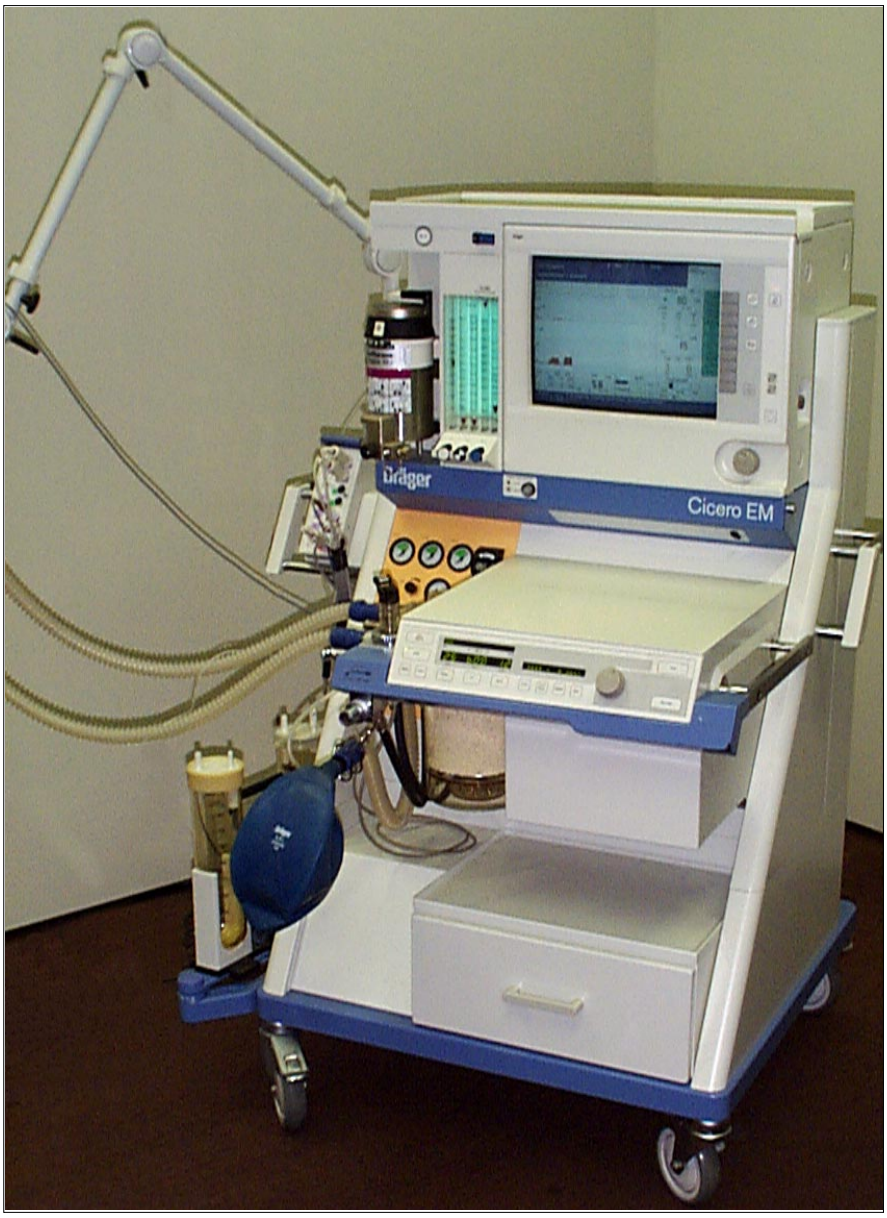
Cicero EM

Integrated Anaesthetic Workstation

Instructions for Use



Software-Versionen:

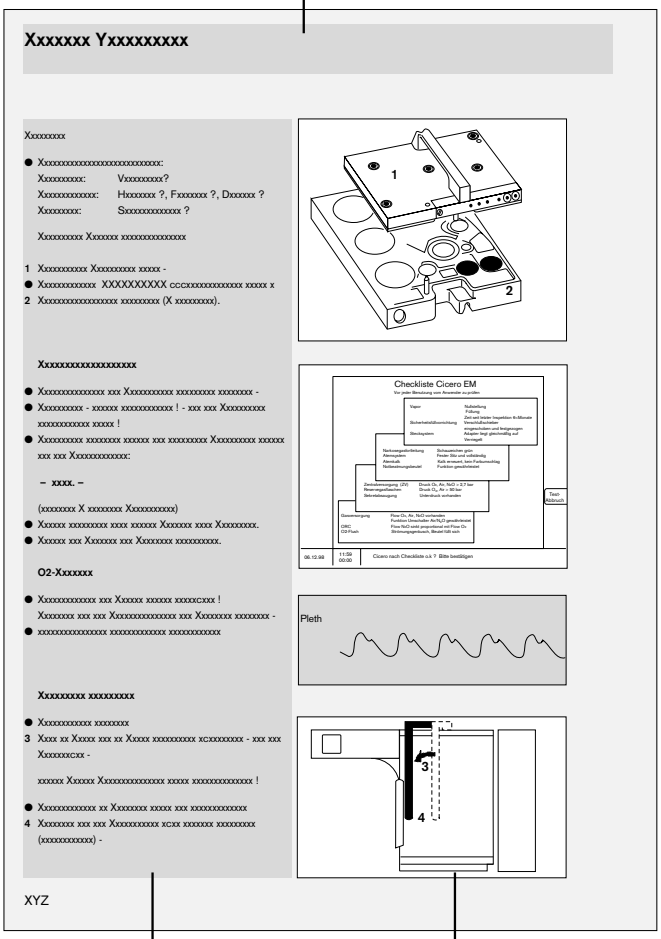
Ventilator: 6.n/7.n
Monitor: 4.n

Each page is organized according to the following principles:

At the top – the subject ...

of the main chapter as listed in the Overall Contents on page 3.

It is always contained in a headline and printed in bold type at the beginning of the chapter.



Left-hand column – the text ...

contains explanations, prompts the user to do something and describes the machine's response.

The dots and numbers refer to actions, while the numbers also draw attention to details in the illustrations supplementing the text.

The numbering starts anew on each page.

Right-hand column - the illustrations ...

make it easier to locate the various parts of the equipment.

Details mentioned in the text are highlighted in bold type or coloured black.

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

Integrated anaesthetic workstation »Cicero EM« with system monitor

Universally applicable, integrated anaesthetic workstation for

- Inhalation anaesthesia for adults, children and neonates.
- Inhalation anaesthesia in semi-closed to virtually closed systems with »low flow« and »minimal flow« techniques (for minimum gas and anaesthetic consumption).
- Automatic ventilation (IPPV).
- Synchronized intermittent mandatory ventilation (SIMV).
- Pressure-controlled breathing (PCV) in the PCV ventilator.
- Manual ventilation (MAN).
- Spontaneous breathing (SPONT).
- Automatic anaesthetic agent recognition.

The following information is displayed in colour on the system monitor:

- Airway pressure and temperature
- Inspiratory O_2 concentration
- Expiratory tidal volume
- Patient compliance
- CO_2 and anaesthetic concentration at the Y-piece
- Fresh gas balance

together with the main haemodynamic parameters monitored with the parameter box:

- ECG curve with heart rate and ST segment analysis.
- The real-time curve of the invasive blood pressure (iBP) in two channels, with the systolic, diastolic and mean pressure values.
- The values of the non-invasive blood pressure (NiBP) with the systolic, diastolic and mean pressure values.
- The body temperature in two channels.
- The functional O_2 saturation (SpO_2) with the pulse rate.
- The plethysmogram.

Other accessories (optional)

Vapor*)
Anaesthetic vaporizer for enflurane, isoflurane, halothane and sevoflurane.

Connection for two Vapor vaporisers*)

Devapor*)
Anaesthetic vaporizer for desflurane.

Anaesthetic gas scavenging system*)

Uninterruptible power supply*)

Passive air conditioning*)
Heated breathing hoses.

pEEG*)

Notes on operation

Only non-flammable anaesthetic agents conforming to EN 740 may be used. Risk of fire!

Since this apparatus 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 apparatus.

Any additional electrical equipment which is latched onto the top of the workstation must also be connected to the base unit by means of an equipotential bonding conductor!

Electromagnetic fields exceeding the limits specified in EN 60601-1-2 may interfere with the operation of the device and therefore put patients at risk.

Mobile radio telephones must not be used within 10 metres of the workstation!

Cicero EM must not be used with magnetic resonance tomography (MRT, NMR, NMI).

The workstation should **only** be moved by the handles!

Always operate the device under the supervision of qualified medical personnel in order to obtain prompt assistance in the event of malfunction.

Retrofitting in different devices

The software described in these Instructions for Use, in combination with the »Cicero EM«, has passed a conformity evaluation procedure conforming to 93/42/EEC (medical appliances); the corresponding conversion kits therefore bear the CE mark of conformity.

The conversion kit can also be installed in the »Cicero EM color« even if the unit itself does not bear the CE symbol, because the conformity evaluation procedure has confirmed the suitability of the product for this type of device.

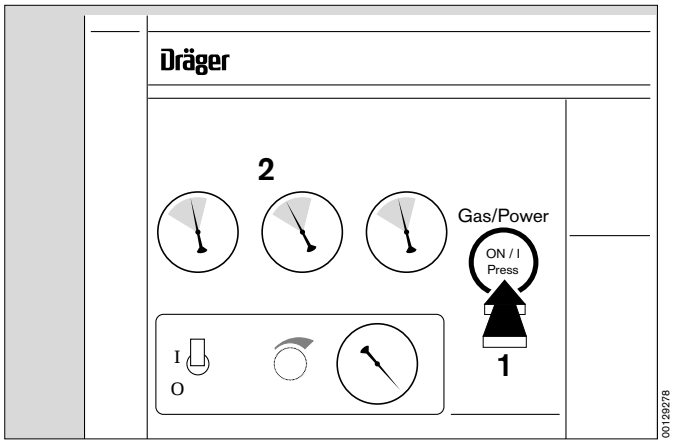
*) Refer to the separate Instructions for Use for this equipment.

Emergency Quick-Start

Press the master switch (1)

– The pressure gauges **(2)** are in the green zone.

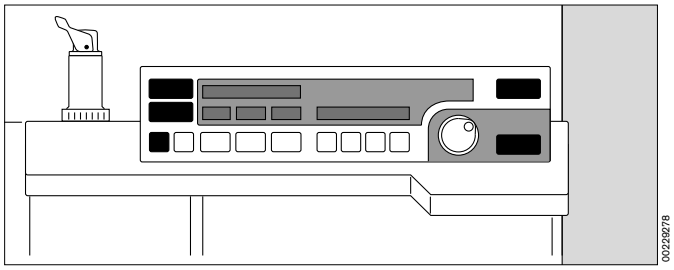
– All lamps on the ventilator light up.



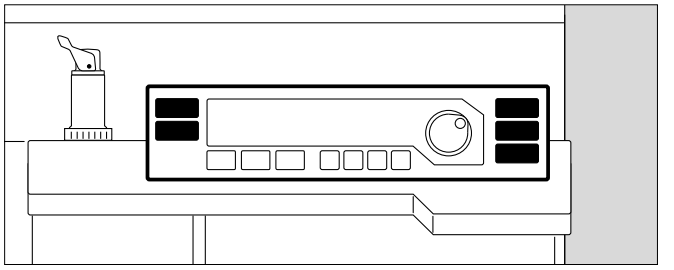
Press a function key on the ventilator

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

– The message »**Test interrupted**« is displayed.



For devices without PCV mode (software 6.n):



Deliver fresh gas

– With the delivery valve buttons **(3)** under the measuring tubes

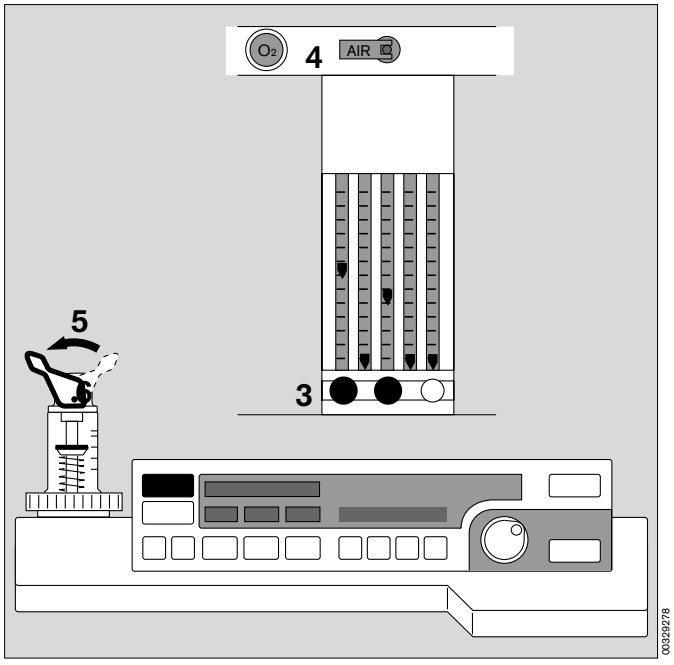
– If necessary fill the system rapidly with the O_2 flush **(4)**.

– The manual ventilation bag should fill.

Set the APL pressure limiting valve (5) to »MAN«

Set maximum pressure

– Turn the valve head **(6)** until the disc is at the desired maximum pressure.



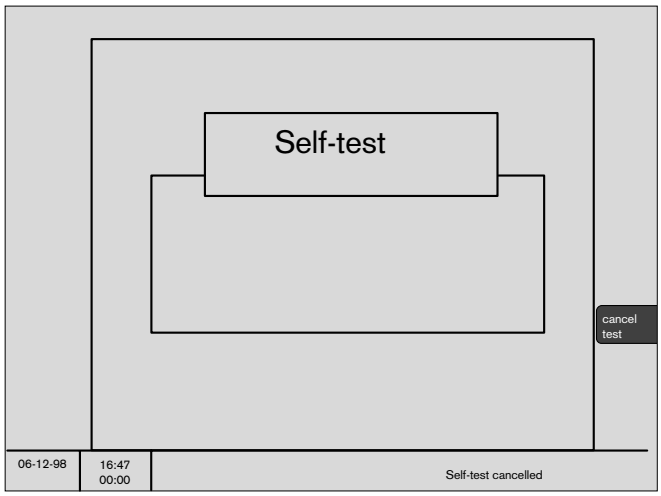
Notes on Quick Start

The Quick Start procedure is permitted a maximum of 10 times in succession, and only if the previous (full) self-test was completed without error.

Otherwise, the display on the ventilator and the system screen instruct the user to run through the complete self-test.

Manual ventilation remains possible under all conditions!

- Quick Start can also be triggered by the **»Cancel Test«** softkey.
- Quick Start can be triggered at any time, even during a self-test.



If there is a power failure (manual ventilation is possible)

Make sure that the master switch is pressed down

– The acoustic power failure warning is muted after 30 seconds.

Deliver fresh gas - set APL valve

– If required, press the O_2 flush button (**»O_2 +«**).

Note: If there is a power failure, the piston of the ventilator is pushed to its end position by the airway pressure. This increases the system volume by a maximum of 1.4 litres.

If there is a gas failure

In case of AIR failure (medical air)

– The system automatically switches over to O_2 supply.

In case of O_2 failure

– The system automatically switches over to the AIR supply. An acoustic alarm is sounded (O_2 shortage signal). The supply of N_2O is disabled.

If both O_2 and air fail
The patient must immediately be ventilated with the separate emergency ventilation bag!

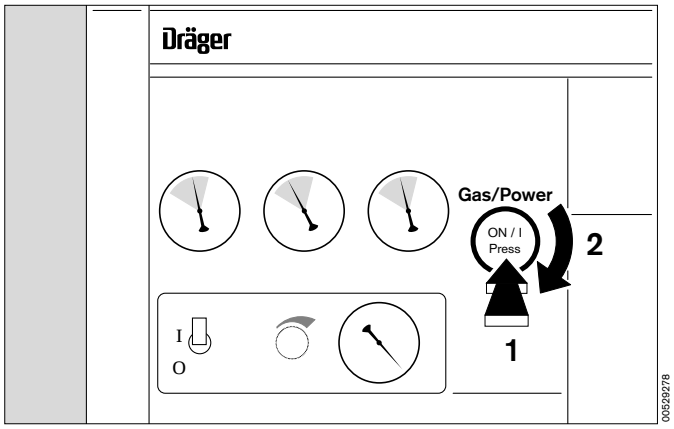
Page

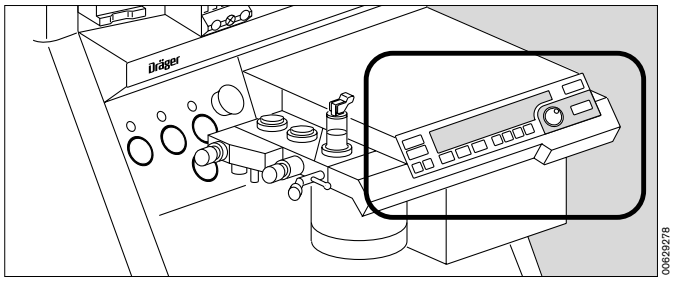
Ventilator operating concept

Master switch for power and gas

1 Press to switch on. The switch clicks into position.

2 Turn clockwise to switch off.





Hardkeys – for setting the operating modes

»**MAN / SPONT**« key
for manual ventilation or spontaneous breathing.

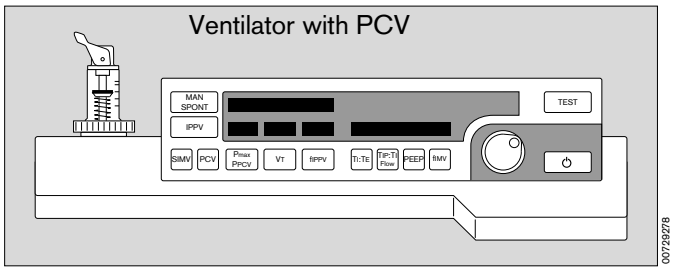
»**IPPV**« key
for IPPV mode.

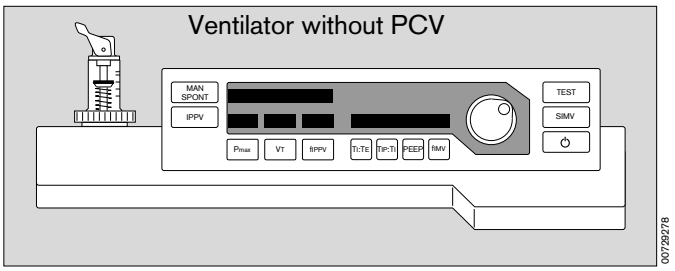
»**SIMV**« key
for SIMV mode (see illustrations for the specific ventilator versions)

»**PCV**« key
for PCV mode (for PCV ventilator).

»**TEST**« key
for leakage test and compliance measurement.

⏻ Standby key.





for setting ventilation parameters

Below the display window:

»**Pmax / PPCV**« key
for setting the maximum pressure for IPPV and SIMV ventilation.

The same key is used in PCV mode to set the plateau pressure.

»**VT**« key for setting the tidal volume.

»**IPPV**« key
for setting the ventilation frequency in IPPV mode.

»**TI : TE**« key
for setting the time ratio between inspiration and expiration.

»**TIP : TI / Flow**« key
for setting the relative inspiratory pause for IPPV and SIMV ventilation.

The same key is used in PCV mode to set the inspiratory flow.

»**PEEP**« key
for setting the PEEP pressure for IPPV mode.

»**fIMV**« key
for setting the ventilation frequency in SIMV mode.

Display window with dialogue function

(in combination with the rotary control)

Example: adjusting the maximum pressure

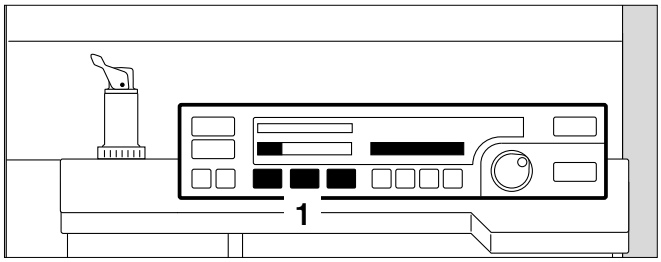
In the black field, beside the rotary control:

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.

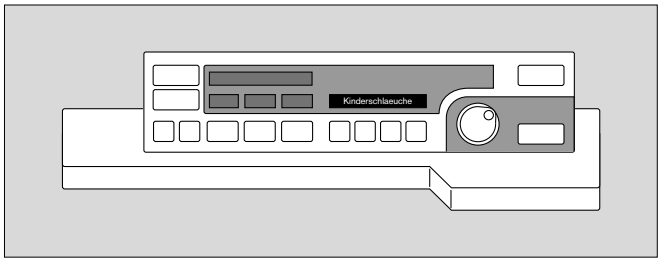
3 The value on the right (»**28**«) is confirmed as the definitive value by pressing the control.

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 100) –

  Example »**Infant hoses**«:



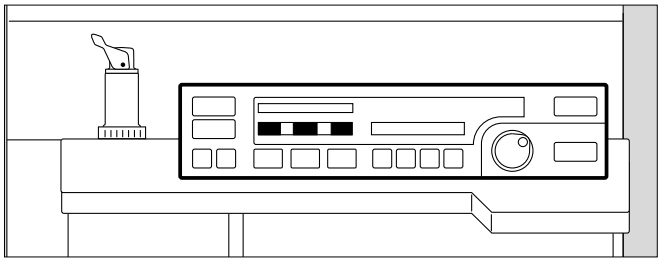
Display window without dialogue function

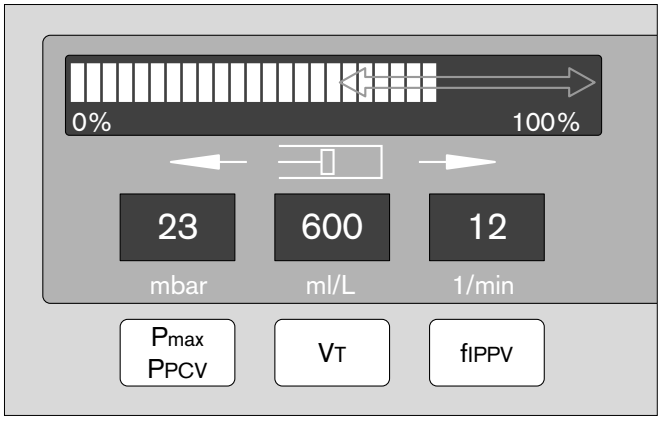
Top left:

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.

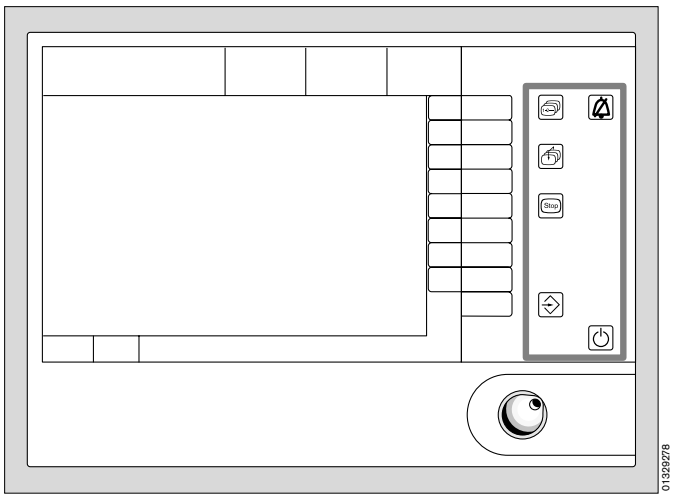




Monitor operating concept

Hardkeys

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



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

The system screen mode depends on the ventilator mode:

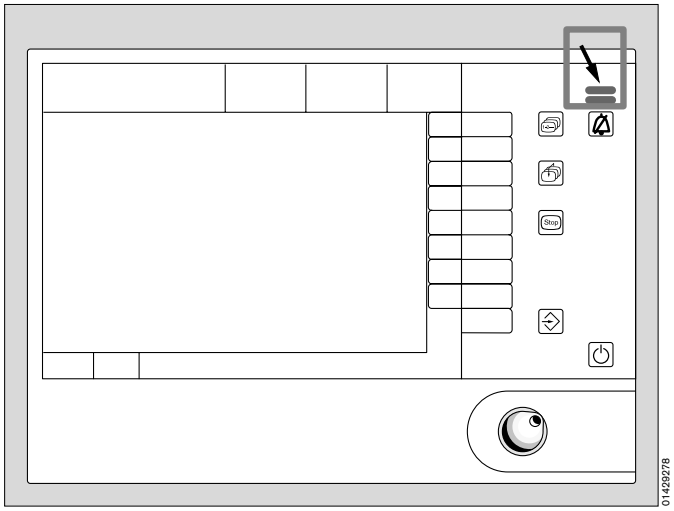
Standby can only be selected on the system screen if the ventilator is also in standby.

The system screen 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 (see page 79).

During this period, any new advisory and caution messages will not be audibly signalled but will appear as text in the alarm fields. Only new warnings will be signalled once by the appropriate tone sequence.

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



This key is used to call up a menu of the available display options on the system screen. Selection is made by turning and pressing the rotary control (see page 68).

This key always calls up the last standard screen used (see page 68).

This key is used to »freeze« the curves on the display so that they can be viewed in more detail.

This key is used to generate a manual entry in the list screen (see page 70).

Indicators

Above the key are two bar-shaped indicators that indicate the alarm status even when the acoustic alarm has been switched off.

Red (upper) flashing lamp	**Warning**	**!!!**
Yellow (lower) flashing lamp	**Caution**	**!!**
Yellow lamp constantly lit	**Advisory**	**!**

Softkeys

1 Beside the screen, on the right-hand side, there is an unmarked touch-sensitive keypad.

2 The function of these keys depends on the software and is indicated on the screen itself.

Only those keys which can be activated are actually shown.

Pressing some of the softkeys or the screen selector key  will open a menu.

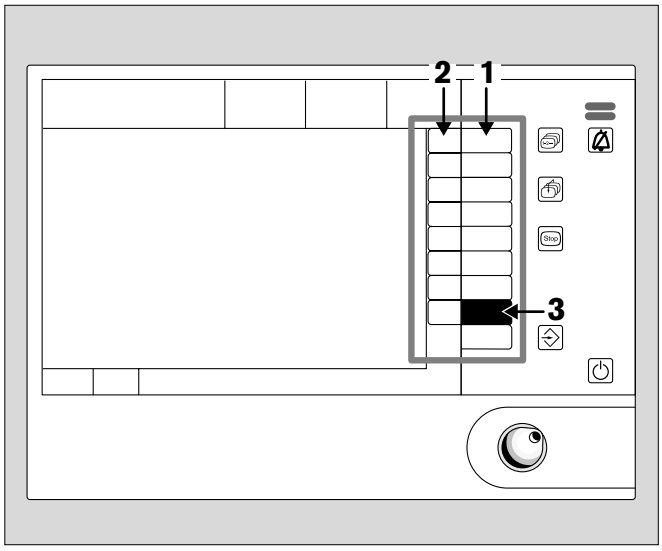
The area where selections can now be made is turquoise, and the cursor is a yellow rectangle.

- To select: Turn rotary control.

  The cursor moves within the turquoise area.

- To confirm: Press rotary control.

  The selected function appears.



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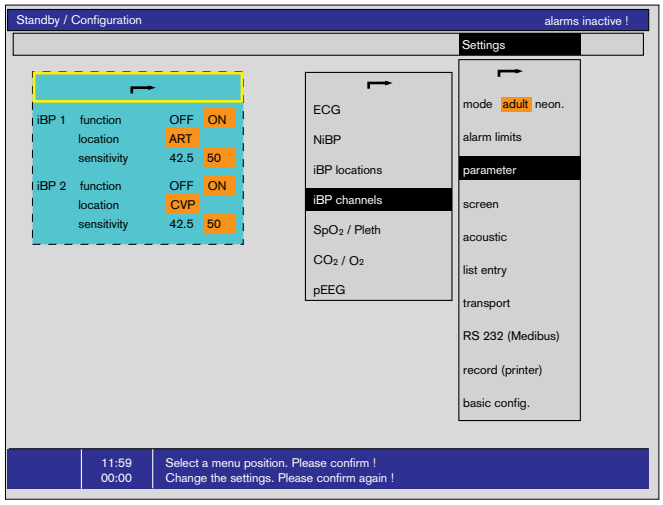
All menu levels are displayed in staggered arrangement. Inactivated menus are grey. The selected menu item is highlighted in black and white.



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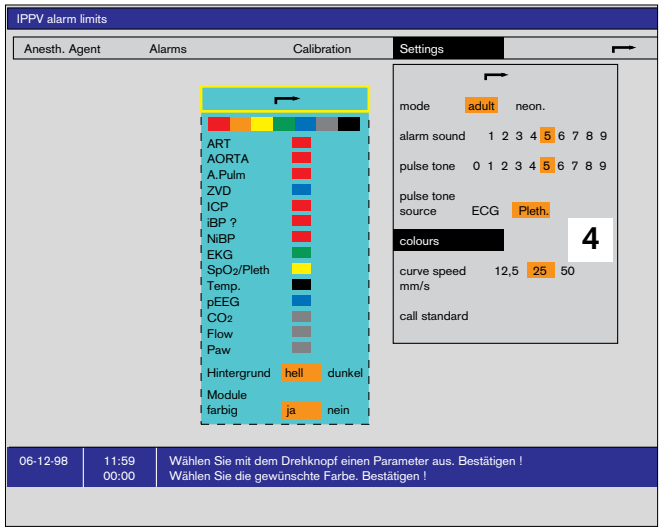
Configuring the colours

3 Press the **»Config«** softkey.

4 Under »Settings«, select the option »Colours«.

- Select the desired parameter in the colour menu and confirm.
- Turn the rotary control until the desired colour is displayed and then confirm



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Page

Preparing for use

The device must be correctly prepared and checked before every use!

Connecting the electrical power supply

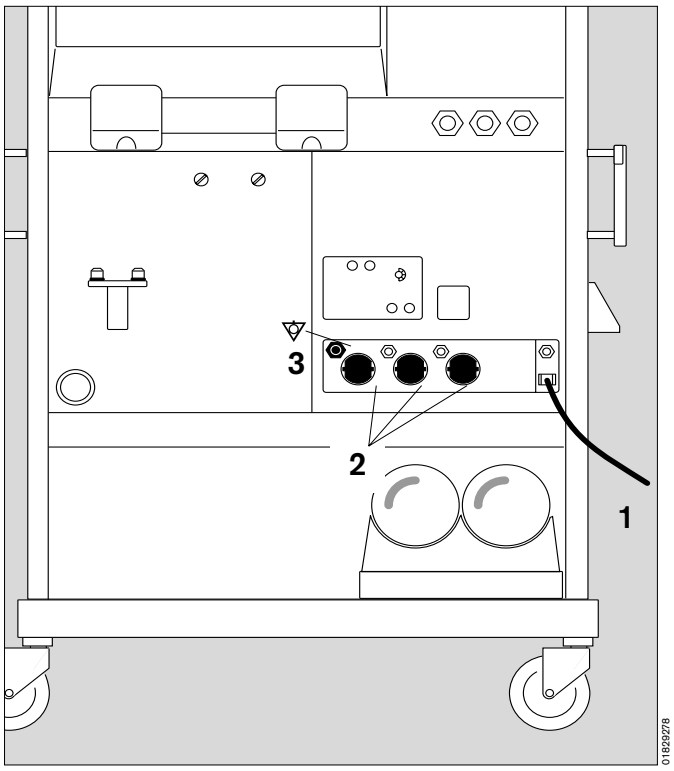
The mains voltage must be within the voltage range specified on the nameplate on the back panel.

1 Plug the power plug into the wall socket.

Auxiliary mains sockets:

2 Sockets for additional devices that are switched on and off with the master switch.
(3 sockets. Maximum current per socket: 2 A)

The sum of the derived current in the mains line must not exceed 500 µA (IEC 601/1).



Equipotential bonding

(e.g. for intracardial or intracranial operations)

3 Connect one end of the earthing cable to the terminal stud on the back panel.

- Connect the other end to the equipotential bonding stud, e.g. on the operating table or ceiling lamps.

Uninterruptible Power Supply (optional, see Instructions for Use of the UPS)

When the machine is powered by the UPS battery during a mains power failure, no power is supplied to the auxiliary sockets!

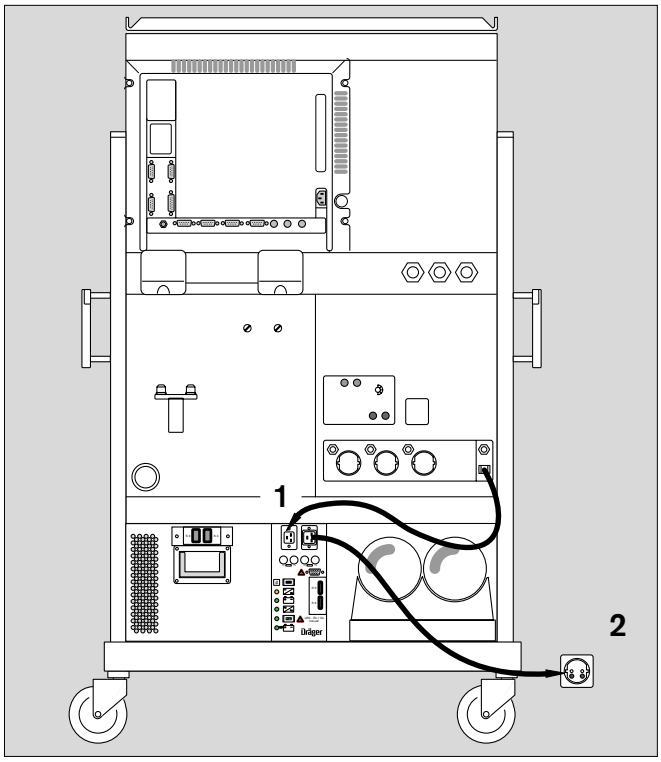
The Desflurane Vapor unit is powered by the side connector for non-heating apparatus (No. 9 on page 140) and will therefore continue to run as normal.

