaesthetic gas measurement: Measurement of the anaesthetic agent can be falsified by vapours of organic substances (such as those contained in cleaning agents or disinfectants) in the air round about, the sampling hose or the T-piece. Elevated values for anaesthetic agent will be displayed, particularly when using halothane, if the patient's breathing air contains alcohol.

Mixtures of different anaesthetic vapours may considerably impair the accuracy with which the concentration is measured!

**Disturbance variables in sampled gas measurement**

When analysing the measured values, the temperature, humidity and pressure conditions during measurement must be taken into account.
Whereas calibration takes place with dry gas under NTPD conditions (Normal Temperature 20 °C, Pressure 1013 hPa, Dry - relative humidity 0 %), the measurements during patient monitoring are taken by sampling the gas under BTPS conditions (Body Temperature 37 °C, ambient Pressure, Saturated - relative humidity 100 %).

The gas sampling and measurement process creates a negative pressure of about 100 to 200 mbar compared to ambient pressure at the concentration measurement site (depending on sample flow, condensation and water separator). The partial pressure measured at the sensor is corrected to the current ambient pressure with the aid of the pressure measured in the measuring cuvette.

Effect of temperature:

The gas temperature at the sensor is measured and its effect on concentration measurement is compensated.

Effect of humidity:

The gas sampled during expiration has a temperature of 37 °C and a relative humidity of about 100 %.

It contains about 47 mmHg water vapour. Up to the water trap, the gas cools down to approximately ambient temperature. The water vapour content is reduced to e.g. 17 mmHg at approx. 20 °C. The difference condenses in the sampling hose and is separated in the water trap. Consequently, the volume at sea level is reduced by 30 : 760 = 4 %, thereby increasing the measured relative gas concentration by 4%. This error is not corrected in the PM 8050 because it is small compared to the specified accuracy of the sensors.

Example:

| Gas | Concentration at the Y-piece | Displayed value |
|---|---|---|
| $O_2$ | 30% | 31% |
| $N_2O$ | 57% | 59% |
| Isoflurane | 2% | 2% |
| $CO_2$ | 5% | 5% |
| Water vapour | 6% | — |

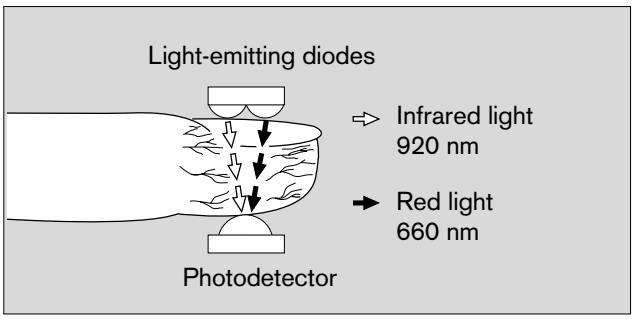
### $SpO_2$ measurement

The light absorption properties of oxygenated arterial blood (oxyhaemoglobin $HbO_2$) differ from those of unsaturated venous blood (reduced haemoglobin Hb).

$O_2$ saturation is a logarithmic function of the irradiated light intensity (Lambert-Beer's law).

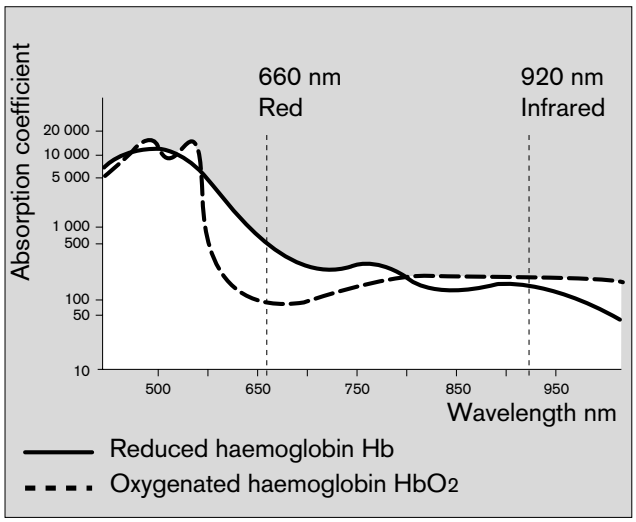
The effect of such dyshaemoglobins as carbon monoxide haemoglobin HbCO and methaemoglobin MetHb is normally negligible.

The sensor comprises two light-emitting diodes which alternately emit infrared and red light at typical wavelengths of 920 nm and 660 nm respectively. The radiation intensity is measured by a photodetector opposite the diodes. The sensor is positioned on a limb in which the arterial blood vessels can be irradiated, such as a finger, toe or the nose.

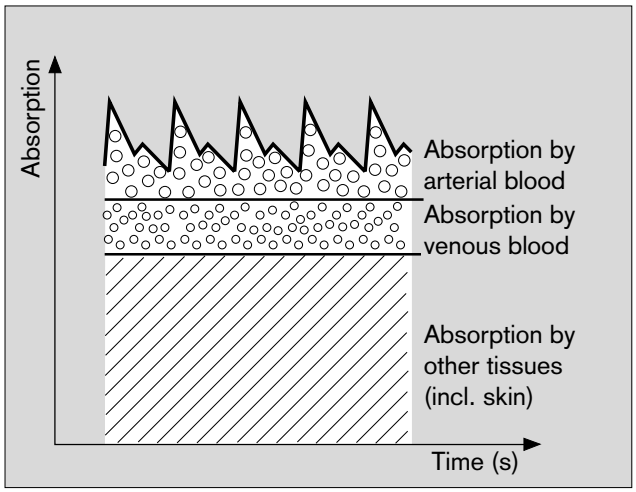



These two wavelengths – 920 nm and 660 nm – are used because meaningful absorption values are still obtained for oxygenated and reduced blood, even in the presence of slight perfusion, and because they differ significantly. The light alternately emitted by the diodes is completely absorbed by the pulsating arterial blood, the skin, finger nails, muscular tissue, bones and venous blood.