1 Plug the Cicero power plug into the socket of the UPS.

2 Plug the UPS mains plug into the mains socket.

The UPS can supply the Cicero EM with electrical energy for about 45 minutes. It is activated automatically in the event of a power failure.

In the case of a ceiling unit, the auxiliary sockets are not fitted.



Connecting the compressed gas supply

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

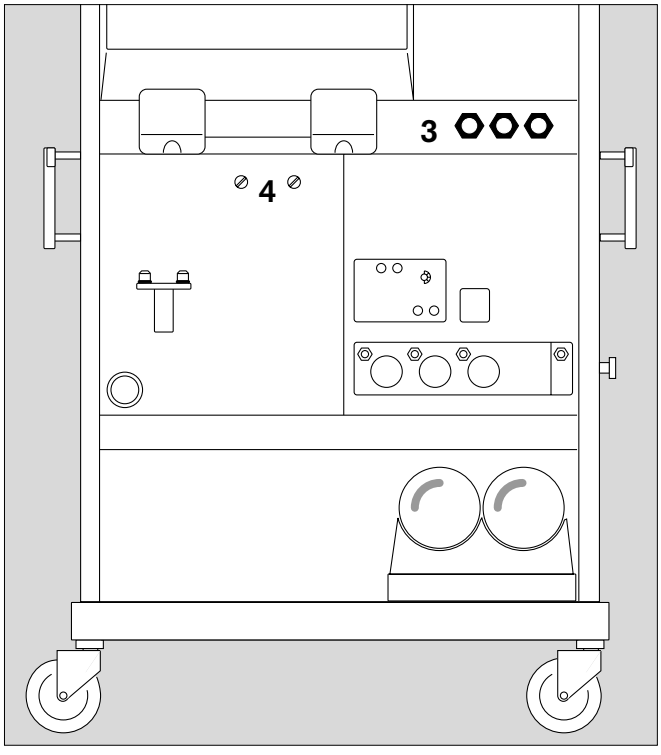
Switch-on lock:
If the machine is switched on without pressure on the O_2 line, it is impossible to meter the other gases for safety reasons!

»Pressure supply« appears on the ventilator.

- Connect O_2 supply and confirm.
- Check that the supply pressure is adequate on the pressure gauges on the front (pointers must be in the green area).

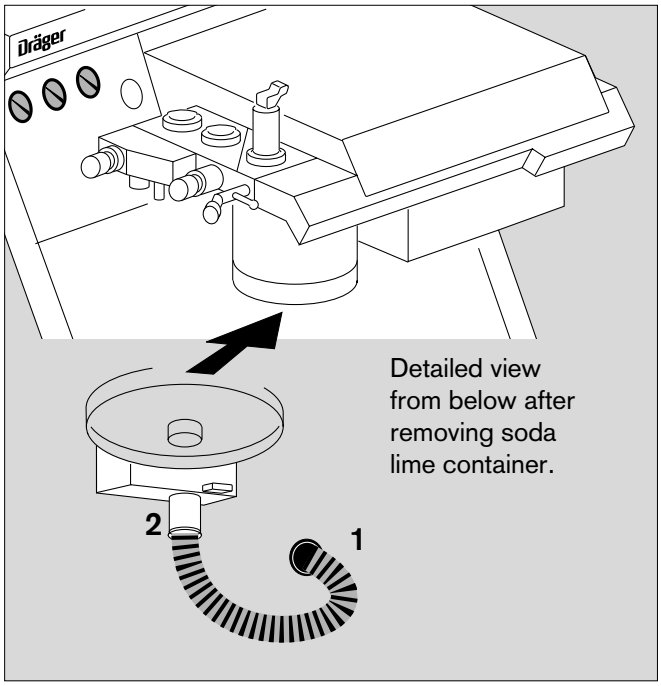
4 Holder for anaesthetic gas scavenging. See next page and separate Instructions for Use.

- If the machine is equipped with a vacuum bronchial aspirator (option), a vacuum supply system must be connected.



Installing the anaesthetic gas scavenging system:

- Hook the collecting system to the mount on the back of the Cicero:
  Place the slots of the receiving system over the holders and slide the receiving system down.
  See also **"What's what"** on page 146, No. 14.



Connecting the transfer hoses

1 Pass transfer hose from behind through the hole in the Cicero EM and

2 connect the hose to the scavenging connector of the breathing system (only on first installation - the hose then remains on the connector).

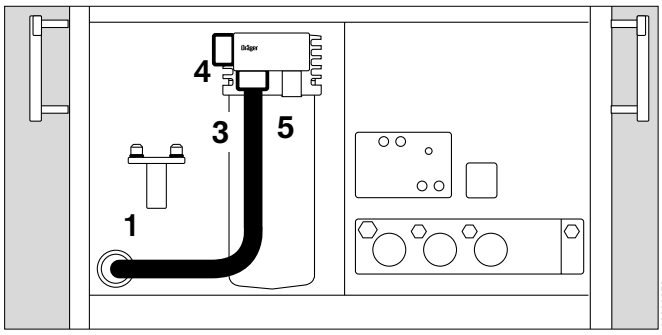
3 Connect the transfer hose to the connector on the receiving system.

- Make sure the connection is secure!

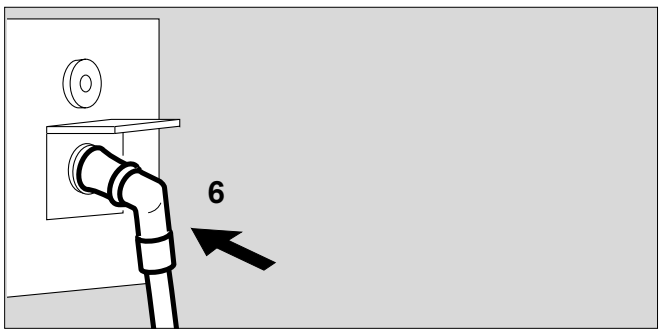
4 Make sure that the connector for the second transfer hose is sealed with a screw plug.

Do not plug the openings of the receiving system, otherwise the breathing system could be drained.

5 Connect the scavenging hose to the output connector of the scavenging system.



6 Plug the connector of the scavenging hose into the wall socket. The visual indicator shows »**green**«.



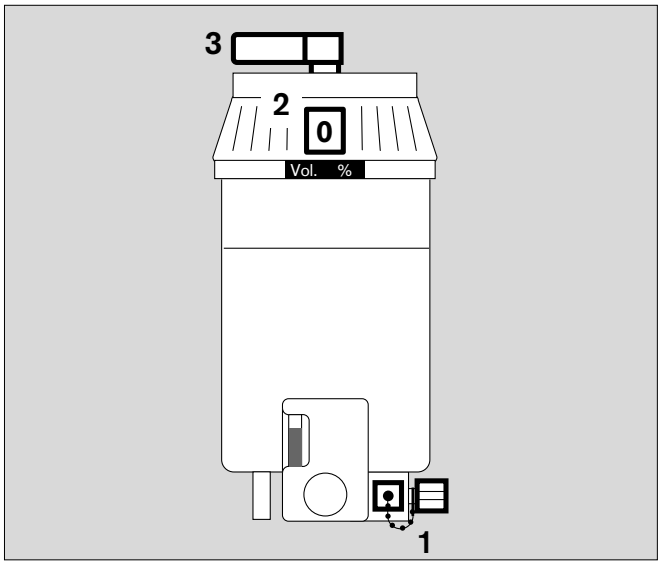
Anaesthetic vaporizer:

- Only use the Vapors listed in the list of accessories!
- Note the separate Instructions for Use of the Vapor.
- Only use the Vapor intended for each anaesthetic agent!

1 The fill plug must always be inserted and securely tightened!

2 The thumbwheel must always be set to zero when there is no fresh gas flow.

3 Vapor must always be secured by means of the locking lever (set to the left-hand limit).



Connecting external equipment

Connection via the printer interface:

4 with a data cable for printers with serial interface, such as:

Deskjet (made by Hewlett-Packard)

This connector may also be used as an RS 232 MEDIBUS interface.

- Equipment plugs must be secured with screws!

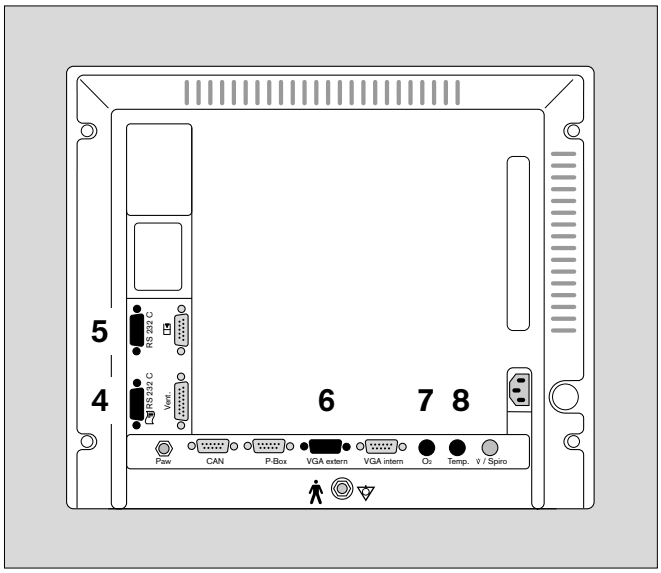
For interface configuration, see page 64.

Connection via the Dräger RS 232 MEDIBUS interface:

5 with data cable for standard PCs or other monitors.

- Equipment plugs must be secured with screws!

For interface configuration, see page 63.



After removing the outer back panel, the following connections are accessible:

External screen

6 Any S-VGA-compatible screen can be connected.

External O_2 sensor for inspiratory measurement:

7 Connect to the socket marked »O_2«.

Airway temperature sensor

8 Connect to the socket marked »Temp«.

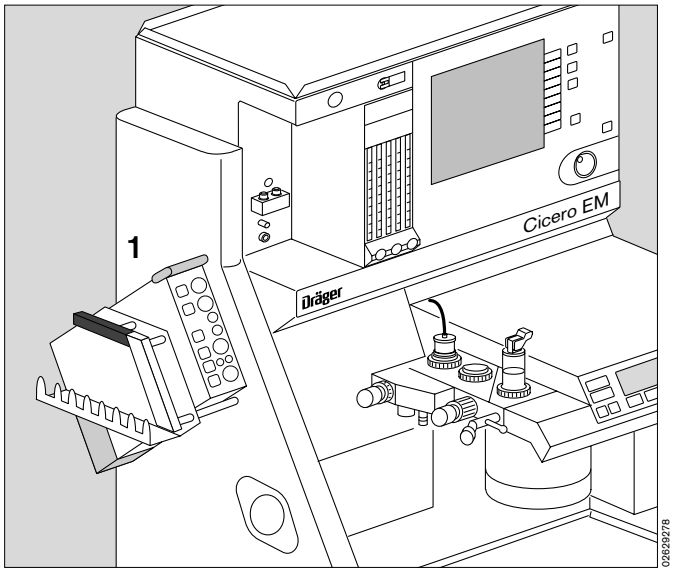
Fitting the parameter box

The parameter box can be operated either in the blue holder or in the slot-in housing. The slot-in housing can be mounted by Dräger Service on the left-hand side of the Cicero EM.

The blue holder can be mounted by the user in any position on a standard rail (10 x 25 mm).

In the blue holder, the parameter box can be tilted up and down. In the slot-in housing its position is rigidly fixed.

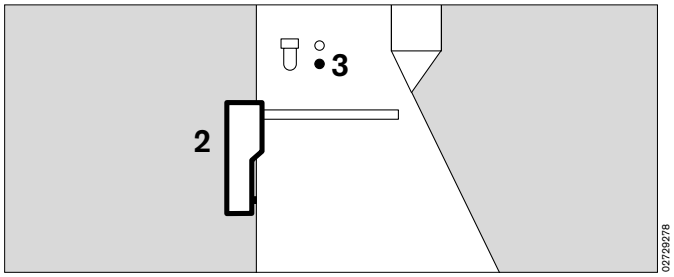
In both cases, the synchronising output for an external defibrillator is accessible from the rear.



Slot-in housing:

1 Push the parameter box straight into the slot-in housing. The parameter box locks into position, and the electrical connections are made.

To remove the parameter box, pull the blue handle on the box to release the locking lever. The parameter box can then be simply pulled out of the housing.



Blue holder:

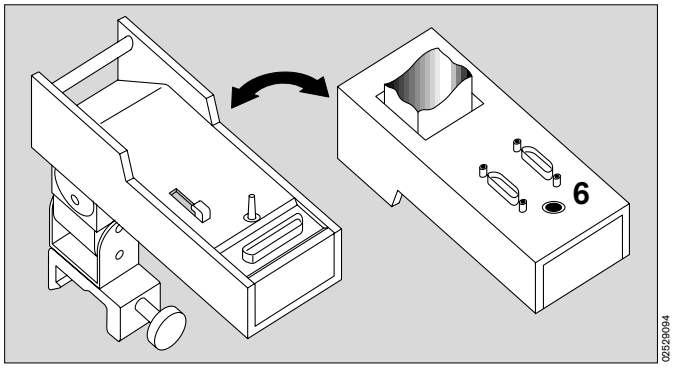
2 Fix the blue holder in a suitable position.

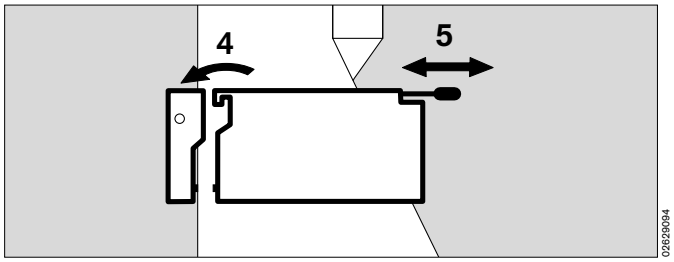
3 Connect the cable of the mounting base to the connector on the side of the Cicero EM.

4 Hang the parameter box onto the mount from above. The plug connector must engage.

5 To remove, pull the blue handle on the parameter box. The parameter box is released and can be taken out of the blue holder.

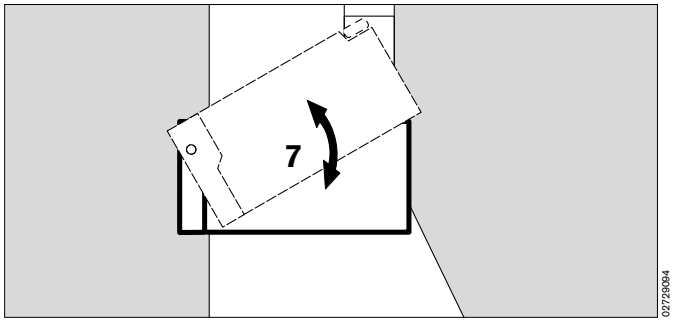
6 Defibrillator connection.





Tilting the parameter box:

7 The parameter box can be swivelled up and down.



The parameter box is the central component of the Dräger transport function. See the separate section in these Instructions for Use, page 86.

Checking workstation with checklist

Manual tests:

After switching on, the apparatus runs through a self-test.

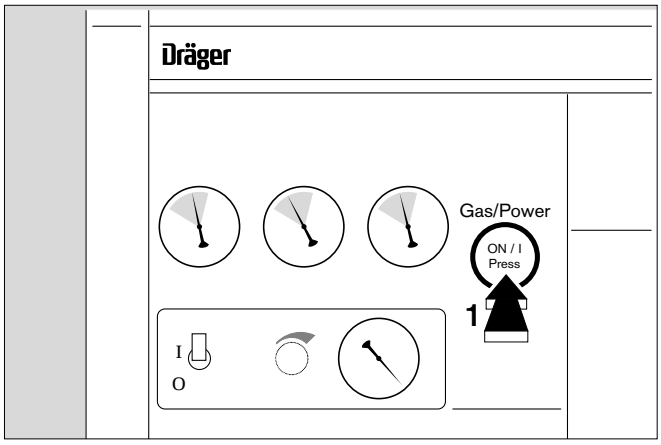
Prerequisites:

Machine is fully equipped -
Instructions for Use are familiar -
User has been instructed on using the machine -

Duration: approx. 5 minutes

Switching on:

1 Press the master switch.
(Combined master switch for gas and power)
The self-test starts



The user must first check:

On the ventilator:

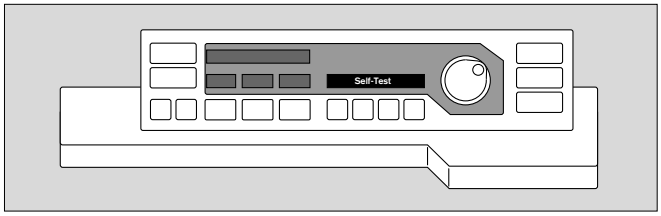
– Indication of software version, all indicator lamps light up for approx. 2 seconds. A single tone sounds.

– The message

»**Self-test**«

appears briefly in the display window.

The Ventilator display goes dark. No operations on the ventilator are required during the self test.



On the screen:

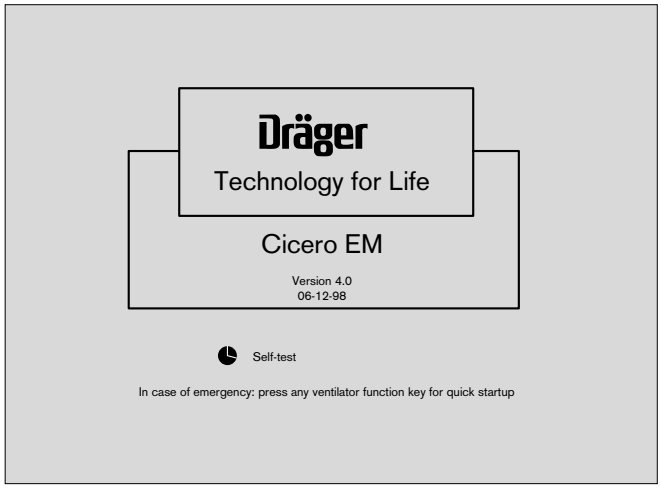
– The internal program memories are tested. All LEDs and display elements light up for approx. 2 seconds.
The LED in the standby key ⏻ remains lit.

– Two warning tones sound.

– A clock symbol 🕘 appears on the screen = duration of self-test.

– The keys are still inactive.

Please wait!



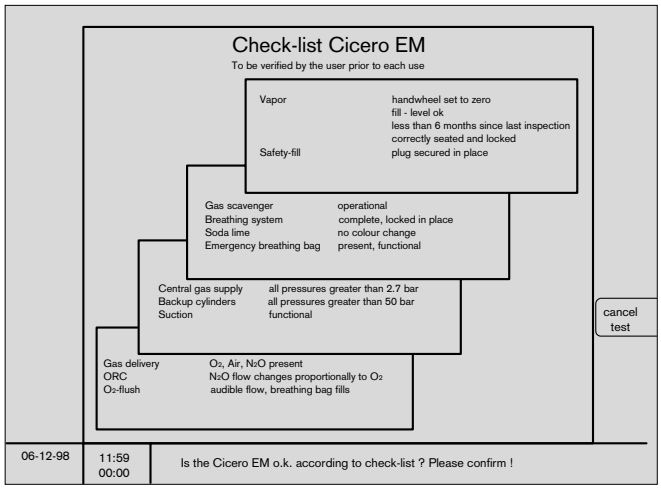
Shortly afterwards:

– The checklist appears.

● Indication in user advisory field:

Is the Cicero EM o.k. according to checklist? Please confirm!

● The user is consequently prompted to check the points listed.



The equipment must be checked every time, immediately before being used!

Check Vapor:

– Set the handwheel to »O«.

– Filling level OK?

– Last inspection less than six months ago?

Safety filler:

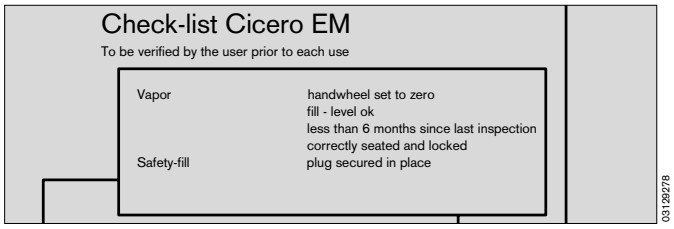
– The plug is inserted and secured.

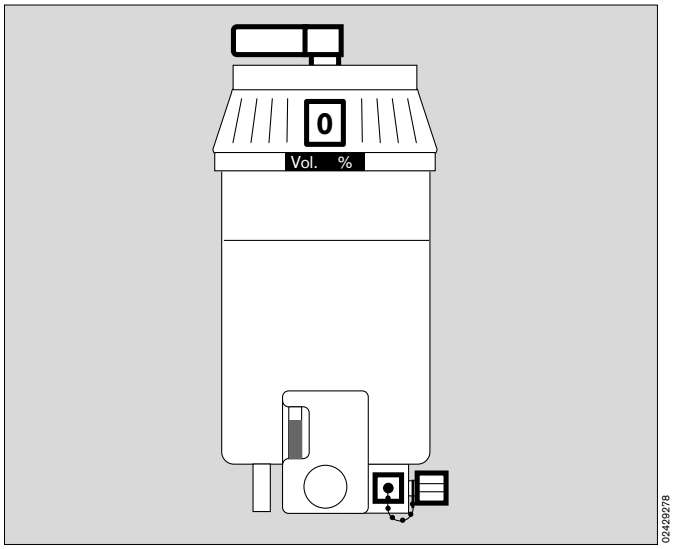
Vaporiser mount:

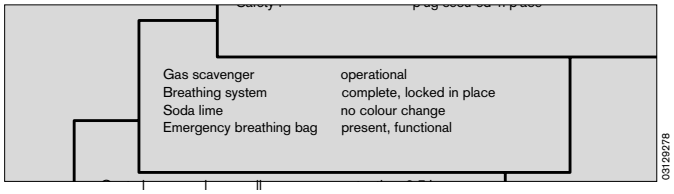
– Vaporiser is correctly seated.

Locking mechanism:

– Plug-in system is locked (lever to the left as far as possible).







Check anaesthetic gas scavenging:

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

– Hose connected to breathing system?

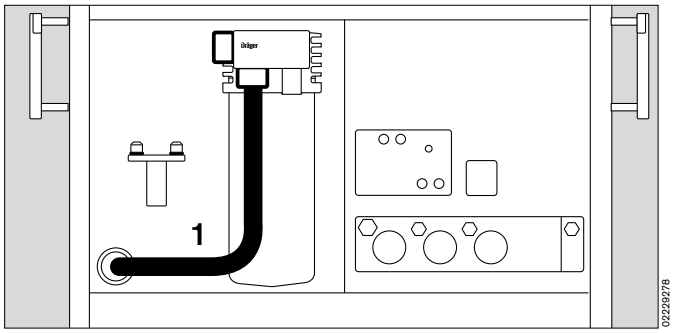
– Is the anaesthetic gas scavenging system correctly installed?

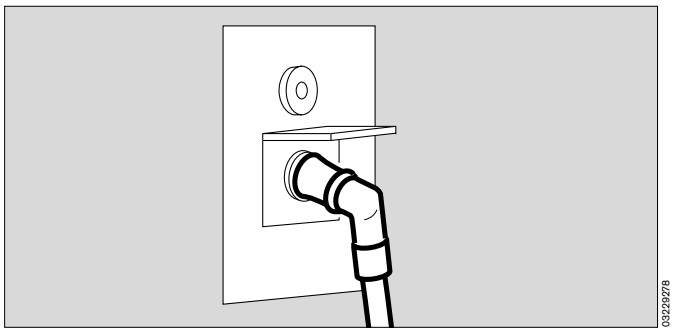
– Are the two hoses fitted correctly?

– Are the vents open?

– Are all hoses free of kinks?

1 Is the transfer hose of the anaesthetic gas scavenging system free of condensate? Drain if necessary.

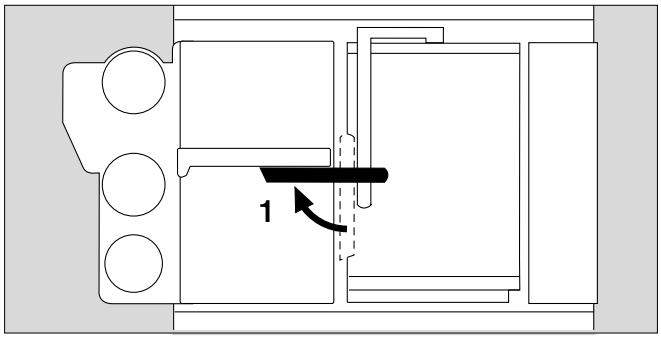




Check breathing system:

Lift table top:

1 Lever set to the position shown in black.



Check completeness:

2 Valve discs inserted.

– Pressure limiting valve (APL) present.

– Inspiratory microbial filter (optional). **Symbol:**

– Expiratory microbial filter (optional). **Symbol:**

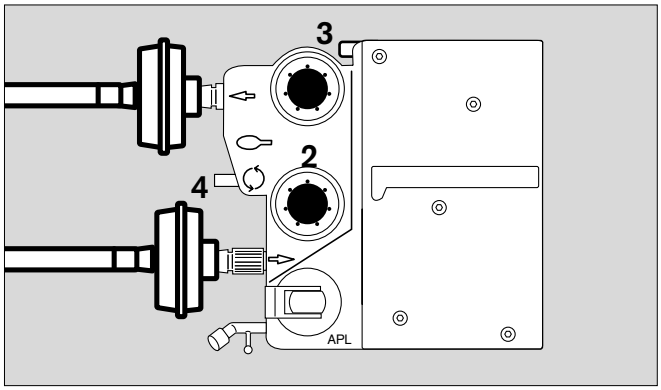
3 Pressure measuring hose with filter connected.

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

5 Hose with manual ventilation bag present. (Connected from below; not shown) **Symbol:**

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

6 Fresh gas hose connected. (Connected from below; not shown)



Water trap (option)

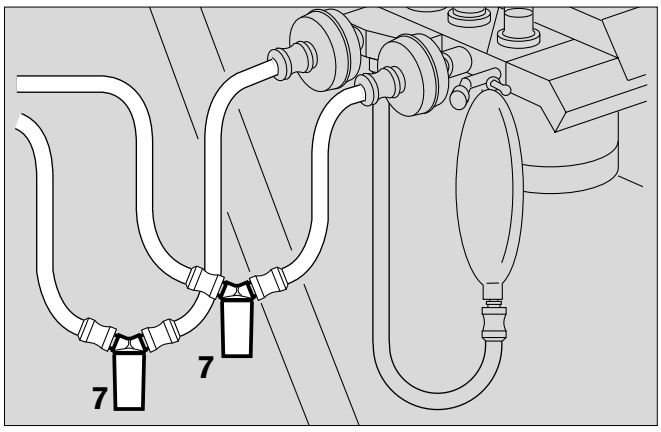
7 Water traps are recommended in both the inspiratory and the expiratory lines during prolonged anaesthesia, low-flow anaesthesia and when using a humidifier.

– 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!

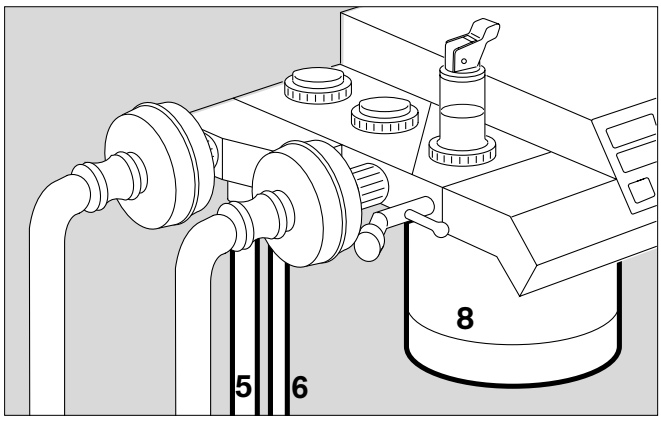


Check soda lime:

8 Soda lime has not noticeably changed colour (purple).

– Filling level adequate (up to the mark).

– The absorber vessel must be screwed in (counter-clockwise) as far as it will go.



Emergency ventilation bag:
(not shown)

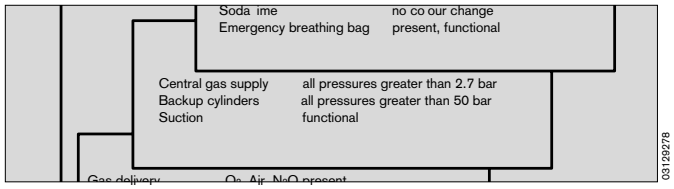
– Bag is complete and hung from the side of the Cicero EM.

– Bag functions correctly.

Central medical gas supply

– The connectors have been pressed right into the wall sockets for O_2, AIR and N_2O (not in holding position!).

1 Pointers of all three pressure gauges are in the green range.

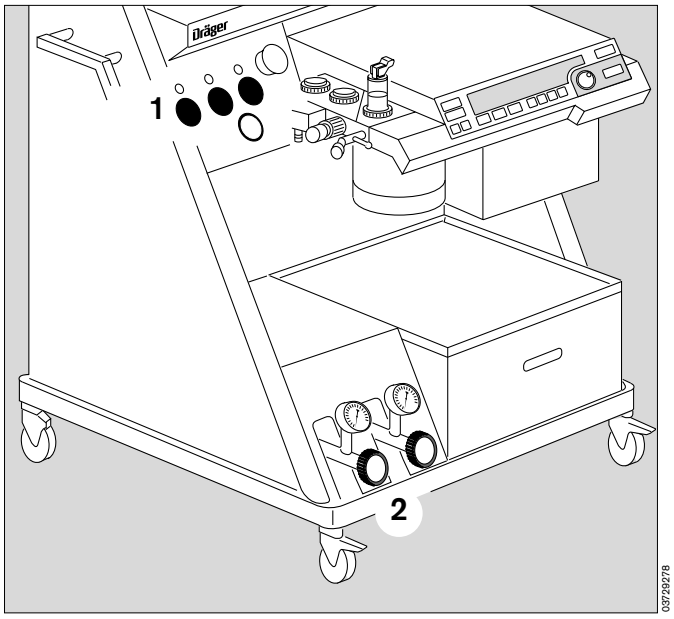


Reserve cylinders (option)

2 Open cylinder valves.
Pressure indicator on O_2 and AIR cylinders exceeds 50 bar?

Replace cylinders if not!

- Close cylinder valves (to prevent gas leaks).



Checking the secretion aspirating system:

3 Negative pressure switch to »I«.

4 Set negative pressure to required intensity by means of rotary control.

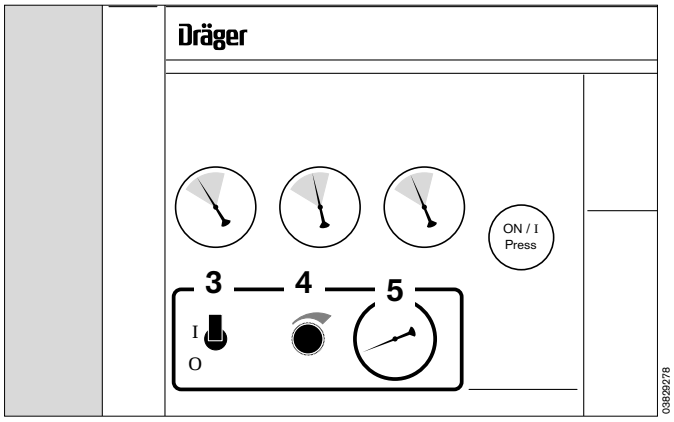
Seal the aspiration holes (or fold over the hose) and

5 Check negative pressure on pressure gauge.

3 Negative pressure switch to »O«.

If the negative pressure generated is insufficient,

- replace microbial filter in ejector system (see »**Maintenance intervals**«, page 137 and »**What's what**«, page 140, No. 11).
- Check adequate supply of compressed gas.



Check gas delivery

1 Switch over to »**AIR**«.

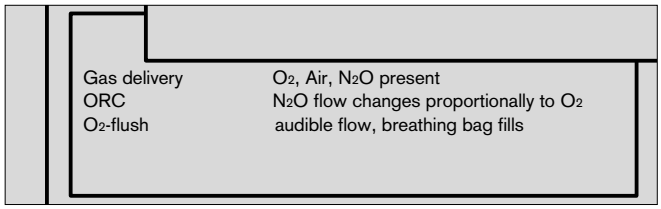
2 Open O_2 and AIR delivery valves until the floats in the measuring tubes indicate more than 9 L/min.

Open N_2O delivery valve completely.

– Does N_2O measuring tube indicate »O«?

1 Switch over to »**N_2O**«.

– Does N_2O measuring tube indicate more than 9 L/min?
Does AIR measuring tube indicate »O«?



Check Sensitive Oxygen Ratio Control (S-ORC)

2 Slowly close O_2 delivery valve -

– check:
N_2O indication decreases to »O« proportionally with O_2.

1 Switch over to »**AIR**«.

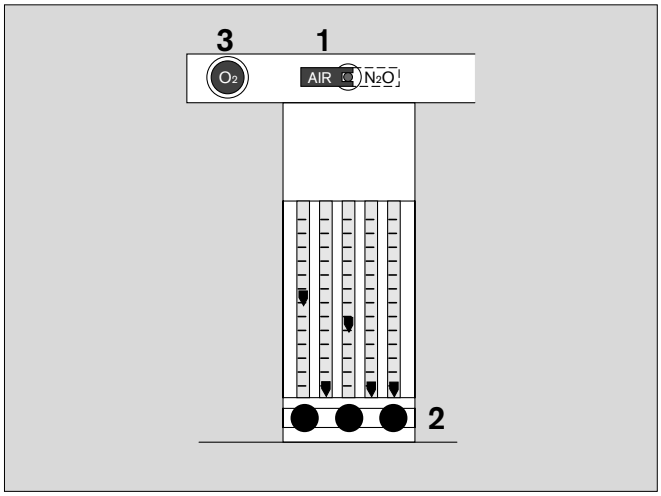
● Close N_2O delivery valve.