Except for the pulsating arterial blood, the amount of light absorbed by the other components remains constant as regards the quantity and optical density over a defined unit of time.



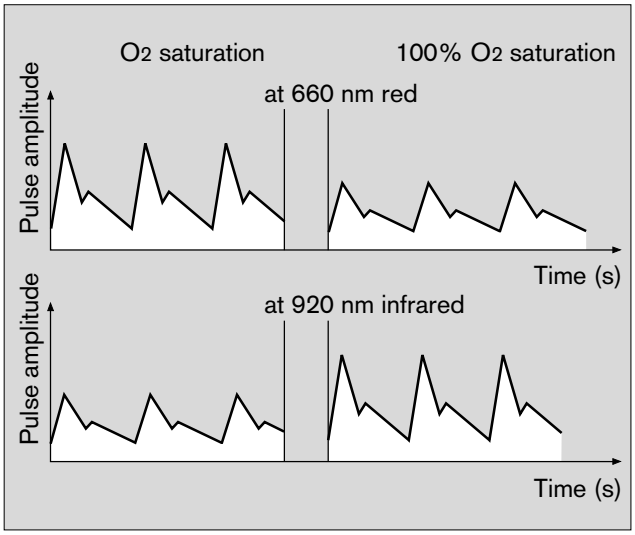

The arterial blood pulsating with every beat of the heart, however, produces a change of volume synchronous with the pulse in the irradiated tissue. In other words, absorption of the irradiated light also changes in time with the pulse.




The light absorbed when there is no pulsating blood (during the diastole) is determined first. This yields the amount of light absorbed by tissue and non-pulsating blood.

The absorption value does not normally change during the pulse phase and provides a reference value for the pulsating part of the absorption.

Following the next beat of the heart, the absorption is measured again when the pulsating blood enters the tissue. The absorption of light changes for both wavelengths, due to the pulsating arterial blood.




The diagram above shows an example of the light absorbed by the blood at 660 nm (red) and 920 nm (infrared).

At 660 nm, the absorption and corresponding pulse amplitude decrease with increasing $O_2$ saturation, but rise at 920 nm. Since the absorption coefficients of $HbO_2$ and Hb are known for both wavelengths, the system can calculate how much of these two haemoglobins is present. The quotient obtained by dividing the oxygenated haemoglobin ($HbO_2$) by the reduced and oxygenated haemoglobin (Hb + $HbO_2$) is known as the functional saturation:

$$\%\ SpO_2\ (func) = 100 \cdot \frac{HbO_2}{HbO_2 + Hb}$$

and refers to the haemoglobin capable of transporting oxygen.

Dyshaemoglobins, HbCO and MetHb are normally negligible, but may affect the accuracy of the measurement.

### Temperature measurement

Temperature-dependent change in resistance of an NTC resistor (NTC = negative temperature coefficient) with linearization circuit.

### Pressure measurement

**Principles of measurement:**
Piezoresistive change of resistance in a membrane.

**Determination of PEEP and plateau pressure:**
PEEP (positive end-expiratory pressure) is the airway pressure at the end of expiration.

$P_{lat}$ (plateau pressure) is the airway pressure measured 16 milliseconds before expiration begins.

## Definitions for »low-flow« and »minimal flow« anaesthesia

Low-flow anaesthesia is performed with a fresh gas flow considerably below the minute ventilation. When setting such low fresh gas volumes, the anaesthetic gases must be returned to the patient via a semi-closed or closed rebreathing system.

The rebreathing volume increases when the fresh gas flow is reduced and the excess gas volume decreases correspondingly.

Although the fresh gas flow can only be infinitely reduced to the gas volume taken up by the patient at a given moment of anaesthesia in a completely hermetic system, a distinction is nevertheless made between the following methods:

The fresh gas flow is reduced to 1 L/min for **low-flow anaesthesia** and to 0.5 L/min for **minimal-flow anaesthesia**.

In the case of **non-quantitative anaesthesia** in a closed system, the gas delivery settings are corrected frequently to adjust the fresh gas volume in line with the volume of gas taken up by the patient so that the internal pressure and charge of the breathing system do not decrease and the ventilation pattern remains unchanged.

In the case of **quantitative anaesthesia** in a closed system, the composition of the fresh gas corresponds exactly to the volumes of oxygen, nitrous oxide and inhalation anaesthetic taken up by the patient at a given moment in anaesthesia. This ensures that the composition of the anaesthetic gas also remains constant, in addition to the gas charge in the system and the ventilation pattern.

(Source: Baum, J.: »Die Inhalationsnarkose mit niedrigem Frischgasflow« (Inhalation anaesthesia with low fresh gas flow), published by Thieme, Stuttgart 1992)

## SIMV
## Synchronized Intermittent Mandatory Ventilation

Mixture of mechanical ventilation and spontaneous breathing.