Check O_2 flush

3 Press button »**O_2+**« –

– Is there a distinctly audible flow noise?

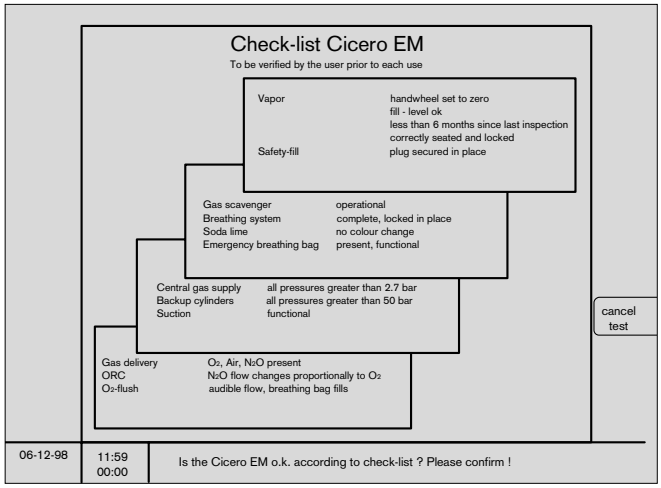
– Does the manual ventilation bag inflate?



End of manual test according to checklist:

– Confirm if all points are OK:

● Press rotary control on system screen.



Now the interactive part of the self-test begins (see following page)

The following symbols are used:

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

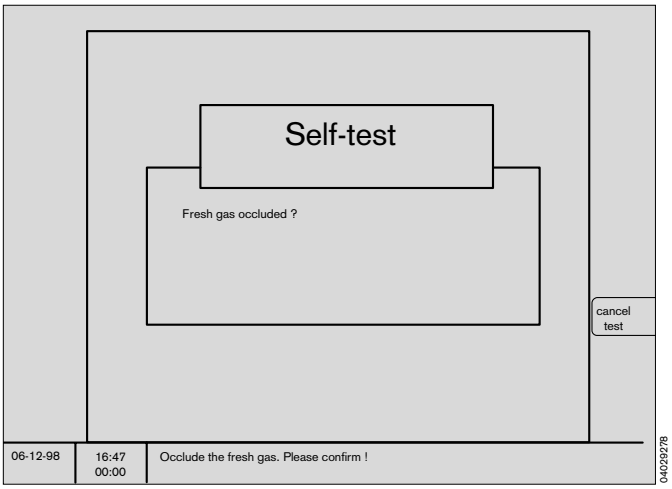
◴ = Waiting period. The selected test step is being performed by the machine.

✔ = The action has been completed successfully.

As a basic rule, the general task to be performed is specified in the centre field, and detailed operating instructions to the user are given at the bottom of the screen. The test begins with the question:

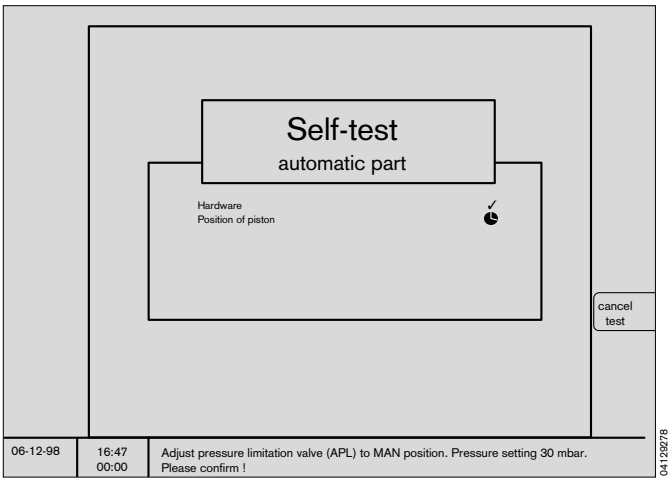
Fresh gas occluded?

- Close all delivery valves on the measuring block.
- Press rotary control to confirm.



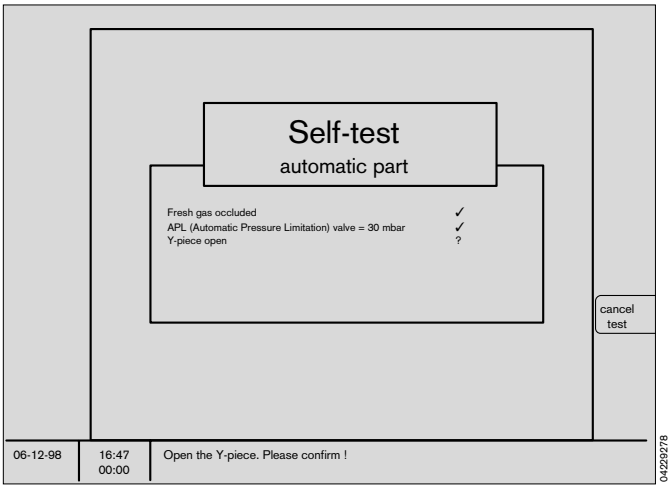
APL (Automatic Pressure Limitation) valve = 30 mbar?

- Flip the APL pressure limiting valve to »**MAN**« and turn the valve head to set it to 30 mbar.
- Press rotary control to confirm.



Y-piece open?

- The Y-piece should be attached to the breathing hoses and the patient connection should be open. (For instance, it may be lying on the table.)
- Press rotary control to confirm.
- Wait a few seconds.



Y-piece occluded?

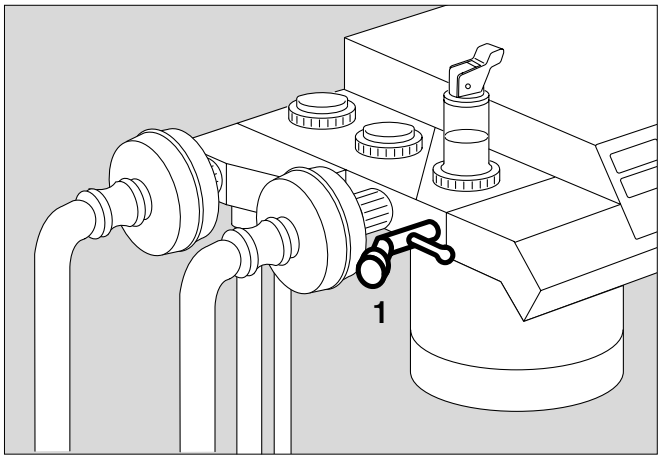
1 Fit the patient connection of the Y-piece onto the cone provided.

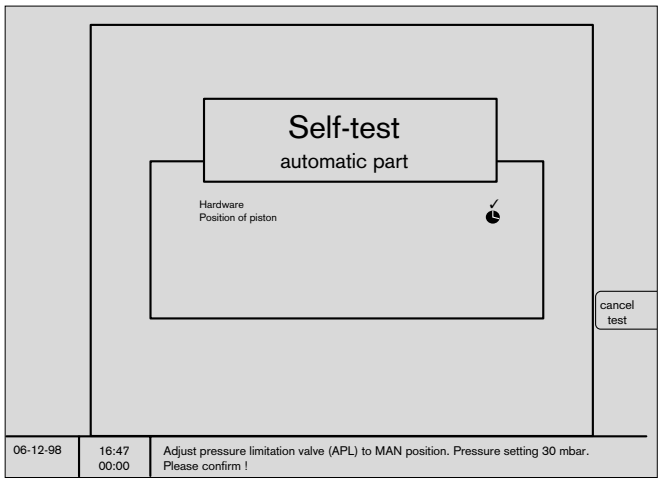
- Press rotary control to confirm.

– Additional internal tests requiring an occluded Y-piece are then conducted by the ventilator.

The leakage test includes the measured gas sampling and return lines. These lines must therefore be correctly connected and not open-ended.

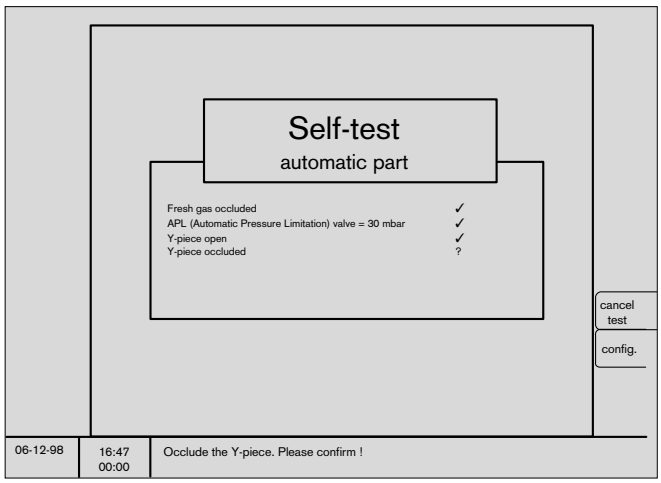
An open T-piece or open Luer lock will result in major leakages!





The automatic part of the self-test follows immediately.

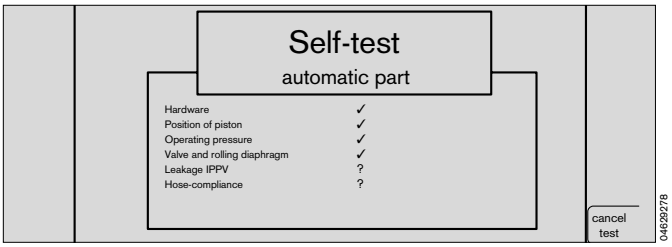
A list in the middle of the system screen shows, with symbols, which points have already been completed, with results if applicable, and which have still to be carried out.



Any faults found are immediately reported in the error field and a brief note on action to remedy the fault appears in the user advisory field.

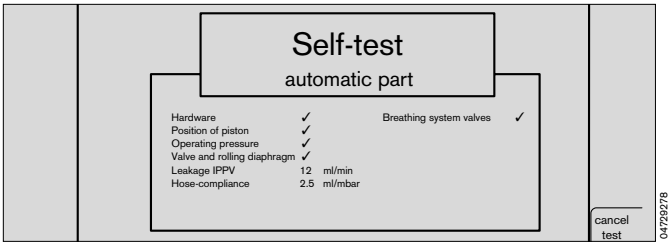
The system stops until the user presses the rotary control to confirm that the fault has been corrected.

DrägerService must be contacted in the case of faults which cannot be remedied by the user (e.g. repeated display of the same fault message or of a three-digit service number).



Test result:

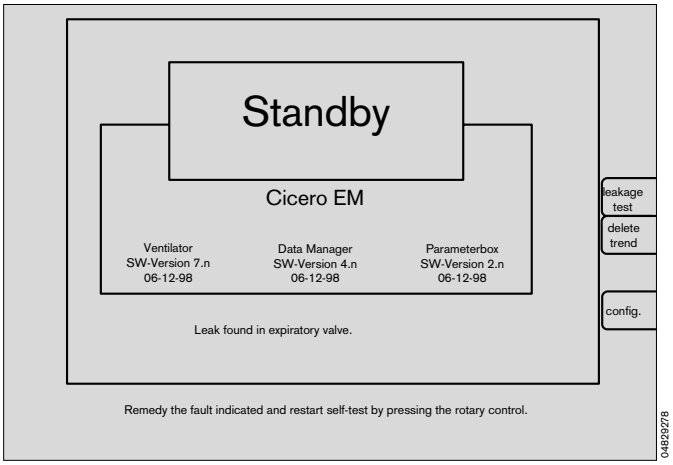
At the end of the test, all successfully tested items are marked with a tick (✔). The measured values for IPPV leakage and hose compliance are displayed.



Also, the entire sensor system is automatically self-calibrated. No user intervention is needed.

During the leakage test, the expiration valve is tested for leaks. If a leak is found, the corresponding fault message is generated after the leakage test.

The fault must be remedied. The self-test must then be restarted by pressing the rotary control!



The system switches to »Standby« when the self-test has been completed successfully.

It is now ready for operation and the illumination of the flow measuring tubes go out.

»**Standby**« means that:

– The system can immediately be switched to any operating mode.

– Gas consumption is zero.

– Power consumption is marginal.

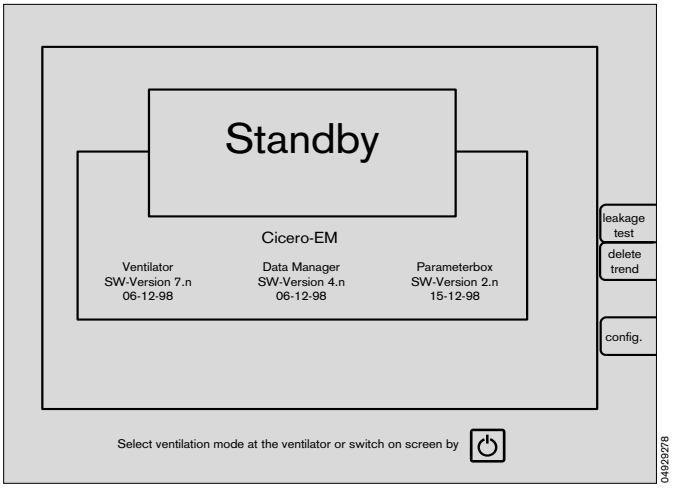
– The piston pump is in withdrawal position.

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).

The system should be switched off completely and not left in »**Standby**« if it is not required for several hours.

In »**Standby**«, the screen is switched to screen-saver mode after one minute if there are no further user inputs. It is reactivated automatically whenever a key is pressed or the rotary control turned.



Fresh gas outlet (option)

Preparing

1 Fit the hose of the semi-open system (e.g. Mapleson system) to the external fresh gas outlet, and connect the anaesthetic gas scavenging hose.

- Perform self-test in conformity with the Cicero EM Instructions for Use.

2 Set the desired O_2 and N_2O flows at the flowmeter block.

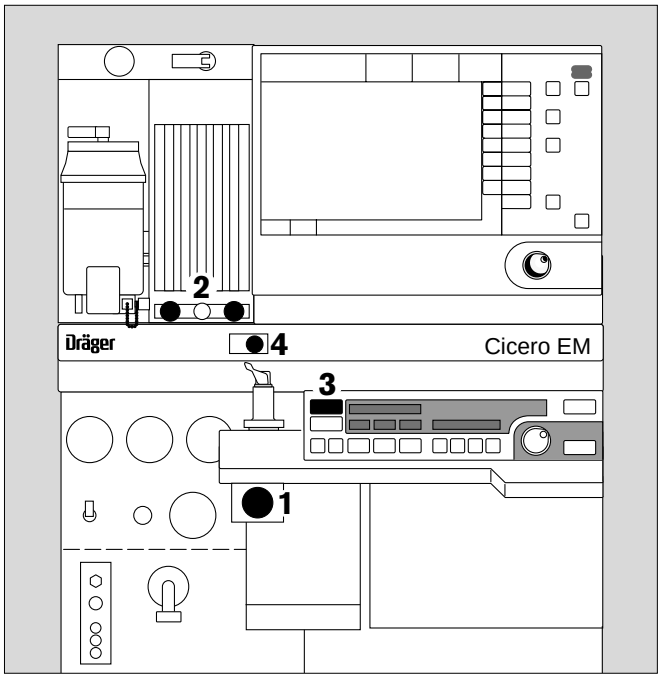
3 Press »**MAN SPONT**« on ventilator for at least 1 second (or press the key and confirm with the rotary control. Setting by Dräger Service).

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.



Operation

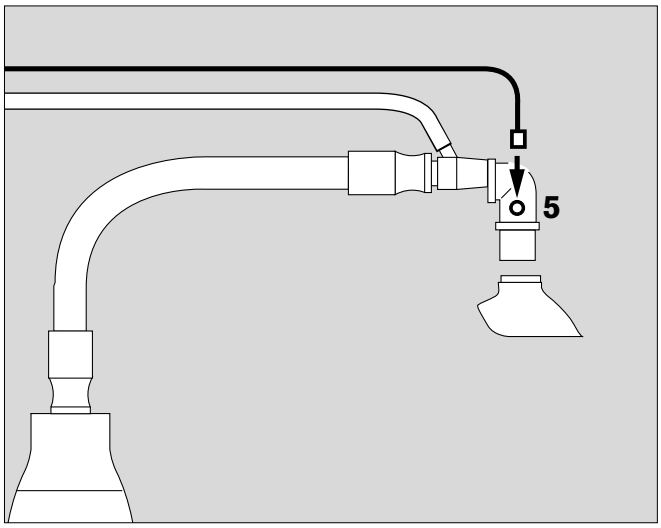
Only available in »MAN/SPONT« mode

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

4 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 closed.

5 Monitoring the breathing gas (O_2 and anaesthetic gases) in semi-open mode with the sample measurement at the mask manifold of the semi-open system in HLM screen mode.



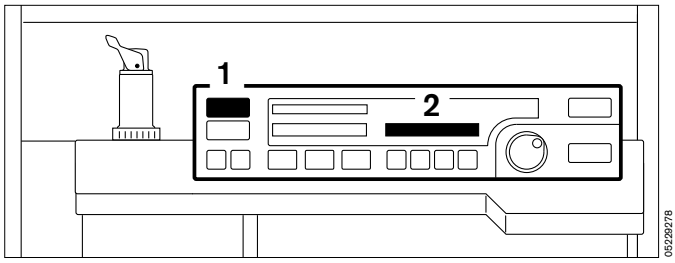
Pressure and flow are not monitored.

When switching on and in the event of a power failure lasting longer than 2 minutes, Cicero EM switches automatically to the circle system.

Page

Anaesthesia ventilation

Select Manual / Spontaneous mode

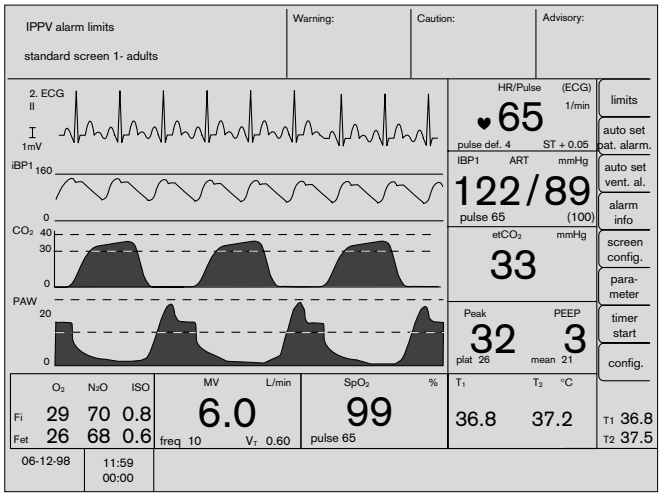


1 Press key »**MAN SPONT**« on ventilator for at least one second (or press the key and confirm with the rotary control. Setting by Dräger Service as from software version 7.2).

2 Display in dialogue field:

MAN/SPONT

»Standard screen 1« appears with the alarm limits for MAN/SPONT mode.



The PEEP and Pmax keys on the ventilator are disabled.

If the manual ventilation bag is squeezed without pressing a key while the machine is in »**Standby**« mode, the machine automatically activates MAN/SPONT mode.

Select the carrier gas for the anaesthetic agent:

3 Set the switch to »**N2O**« or »**Air**«.

Spontaneous breathing

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

5 Set fresh gas –
detailed information on setting the fresh gas flow can be found in the Annex on page 168.

Manual ventilation

with breathing bag

The airway pressure is limited via the pressure limiting valve APL.

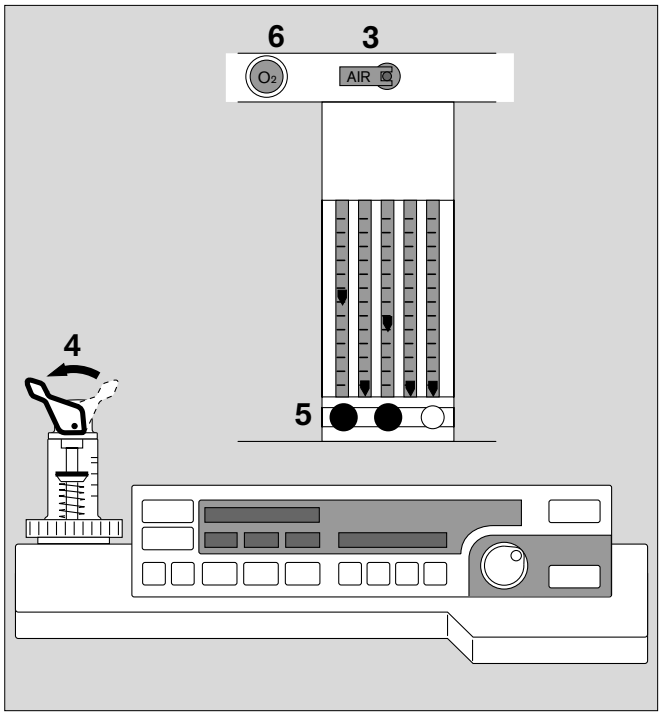
4 Set pressure limiting valve APL to »**MAN**« and set required ventilation pressure:
turn valve head.

To fill system:

6 Press »**O2 +**«.

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

- start manual ventilation.



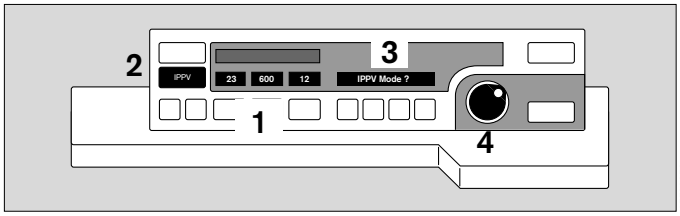
Selecting IPPV mode

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 apparatus:
(may be altered by DrägerService if requested by customer)

V_T	Tidal volume	0.6 L
f_{IPPV}	IPPV frequency	12 per min.
P_{max}	Maximum ventilation pressure	25 mbar
T_I:T_E	Inspiration/expiration time ratio	1 : 1.7
T_{IP}:T_I	Ratio of inspiratory pause time/inspiration time	10 %
PEEP	Positive end-expiratory pressure	0 mbar



2 Press [IPPV].

3 Display in dialogue field:

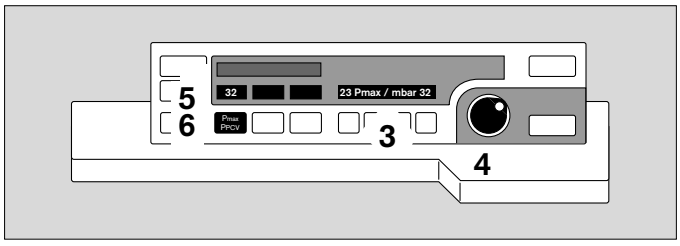
IPPV Mode ?

4 Press rotary control to confirm - ventilation starts -

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

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

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



5 Press »**Pmax**«.

6 The set value appears in the window above, while

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

4 turn rotary control:

3 the value on the right changes -

4 continue turning until the required maximum pressure is reached. Press rotary control to confirm this value -

6 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 f_{IMV} are adjusted like P_{max} after pressing the corresponding parameter key.

Automatic device compliance correction

Only set the desired patient tidal volume!

The compliance of the breathing system and of the hoses used are established by the apparatus during the self-test or during a manual leakage test. 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 44)

A detailed description of automatic compensation of the system compliance can be found in the Annex on page 167.

Ventilation with pressure limitation

When the set maximum ventilation pressure Pmax is reached, inspiration is adjusted so that the pressure remains constant up to the end of inspiration (see page 37).

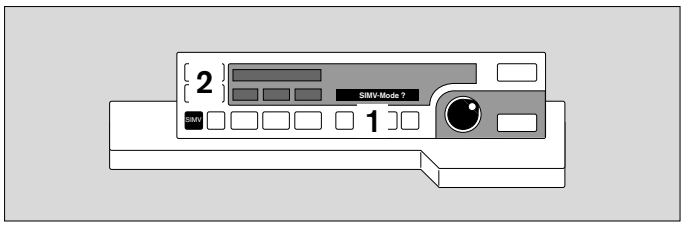
The set tidal volume is not fully applied in this case!

1 Display on ventilator:

Pressure limitation

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 is 10 mbar. As from software version 7.n, this minimum difference is reduced to 5 mbar. Settings that result in a smaller pressure difference are not permitted by the system. The minimum Pmax setting remains 10 mbar, as in previous versions.

– **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.

Selecting SIMV mode

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 180).

PEEP is not active in SIMV mode!

After switching on, the ventilation parameters programmed upon delivery are active in SIMV mode. They can be changed by DrägerService on request.

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

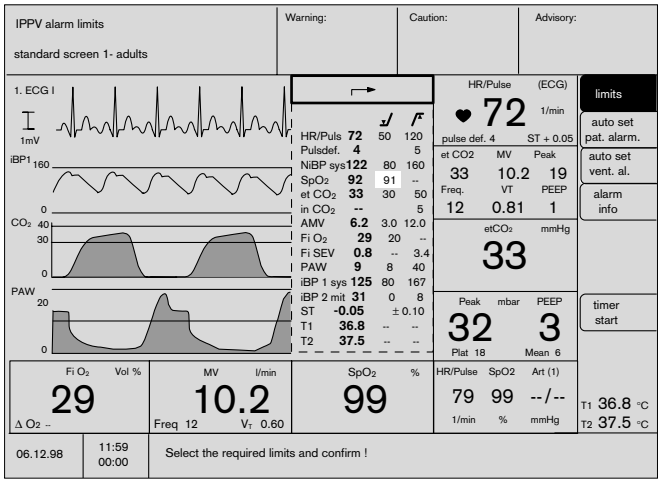
Settings upon delivery of new apparatus:

V_T	Tidal volume	0.6 L
f_{IMV}	IMV frequency	12 per min.
P_{max}	Maximum ventilation pressure	25 mbar
T_{IP}:T_I	Ratio of inspiratory pause time/inspiration time	10 %
T_I:T_{IE}	Inspiration/expiration time ratio	1:1.7

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 system screen.

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 system screen for five seconds. This message does not require confirmation (see page 81).

When setting frequencies of **more than 6 per minute**, the system **automatically** reverts to the IPPV alarm limits and indicates this on the system screen.



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

1 Press the »**SIMV**« key.

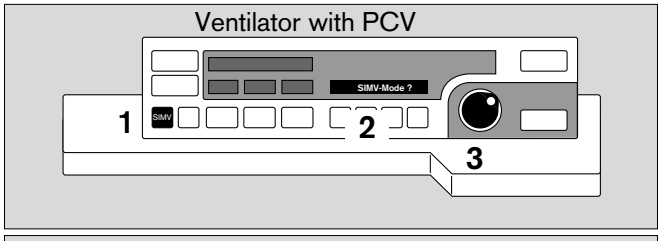
2 Display in dialogue field:

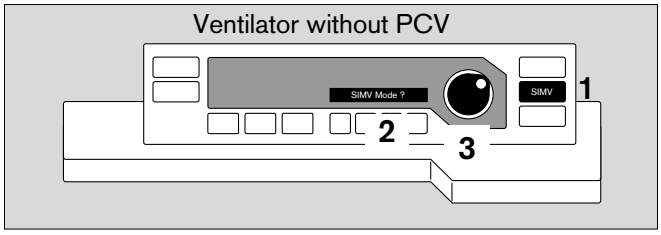
SIMV Mode ?

3 Press rotary control to confirm - ventilation starts -

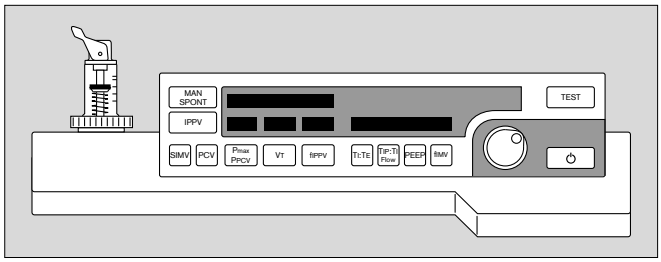
the parameters P_{max}, V_T, f_{IMV}, PEEP and piston movement are displayed on the ventilator -

the system screen is also started and the alarm limits for SIMV are activated.
To adapt the alarm limits automatically to the ventilation mode, see **»Alarm concept«** on page 78.





Selecting PCV mode (PCV ventilator)



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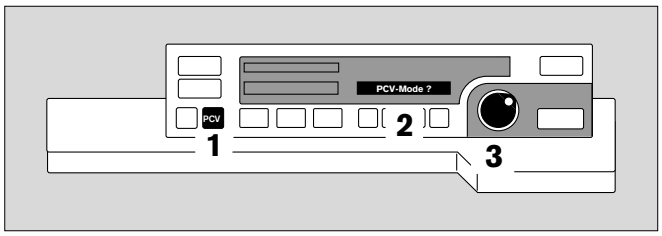
After switching on in PCV mode the ventilation parameters originally set by the factory or subsequently reprogrammed by Dräger Service are applied.

Settings on delivery of a new machine:
(can be modified by Dräger Service at the customer's request).

fiPPV	PCV frequency	12 per min.
Flow	Inspiration flow	50 L per min.
TI:TE	Ratio of inspiration time to expiration time	1:1.7
PEEP	Positive end-expiratory pressure	0 mbar
PPCV	PCV operating pressure	10 mbar

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



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1 Press the »**PCV**« key.

2 Display in dialogue field:

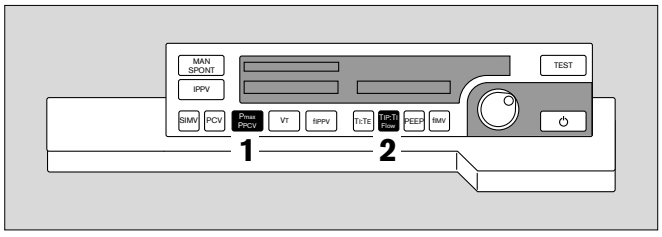
PCV mode ?

3 Press the rotary control to confirm – ventilation in PCV mode starts.

In the absence of confirmation, the message »**PCV-Mode ?**« disappears after 10 seconds without any change in the ventilation function.

The parameters PCV, fIPPV, Flow, PEEP and piston movement are displayed on the ventilator.
The system screen is also started, and the alarm limits for IPPV are activated.

PCV characteristics and settings



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1 The »**Pmax**« key is also labelled »**PPCV**«.

In »**IPPV**« mode the key has the »**Pmax**« function.
In »**PCV**« mode the key has the »**PPCV**« function.

- The »**PPCV**« value defines the level of the pressure curve plateau that is attained during inspiration and exactly maintained until the start of expiration.

2 The »**TIP :TI**« key is also labelled »**Flow**«.

In »**IPPV**« mode the key has the »**TIP :TI**« function.
In »**PCV**« mode the key has the »**Flow**« function.

- The »**Flow**« value defines the gradient of the inspiratory curve. The permitted value range is between 5 and 75 l per min.

Special features of mode changes

Changing from IPPV or SIMV to PCV

The PEEP setting is transferred to PCV mode from IPPV/SIMV.

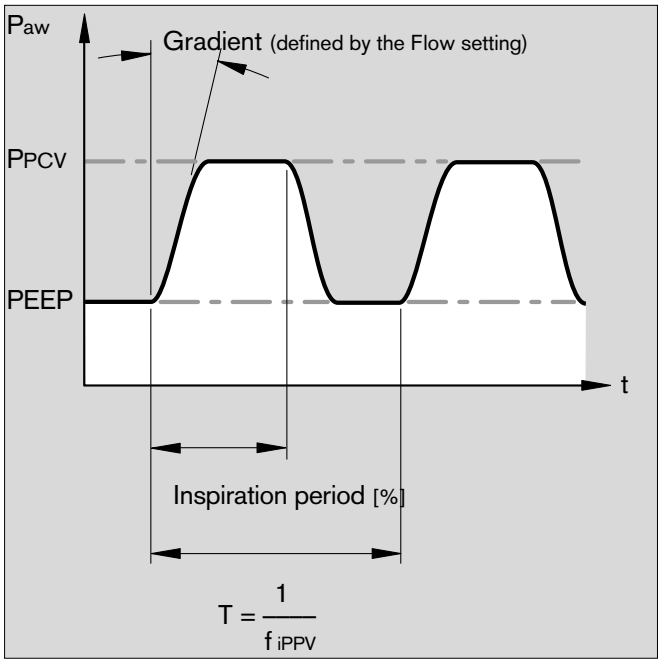
The P_{PCV} value is the last set plateau pressure. Its maximum value is P_{max}. If the transferred P_{PCV} value is not at least 5 mbar more than PEEP, the P_{PCV} value is set to PEEP + 5 mbar.

If the Cicero EM is started up in PCV mode, the preset standby value for P_{PCV} is used. For the Flow, the standby value is always set to 50 l/min. These default settings can be modified by Dräger Service at the customer's request.

Changing from PCV to IPPV or SIMV

The PEEP setting is transferred to the selected mode from PCV.

P_{max} is set to the last value applied in IPPV/SIMV ventilation, provided that P_{max} is at least 5 mbar more than PEEP. If not, P_{max} is set to PEEP+5 mbar.



Adjusting P_{PCV} and Flow

As with all settings on the ventilator:

- Press the function key; the existing value and the proposed new value are displayed in the dialogue window.
- Turn the rotary control: the proposed new value changes.

On reaching the desired setting:

- Press the rotary control: the new value is set.

Special alarm features

In PCV mode, the system screen is in »**IPPV**« monitoring mode. There is no special monitoring mode for »**PCV**«.