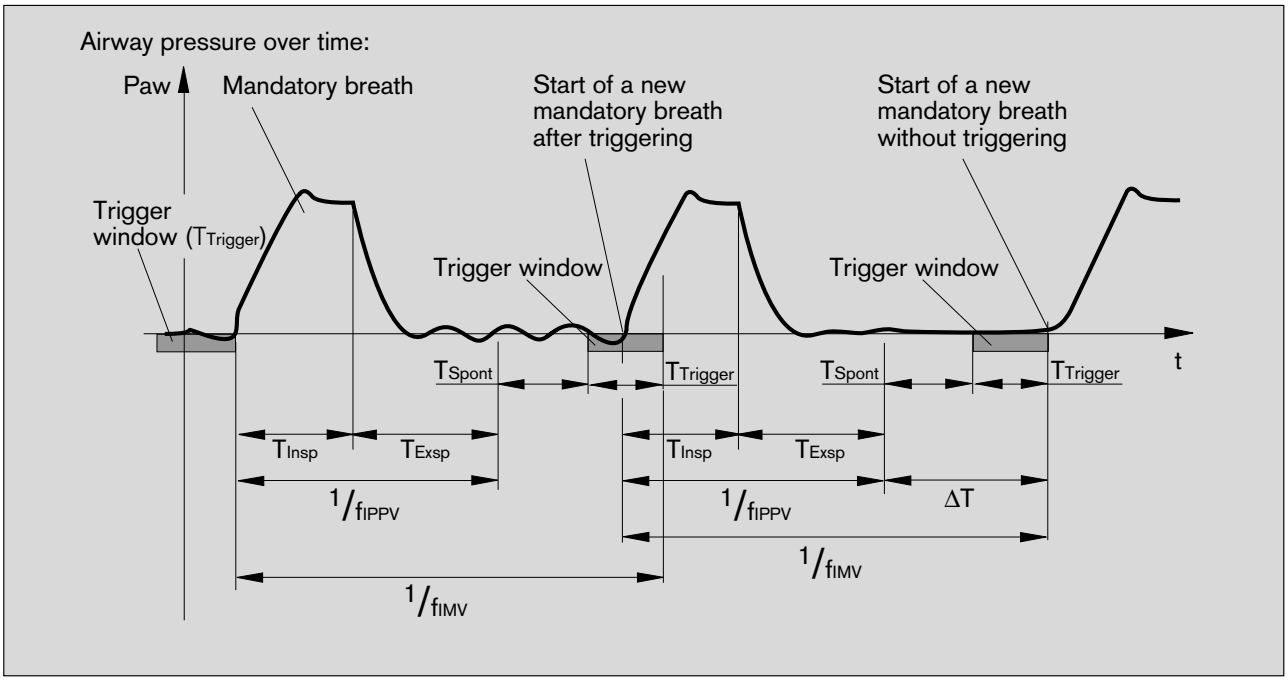
In SIMV mode, the patient can breathe spontaneously at specified regular intervals. Between these intervals, mandatory (i.e. automatically delivered) ventilation strokes ensure a minimum degree of ventilation.

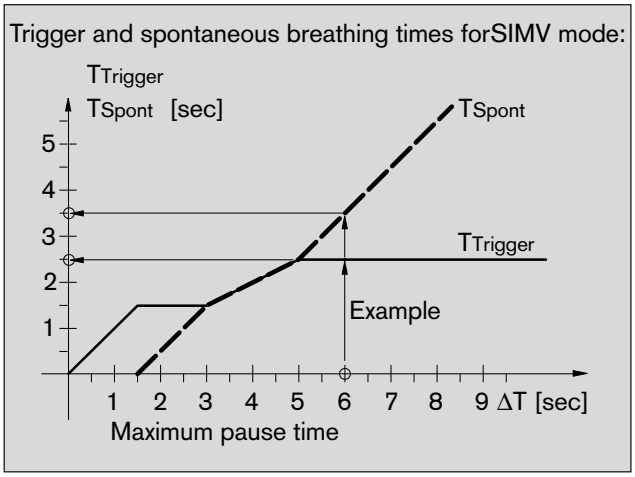
The mandatory ventilation strokes are the same as those for IPPV ventilation. They are defined by the parameters $V_T$, IPPV frequency $f_{IPPV}$, $T_I$:$T_E$ and $T_{IP}$.

Each mandatory breath is followed by a pause in which the patient can breathe spontaneously.

In order to prevent the next mandatory breath being applied during the expiratory phase of spontaneous breathing, a trigger function ensures that the mandatory ventilation stroke is synchronized with the inspiratory spontaneous breathing phase during an expectation period.

The time between the end of each mandatory ventilation stroke and the beginning of the next is subdivided into a spontaneous breathing time $T_{Spont}$ and a trigger time $T_{Trigger}$.






**Example:**

$f_{IMV}$ = 5 per minute

$f_{IPPV}$ =10 per minute

$$\Delta T = \frac{1}{f_{IMV}} - \frac{1}{f_{IPPV}} = \frac{1}{5 \text{ per min.}} - \frac{1}{10 \text{ per min.}} = 6 \text{ s}$$

From the diagram we can see that:

$T_{Spont}$ = 3.5 seconds and

$T_{Trigger}$ = 2.5 seconds

During the trigger time, the system checks whether the airway pressure drops at least 1 mbar below the pressure measured at the end of the expiration phase.

The mandatorily applied minute volume may increase if an automatic ventilation stroke is applied at the beginning of each trigger period!

The duration of a mandatory stroke plus the spontaneous breathing time is calculated as follows:

$$\frac{1}{f_{IPPV}} + T_{Spont} = 6 \text{ s} + 3.5 \text{ s} = 9.5 \text{ s}$$

This corresponds to a frequency of approx. 6 per minute and the applied minute volume increases to 6 per minute • $V_T$.

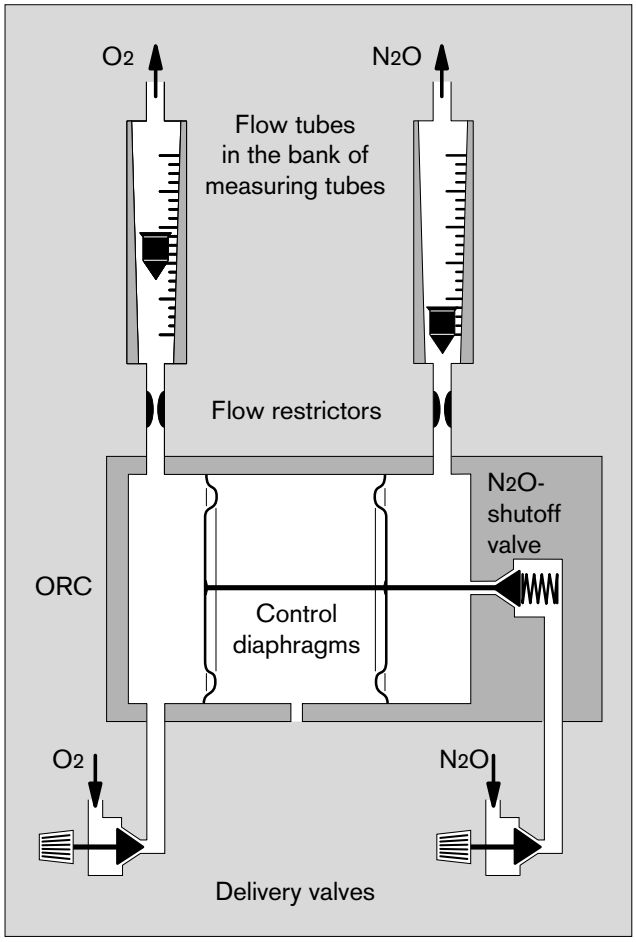
## Oxygen ratio control - S-ORC

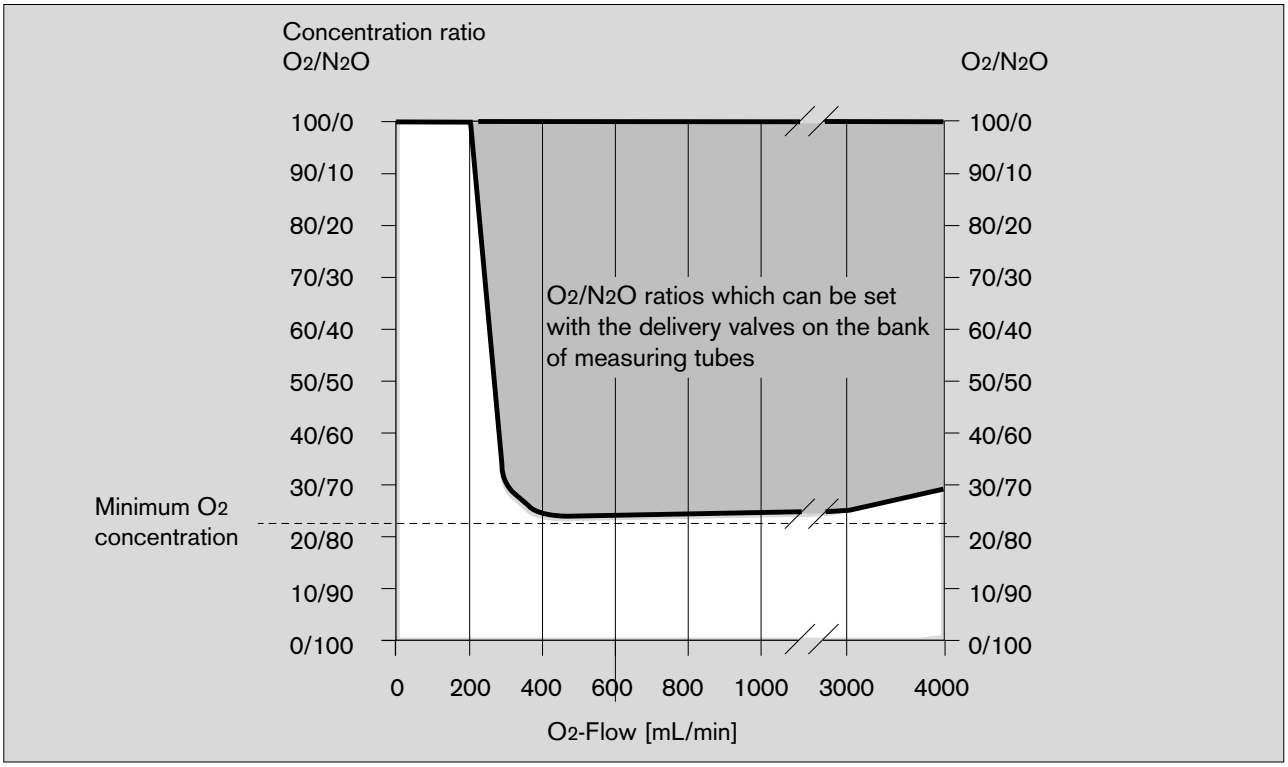
To ensure an $O_2$ concentration greater than 21% by volume in the fresh gas, the anaesthetic workstation has an $O_2$ ratio control system (S-ORC = **S**ensitive **O**xygen **R**atio **C**ontroller).
S-ORC limits the $N_2O$ flow as a function of $O_2$ flow. Up to an $O_2$ flow of 200 mL/min, $N_2O$ is cut off. $N_2O$ is slowly released as from an $O_2$ flow of 200 mL/min. For $O_2$ flows greater than 300 mL/min, $N_2O$ can be added, and the S-ORC prevents the $O_2$ concentration falling below 21% $O_2$ by volume.