If the selected ventilation pattern in PCV deviates considerably from the last pattern selected in IPPV mode, AMV or pressure alarms may be triggered in the usual form:

– Yellow/red flashing light
– Tone sequence
– Message in the yellow/red field
– The limit value menu is automatically displayed
– The limit values can be adjusted

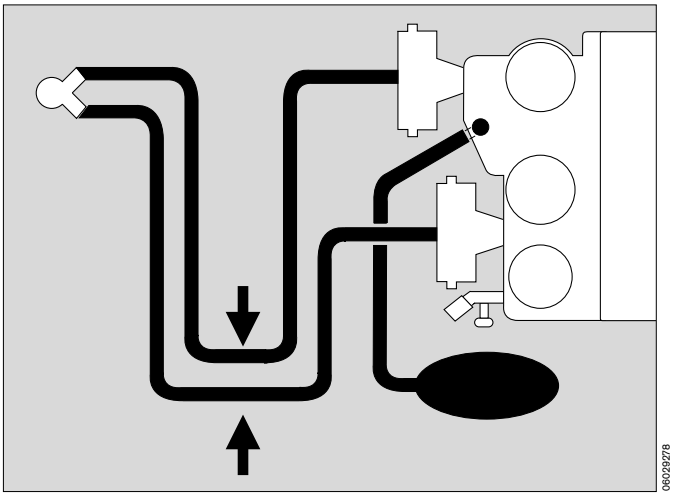
If the »**auto set vent. al.**« key is pressed, the system calculates the new alarm limits from the limits applied in the last IPPV ventilation mode. We therefore recommend that you set the alarm limits manually in the limit value menu.

Paediatric use

Infant hose set

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

If a breathing gas humidifier is used, water traps should be installed at the lowest points of the breathing hoses (arrows) 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.

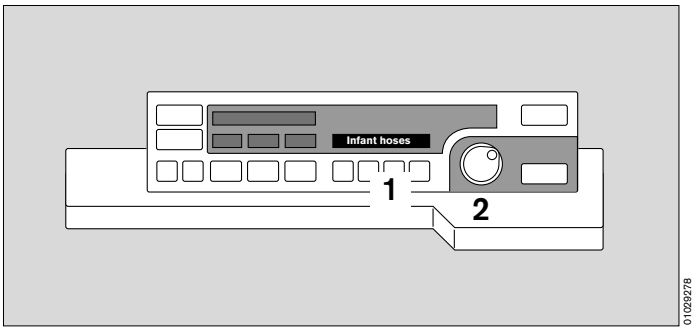
The setting increments and the metering precision for the tidal volume VT depend on the selected adjustment range.

(The adjustment range <20 mL is only selectable in software version 7.2)

Range	Interval	Metering accuracy
< 20	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:

Infant hoses!

- Fit infant hoses –

2 press rotary control to confirm.

Then switch to »**Standby**« and call up the leakage test (see page 46) so that the new compliance can be calculated:

Invoking the leakage test

1 Press TEST on the ventilator for at least three seconds or press the softkey »**Leakage test**« on the system screen -

2 Display in dialogue field on ventilator:

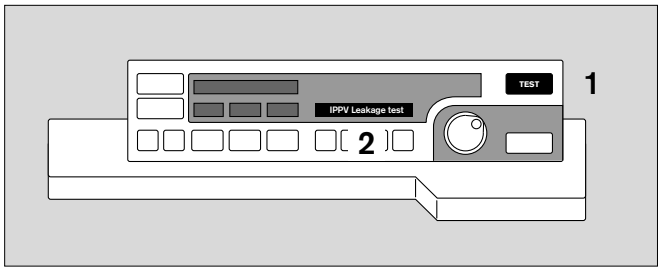
IPPV leakage test followed by: **IPPV leak = xx mL**

The menu for the leakage test appears on the system screen followed by the current leakage and compliance values a few seconds later.

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

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

The system screen should be switched over to »**Neon**« mode (see page 49), in order to adapt the NIBP starting pressure and the alarm limits to the patient.



Anaesthesia ventilation with the Kuhn system

- Prepare the Kuhn set in accordance with separate Instructions for Use -
- Connect anaesthetic gas scavenging hose.

3 Press MAN SPONT on ventilator for at least one second -

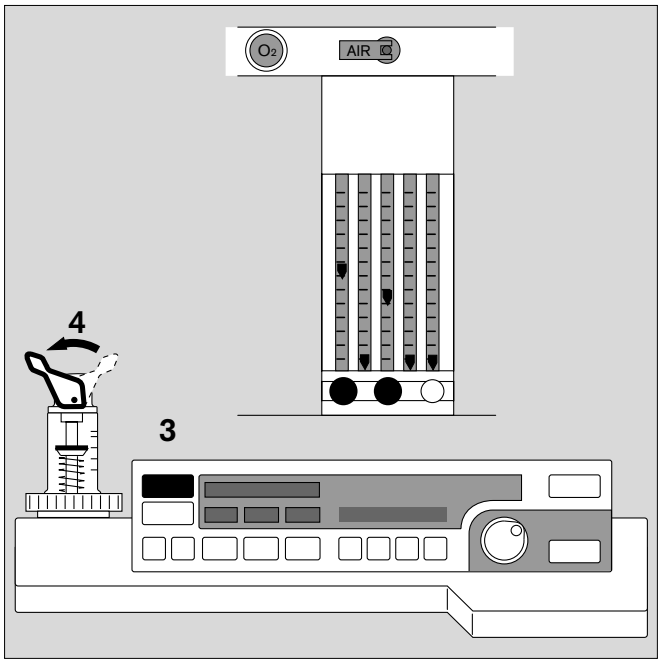
4 Set pressure limiting valve APL to »**MAN**« -

- Connect inspiration hose via

5 connecting sleeve - Symbol: ⇦

6 Expiration connector remains open - Symbol: ⇨

7 Connect concertina hose and breathing bag to manual ventilation connector. Symbol:



The pressure indicated on the system screen 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.

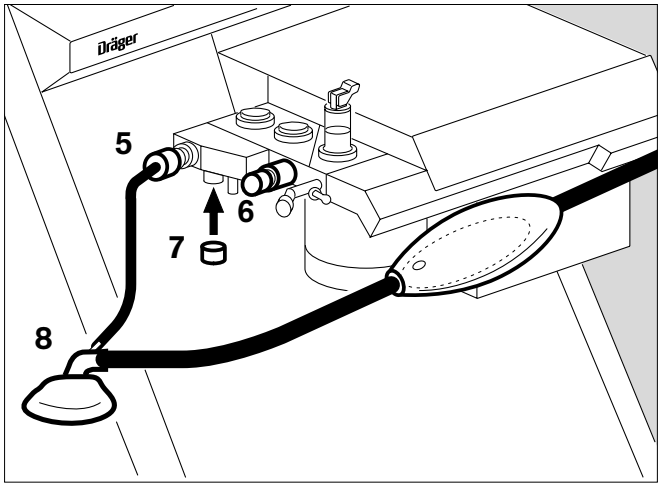
In case the Cicero EM is equipped with an external fresh gas outlet (see page 29) this should be used.

National regulations on the minimum monitoring requirement must be observed!

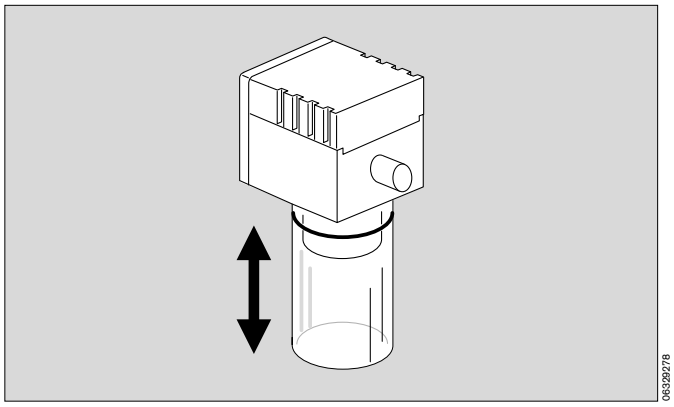
The breathing gas can be monitored by

8 the measuring connection on the mask manifold or

5 at the inspiration output (switch the system screen to HLM mode for this purpose)



Check the water trap



– Regularly check the water trap on the left-hand side of the Cicero EM. When the level comes close to the **»Full«** mark, remove the jar by pulling it down and empty it.
– Fit the jar firmly back in place!

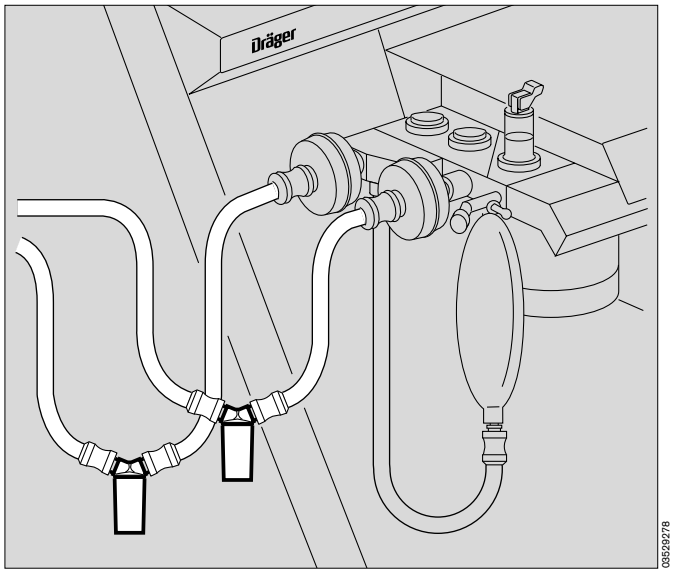
If the permitted maximum level is exceeded, the measured gas sampling system is switched off automatically.

The advisory message **»WATER TRAP? !«** is displayed on the system screen.

CO_2, O_2, breathing gas and N_2O measurements will then no longer be possible!

Remedy: Drain the water trap as described.

Check water separators

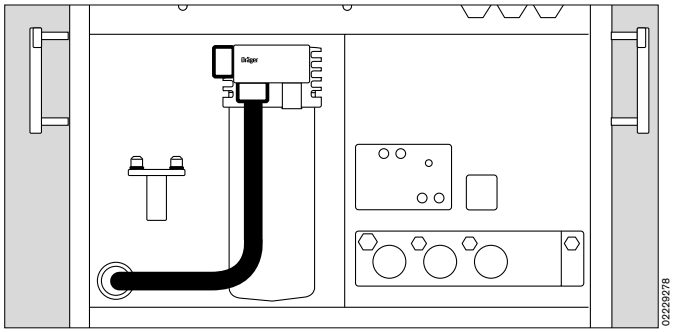


– Water separators must be fitted at the lowest point in the hose and hang downwards.
– They must be checked regularly and drained if necessary.

  Note hygiene regulations - risk of infection!

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

Anaesthetic gas scavenging line (AGS)

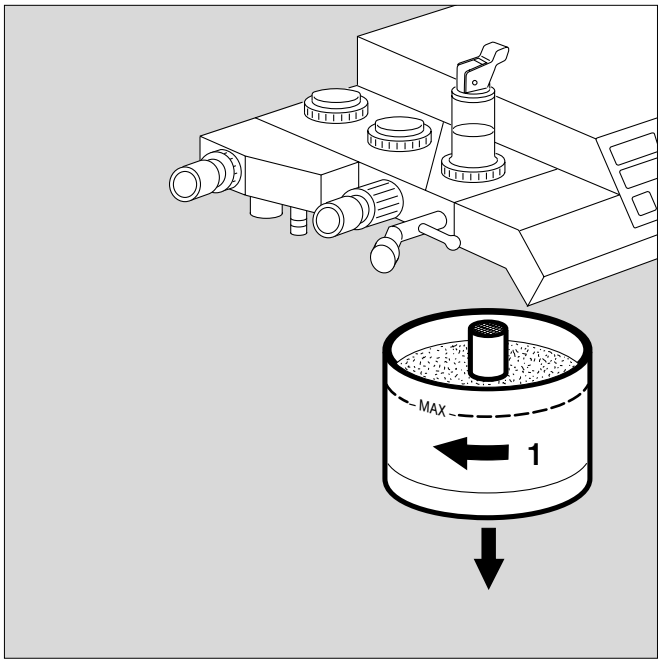


– Check the transfer hose.

  Condensate may have collected in the hose – drain if necessary.

Check soda lime

The soda lime turns purple from the bottom upwards when saturated with CO_2. To monitor the amount of CO_2 absorption by the soda lime, the $FiCO_2$ value can be displayed on the system screen (see page 50).
$FiCO_2$ is monitored during IPPV ventilation (default value: adults 5 mmHg, neonates 8 mmHg; individually adjustable from 0 to 10 mmHg). Change the soda lime after 2/3 of the charge has changed colour. The colour may fade again due to drying out after prolonged breaks.



Changing soda lime during operation
(filling container, see page 128)

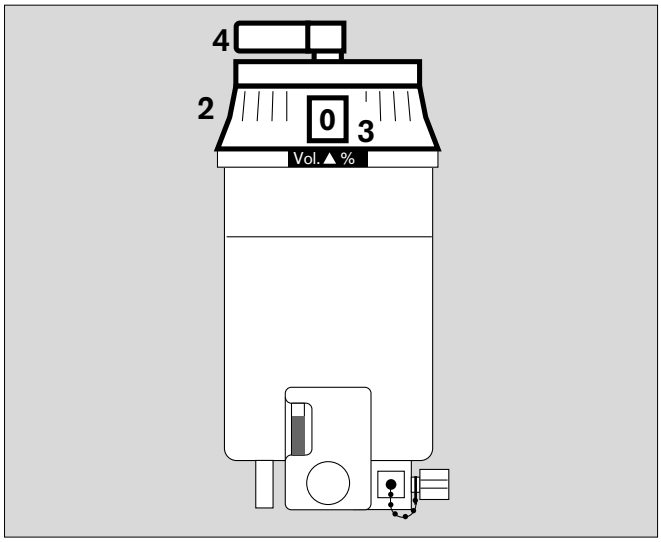
- Prepare a replacement soda lime container.
- Switch off the Vapor.
- Stop N_2O delivery.
- Set ventilator to »**MAN/SPONT**« and the pressure limiting valve to »**SPONT**«.

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.
- Reset the machine to previon settings.
- Remove spent soda lime from the container.

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

Anaesthetic vaporizer



2 Handwheel with scale in % anaesthetic agent by volume.

3 Zero button.
Locks in zero position (»O«) automatically when the Handwheel is turned clockwise to the limit.

4 Locking lever.

To the left: Vapor is locked onto the plug-in system.

To the front: Vapor is released and can be lifted off the plug-in system. It must not be tilted more than 45 degrees!

When using the connection for two Vapor units, the Handwheel of the desired Vapor must first be released. The second Vapor is then automatically locked.

3 Press zero button and turn handwheel anticlockwise -
until required setting is reached.

Secretion aspirator

Set negative pressure:

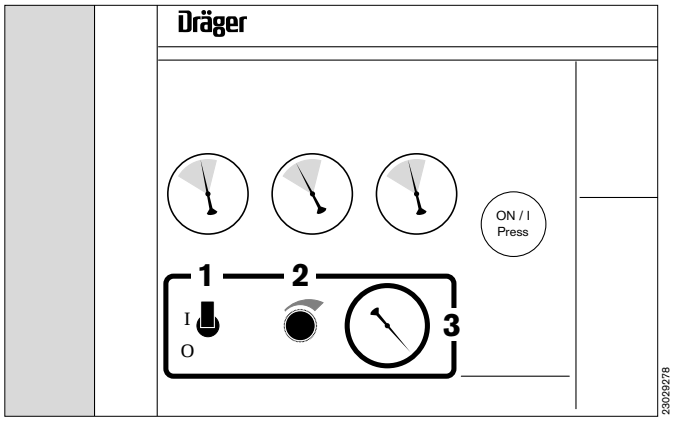
1 Set negative pressure switch to »I«.

2 Set required negative pressure with rotary control.

Seal the aspiration ports (or fold over the hose) and

3 check negative pressure on pressure gauge.

1 Set negative pressure switch to »O«.



Aspiration:

1 Set negative pressure switch to »I«.

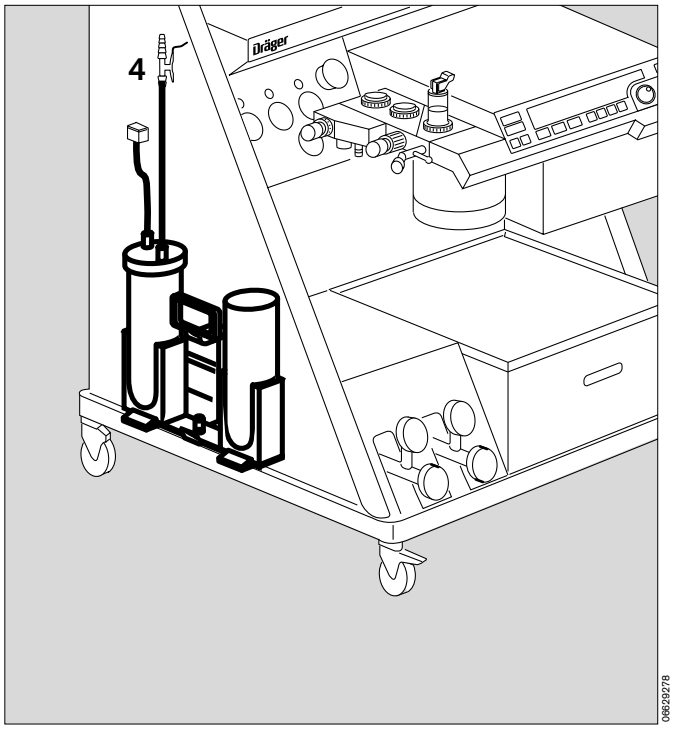
4 Cover the »**Fingertip**« with your index finger.

- The aspiration capacity can be adjusted very accurately with the aid of auxiliary air.

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

Note hygiene regulations - risk of infection!

In order to avoid uncontrolled negative pressures in the breathing system and patient's lung, we recommend that you only carry out aspiration when the Y-piece is disconnected from the patient tube.



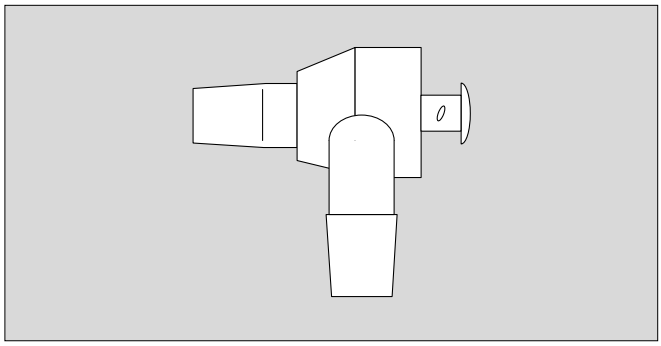
Changing patients

Changing parts:

Refer to page 117 and 125 for a schematic overview and description of methods for cleaning and disinfection.

Maintenance intervals: page 137.

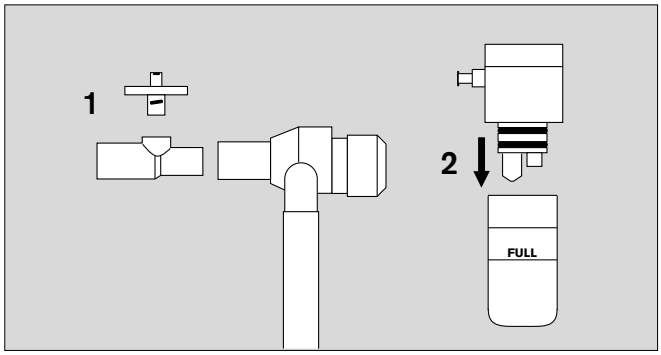
- Machine in Standby mode -
- Vapor: thumbwheel set to »O« = Off.



After treating an infectious patient

the entire machine must be cleaned, disinfected and sterilized.

Note hygiene regulations - risk of infection!



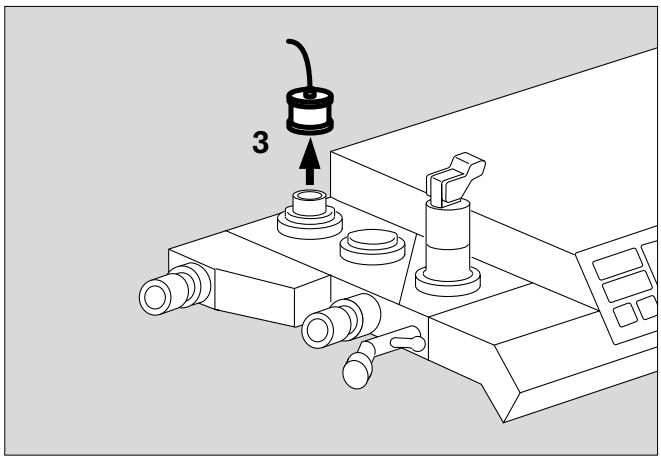
After treating a non-infectious patient

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 Draw the water trap container down and off to be emptied -



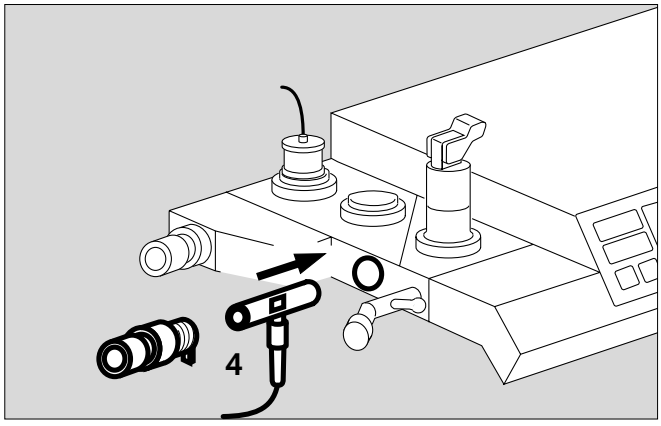
The following must also be changed when working without microbial filters:

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.
- Release the hose of the anaesthetic gas scavenging system (lock in front of the connector - No. 5 on page 118), and also disconnect from the wall socket of the central scavenging system.



After use

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 **»Standby«** on the ventilator for at least 1 second (or hold down the key and confirm by pressing the rotary control. Setting by Dräger Service as from software version 7.2).

2 The following message is displayed:

»Standby«

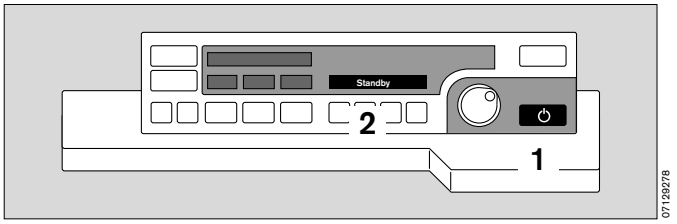
The flow tubes are no longer lit up.

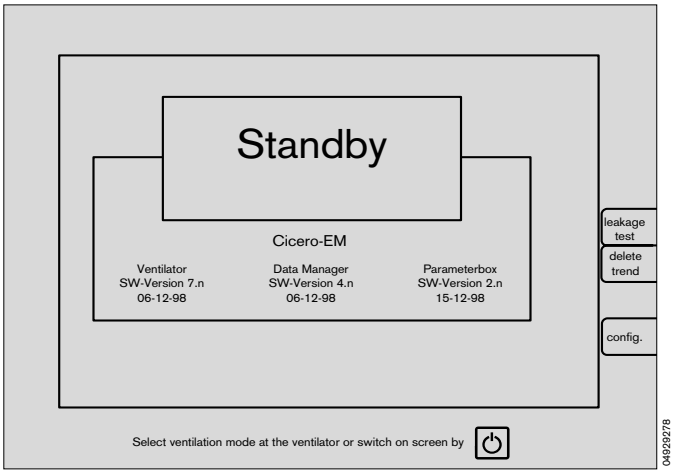
The system screen remains operational and should be set to **»Standby«** by pressing ⏻ if not required.

The system screen can only be switched to Standby if the ventilator is already in Standby!

- Set the Handwheel on the Vapor to **»O «.**
- Close the delivery valves for O_2, N_2O and AIR.

Continuing fresh gas flow while the device is in standby mode can cause the soda lime to dry out!

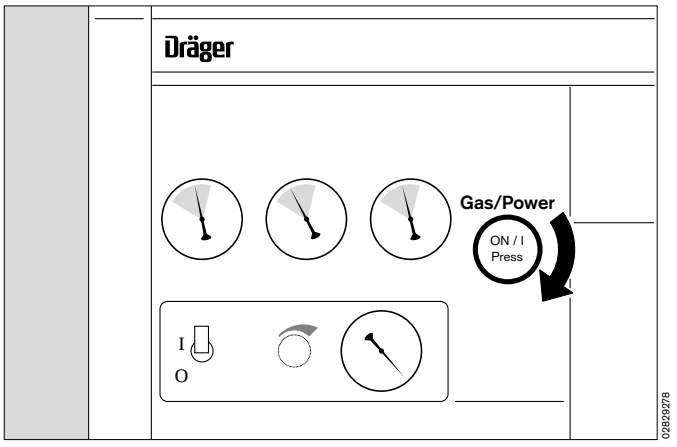




In **»Standby«**, the screen is switched to screen-saver mode after two minutes in the absence of any user input. The screen is automatically reactivated when any key is pressed or the rotary control is turned.

If operation is interrupted for several hours, we recommend that you switch the system off instead of leaving it in **»Standby«**:

- Turn master switch clockwise to **»O «**. After switching off, the message **»Power off«** is displayed for about 10 seconds.
- Disconnect gas hoses from wall sockets -
- close reserve gas cylinders (if used)
- roll up hoses and hang them over the holder at the back of the machine.
- Disconnect mains plug. This instruction does not apply if using a UPS.



Page

System screen functions

»Standby« screen

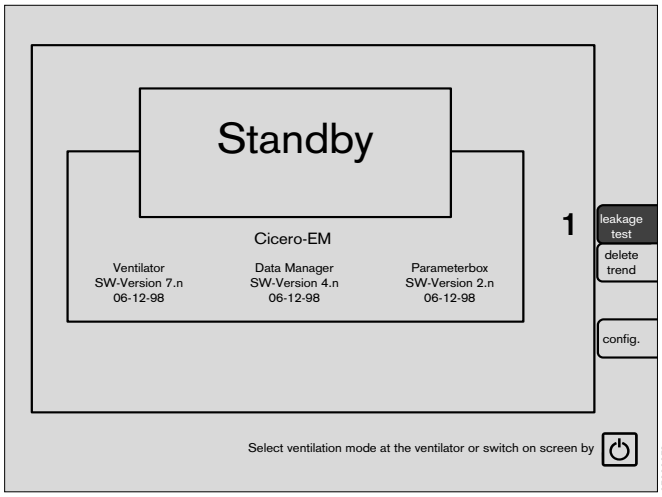
In Standby mode, the Cicero EM is immediately ready for operation. The **»Standby«** screen contains the following softkeys:

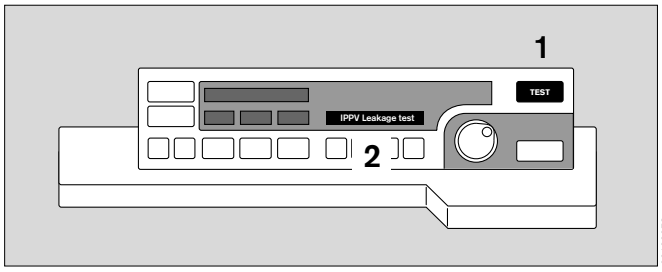
– the leakage test,

– deleting the trend and list memory,

– system screen configuration.

If the device is left in Standby mode for longer than two minutes, the screen is automatically switched off (dark). It is automatically switched back on by any user input (key, rotary control, etc.).





Running the leakage test:

The sample line and the sample gas return must be connected correctly before starting the leakage test. They are then included in the test as part of the overall system. An open T-piece or open Luer lock can result in major leakages!

1 Press either the softkey »**leakage test**« on the system screen or the »**TEST**« key on the ventilator.

2 Display in dialogue field on ventilator:

IPPV leakage test

followed by:

IPPV leak = xx mL

The menu for the leakage test appears on the system screen, followed after a few seconds by the current leakage and compliance values.

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

The machine reverts to »**Standby**« after the test.

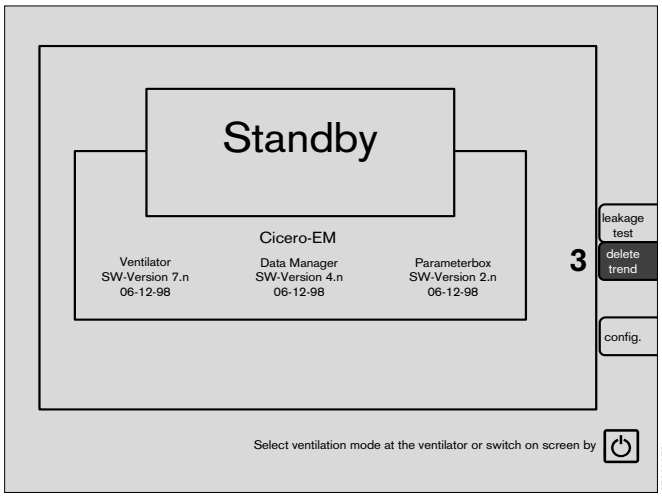
Delete trend; e.g. for a new patient:
Trend memory, list and Parameter Box memory (if used) are deleted!

3 Press the softkey »**delete trend**« on the system screen. Description on page 71.

The system enquires again whether the trend is really to be deleted.

- Press softkey »**delete**« to confirm.

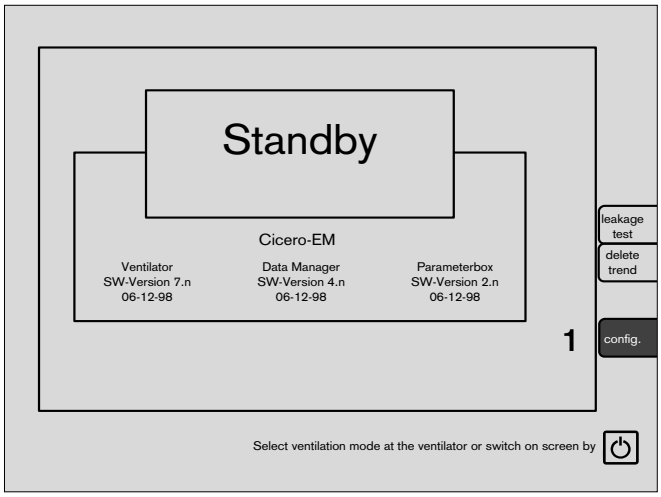
The original screen is restored if the softkey »**do not delete**« is pressed.

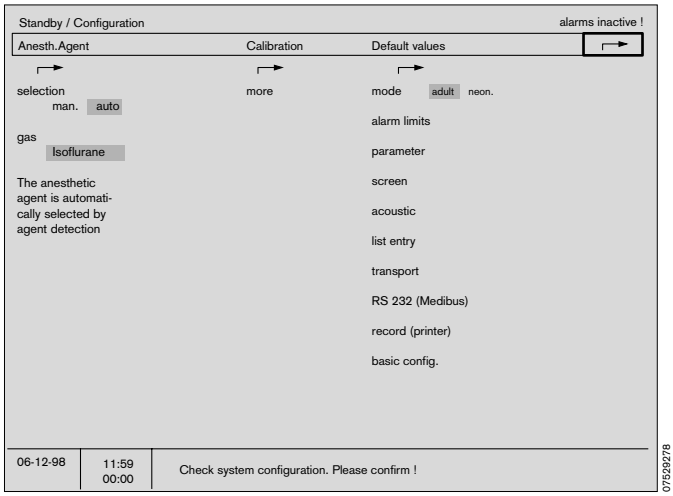


Basic screen configuration

Access to Configuration

1 When you press the **»Config«** screen key, the screen opposite is displayed:





Default values

The **default** settings are permanent. They are activated after every modification and every time the device is switched on.

By contrast the **standard alarm limits** are activated after each standby.

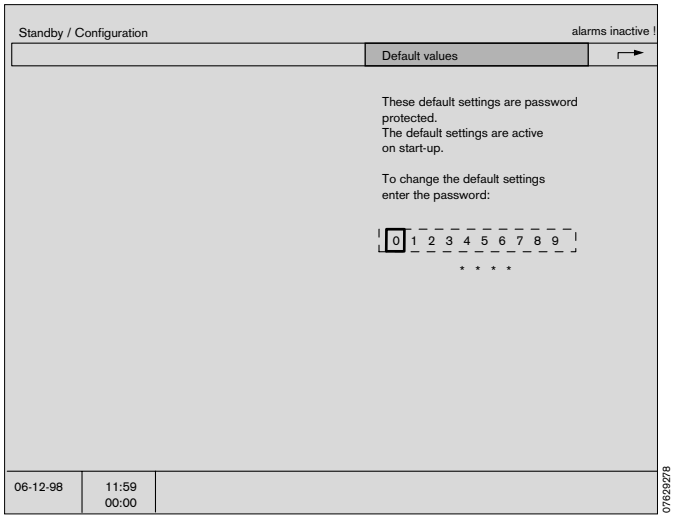
The standard are protected by 4-digit code against unauthorised modification.

Dräger Service can deactivate this protective function or can program a different code freely selectable by the user.

Enter code:

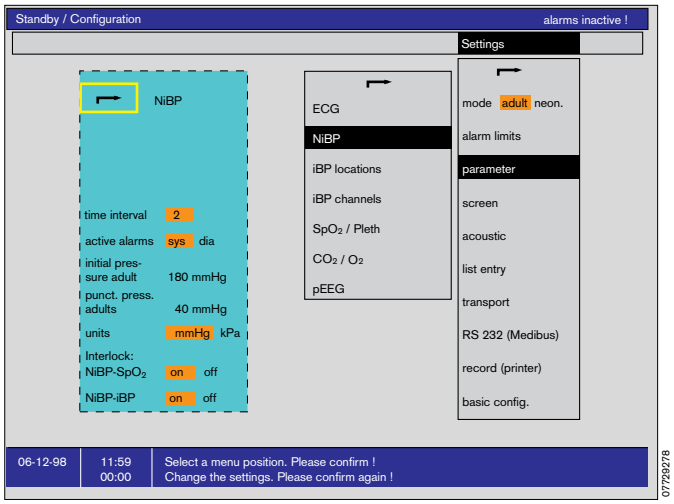
- Select the digits one by one by turning the rotary control and press to confirm. After the fourth correct digit has been entered, access is granted to the selection range.

  (The operating procedure for the basic screen configuration is described on the next page).



Operating Description

Part of screen:	Representation:
Active menu level	Turquoise
Inactive menu level	Grey
Cursor	Yellow frame
Selected menu option	Inverse video (white on black)
Current settings	Orange background
Operating function:	**Action:**
Move cursor	Turn rotary control
Confirm selection	Press rotary control
Go back one menu level	Select » ⮡ « and confirm



The following basic configurations are possible:

Mode Changeover between adult and neonatal mode.

Alarm limits Selects the active alarm limits for neonates or adults when switching over to MAN/SPONT.

Parameters Standard settings of the patient parameters.

Screen Configure screens.

Acoustics Select volume and type of tone sequences.

List entry Define the criteria for an entry in the list screen.

Transport Define the data exchange protocol between the parameter box and the system screen when transporting the patient.

RS 232 (MEDIBUS) Set the interface parameters.

Log (printer) Configure the printer interface.

Basic setting Date, time and language setting.

Mode

The Cicero EM has separate operating modes for adults (adult) and neonates (neon). These modes differ in the following way:

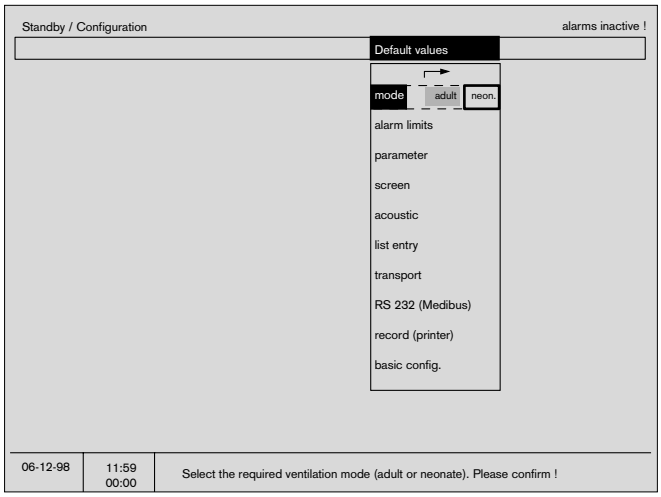
– Default alarm limits (see below)

– Volumeter measuring range (see page 58)

– NiBP functions (see page 91)

– ECG functions (see page 89).

Every time the Cicero EM is switched on, it automatically operates in the mode selected in this menu.



Alarm limits

The standard alarm limits are defined

– separately for adults and neonates,

and, in order to activate/deactivate the MAN/SPONT alarm limits, for

– et CO_2,

– in CO_2,

– O_2 high and

– AMV.

The default alarm limits are automatically activated after either:

– switching on the Cicero EM,

– leaving **»Standby«** mode,

– selecting **»default«** under **»Alarms«**,

– switching over between **»Neon«** and **»adults«** mode

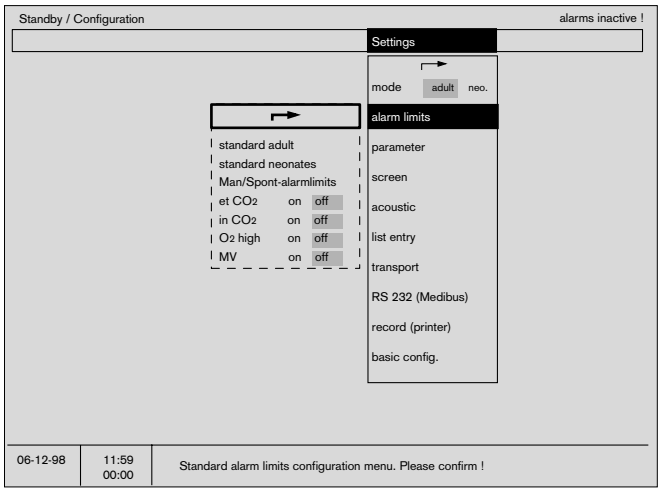
The limit values are allocated in groups to the following measurement parameters:

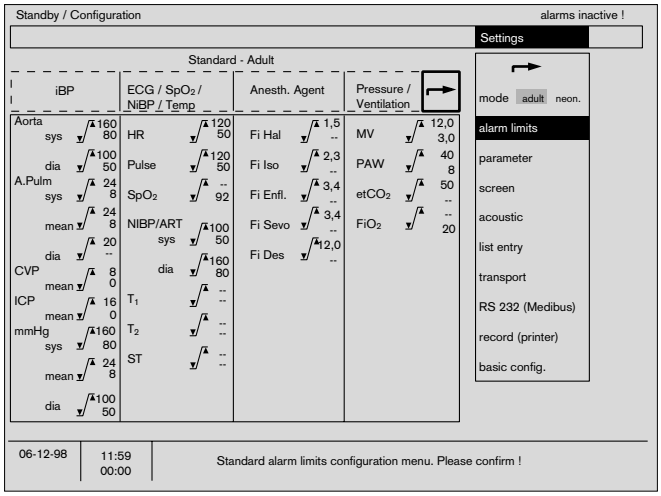
– **iBP**

– **ECG / SpO_2 / NiBP / Temp**

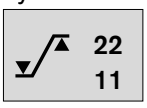
– **Anaesth. Agent**

– **Pressure / Ventilation**





Both the upper and lower limit is displayed at the limit symbol:

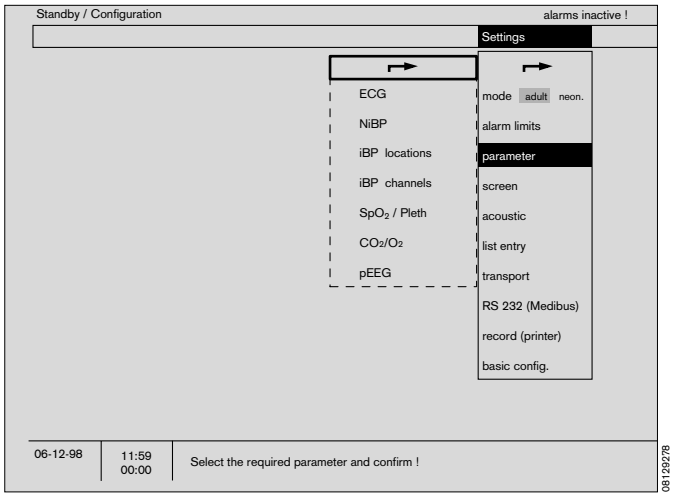


Upper limit
Lower limit

Two dashes (– –) instead of a number indicate that this alarm limit is deactivated and not monitored. This is set by turning the rotary control respectively above or below the maximum or minimum settable value and pressing to confirm.

Not all the alarm limits can be deactivated!

Parameters



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

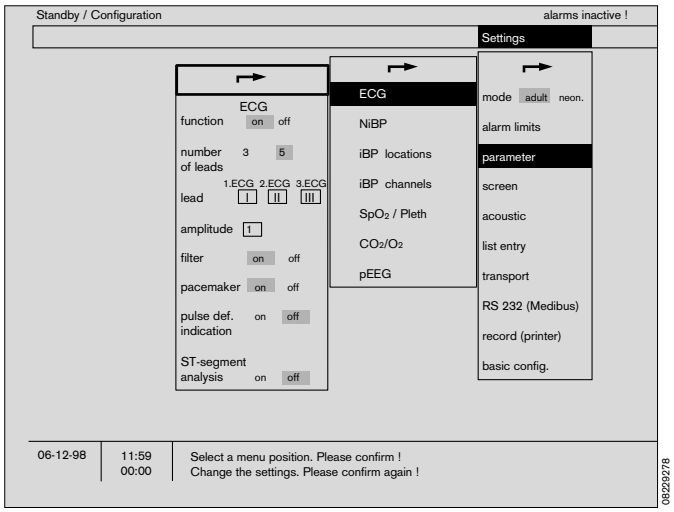
ECG	Electrocardiogram.
NiBP	Non-invasive blood pressure.
iBP location	Determines where iBP is to be measured.
iBP channels	Preselecting the iBP channels.
SpO2/Pleth	Pulse oximetry/plethysmogram.
CO2/O2	Capnography/oxygen measurement.
pEEG	Data-compressed electro-encephelogram (processed EEG).

The settings defined here are activated:

– after switching on the unit

– after selecting **»Standard«** under **»Settings«** during operation (see page 77).

ECG settings



measuring function	Switching ECG measurement on or off.
number of leads	Choice of 3 or 5 leads.
lead	Selects the displayed lead separately for the 1st, 2nd and 3rd ECG curve. With a 3-core cable, the choice is limited to the 1st ECG.
amplitude	Sensitivity of the measurement.
filter	Switches the filter on or off (see page 89).
pacemaker	Switches pacemaker detection on or off.
pulse deficit indication	Switches the pulse deficit indication on or off.
ST segment analysis	Switches the ST segment analysis on or off.

If a 3-wire lead (3-core cable) is selected, only one ECG can be displayed, and so the options for the 2nd and 3rd ECG are cancelled.

NiBP settings

(see also page 91)

time interval Sets the time between measurements.

active alarms Determines which parameter is to be monitored (systolic or diastolic pressure).

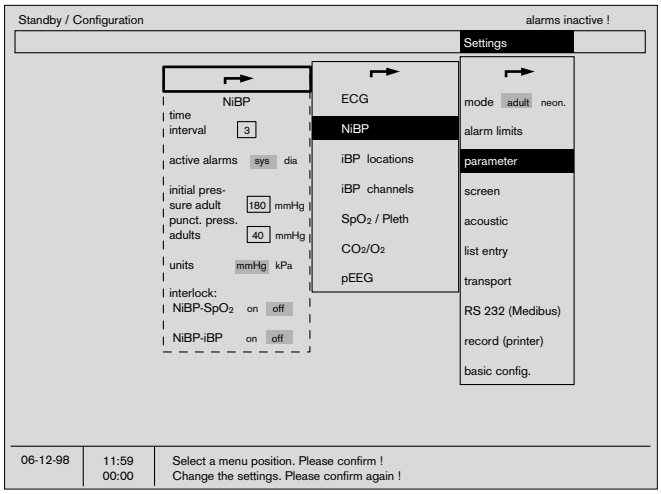
initial pressure Sets the starting pressure.

punction pressure Sets the punction pressure.

The initial and punction pressure can be set separately for adults and neonates. To do so, switch from **»adult«** to **»neon«** and vice-versa under **»Mode«**.

unit Selects the measuring units

interlock When set to **»on«**, peripheral pulse alarms are suppressed while the sphygmomanometer cuff is being inflated.



iBP locations

(See also page 94) With this function, measuring sites can be preselected independently of the channel. The following locations are available:

ART Artery

AORTA Aorta

A.Pulm. Pulmonary artery

CVP Central venous pressure

ICP Intracranial pressure

? Other location

The following parameters can be selected:

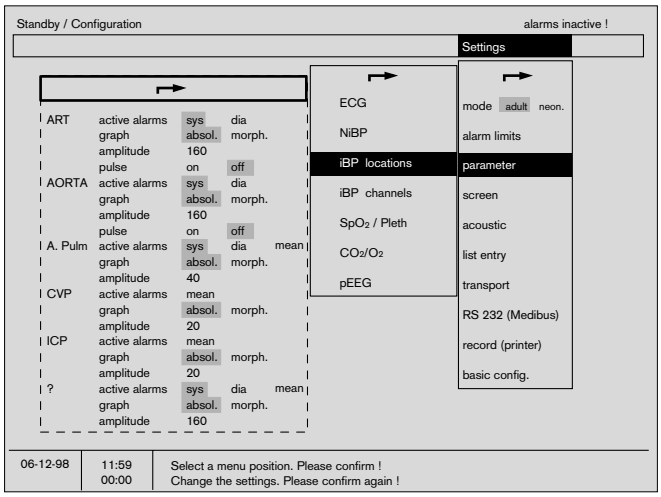
monitoring Systolic, diastolic or mean pressure.

graph abs = fixed curve scale

morph = variable scale. For maximum curve height.

amplitude Scale of the curve. Can only be used with fixed scales (**»abs«**).

pulse Switches pulse indication on/off.



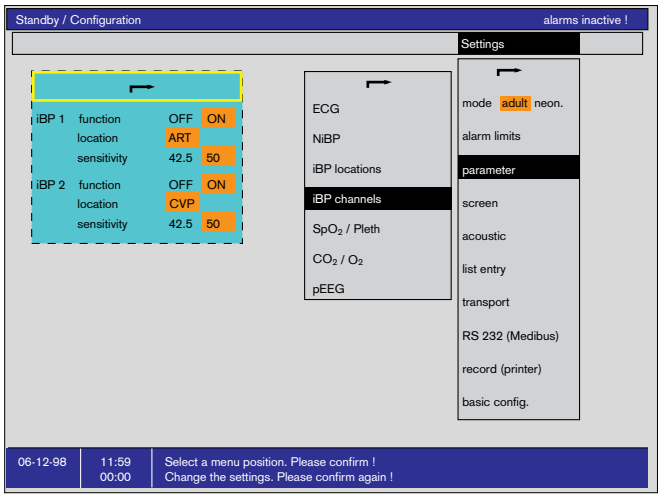
iBP channels

defines input channels P1 and P2 of the parameter box:

measuring function Switches the channel on/off.

location Determines the location for this channel.

sensitivity Selects the sensor sensitivity. 42.5 or 50 µV/V/mmHg



SpO_2/Pleth settings

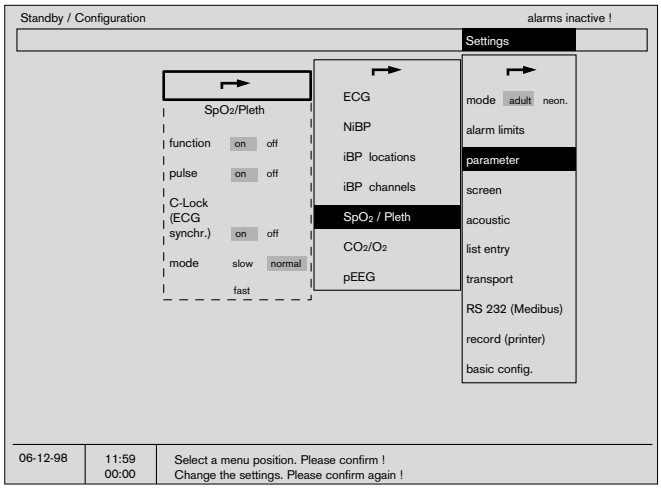
(see also page 97):

measuring function
Switches SpO_2 measurement on and off.

pulse Switches pulse rate display on and off.

C-Lock (ECG synchr.) Switches ECG synchronization on and off.

mode Determines the speed of measurement. Fast measurements are more susceptible to antefoets.



CO_2/O_2 settings

sample rate Selects the flow rate of the sample gas through the sample gas line at the Y-piece. Dräger recommends 200 mL/min with connected sample gas return line.

CO_2 amplitude The maximum amplitude of the CO_2 real-time curve can be set here.

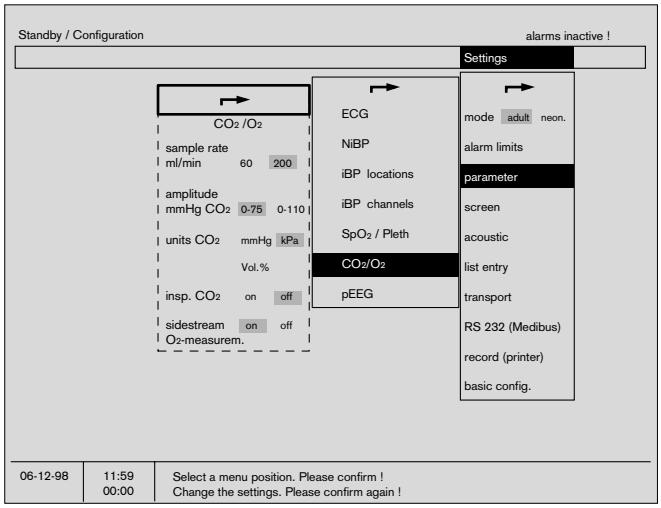
CO_2 unit The CO_2 measuring unit can be selected between mmHg and kPa.

insp. CO_2 Switches the numerical display of the inspiratory CO_2 concentration on or off. Inspiratory CO_2 is monitored in IPPV mode with an adjustable alarm limit of 0 to 10 mmHg.

sidestream O_2 measurement

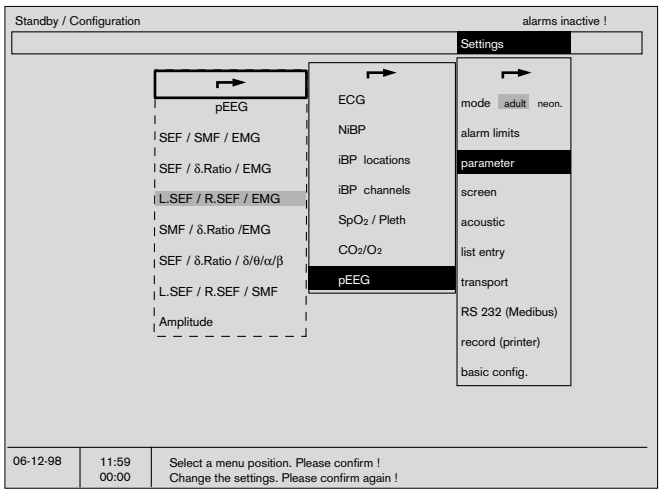
»on«: O_2 is measured by sampling the sidestream.

»off«: O_2 is measured by measuring O_2 at the inspiratory port (requires inspiratory O_2-sensor).



pEEG settings

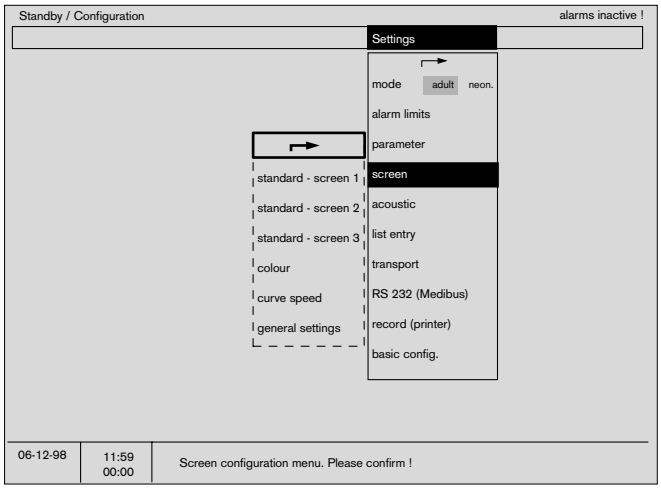
This menu selects the pEEG Parameters displayed in the pEEG module (see page 58).



Configuring screens

Three standard screens can be configured and stored independently of one another. The colour configuration of the screen can be defined. The following menu options are available:

– **Standard screen 1**
– **Standard screen 2**
– **Standard screen 3**
– **Colour**
– **Curve speed**
– **General settings**



The screens are made up of »**Graphs**« and »**Modules**« which can be selected via the menu with the aid of the rotary control.

Configuring standard screen 1 (or 2 or 3)

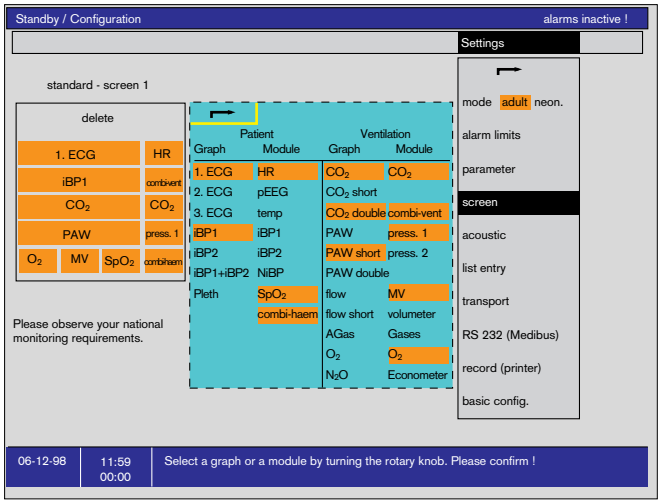
Example:

The screen structure is shown schematically on the left-hand side of the screen. Alongside it, there is a table of graphical and numerical modules for selection.

Modules which have already been selected are shown against an orange background.

- Turn the rotary control to move the rectangular cursor bar (yellow) to the desired module or graph in the table.
- Press the rotary control to confirm.

  The selected item in the table is highlighted against a white background and is displayed in the schematic illustration on the left, framed by the rectangular yellow cursor bar.
- It can be moved in the schematic with the aid of the rotary control.
- When the rotary control is pressed to confirm, the module is then locked in that position on the screen.
- The module is deleted by pressing »**Delete**«.



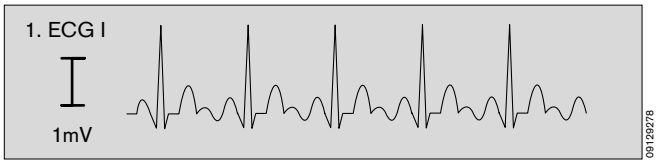
The standard screen selected by this method is activated

- every time the device is switched on
- on quitting the described standard screen configuration.
- on calling up »**Standard**« in the operating configuration.

Observe national regulations on the minimum measurement parameters to be monitored!

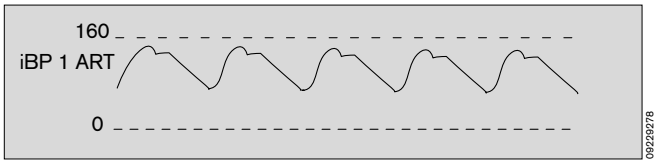
Examples of the other selectable graph modules:

ECG graph ECG real-time curve. The lead and amplitude are selectable.



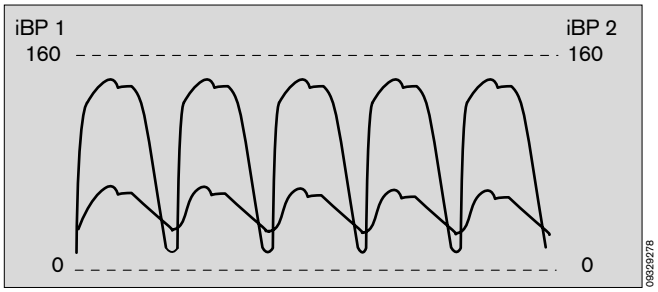
iBP graphs:

iBP 1 Real-time curve of the channel 1 invasive blood pressure measurement. The reference lines are added as dashed lines.



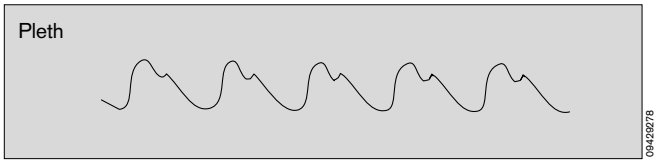
iBP 2 As above, but for channel 2.

iBP 1 + **iBP 2** Display of two iBP curves in a single graph of double module size.



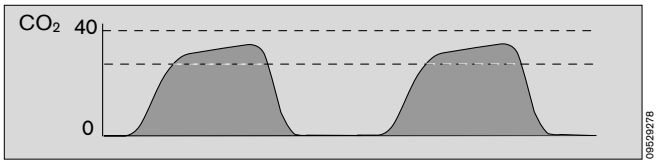
Plethysmogram

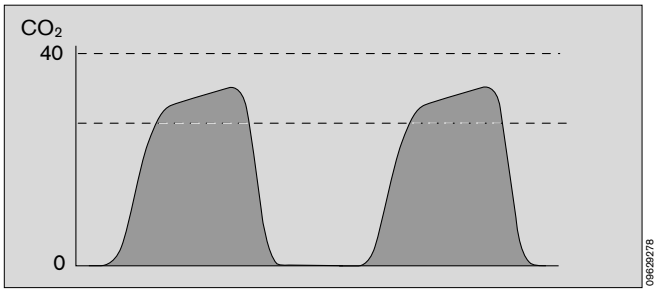
Real-time curve of the plethysmogram measured by the SpO_2 sensor.



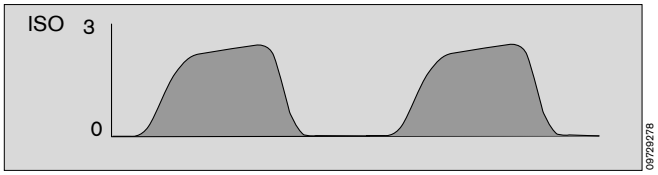
CO_2 graph Real-time curve of the CO_2 concentration of the breathing air in the Y-piece. The alarm limits are shown as dashed lines.

The curve can also be displayed in a double-height module.

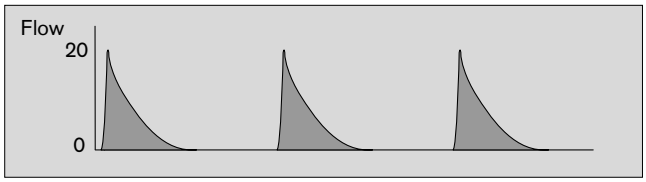




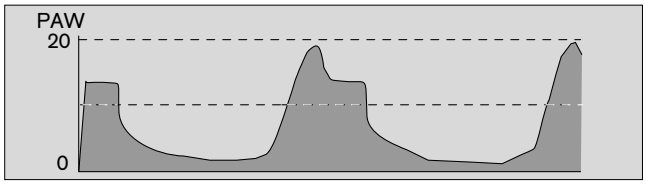
AGAS graph Real-time curve of the anaesthetic agent concentration of the breathing gas at the Y-piece.



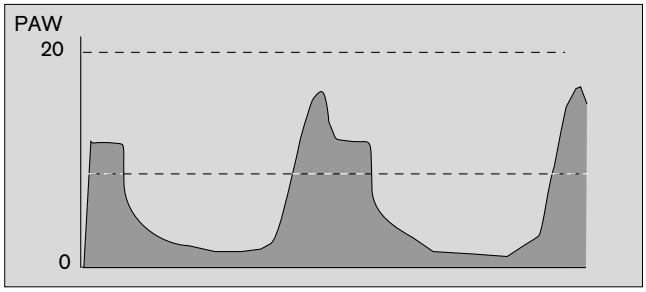
Flow graph Real-time curve of the expiratory breathing gas flow.



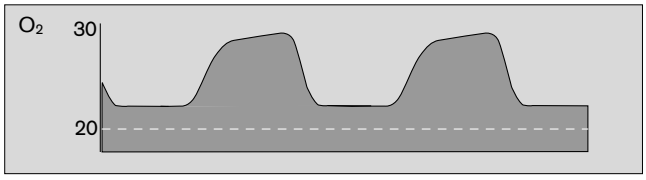
PAW graph Real-time curve of the airway pressure. The alarm limits are shown as dashed lines (only the upper limit in Man/Spont).



The curve can also be displayed in a double-height module.



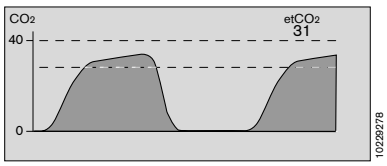
O_2 graph Real-time curve of the oxygen concentration at the Y-piece.



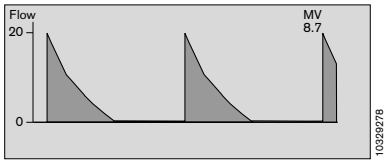
Short curves

The curves for CO_2, Flow and PAW can also be configured as short curves, so that they fit into the area of a numerical module:

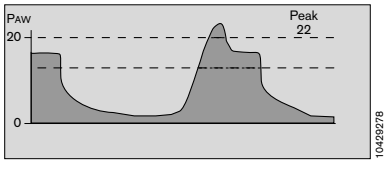
CO_2 short (with indication of the CO_2 value)



Flow short (with indication of the AMV value)



PAW short (with indication of the peak pressure)



Examples of the selectable numerical modules:

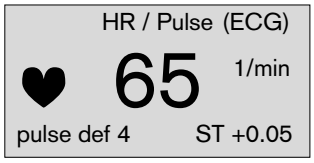
HR/Pulse module

Shows the heart rate/pulse rate, which can be obtained from the ECG, SpO_2 or iBP. The data source is shown in descending order of priority.

Order of priority:

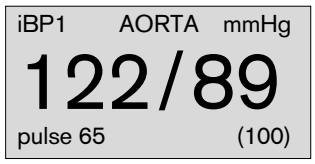
1. ECG
2. SpO_2
3. iBP 1
4. iBP 2

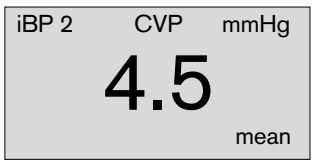
This module also displays the pulse deficit (calculated from the difference between the heart rate and the pulse rate obtained from SpO_2 measurement) and the ST segment height of the 1st ECG.



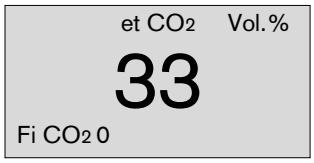
iBP 1/2 module Shows the systolic/diastolic and mean values of the invasive blood pressure measurement. The pulse rate can be displayed at the same time.

For central venous and intracranial pressure, the mean value is displayed in large figures.

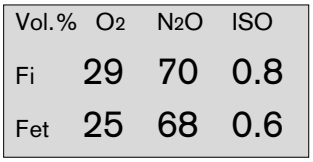




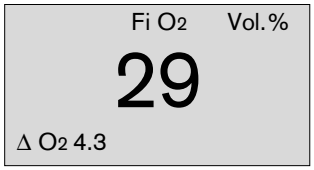
CO_2 module The end-expiratory CO_2 concentration of the breathing gas ($etCO_2$) is indicated. The inspiratory value ($FiCO_2$) can also be shown.



Gases module Shows the composition of the breathing gas in relative concentrations of O_2, N_2O and anaesthetic agent.

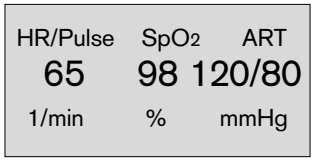


O_2 module Shows the inspiratory O_2 concentration of the breathing gas (FiO_2) and the difference in relation to the expiratory O_2 concentration (ΔO_2).



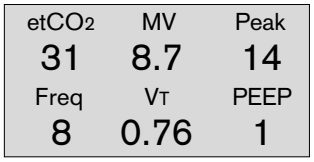
Comb. haem. module

Shows the combination of measured values obtained from the measurements of HR/Pulse, SpO_2 and iBP (only ART measuring site).

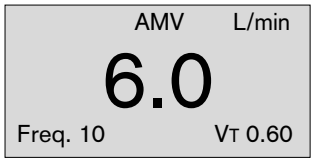


Comb. vent. module

Shows the combination of measured values obtained from the measurements of etCO2, AMV, Peak, Freq, VT and PEEP.

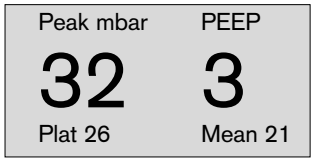


AMV module Shows the expiratory tidal minute volume, breathing frequency and VT.



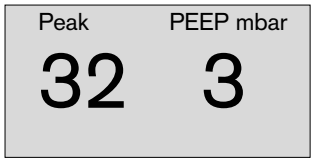
Airway pressure module 1

Shows the maximum airway pressure and the measured PEEP; also (small print) the plateau pressure and mean pressure value.

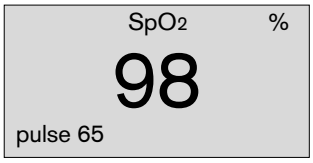


Airway pressure module 2

Shows the maximum airway pressure and the measured PEEP.

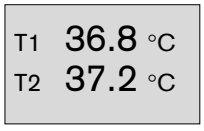


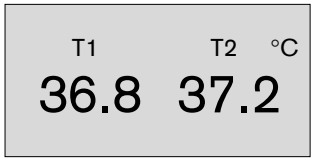
SpO2 module Shows the functional O2 saturation of the blood and the pulse rate.



Temperature (small)

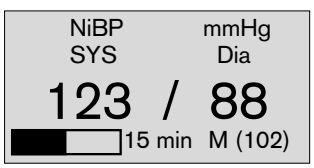
This module displays the temperatures T1 and T2 in the bottom right-hand corner of the screen (for the configuration see »**General settings**« on page 61). Alternatively, temperatures T1 and T2 could also be displayed in a normal module.





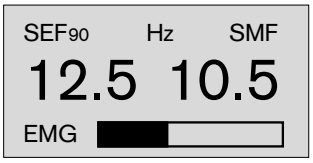
NiBP module Shows the non-invasive blood pressure, the mean pressure and the time remaining until the next measurement.

During the measurement, the bar graph shows the current sphygmomanometer pressure.

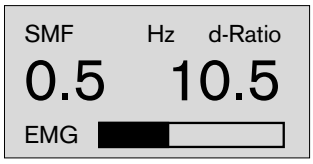


pEEG modules pEEG modules are available for selection in the parameter menu (see page 52).

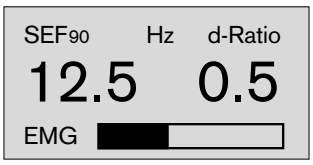
Please observe the separate Instructions for Use!