The graph shows the range of adjustable $O_2/N_2O$ ratios.

S-ORC is not an oxygen-specific monitoring system. By adding anaesthetic vapours (e.g. Desflurane up to 18% by volume), the $O_2$ concentration in the fresh gas is reduced.

Therefore:
**Monitor the $O_2$ concentration with the breathing gas monitor.**



## Safety features of gas supply

### $N_2O$ lock and AIR changeover

If the $O_2$ supply fails during operation,

– the $O_2$ shortage signal sounds (pneumatic whistle),

– delivery of $N_2O$ is stopped and

– «**AIR**« is automatically activated on the bank of measuring tubes, although the control lever is still set to »**$N_2O$**«.

Resumption of the $O_2$ supply pressure is detected by the machine and the former status is restored automatically.

### Drive gas changeover

Approx. 2 L/min drive gas are required for the ventilator and approx. 12 L/min for the secretion aspirator. This gas is normally drawn from the compressed air supply.

If it is not available or has failed, the machine automatically switches over to the $O_2$ supply and draws its drive gas from there.

## Notes for reducing condensation

Water vapour is liberated when $CO_2$ is absorbed by the soda lime.
The greater the proportion of rebreathed gas (low-flow technique), the more moisture is produced.

Cato has been optimized for this low-flow technique:

– The electric heating prevents condensation forming in the breathing system.

– A large water trough has been integrated into the base of the absorber pot to collect condensation.

– The large cross-sections of the gas lines and valves reduce the risk of condensation impairing their functioning.

The following points should be noted when carrying out low-flow anaesthesia in practice, particularly during extensive surgery and at low room temperatures.

- Hoses should be routed so that condensation can collect at the lowest point and cannot flow back to the patient or to the breathing system.
  Condensation must be drained from the hoses at regular intervals.
- Water traps should be used for surgery lasting more than 1.5 hours. They must be positioned at the lowest point in the system so that the condensation can flow into the water traps.
  Water traps must be drained regularly.

  Pressure and flow measurement may be impaired if condensation flows into the breathing system.
- The breathing system must be replaced by a dry one in such cases.
- The microbial filter must be protected against condensation. Although insensitive to moisture, condensation will increase the resistance in the microbial filter!
  The microbial filter must then be replaced.

  If condensation collects in the pressure measuring line:
- Replace the pressure measuring line and its filter.
- Install the T-piece and filter for the sampling hose with the connection pointing upwards.
  A new T-piece must be fitted after every patient.
- Install the Y-piece with Luer-Lock connection, measuring port pointing upwards.
  If microbial filters are used in the breathing system, the Y-piece and hoses must be replaced after every patient.
  If microbial filters are used in the Y-piece:
  the Y-piece and hoses must be replaced every day.
- The sampling hose must be replaced if there are droplets of condensation in the hose.

### Recommendation

If condensation is to be expected:

- Replace the breathing system and piston cylinder unit every day.
- Replace the soda lime every day.

If the breathing system and piston cylinder unit cannot be replaced every day:

- Drain the condensation frequently with the aid of a disinfectant.
- Leave the breathing system and piston cylinder unit open for a few hours so that they can dry.

# Operation of the ceiling version

## Cato with ceiling suspension unit DVE 808X

The DVE 808X with corresponding lift and brake control, as well as the required mount, should be used as the ceiling suspension unit for the Cato.

The DVE is turned and pivoted manually after releasing the brakes.

The ceiling version of the Cato includes a mounting arm with which the machine is coupled to the mount on the DVE. Both the mounting arm and the mount are equipped with sensors ensuring that the Cato has been correctly fitted and coupled. This is signalled by green LEDs on the touch-sensitive keypad of the pendant control panel.

The main arm of the DVE 808X with Cato may have a maximum length of 100 cm plus 50 cm for the extension arm.

The worktop on the ventilation part of the Cato is normally 83 cm above the floor. The height of the DVE can be adjusted relatively by +53 / –7 cm.

The rate of lift equals 15 mm/s. Further technical details can be found in the Instructions for Use/Installation of the DVE 808X.

### Unterbrechungsfreie Stromversorgung

Bei einem Deckengerät entfallen die Hilfs-Netzsteckdosen.

## General requirements

DVE units equipped for connection of a Cato must be capable of carrying a load of 250 kg with the safety specified by EN 60601-1.

It should be noted that these requirements must also be met when the mounting arms are positioned at an adverse angle. The structural conditions must also be checked to ensure that they can safely bear the resultant loads.