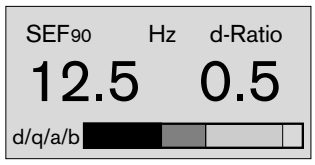
SEF / SMF / EMG



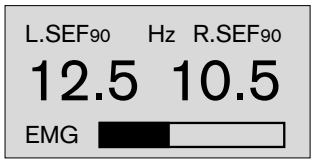
SMF / d-Ratio / EMG



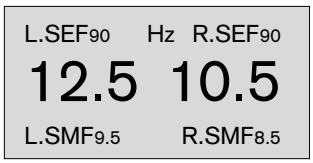
SEF / d-Ratio / EMG



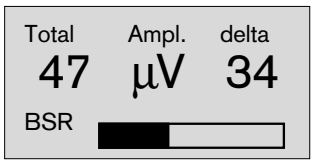
SEF / d-Ratio / d / t / a / b



L.SEF / R.SEF / EMG



L.SEF / R.SEF / SMF



Amplitude

Volumeter module
This module comprises a breath volumeter (upper bar graph) and a minute volumeter (lower bar graph). The length of the bar represents the maximum measured value in accordance with the mode selected:

Mode	Breath VT	MV
Neonates	0.25 L	2.5 L/min
Adults	1.25 L	12.5 L/min

Breath volumeter:

– The expiratory volume of each breath (VT) is shown graphically by the upper bar and numerically in large numerals abore.

Minute volumeter:

– The minute volumeter in the lower bar graph runs for 60 seconds, during which it adds up the tidal volumes.

The time expired is shown in seconds together with the value in large numerals. The individual breaths are shown as segments in the bar graph. The volumeter stops automatically after 60 seconds and beeps. The measured values are displayed for 4 minutes and then deleted.

To start the volumeter:

- Press the rotary control. If it is pressed again during the 60 seconds, the values are deleted and the volumeter restarted.

Econometer module

In IPPV mode, shows the fresh gas balance in the breathing system in the form of a bar graph (see description on page 179)

Bar in the right-hand sector: The fresh gas flow is unnecessarily high for standard applications.

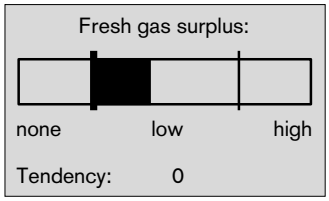
Bar in the left-hand sector: Risk of fresh gas shortage.

In this case, an advisory alarm draws attention to the potential lack of fresh gas even before the **»FRESH GAS? !!«** caution message is displayed on the system screen.

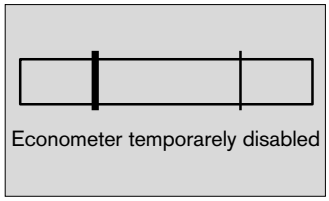
A tendency indicator shows whether the system is filling (arrow pointing to right), emptying (arrow pointing to left) or whether the level is remaining constant (indicator »O«).

Immediate action need only be taken in the event of the »FRESH GAS? !!« caution message.

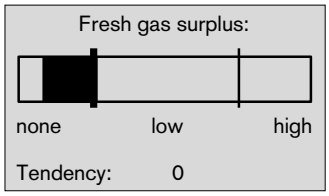
The econometer is switched off when the ventilator operates outside the frequency range of 6 to 40 strokes per minute.



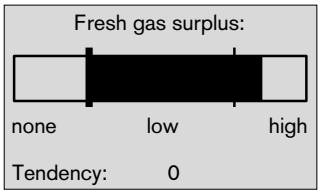
Good setting



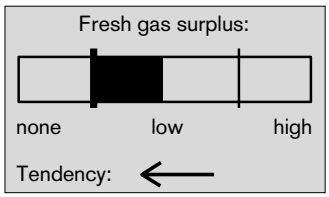
The econometer is switched off.



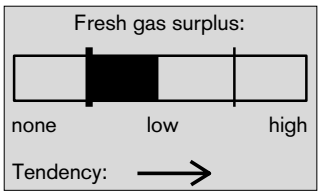
Risk of fresh gas shortage



High fresh gas surplus



Good setting
but tendency dropping

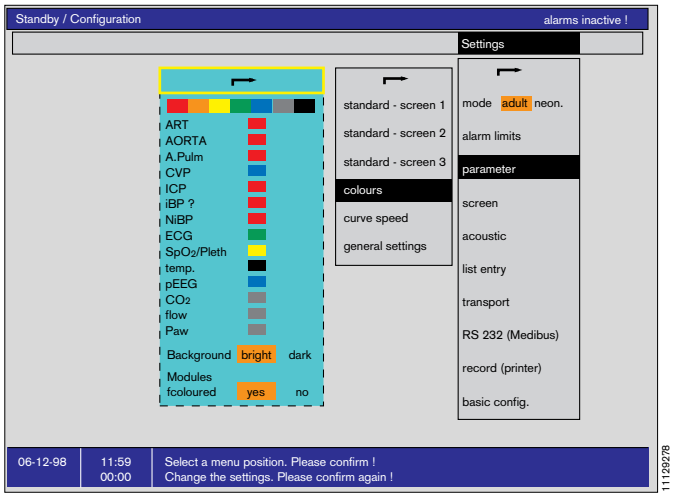


Good setting
but tendency rising

Configuring the screen colours

Colour settings always relate to all the settings associated with a particular parameter. The curves and their corresponding numerical modules are always in the same colour if colour numerical modules are configured by the user.

- Select the desired parameter and confirm.
- Change the colour by turning the rotary control. Colours are displayed in the same order as the colour scale at the top of the menu.
- Confirm the selected colour.



Configuring the background settings

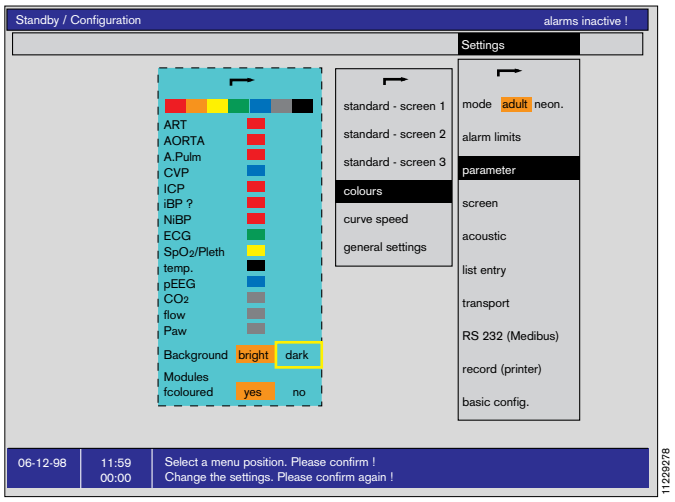
dark Black background, bright curves and numbers. Use preferably in a dark environment.

bright White background, dark curves and numbers. Use preferably in a bright environment to avoid reflections on the screen surface.

colour modules

yes The numerical modules are displayed in the same colour as the associated curve.

no The numerical modules are displayed monochrome.

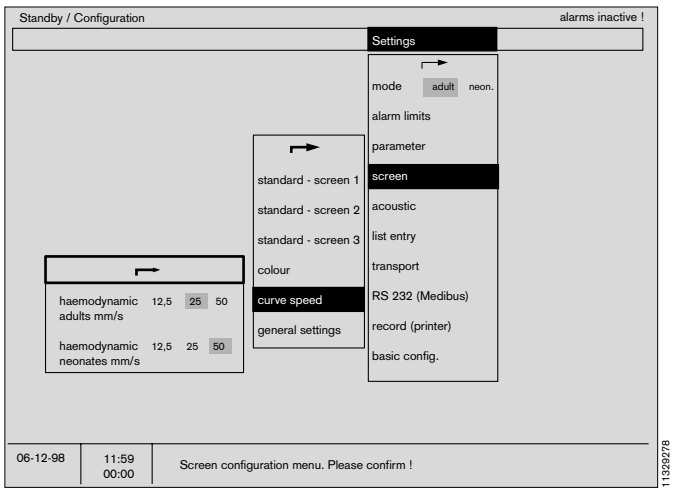


Configuring the curve speed

The speed of the curves is determined in mm/s for the following measured values:

haemodynamic adults Haemodynamic parameters in adult mode.

haemodynamic neonates Haemodynamic parameters in neonatal mode.



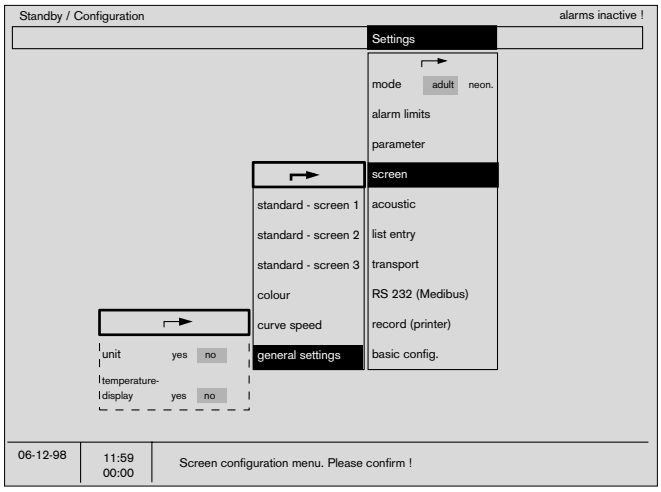
Configuring the general settings

The following can be switched on (»**yes**«) or off (»**no**«):

units Indication of the units.

Temperature display Option to display the body temperatures in the bottom right-hand corner of the screen (below the softkeys).

This display configuration saves space for a numerical module.



Acoustic

The volume and tones are defined here.

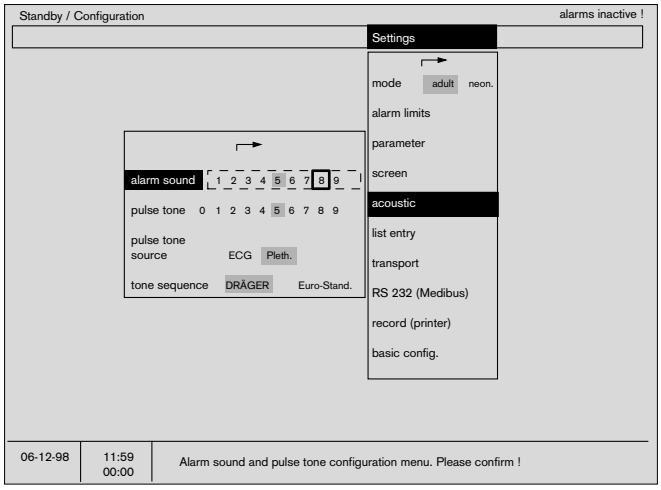
»**0**« equals »**off**«, while »**1**« is the lowest and »**9**« the highest volume.

alarm sound Volume of the alarm

pulse tone Volume of the pulse tone

SpO2-modulated ECG pulse tone The ECG pulse tone can optionally be modulated with the SpO2 value.

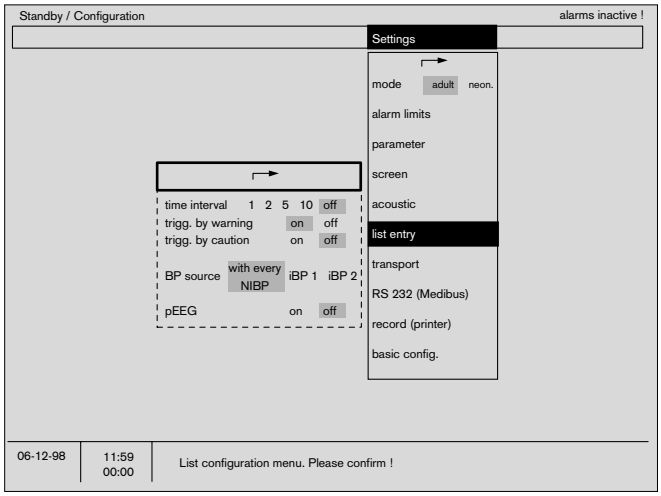
tone sequence Specifies the tone sequence. Either ISO or Dräger standard.



List entry

A menu is displayed to allow the user to select at what times (fixed intervals) or events (warning, caution message, NiBP measurement) list entries are to be made.

In addition, this menu defines the source of the blood pressure value and whether EEG entries are required. If EEG entries are selected, they replace the temperature entries.



Transport function

The parameter box stores the following data, which can be transferred to the system screen:

– Patient data from the list screen,

– Alarm limit settings and

– Measurement parameter settings.

The patient remains connected to the parameter box while in transit. The patient's data remains constantly available. There is no need to reconnect the patient and set system screens.

The transport function can be preset in **»Standby«** (operation in normal use is described on page 83 in the **»Parameter box«** section).

Transport function on/off

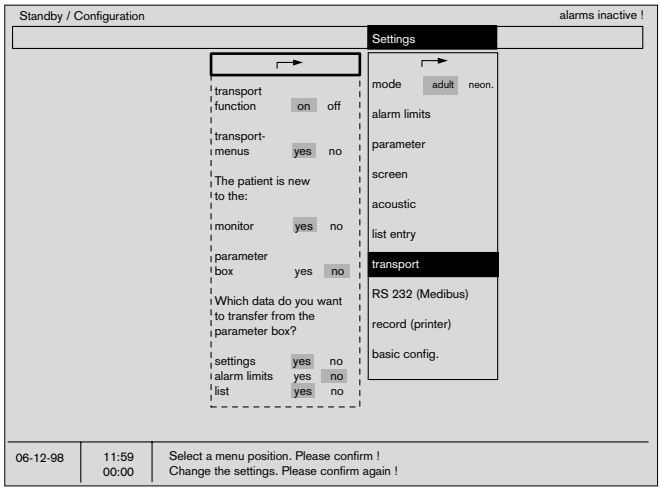
When switched **»off«**, no data is exchanged between the parameter box and the system screen (suitable for stationary use of the parameter box).

When switched **»on«**, data is exchanged.

Transport menus yes/no

If switched to **»no«**, data is transferred between the parameter box and the system screen in accordance with the presetting in **»Standby«**.

If switched to **»yes«**, the user can modify the type and scope of data transfer during operation (see also **»Parameter box«** section on page 86).



The patient is connected for the first time to …

If a patient is connected for the first time, the parameter box will not yet contain any stored data for the patient. This will generally be the case in the admissions room.

If so, enter **»yes«** next to **»parameter box«**.

In response, any remaining data from the previous patient will be deleted!

If the patient arrives with parameter box already connected, i.e. with a "previous history" on the device, enter **»no«** after **»Parameter box«**. Data will then be transferred from the parameter box to the system screen. Such cases will generally occur in the operating theatre and in the recovery room.

The following dialogue is then displayed on the system screen:

»Do you want to transfer the following data from the parameter box?«

Settings yes/no

If **»yes«**, the settings of the measurement parameters are transferred from the box (e.g. iBP calibration, NiBP interval, ECG amplitude, etc.).

If **»no«**, the current system screen settings remain valid.

Alarm limits yes/no

If **»yes«**, the alarm limits are transferred.

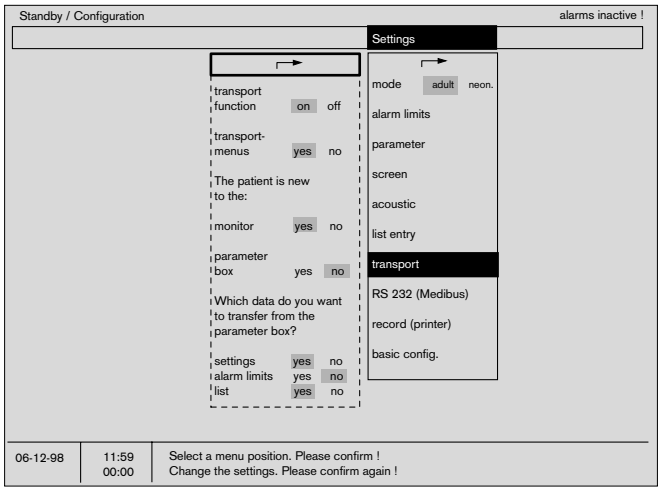
If **»no«**, the current settings of the system screen will remain valid.

List yes/no

If **»yes«**, the data stored in the parameter box is transferred and inserted in the list.

If **»no«**, the data stored in the parameter box is not transferred.

In normal operation (see section on the **»Parameter box«** on pages 86), this dialogue is only displayed when the **»Transport menu«** is set to **»yes«**. Otherwise, the instructions programmed here are executed directly.



External Dräger RS-232 interface (MEDIBUS)

The interface parameters for data transfer are programmed here:

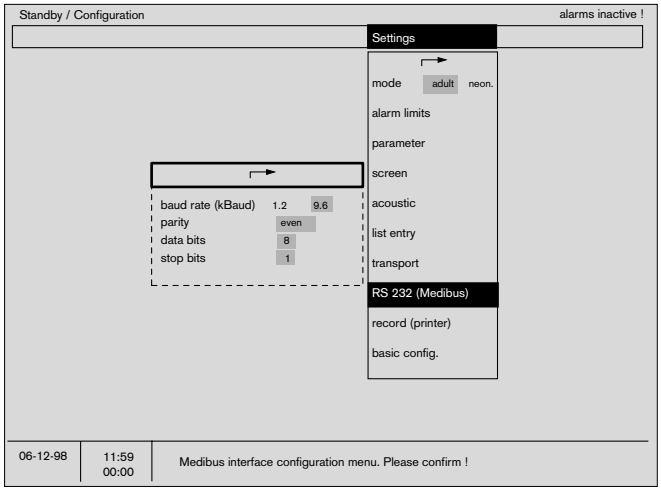
Settenigs for connecting the Dräger pEEG monitor:

baud rate: 1.2 or 9.6

parity: even (Information only, cannot be selected!)

data bits: 8 (Information only, cannot be selected!)

stop bits: 1 (Information only, cannot be selected!)



Record (printer)

This menu is used to configure the interface for data transfer to a logging printer (see Instructions for Use of the device to be connected):

record output Determines whether the printer interface is to be used for a printer or as an additional MEDIBUS interface.

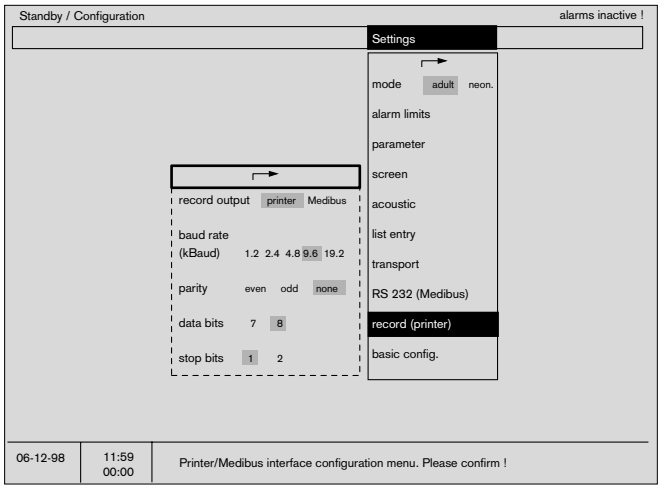
baud rate 1.2, 2.4, 4.8, 9.6 or 19.2

parity »**even**«, »**odd**« or »**none**«

data bits 7 or 8

stop bits 1 or 2

If the printer interface and Medibus interface are used simultaneously, the Baud rate must be set to 1.2.



Basic configuration

The basic configuration comprises three items:

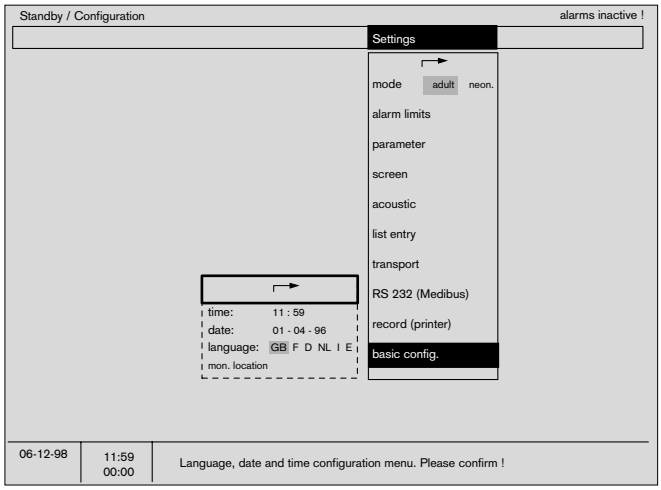
– **time** for the current time

– **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**
Spanish	**E**
Italian	**I**
Danish	**DK**
Swedish	**S**
Norwegian	**N**

– **location** The location of the device can be entered. If so, it will then be displayed in the list screen after the data has been transported with the parameter box.



Language table

Language	Ventilator SW	Monitor SW
English	All	All
French	All	All
German	All	All
Dutch	All	All
Spanish	All	All
Italian	All	All
Danish	as from 7.01	as from 4.0
Swedish	as from 7.01	as from 4.0
Norwegian	as from 7.20	as from 4.0

Text input for the location:

- Select »**monitor location**«. A frame appears in the input field.
- Letters are displayed inside this frame in alphabetical order when you turn the rotary control.
- Confirm the desired letters. The frame jumps to the next position where a letter can be entered.

Select the arrow symbol to exit this menu.

Calibration

Since all sensors of the Cicero EM are calibrated fully automatically, the use of this menu is not required in normal operation. The following functions can be calibrated in this menu:

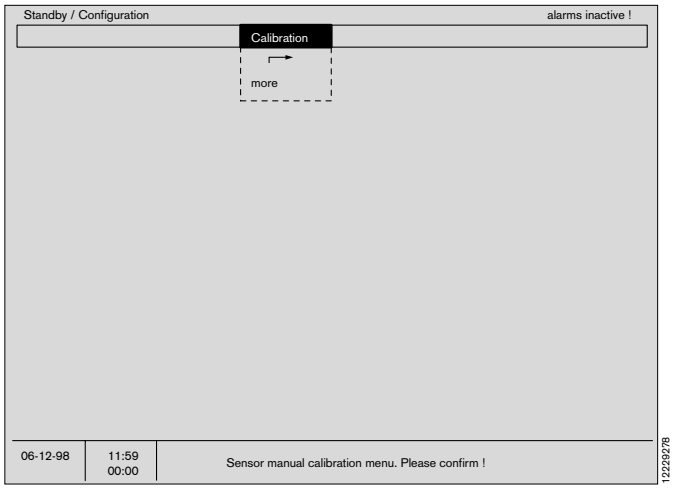
– O_2 sensor with 21% O_2 by volume.
– Flow sensor.
– O_2 sensor with 100% O_2 by volume.
– Linearity check of the O_2 sensor.
– Zero point of the gas sensor.

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.



O_2-sensor 21% by volume

New sensors must be allowed to run in for 15 minutes. (The zero point stability is increased)

For the inspiratory O_2-sensor:

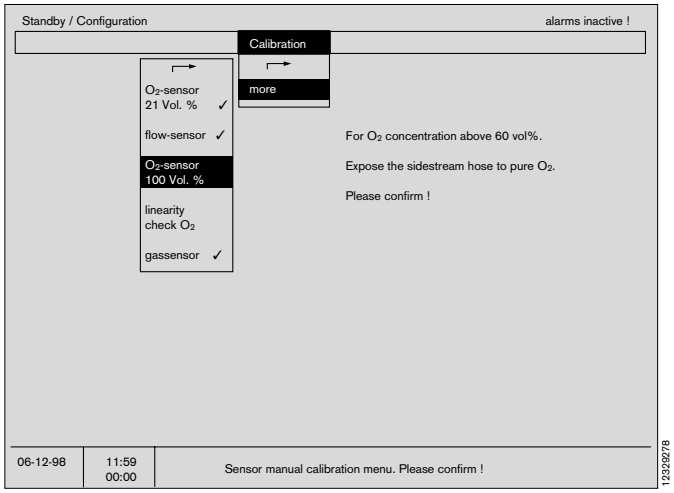
- Remove the sensor cell and expose to ambient air.
- Select the **»O_2 sensor«** field and confirm.

The sidestream O_2-sensor is calibrated automatically. For manual calibration:

- Select the **»O_2 sensor 21 Vol.%«** field and confirm.

Wait until the clock symbol (◴ ,◷ , …) is replaced by a tick (✔).

- Reconnect the inspiratory sensor (if used).

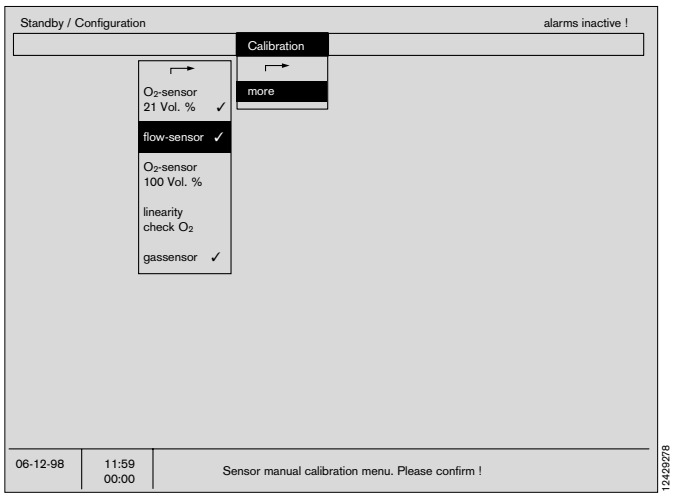


Flow sensor

This procedure is only required if the flow sensor is not calibrated automatically. Auto-calibration is only possible if gas measurement is connected.

Manual calibration deactivates auto-calibration until the equipment is restarted or for a maximum of 24 hours.

- Ensure that there is no movement of air inside the sensor and that pure air is present in the sensor (seal one side with your hand and hold horizontally to prevent false calibration. See also page 177).
- Select the **»flow-sensor«** field with the rotary control and press to confirm. The tick (✔) indicates that calibration is complete.



O_2-sensor 100 Vol.% O_2

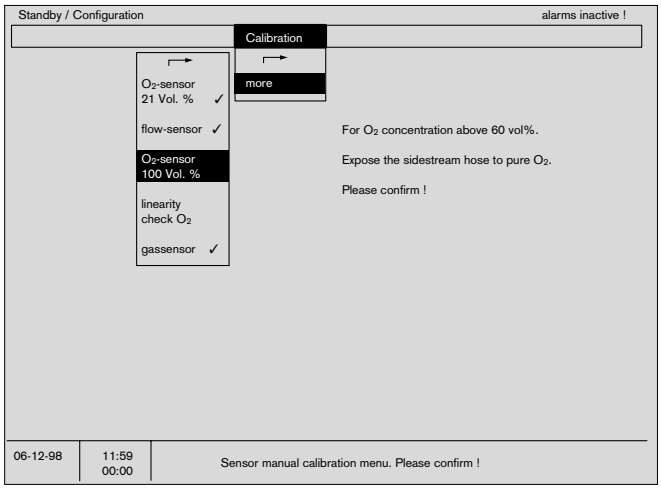
For calibrating the sensor in pure oxygen:
Note the information on the screen; see also page 176.

For the inspiratory O_2-sensor:

- Remove the sensor cell and expose it to pure oxygen.

For the sidestream O_2-sensor:

- Expose the end of the sampling hose to pure oxygen.
- Select the field »**O_2-sensor 100 Vol.%**« with the rotary control and press to confirm. The tick (✔) shows that calibration is complete.



Linearity check O_2

Note the information on the screen; see also page 106!

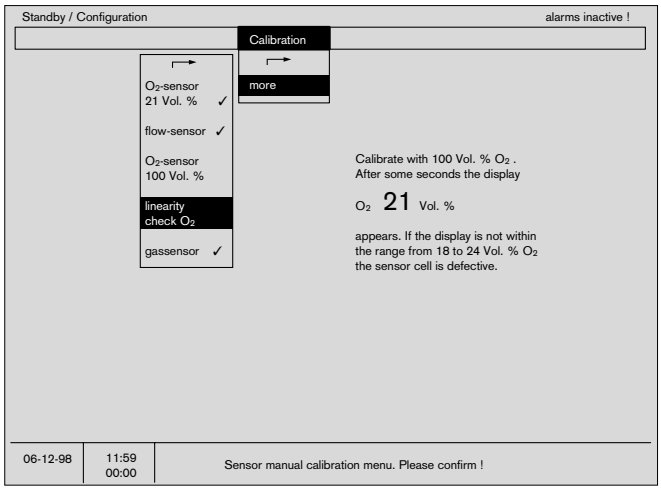
For the inspiratory O_2-sensor:

- Remove the sensor cell and expose it to pure oxygen. Calibrate with 100% O_2. Then expose the sensor cell to ambient air.

For the sidestream O_2-sensor:

- Expose the end of the sampling hose to pure oxygen. Calibrate with 100% O_2. Then expose the end of the hose to ambient air again.
- Select the field »**linearity check O_2**« with the rotary control and press to confirm.

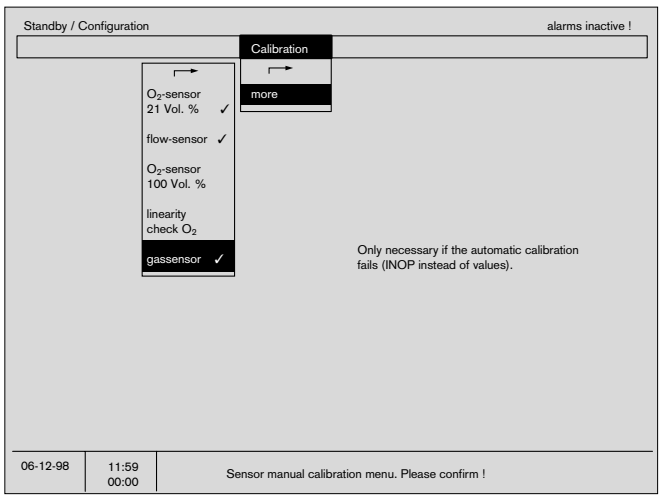
  »**O_2 : 21 Vol.%**« appears after 20 seconds.
  The sensor cell is defective if the value displayed does not lie between 18 and 24 Vol.% O_2.



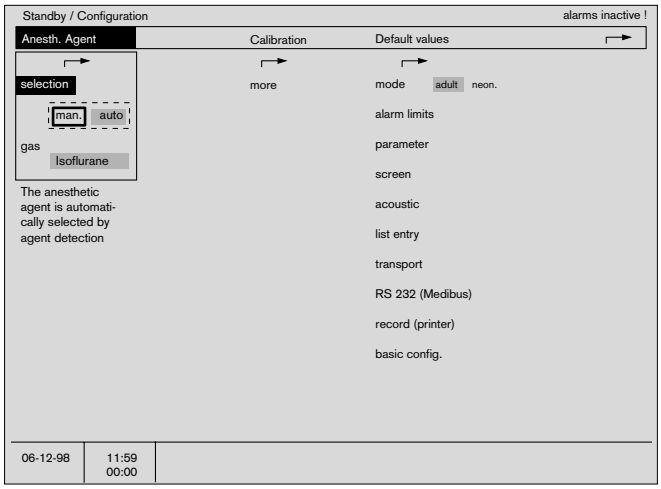
Gas sensor zero check

Zero alignment of the gas sensor for N_2O, anaesthetic agent and O_2 is generally automatic. If manual calibration is desired:

- Select the field »**gas sensor**« with the rotary control and press to confirm.



Anaesthetic agent



The Cicero EM has an automatic anaesthetic agent identification system and can therefore recognise the anaesthetic agent actually used. If automatic recognition is not required by the user, the anaesthetic agent can also be selected manually.

- Select »**selection**« and confirm -
- Position the cursor frame over »**man**« with the rotary control and confirm -
- Select the »**gas**« option and confirm -
- Turn the rotary control until the desired anaesthetic agent is displayed in the window.

Automatic anaesthetic recognition can be reactivated at any time by selecting and confirming »**auto**«. This selection overwrites the manual settings.

The responsibility for the choice of anaesthetic agent and correct filling of the Vapor remains with the user.

When the anaesthetic agent is changed, the trend memory for the anaesthetic agent concentration is automatically deleted.

When using for the first time, the anaesthetic agent is set to **»auto«** by default.

Notes on automatic anaesthetic agent recognition:

– The measuring accuracy required by the ISO standard is attained at the latest 4 minutes after switching on the unit.

– The threshold value for automatic recognition is 0.15 Vol.%.

– Gas mixtures are recognised as from a concentration of 0.4% by volume for the second gas.

  In the event of a gas mixture, the main gas is identified and measured. When changing gas the measured value display informs the user of the gas status:

Phase	Insp. value	Exsp. value	Display
1	dithered	bright	»AGAS mix«
2	dithered	dithered	»AGAS mix«
3	bright	dithered	»AGAS mix«
4	bright	bright	

1: Mixture during inspiratory phase, while expiratory phase still has pure gas.

2: Mixtures during both inspiratory and expiratory phases.

3: Pure gas (again) during inspiration, while expiratory phase (still) has gas mixture.

4: Pure gas (again) in both breathing phases.

Switching on the system screen

The system screen starts up automatically whenever a ventilation mode is invoked on the ventilator. »**standard screen 1**« is displayed with the monitoring mode corresponding to the selected ventilation mode.

To start up the system screen alone:

1 Press ⏻ or ▭ on the screen.

2 To call up a selection menu:
Press ▭.

A selection menu appears for the following screens:

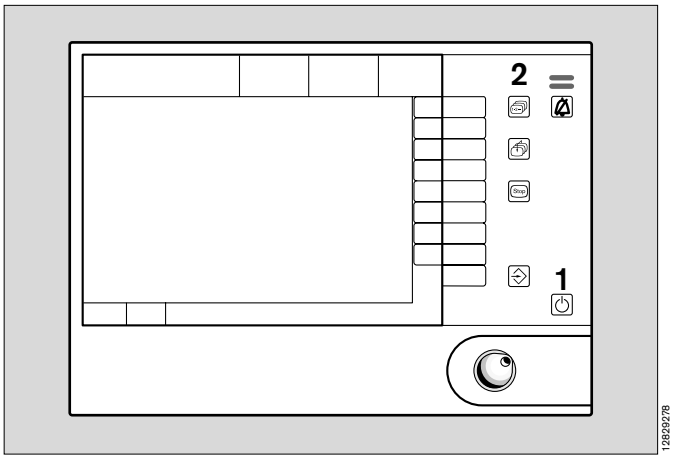
Standard-screens 1, **2 and 3**,
Data-screen,
List screen and
Trend screen.

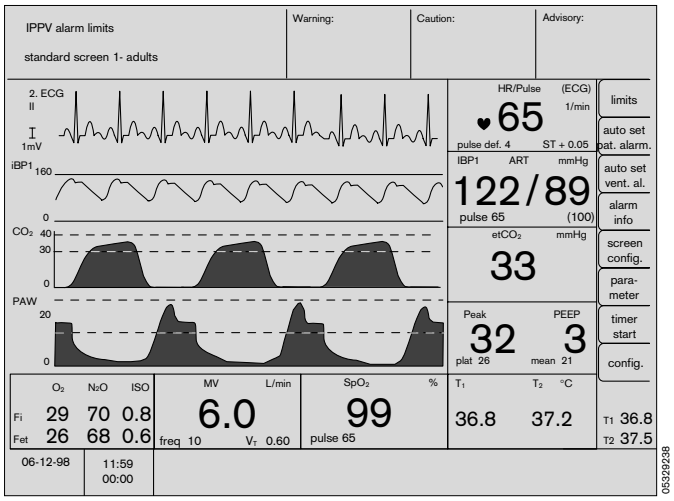
– **Standard screens 1**, **2** and **3**
contain the graphical and numerical modules configured by the user.

– The **data-screen**
contains a tabular overview of all measured values. The top curve and top module of the last selected standard screen are displayed above these values.

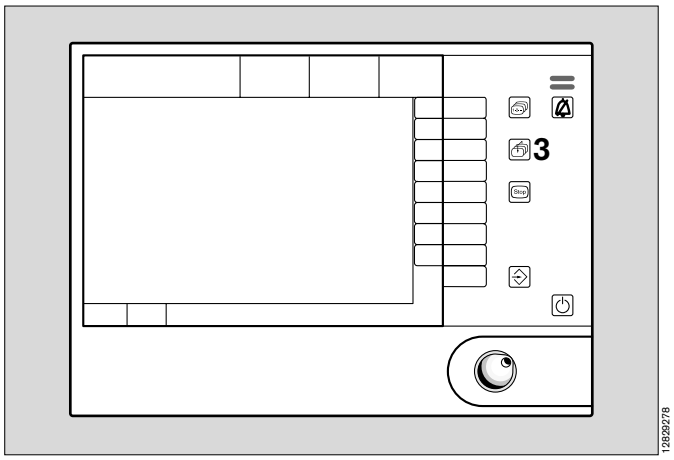
– The **list screen**
contains all the measured values and alarms which have been saved and makes it easier to complete the anaesthetic record (See page 70). The top curve and top module of the last selected standard screen are displayed above these values.

– The **trend screen**
shows the measured values over time. The top curve and top module of the last selected standard screen are displayed above these values.





3 Press ▭ to return directly to the last selected »**standard screen**«.



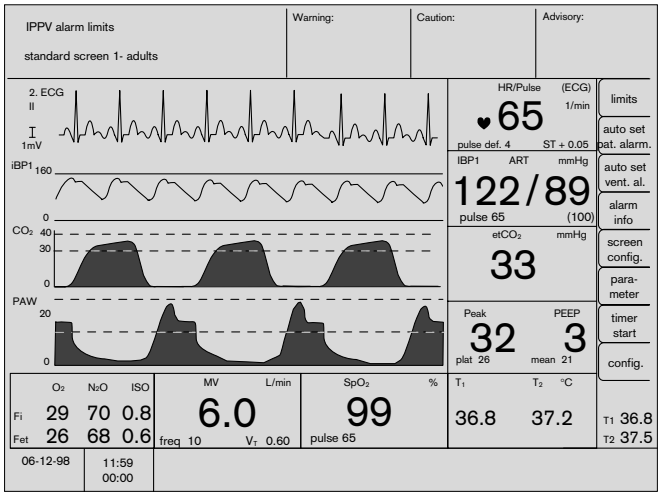
Standard screens

The three standard screens are preconfigured by the manufacturer.

The configuration of these screen pages is described from page 47 ff. onwards.

The softkeys are described on page 13.

Example of a standard screen:

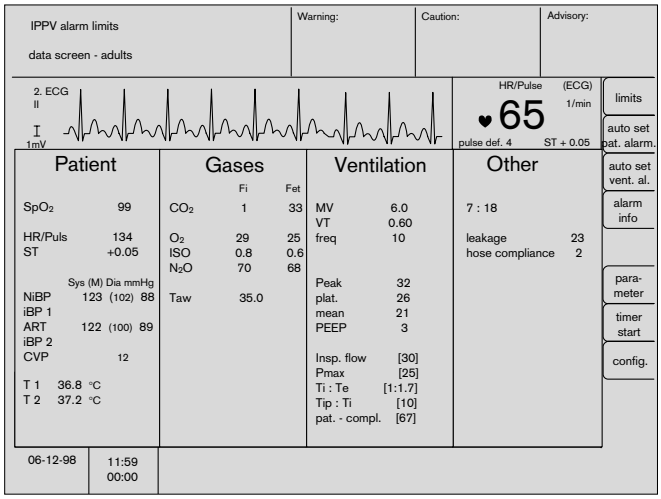


Data screen

All the current measured values are presented on this screen in tabular form.

The results of the last leakage/compliance test are shown with date and time in the column headed »**Other**«.

The curve shown at the top is the uppermost curve of the last selected standard screen.



List screen

Certain measured values which have been automatically or manually saved are displayed here for documentation (to facilitate compilation of the anaesthetic record).

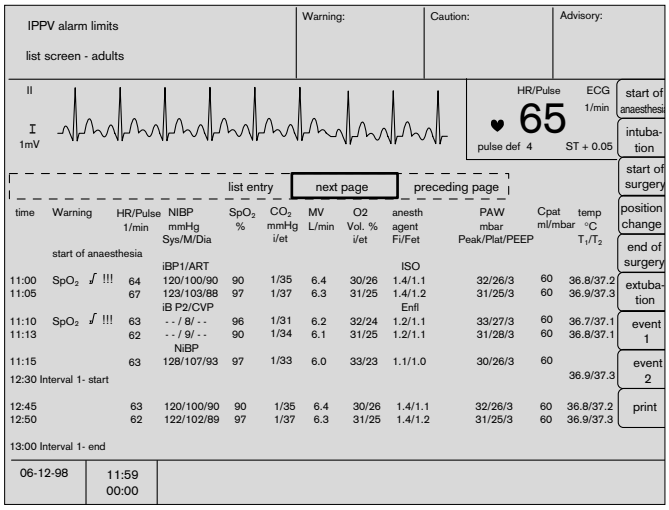
A time interval, delimited by the connection and disconnection of the parameter box, is indicated in the list by the label »**interval x start**« and »**interval x end**«. The user programmed location of the device is also displayed after the data has been transferred (see page 64).

The measured values and the warning or caution messages triggering them are recorded line by line, together with the time, either at specified intervals and/or as a function of warning or caution messages or of an NiBP measurement.

A list entry can be generated manually at any time by pressing  indpendently of the screen in use. Additionally a number of predefined labels can be inserted into the record using the Softkeys.

For example: »**Start of surgery**«
»**position change**«
»**Intubation**«

The list can run into several pages - so that you may have to "leaf through" for a specific entry.



Return to previous page:

- Select »**previous page**« with the rotary control and press to confirm.

Continue to next page:

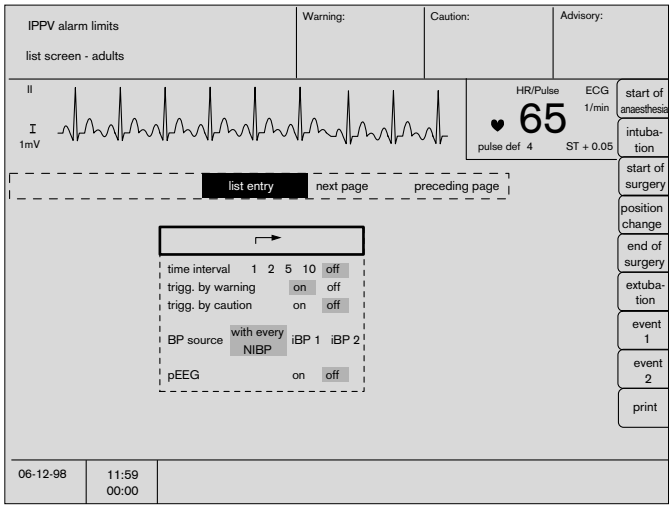
- Select »**next page**« with the rotary control and press to confirm.

Define list entry:

- Select and confirm **»list entry«**. A menu is displayed for the user to define the times (fixed intervals) or events (warning, caution message, NiBP measurement) at which list entries should be made.
- In addition, this menu defines the source of the displayed blood pressure measurement and whether EEG entries are required. If EEG entries are selected, they replace the temperature entries.

Print list entry:

- Press the »**print**« softkey to print out the complete list on a connected external printer.



Trend screen with zoom function

The measured values are shown as a function of time since measurement began.

The values can be stored for a maximum of 8 hours.

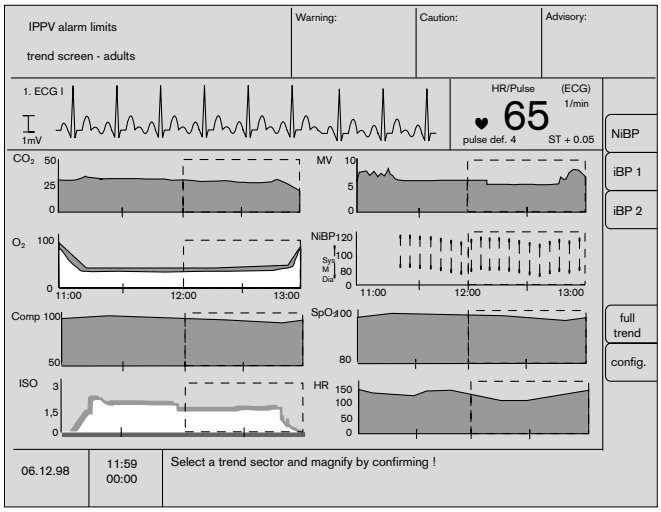
The zoom function can be called up when the system has been in operation for more than 30 minutes. A segment of the time range can be enlarged (possibly several times) with this function. The segment is identified by a dashed border.

Example:

- Turn rotary control - move segment.
- Press rotary control - the dashed area is extended to cover the full display width.

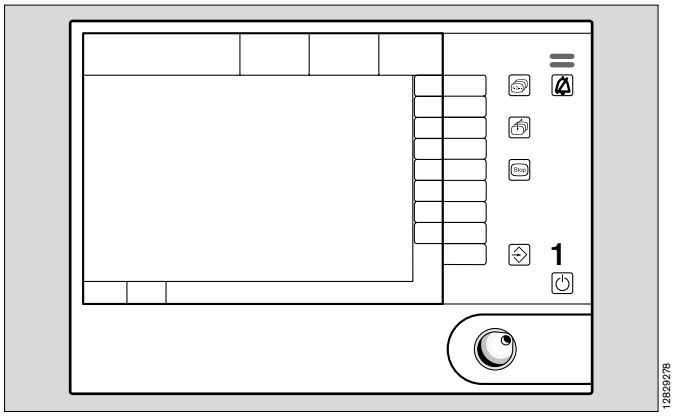
  If the system screen has been in operation for a sufficiently long period of time, a new dashed area appears which can then be extended as described above.

  The maximum has been reached when no additional dashed frame appears.



Full trend:

- Press »**full trend**« in order to redisplay the complete trend.
- By activating the softkeys
  – »**NiBP**«,
  – »**iBP 1**« and
  – »**iBP 2**«
  the relevant blood pressure trends can be selected, with the display of diastolic, systolic and mean pressure.



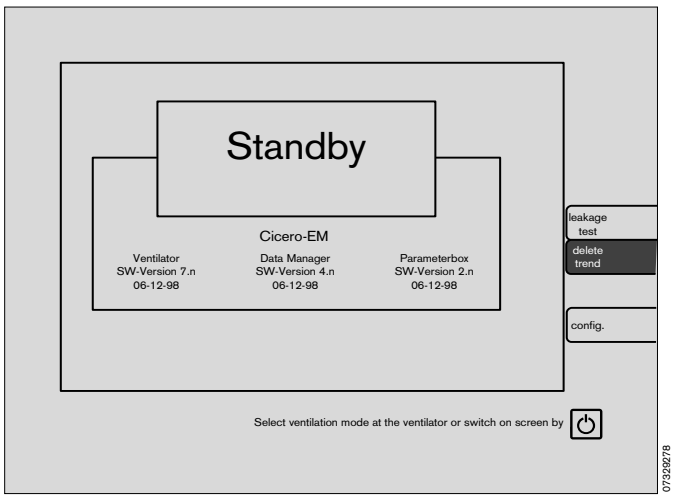
Clearing the list and trend memory:
In principle, the trend memory and list of the system monitor are erased by switching off the Cicero EM.

The trend memory and list can also be cleared in standby mode.

If a parameter box is connected, its list memory will also be cleared.

1 Press ⏻ to switch over to »**Standby**« mode.
  This is only possible if the ventilator is already in »**Standby**« mode.

- Press the softkey »**delete trend**«.
  The system enquires again whether the trend is really to be deleted.
- Press the softkey »**delete**« to confirm.
  The original screen is restored by pressing the softkey »**do not delete**«.



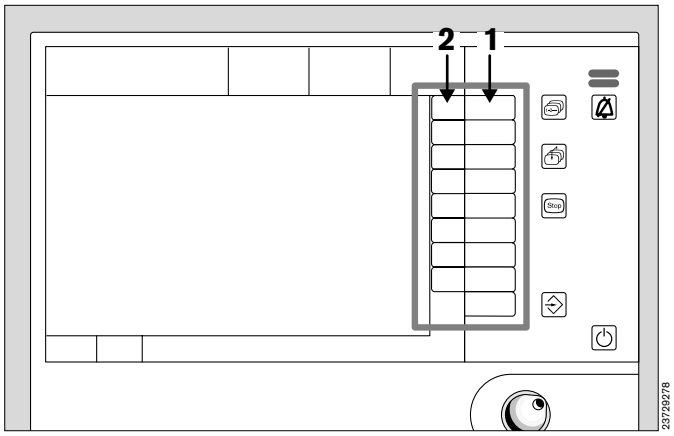
The stored trend of the anaesthetic agent concentration is deleted every time the anaesthetic agent is changed.

Softkeys

1 On the right-hand side, beside the screen, there is an unmarked touch-sensitive keypad.

2 The function of these keys changes and is indicated on the screen.

Only those keys which can be activated are indicated on the screen.



Limits

The display comprises the designation of the measured value, the value actually measured on the patient (large numerals) and the set upper and lower alarm limits (small numerals) under the symbol for the relevant alarm limit (lower: ↓, upper: ↑).

A deactivated alarm limit is indicated by dashes in the numbers field, and an alarm limit that cannot be activated is indicated by a blank field.

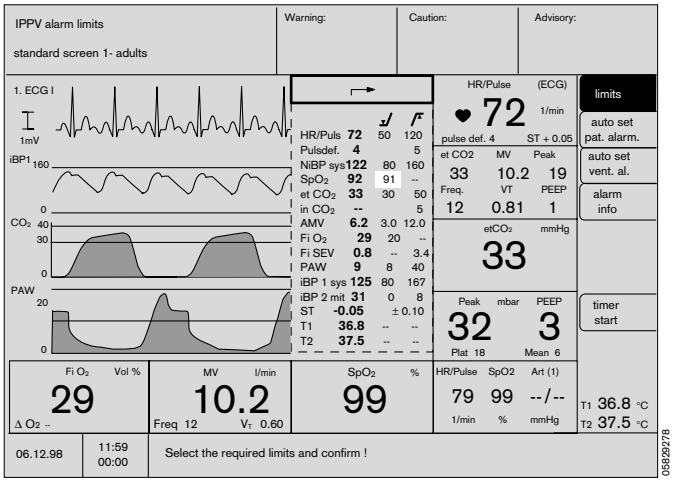
The limit value settings only apply temporarily! They are overwritten by the standard alarm limits when

– the Cicero EM is switched on.

– the system screen is switched to »**Standby**«.

– the setting »**Default**« is selected and confirmed for »**Alarms**«.

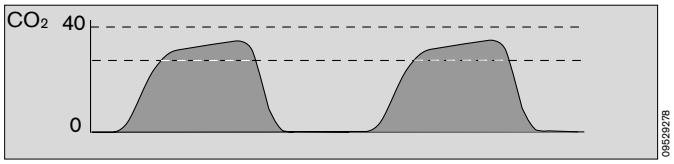
– the mode is switched over between »**neon.**«/»**adult**«.



To change alarm limits:

- Move the cursor frame to 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.

Each active alarm limit is shown as a dashed line in the dynamic gas curve displayed on the screen. In this example: CO_2 curve.



Refer to the section describing the »**Alarm concept**« from page 78 onwards for information on the links between certain alarms.

The limit value menu is automatically displayed whenever an alarm limit has been violated.
(see »**Alarm concept**«, page 78)

Patient alarm AutoSet

Alarm limits can also be set **automatically once the patient is stable**.

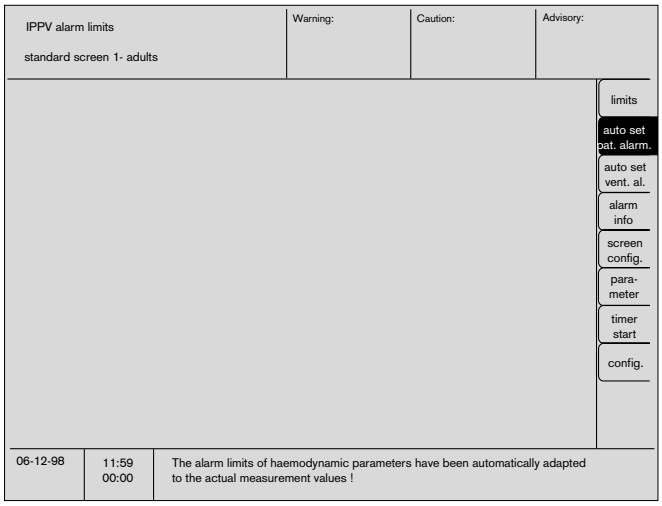
The user can set a new limit range with new upper and lower alarm limits by pressing the softkey »**auto set pat. al.**«.

The alarm limits set in the »**limits**« menu are deleted and cannot be automatically reactivated. The default alarm limits remain unaffected by the Autoset and can be reactivated at any time via the functions »**config.**«, »**alarms**« and »**default**«.

The alarm limits for SpO_2 and FiO_2 also remain unaffected.

AutoSet cannot set the lower alarm limits for the heart rate below 40 beats per minute and below 90 mmHg for systolic pressure values (50 mmHg for neonates).

Deactivated alarm limits (– –) are not activated by auto set!



Parameter		new measured value tolerance … upper	lower	Unit	Remarks
ECG/Pulse	HR/Pulse	+20.0	–20.0	beats per minute	but not less than 40 beats per minute
	ST	+0.05	–0.05	mV	
NiBP/ART	SYS	+20.0	–20.0	mmHg	but not less than 90 mmHg (50 mmHg for neonates)
	DIA	+20.0	–20.0	mmHg	
AORTA	SYS	+20.0	–20.0	mmHg	
	DIA	+20.0	–20.0	mmHg	
ART pul.	SYS	+15.0	–15.0	mmHg	
	DIA	+5.0	–5.0	mmHg	
	MIT	+10.0	–10.0	mmHg	
CVP	MIT	+5.0	–5.0	mmHg	
ICP	MIT	+5.0	–5.0	mmHg	
mmHg	SYS	+20.0	–20.0	mmHg	
	DIA	+20.0	–20.0	mmHg	
	MIT	+20.0	–20.0	mmHg	
TEMP		+1.0	–1.0	°C	
$etCO_2$		+5.0	–5.0	mmHg	
Fi AGAS	HAL	+0.5	–0.5	Vol. %	
	ENF	+0.5	–0.5	Vol. %	
	ISO	+0.5	–0.5	Vol. %	
	DES	+0.5	–0.5	Vol. %	
	SEV	+0.5	–0.5	Vol. %	

Ventilation alarm AutoSet

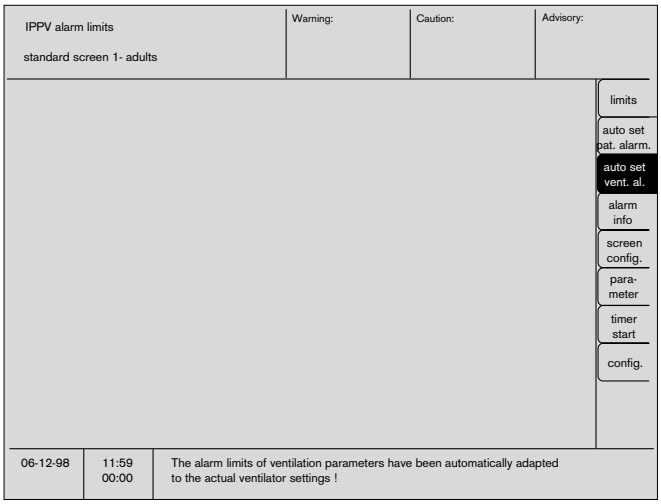
Prerequisite:
The ventilator must be in »**IPPV**«, »**SIMV**« or »**PCV**« mode.

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

The alarm limits previously set in the »**limits**« menu are overwritten and cannot be reactivated!

The default alarm limits are not affected by Autoset and can be reactivated at any time via the functions »**config.**«, »**alarms**« and »**default**«.

Deactivated alarm limits (– –) are not activated by auto set!



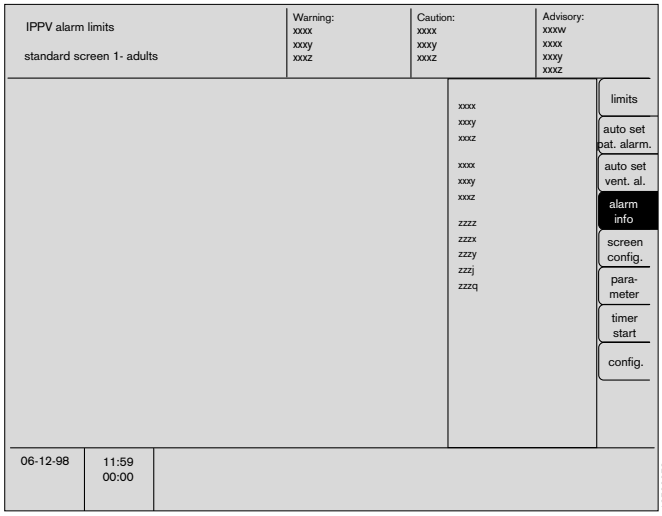
Parameter	new measured value tolerance		Unit
	upper	lower	
P_{aw}	PEEP + (P_{max}- PEEP) / 4	P_{max} + 10	mbar
AMV	V_T * f * 0.6 but always: over 0.5	V_T * f * 1.4	L/min

Alarm Info

The warning and caution fields each have space for displaying three entries. The advisory message field has space for four entries.

If further messages are present, a complete list of all entries in order of priority can be displayed on the system screen by pressing the softkey »**alarm info**«.

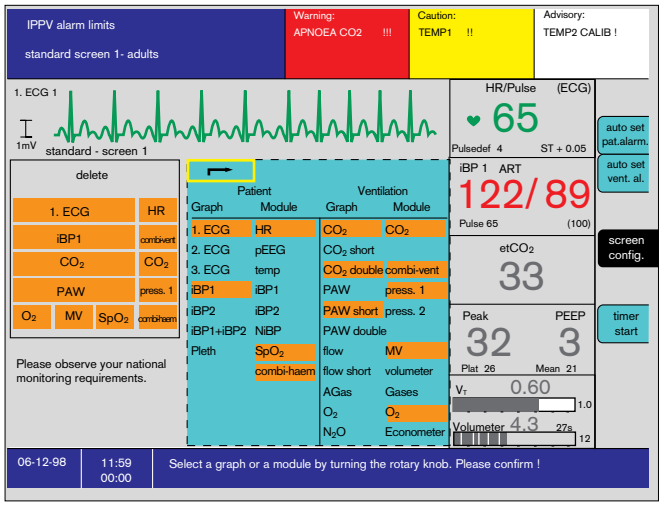
The list can be read as long as the key is pressed.



Configuring the screen structure

A selection menu is displayed when the softkey »**screen config.**« is pressed.

The graphical and numerical modules are selected as described from page 53 onwards.

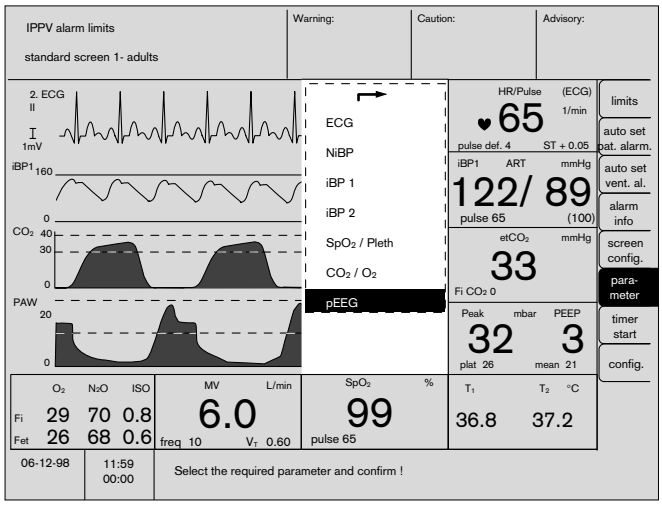


Parameter

A selection menu with the functions »**ECG**«, »**NiBP**«, »**iBP1**«, »**iBP2**«, »**SpO2/Pleth**«, »**CO2 /O2**« and »**pEEG**« is displayed when the softkey »**parameter**« is pressed.

See the section on the »**Parameter Box**« on pages 89 for a detailed description of how to set the parameters for »**ECG**«, »**NiBP**«, »**iBP**« and »**SpO2**«.

The »**CO2 /O2**« and »**pEEG**« menu is identical with the Standby menu described on page 52.

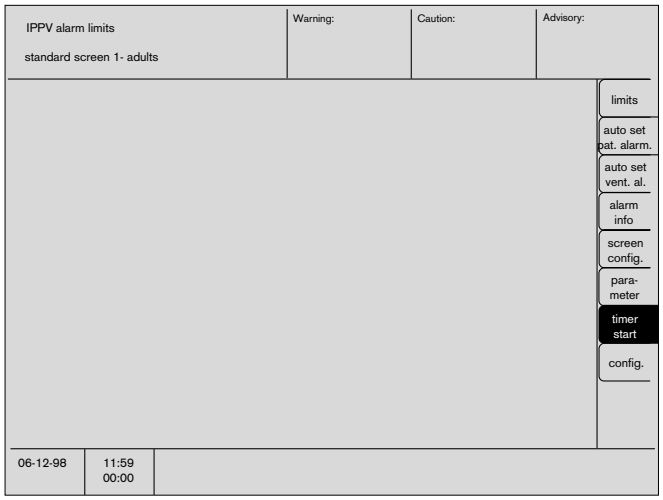


Timer

- The timer is started by pressing the softkey »**timer start**«.

  The time is shown below the actual time on the screen. The softkey changes automatically to »**timer stop**«.

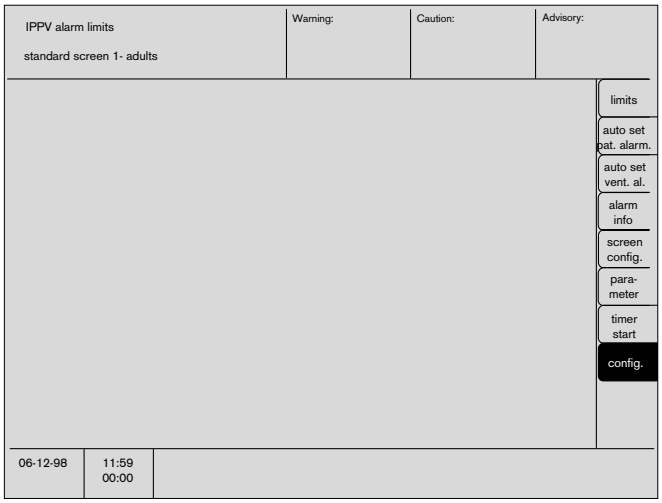
- The timer is stopped when the softkey is pressed again.

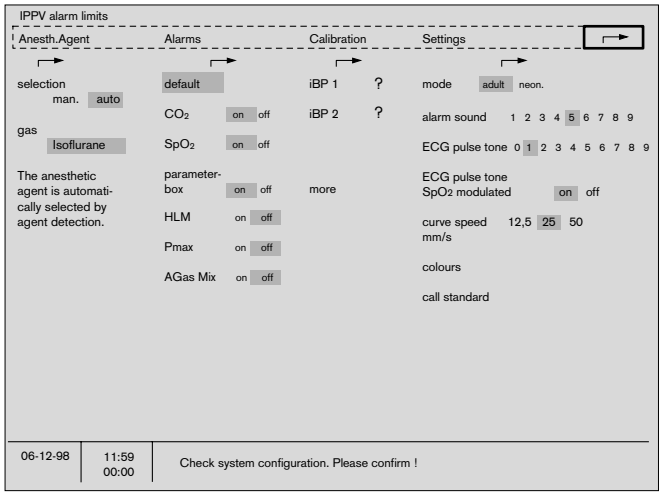


Configuring during operation

This softkey calls up the configuration menu. Refer to the corresponding section from page 47 onwards.

The menu for configuring the settings is displayed:





Settings

- **mode** — Change over between adult and neonate modes.
- **alarm sound** — For setting the volume.
- **pulse tone** — For setting the volume.
- **SpO_2-modulated** ECG **pulse tone** — Activates/deactivates ECG pulse tone modulation by the SpO_2 value.
- **Curve speed** — Sets the speed of the haemo-dynamic curves.
- **colours** — For setting the colours.
- **call standard** — Activates the screen configuration and all parameter settings configured in »**Standby**«.

Calibration

- **iBP 1/2** — To zero invasive blood pressure sensor in channel 1 or 2.
- **Flow sensor** — Calibrates the flow sensor.
- **more** — Calibrate O_2 sensor with 21 or 100% O_2, linearity check of the O_2 sensor, volume, flow, zero point of the gas sensor, NiBP test.

Alarms

- **default** — Activates the standard alarm limits.
- **CO_2** — Activates/deactivates all CO_2 alarms (including »**Apnea**«).
- **SpO_2** — Activates/deactivates all SpO_2 alarms.
- **Parameter box** — Activates/deactivates all parameter box alarms.
- **HLM mode** — Activates/deactivates the heart/lung machine monitoring mode.
- **Pmax** »**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.
- **AGas mix** — When switched »**on**«, a signal tone is generated in addition to the advisory message on recognising a mixture.

Alarm concept

Priority of alarms

The alarms are arranged in order of priority and assigned to specific tones or tone sequences.

The information appropriate to the situation is clearly presented in the separate fields for:

Warning	marked	»**!!!**«	Text in a red field
Caution	marked	»**!!**«	Text in a yellow field
Advisory	marked	»**!**«	Text in a white field

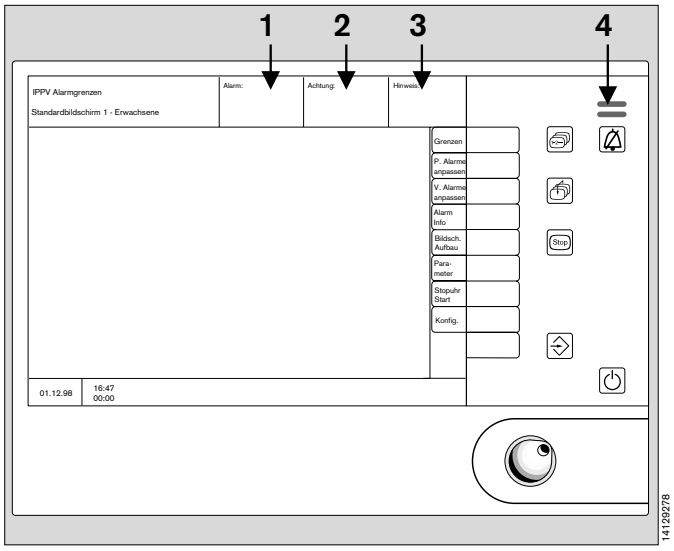
Warnings are accompanied by a continuous tone, caution messages by a tone at 30 second intervals and advisory messages by a single tone. Low-priority technical messages are displayed without audible alarm tone. Tones conforming to the EURO standard or Dräger standard are available as alternatives.

For warnings, the tones conforming to the Euro standard are separated by pauses of about 15 sec.

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

Warning	red,	flashing
Caution	yellow,	flashing
Advisory	yellow,	constant

A summary of all alarm limit settings appears on the screen, and the parameter which has been exceeded is highlighted.



Example:

The SpO_2 concentration has fallen below the lower alarm limit for SpO_2, which is set to 91%.

The measured value is 90%.

– In the alarm field, the symbol for the lower alarm limit ↓ and the parameter name »**SpO_2**« are displayed. The field changes colour from blue to red.

– The red LED flashes.

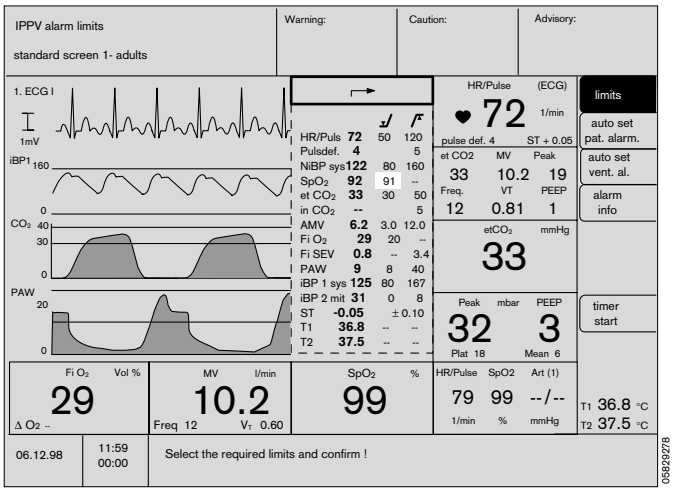
– The alarm tone is sounded.