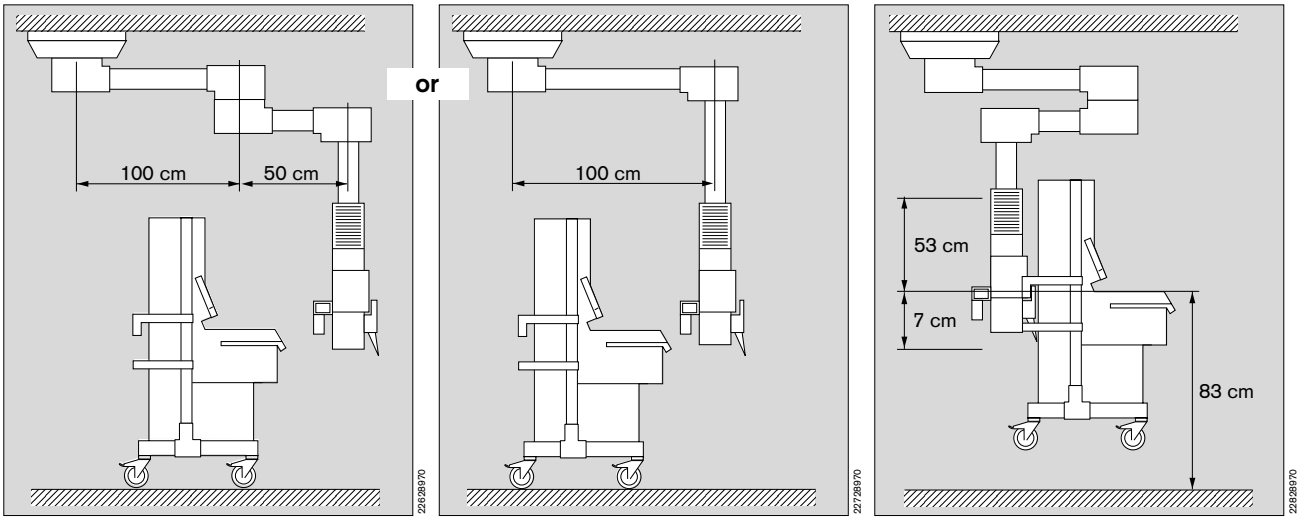
**Maximum permissible total weight = 200 kg. Depending on the DVE used and on the prevailing conditions, the Cato can be raised off the floor to a height of approx. 60 cm. It must not be moved across or positioned above people or life-support systems!**

### No spare gas cylinders

Spare gas cylinders are not installed due to lack of space and because they are too heavy.

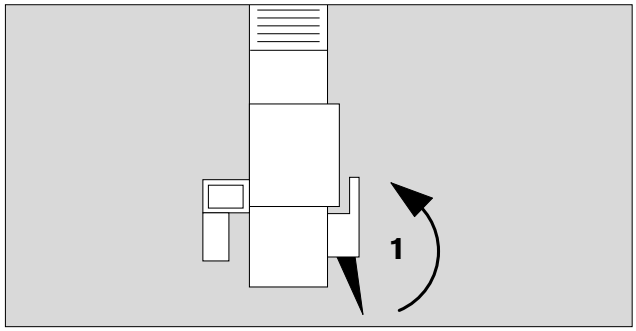
### Dimensions

The dimensions of the ceiling version can be seen in the dimensioned drawing on page 114.



## Connecting the Cato ceiling version

**1** Swing supporting flap upwards!



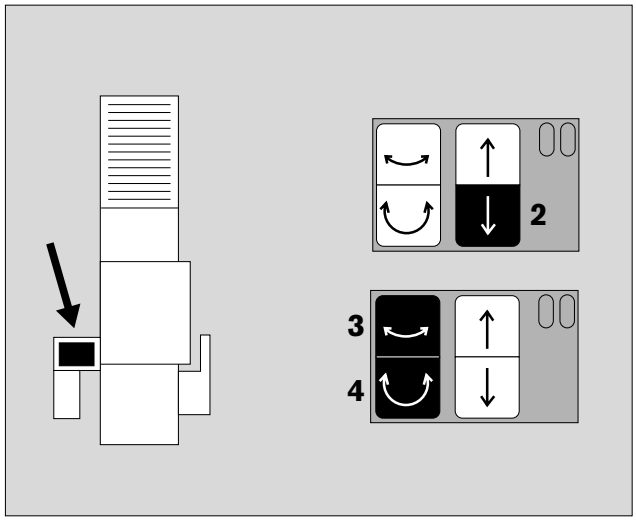

**2** Press key until DVE reaches lower limit stop.

**3** Press key to release the brake of the ceiling and/or intermediate bearing.

The DVE can then be swivelled.

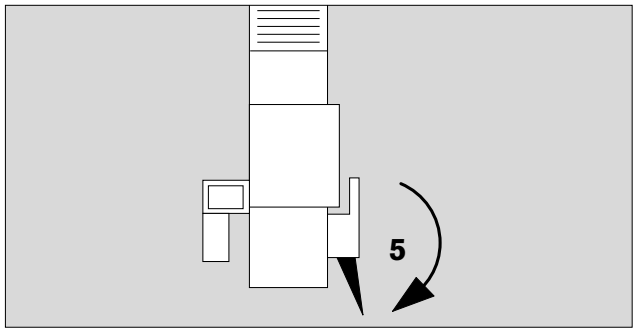
**4** Key for releasing the brake of the head bearing.

The mount for the Cato can now be swivelled.



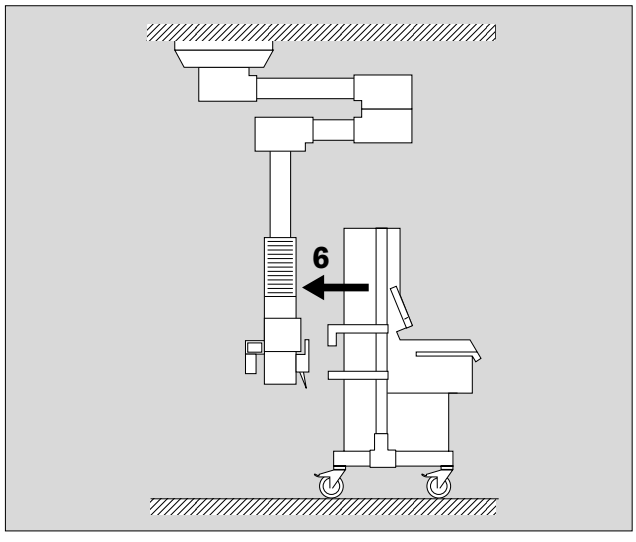

**5** Swing supporting flap down again.

The DVE can no longer be operated via its own keypad.

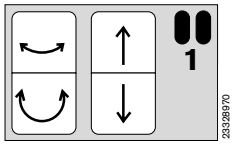



- Plug the mains connector of the Cato into the socket on the DVE.
- Plug the gas withdrawal connectors into the corresponding withdrawal sockets.

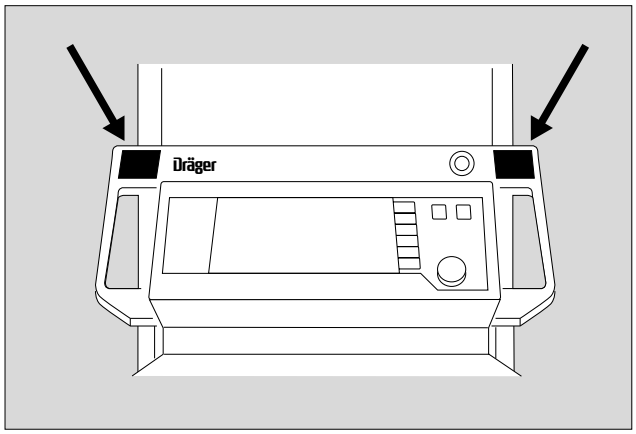
**6** Move Cato right up to the mount on the DVE.



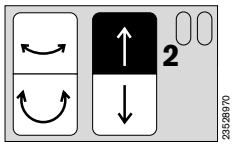
**1** Both green LEDs on the touch-sensitive keypads on the Cato and DVE light up when correctly positioned.




- The DVE can now be controlled (via the keypad in the handles of the Cato)!
  When Cato has been raised approx. 5 cm, the keypad on the DVE also becomes active in parallel to those on Cato's handles.




**2** Press key until Cato reaches the required working height.

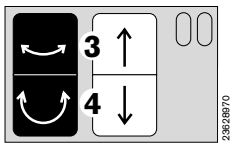



**3** Press key to release brake for the ceiling and/or intermediate bearing.

Cato can now be swivelled.

**4** Key to release the brake for the head bearing.

Cato can be turned.

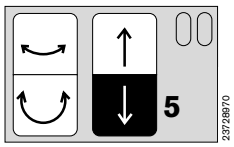



## Disconnecting the Cato ceiling version

**Any obstacles in Cato's path as it descends will be subject to Cato's full weight (approx. 200 kg) and may be crushed.**

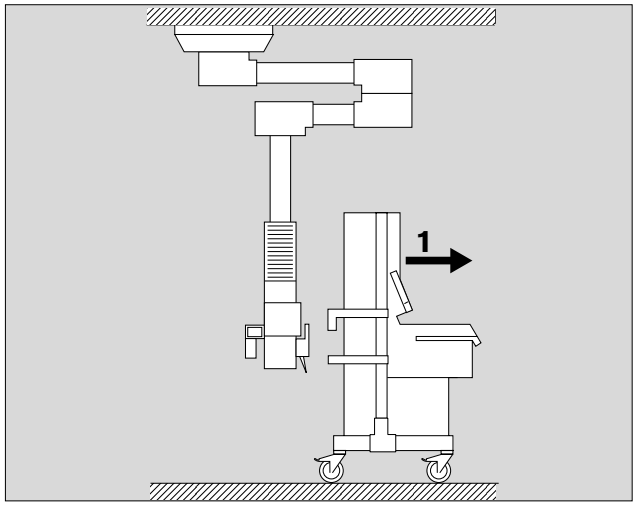
⚠ **Before lowering Cato, always ensure that there is nothing to prevent it from being deposited directly on the floor!**

**5** Press key until lower limit stop is reached.

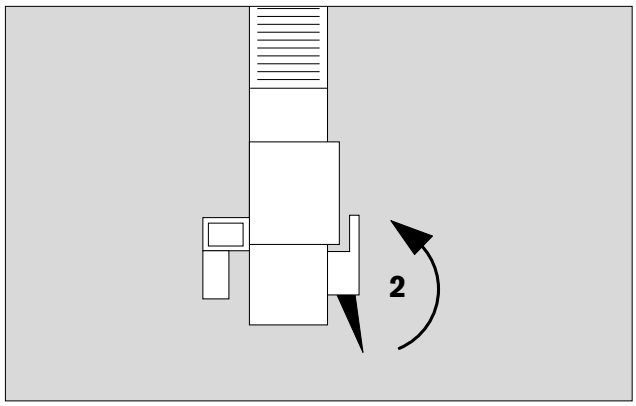



- Disconnect mains plug and gas supply lines of the Cato.

**1** Move Cato away from the DVE.




**2** Swing supporting flap upwards.




- The DVE can now be controlled via its own keypad again!

  As from approx. 5 cm above the lower limit position, the DVE can also be moved upwards even when the supporting flap is lowered.

## What to do if problems arise

- If the machine inadvertently strikes an obstacle before reaching the floor, the DVE will stop **before** it is forcibly disconnected and **cannot** be controlled via the keypad on the Cato.

  The machine can then **only be raised** via the keypad on the DVE.

- If the machine subsequently **remains at an angle** on its mounting journal:

  Briefly lower it onto the ground and pick it up again with the DVE.

- The mount may suffer damage in extreme cases!
  **Call DrägerService** if damage is suspected. Depending on how serious the damage is, the Cato may crash to the ground when raised again!

## Additional maintenance and care instructions

- The windows on the optical sensors must be cleaned!
  Abrasives and scratching agents must not be used.

  The sensors are resistant to all cleaning agents and disinfectants usually used in hospitals.

# Abbreviations used

| Abbreviation | Significance |
|---|---|
| AIR | Compressed air for medical use |
| AMV | Minute ventilation |
| APL | Adjustable pressure limitation |
| AW-Temp | Inspiratory breathing gas temperature |
| BAG | Connection for breathing bag |
| BW | Body weight |
| CAL | Calibration has been performed |
| $C_{syst}$ | System compliance |
| $C_{pat}$ | Patient compliance |
| DGHM | German Society for Hygiene and Microbiology |
| et $CO_2$ | End-expiratory $CO_2$ concentration |
| Fet Des. | End-expiratory desflurane concentration |
| Fet Enf. | End-expiratory enflurane concentration |
| Fet Hal. | End-expiratory halothane concentration |
| Fet Iso. | End-expiratory isoflurane concentration |
| Fet $N_2O$ | End-expiratory $N_2O$ concentration |
| Fet Sev. | End-expiratory sevoflurane concentration |
| Fi Des. | Inspiratory desflurane concentration |
| Fi Enf. | Inspiratory enflurane concentration |
| Fi Hal. | Inspiratory halothane concentration |
| Fi Iso. | Inspiratory isoflurane concentration |
| Fi Sev. | Inspiratory sevoflurane concentration |
| Fi $N_2O$ | Inspiratory $N_2O$ concentration |
| Fi $O_2$ | Inspiratory $O_2$ concentration |
| $f_{IPPV}$ | IPPV frequency |
| $f_{IMV}$ | SIMV frequency |
| Flow | Expiration flow |
| Freq | Respiration rate |
| Hb | Haemoglobin |
| HbCO | Carbon monoxide haemoglobin |
| $HbO_2$ | Oxyhaemoglobin |
| HLM | Heart-lung machine, mode for ... |
| in $CO_2$ | Inspiratory $CO_2$ concentration |
| INOP | Malfunctioning |
| IPPV | Automatic ventilation mode: intermittent positive pressure ventilation |
| LED | Light-emitting diode |
| LED display | 7-segment display with light-emitting diodes |
| Man/Spont | Manual ventilation or spontaneous breathing |
| Mean | Mean pressure |
| NTC | Resistance sensor with negative temperature coefficient |
| Off | Switched off, deactivated |
| ON | Switched on, activated |
| ORC | Oxygen Ratio Control |
| $P_{aw}$ | Airway pressure |
| PC | Personal computer (IBM-compatible) |
| PCV | Ventilation with pressure limitation |
| $P_{eak}$ | Actual measured peak pressure |
| $P_{lat}$ | Plateau pressure |
| Pleth. | Plethysmogram |
| $P_{max}$ | Limit pressure |
| $P_{mean}$ | Mean airway pressure |
| Power | Electricity supply |
| PEEP | Positive end-expiratory pressure |
| SIMV | Synchronized intermittent mandatory ventilation |
| $SpO_2$ | Functional $O_2$ saturation |
| $T_I$:$T_E$ | Ratio of inspiration time to expiration time |
| $T_{IP}$:$T_I$ | Ratio of inspiratory pause time to inspiration time |
| $\dot{V}$ | Inspiratory and expiratory flow |
| $\dot{V}_E$ | Minute ventilation |
| $\dot{V}_{FG}$ | Fresh gas flow |
| $V_{max}$ | Maximum inspiration flow |
| $V_T$ | Tidal volume, stroke volume |
| $V_C$ | System volume |
| ZV | Piped medical gas supply (for compressed air, vacuum, $N_2O$ and $O_2$) |

# Symbols used

| Symbol | Significance |
|---|---|
| ♥ | Pulse rate |
|  | Defibrillator strength |
|  | Lower alarm limit |
|  | Upper alarm limit |
|  | Alarm monitoring inactive |
|  | Cursor frame in menus |
|  | Close menu, return to preceding menu level |
|  | Changeover switch for standby and measuring modes |
|  | Cyclic activation of basic pages |
|  | Display standard page |
|  | Suppress alarm tone for 2 minutes |
|  | Important note! |
|  | Connection for equipotential bonding |
|  | Protection class type BF (EN 60601-1) |
| ? | Request for calibration |
| ✓ | Action has been completed successfully |
|  | Action is being carried out |
| **!!!** | Warning message |
| **!!** | Caution message |
| **!** | Advisory message |
| – – | Alarm limit inactive |

# Index

These Instructions for Use apply only to
**Cato edition**
with Serial No.:

If no Serial No. has been filled in by Dräger these Instructions for Use are provided for general information only and are not intended for use with any specific machine or device.

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Directive 93/42/EEC
concerning Medical Devices

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