– The alarm limits menu is automatically opened. The upper or lower alarm limit that has been exceeded or not attained is highlighted.

  This 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.

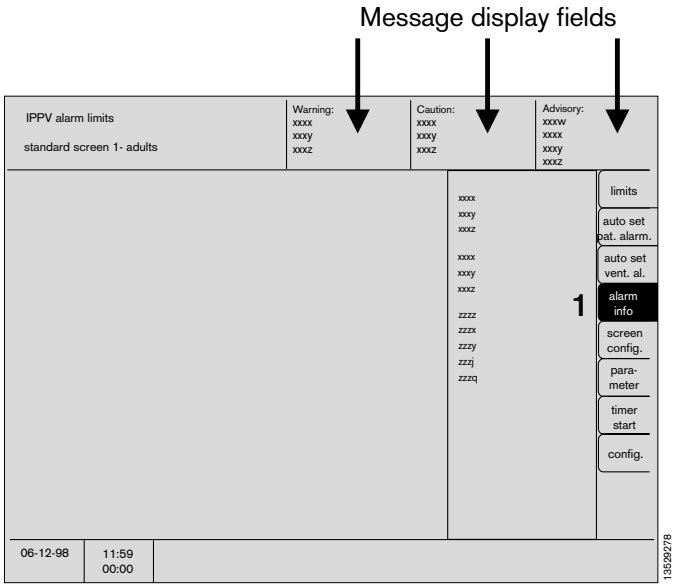
  The limit value menu is always closed whenever a value is confirmed. If the alarm condition is no longer present, the limit value menu closes automatically.



If several alarms occur simultaneously (in this example: pulse rate), the alarm limits which have been exceeded are shown against a dithered yellow background. When the first alarm has been confirmed (by pressing the rotary control on the system screen), the alarm limit of the alarm with the next lower priority is activated and displayed.

Show all alarms

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



Suppress alarm tone:

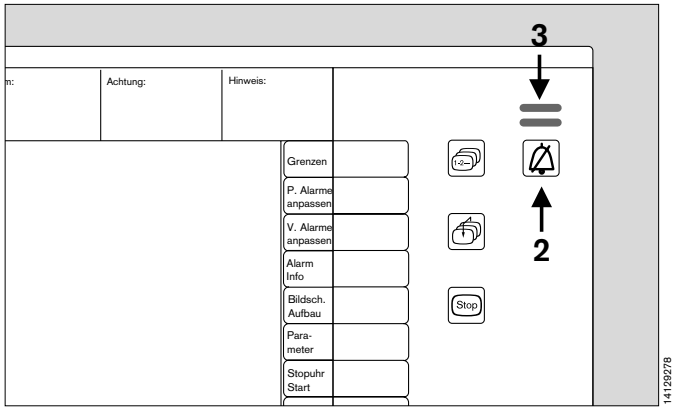
2 Press the key on the screen or parameter box.
The yellow LED will light up.

The alarm tone will be muted for **2 minutes** for Caution and Advisory messages. During this period, any new Caution and Advisory messages that occur will not be acoustically signalled.

New Warning messages will be signalled during this period by a once-only alarm tone.

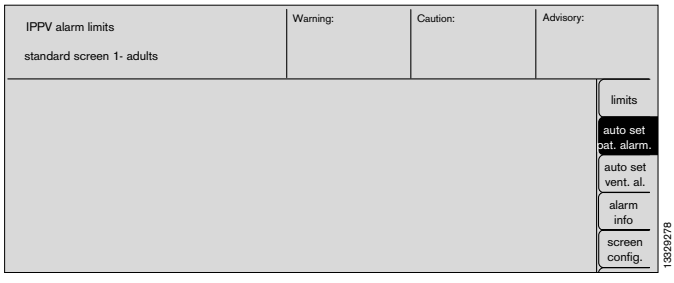
Exception:
NiBP alarms are suppressed until the next measurement is made.

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



To reactivate the alarm tone during the 2 minutes:

2 Press again.
The yellow LED goes out.

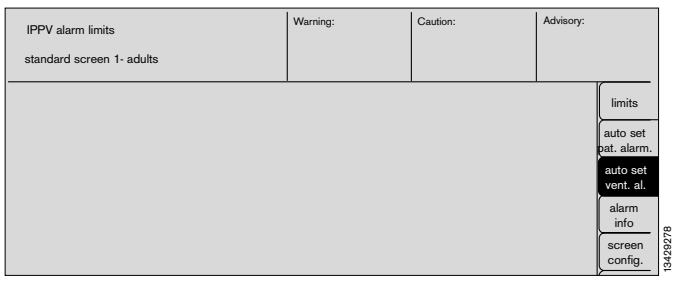


AutoSet patient alarms:

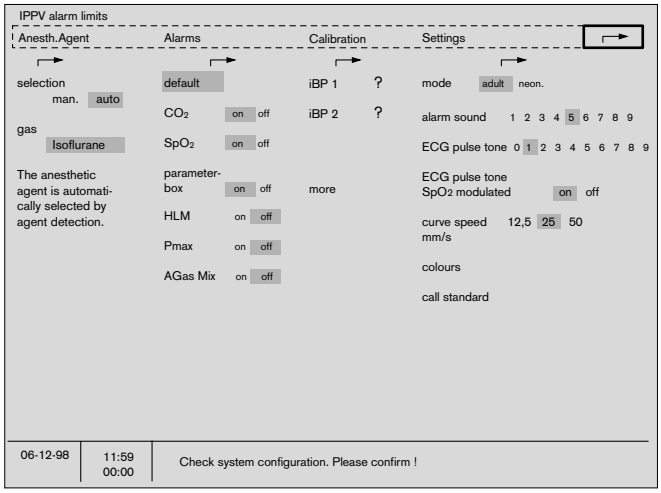
Refer to page 73.

AutoSet ventilation alarms:

Refer to page 74.



Alarm modes



For adults / neonates:

The device stores two different sets of alarm limits, one for adults and one for neonates.

The standard alarm limits for neonates and adults can be configured in the Standby configuration menu.

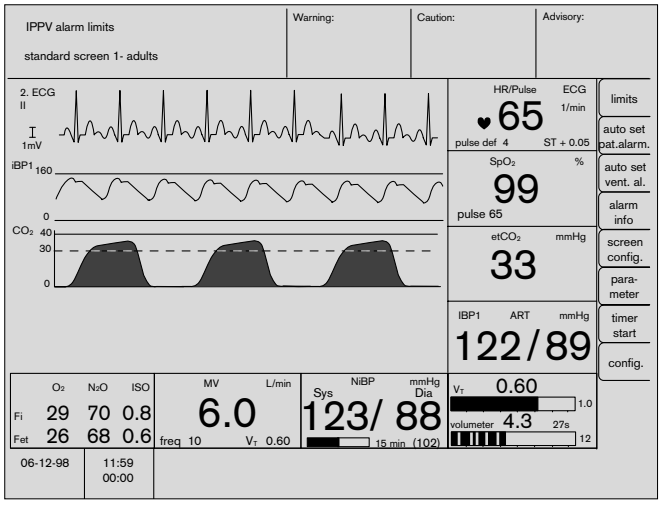
The required mode (»**adult**« or »**neon.**«) is activated under »**mode**« (see page 49).

The current mode is indicated in the status field at the top left of the screen.

Activating default alarm settings

The alarm limits are reset to the preconfigured standard alarm limits via the function »**default**« in the configuration menu. The standard alarm limits are automatically active after starting from »**Standby**« mode. The standard alarm limits are automatically active after starting the screen from »**Standby**« mode and after changing mode between »**adult**« / »**neon.**«.

CO_2 alarm on/off



In »**MAN/SPONT**« monitoring mode, the alarm limits for inspiratory and expiratory CO_2 can also be deactivated by the »**CO_2 alarm on/off**« key.

In this case there will be no CO_2 monitoring!

Press the key again to reactivate the CO_2 alarms.

When changing over to »**IPPV**« monitoring mode or »**SIMV**« with a frequency of more than 6 ventilation strokes per minute, the CO_2 alarms are automatically reactivated.

Changing to »**HLM**« mode or »**SIMV**« with a frequency up to 6 strokes/min. does not affect the deactivation.

When the CO_2 alarm is on and the ventilator is in IPPV mode, the inspiratory CO_2 concentration in the breathing gas is monitored with a fixed maximum limit of 5 mmHg!

The inspiratory CO_2 concentration can be set by the user in the range from 0 to 10 mmHg.

Adaption to the ventilation mode

The alarm limits are switched over automatically with the ventilator.

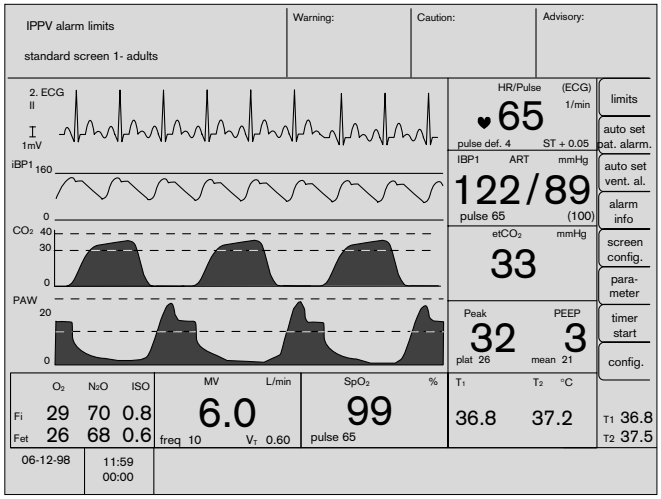
The alarm mode »**IPPV alarm limits**« is automatically activated on the system screen if the ventilation frequency for »**IPPV**« and »**SIMV**« is greater than 6 breaths per minute.und blinkt in den ersten fünf Sekunden.

The MAN/SPONT alarm limits are automatically activated in »**MAN/SPONT**« mode and the SIMV alarm limits for »**SIMV**« mode with a ventilation frequency of less than 6 breaths per minute. The currently active alarm limits are indicated in the status field and flash for the first five seconds.

A special alarm mode can be activated via the function »**alarms**« in the »**config.**« menu for operation with a heart/lung machine (»**HLM**« mode). In this case, all apnea alarms are deactivated and the gas values are indicated continuously, regardless of the respiratory phase.

All other alarm monitoring continues as in the ventilation mode from which »**HLM**« was activated.

The message »**HLM**« is also displayed on screen after the ventilation mode.



Alarm limits in ventilation mode			»**MAN/SPONT**«	»**SIMV**« with fIMV < 6	»**SIMV**« with fIMV ≥ 6 for »**IPPV**« and »**PCV**«
Minute volume	AMV	↑	off/on	off/on	off/on
		↓	off/on	off/on	off/on
Inspiratory anaesthetic agent		↑	on	on	on
		↓	off/on	off/on	off/on
Airway pressure	Paw	↑	on	on	on
		↓	off	on	on
Inspiratory O_2 concentration	FiO_2	↑	off/on	off/on	off/on
		↓	on	on	on
Apnea pressure			off	set to 30 seconds	set to 15 seconds
Apnea flow			off	set to 30 seconds	set to 15 seconds
Apnea CO_2			set to 1 minute	set to 30 seconds	set to 15 seconds
All other alarm limits remain unaffected by this function.					

Special alarm features

Related parameters are combined so that the user is not disturbed by unnecessary cascade alarms.

Combination of Apnea alarms from pressure, flow and CO_2 measurement:

Measurement	Result	Message	Special features
CO_2 Flow Pressure	No breathing Breathing detected Breathing detected	APNEA CO2 !!!	With indication of the time elapsed in seconds
CO_2 Flow Pressure	No breathing No breathing Breathing detected	APNEA !!!	With indication of the time elapsed in seconds
CO_2 Flow Pressure	No breathing Breathing detected No breathing	APNEA !!!	With indication of the time elapsed in seconds
CO_2 Flow Pressure	Breathing detected No breathing No breathing	APNEA !!!	
CO_2 Flow Pressure	Breathing detected Breathing detected No breathing	CHECK PRESSURE !	
CO_2 Flow Pressure	Breathing detected No breathing Breathing detected	FLOW SENSOR !	

If a parameter fails for obvious reasons, the combination is broken up and a separate alarm is signalled for each parameter. Only the CO_2 Apnea alarm is signalled in »**MAN/SPONT**« mode.

Combined alarms for no pulse or heart rate:

The heart/pulse rate is determined from the ECG, SpO_2 and iBP1 and 2.

Measurement	Result	Message	Special features
ECG SpO_2 iBP 1 iBP 2	No heart beat Any Any Any	ASYSTOLE !!!	
ECG SpO_2 iBP 1 iBP 2	Heart beat Pulse No Pulse No Pulse	iBP 1 PULSE? !!!	
ECG SpO_2 iBP 1 iBP 2	Heart beat Pulse Pulse No Pulse	CHECK iBP 2 !	
ECG SpO_2 iBP 1 iBP 2	Heart beat Pulse No Pulse Pulse	CHECK iBP 1 !	
ECG SpO_2 iBP 1 iBP 2	Heart beat No Pulse Pulse Pulse	SPO_2 SENSOR? !	
ECG SpO_2 iBP 1 iBP 2	Heart beat No Pulse No Pulse No Pulse	SPO_2 PULSE? !!!	

The logic of the remaining three parameters is applied if any of the four is deactivated. If a further parameter fails, the combination is broken up and a separate alarm signalled for each parameter.

Monitoring the alarm limits for heart/pulse rates from different sources:

The heart rate is always determined from the 1st ECG.

Two of the three parameters (SpO_2, iBP1 and iBP2) are chosen for monitoring the pulse rate. If two of these parameters output a measured value between the alarm limits, the advisory message »**CHECK xyz**!« is generated instead of a pulse alarm.

A heart/pulse alarm is only generated if at least two parameters indicate a violation of the alarm limits.
If another para-meter fails, the combination is broken up and a separate alarm is signalled for each parameter.

Monitoring the alarm limits of the blood pressure values from different sources:

The NiBP alarm is deactivated when measuring an arterial pressure.

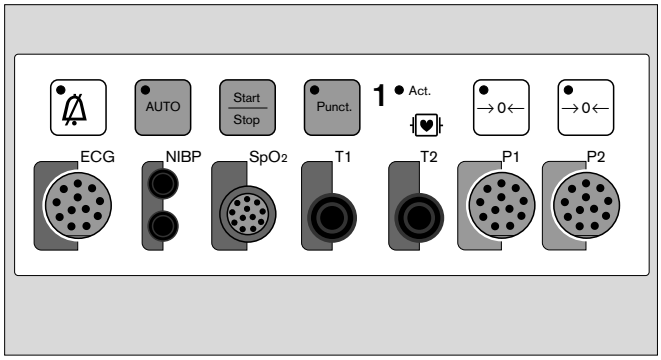
The standard alarm limits for NiBP and ART are coupled.

NiBP alarms are suppressed by pressing  until the next NiBP measurement is performed.

Page

Parameter box

Function keys



The parameter box is controlled by the Cicero EM. A number of functions can be accessed quickly and directly via the function keys.

On pressing this key on the screen or parameter box, the yellow LED lights up.

The acoustic alarm is then muted for **2 minutes** for Caution and Advisory messages.

Please see the explanations on page 79.

Auto — Starts automatic NiBP measurement.

The yellow LED in the key lights up as long as »**Auto**« mode remains active.

Start / Stop — NiBP measurement can be started and ended manually with this key.

This key can also be operated between two measurements in »**auto**« mode. The time intervals of automatic measurement are not affected. If the key is pressed while a measurement is in progress, this measurement will be interrupted and the cuff deflated.

Punct. — A static pressure is built up in the NiBP cuff when this key is pressed in order to stop the venous blood flow. The yellow LED in the key lights up during this time.

The blood flow is released when the key is pressed again. It is released automatically after two minutes. The pressure is set by the user in the NiBP menu.

→0← — Zero alignment key for invasive blood pressure measurement. The infusion system must be exposed to atmospheric pressure and the key pressed twice.

If the message »**CAL**« appears on the screen:

– Check the position of the shutoff valves.
– Does the pressure transducer still detect an arterial pulse?
– Check pressure transducer.

Displays

1 Act.
Power indicator.
Lights up when the parameter box is active. Shortly after inserting the parameter box into the holder, the yellow LED begins to flash until communication with the system screen has been established.
If the system screen is in Standby the LED does not light.

Transport function

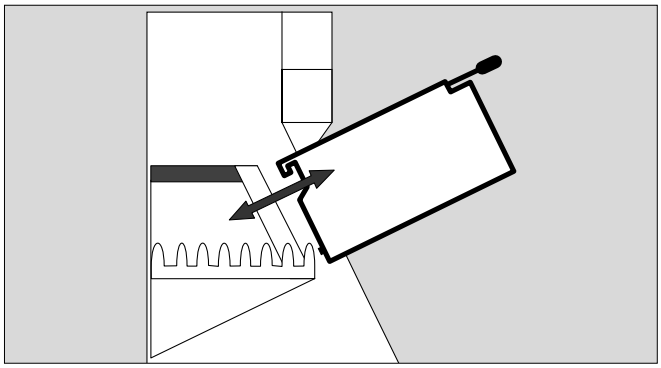
The parameter box stores:

– the patient data from the list screen
– alarm limit settings and
– measurement parameter settings.

The patient remains connected to the parameter box in transit. The patient's data remains constantly accessible. There is no need to reconnect the patient and configure the monitors.

Plugging in/unplugging the parameter box

White housing:



To connect:

- Hold the parameter box by the blue handle.
- Slide the parameter box into the white housing.

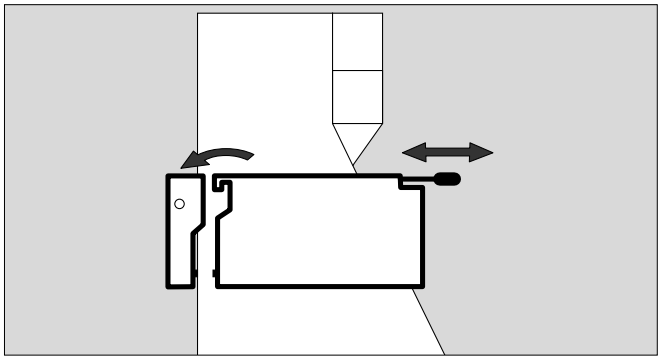
  It clicks audibly into place, and all LEDs on the front panel light up briefly.

To disconnect:

- Pull out the blue handle. After overcoming a tangible resistance, the box is electrically disconnected and freely transportable.

Blue holder:

The parameter box can be tilted in the blue holder. On overcoming a set resistance, it can be adjusted to an ergonomic position.



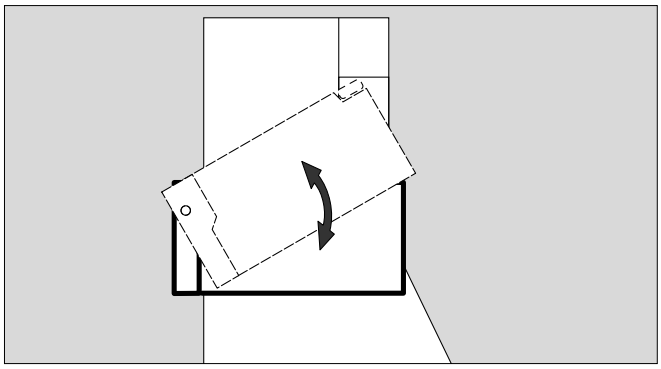
To connect:

- Hold the parameter box by the blue handle.
- Place the parameter box on the crossbar of the holder and allow it to swivel down.

  It clicks audibly into place, and all LEDs on the front panel light up briefly.

To disconnect:

- Pull out the blue handle. Swivel upwards to disconnect electrically, and lift off the crossbar. The box is now freely transportable.



Data transfer

After the parameter box has been clipped into place, it exchanges data with the system screen. It will perform as programmed in **»Standby«** (see page 62).

A complete list of the transported data is given in the **»Technical Data«** on page 160.

Fully automatic procedure

The message

»Data will be transferred as wanted« is displayed.

After about 12 seconds, all parameter box functions are active. No user intervention is required.

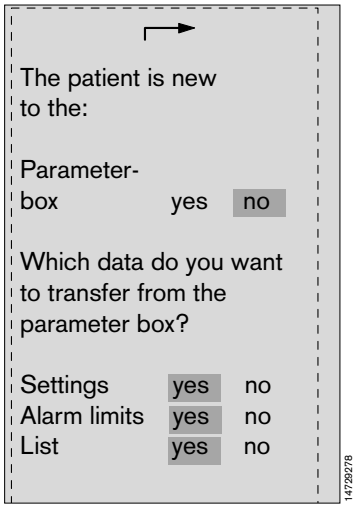
Semi-automatic procedure

The transport menu is displayed, as preconfigured by the user in **»Standby«**.

If the monitoring requirements have changed in the meantime, the user can intervene in the data transfer and modify settings in the same way as for the configuration in **»Standby«**.

Data transfer can of course also be confirmed unchanged after checking the display.

- These settings are confirmed and then transferred by pressing the rotary control. After about 12 seconds, all parameter box functions are active.

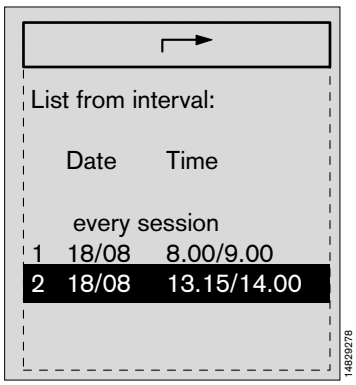


List intervals

If the user has opted to transfer list data in the semi-automatic procedure, the intervals can now be selected.

An interval (monitoring interval) is considered to be the time between connection and disconnection of the parameter box.

Each of these intervals are displayed on a separate line in the list screen, with the identifier **»interval«** and the date and time. In addition, the user-programmed device location is also displayed (see page 64).



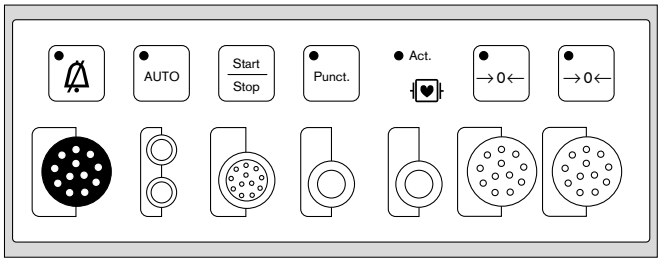
ECG / Heart rate

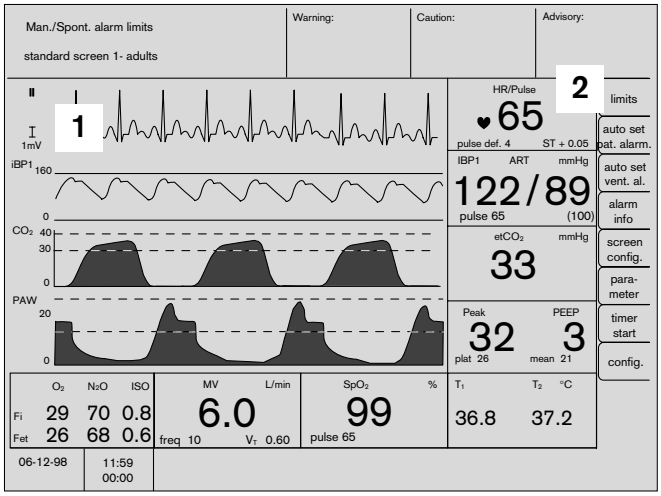
ECG display

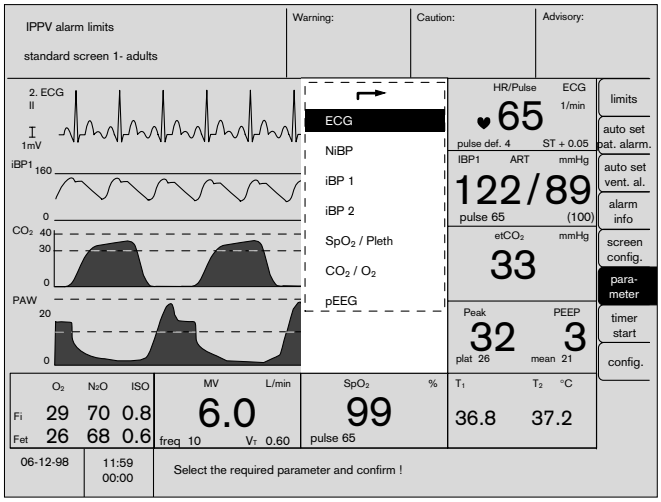
- Insert the electrode cable in the ECG input of the parameter box, and attach the electrodes to the patient (for instructions, see »**Descriptions**« from page 163 onwards).

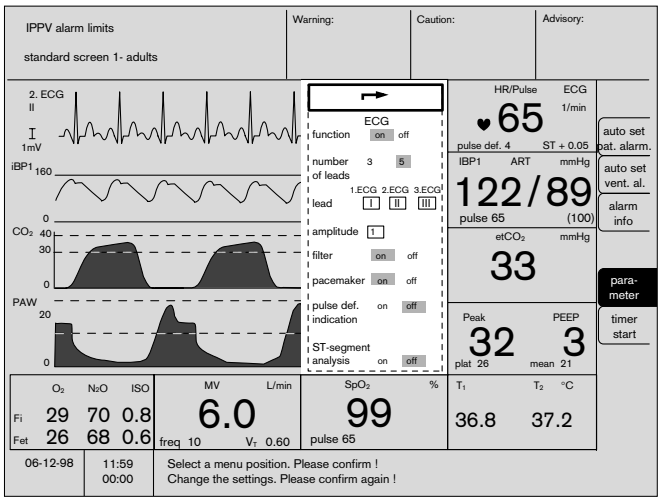
1 The ECG of the preprogrammed lead appears on the system screen as specified in the configuration menu.

2 The heart rate is displayed.









Adjusting settings

- Press the softkey »**Parameter**«. The menu for setting the parameters is displayed.
- Move the cursor frame to »**ECG**« with the rotary control and press to confirm.

measuring function — **on / off**
Activates and deactivates the ECG measuring function.

number of leads — **3 / 5**
Selects the type of cable used. If you are using a 3-lead ECG cable, leads 1, 2 and 3 are available. If only 3 electrodes of a 4 or 5-lead cable are connected, the system displays the following error message: »**Elektrode**«.

lead — I / II / III / **AVR / AVL / AVF / V**
Selects the lead separately for the 1st, 2nd and 3rd ECG. With a 3-core cable, the choice is restricted to lead 1, 2 and 3.

amplitude — **mV / 4 / 2 / 1 / 0.5 / 0.25**
Sets the ECG amplitude in mV on the screen in relation to the reference bar to the left of the ECG graph. Changes to settings are immediately visible on the curve.

filter — **on / off**
»**on**« yields an extremely stable ECG without interference.
»**off**« yields an ECG with higher band width, but less stable.

pacemaker — **on / off**
Activates and deactivates pacemaker pulse detection. Pacemaker pulses are enlarged disproportionately when this function is activated (not taken into account when calculating the heart rate).

pulse deficit indication on / off

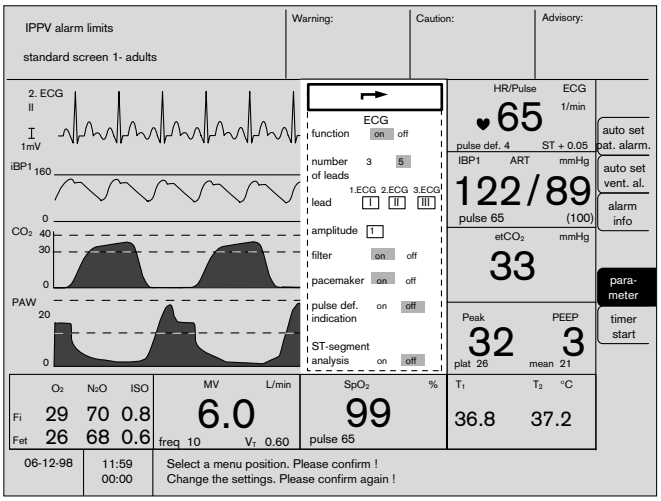
Activates and deactivates the pulse deficit indication derived from the heart rate and SpO_2 pulse.

ST-segment analysis on / off

Activates and deactivates ST-segment analysis. Alarms only active in adult mode.

Monitoring of limit values is deactivated when »**off**«.

The analysis is based on the derivation from the 1st ECG.
ST-segment analysis may be impaired by simultaneous high-frequency electrosurgery!



Electrosurgery during an ECG

ECG measurements are susceptible to interference from electrosurgery (high frequency surgery). To avoid unnecessary false alarms, whilst still guaranteeing safe monitoring, the system responds as follows to detected high frequency interference:

– the ECG curve is always displayed,

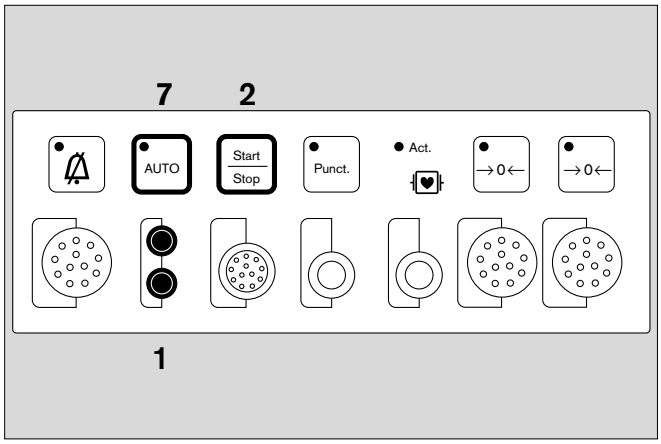
– an »**ECG noise**« error message is displayed,

– the heart rate display is frozen and

– ECG alarms are suppressed.

After the high frequency interference has ceased, the complete monitoring function is again active. If high frequency interference lasts longer than 15 seconds without interruption, the heart rate and S-T segment values are replaced by dashes (» – – «).

Non-invasive blood pressure (NiBP)



Start monitoring

The main steps can be undertaken at the parameter box.

1 Plug the hose connectors into the parameter box. The rubber rings on the connectors can be moistened slightly so that they can be inserted more easily.

- Apply the appropriate cuff to the patient and connect it to the hose. Ensure that all connections are tight. Even slight leaks make measurement impossible.

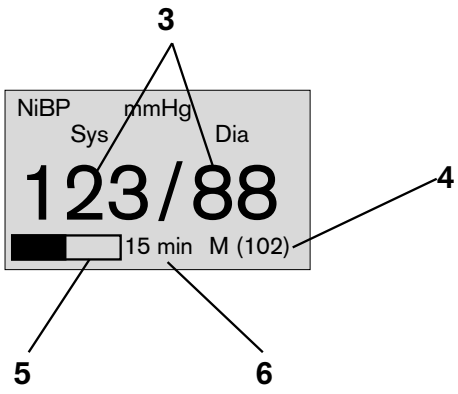
Manual measurement

2 Press Start/Stop.

The cuff is inflated and the cuff pressure indicated constantly in the bar graph within the module.

3 The systolic, diastolic and

4 mean pressure are displayed when the measurement is complete.



Incorrect measurements are repeated 5 seconds after releasing the air. A third and last attempt is made after 30 seconds if the second measurement also proves incorrect.

Automatic measurement

5 Time bar indicating the relative time elapsed between two automatic measurements. The actual cuff pressure is indicated here during the measurement.

6 Time interval for automatic measurement.

7 Press Auto.

The LED in the key lights up and automatic measurement starts. NiBP measurements are performed by the parameter box at the set time intervals.

To interrupt measurement

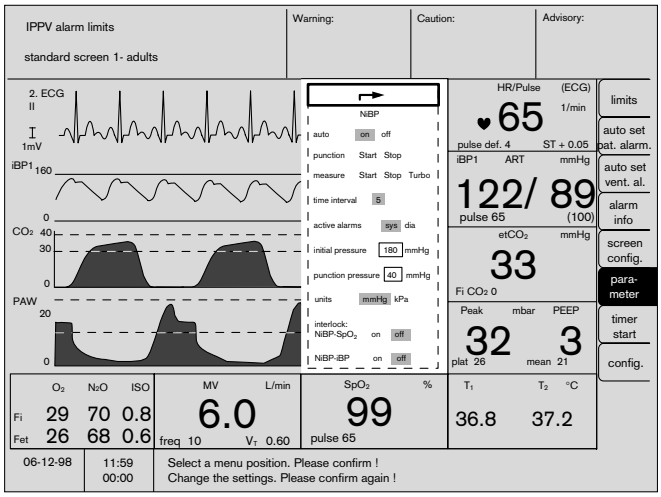
2 Press Start/Stop.

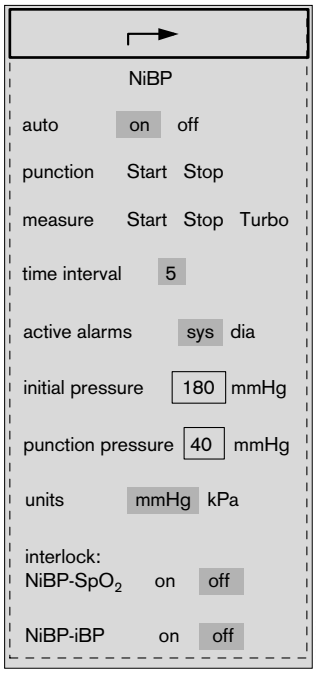
to interrupt measurement. The air is immediately expelled from the cuff.

Changing settings

- Press the softkey »**parameter**«.
- Move the cursor frame to »**NiBP**« with the rotary control and press to confirm.

  The menu for setting the parameter is displayed.





auto **on / off**
Activates automatic measurements at the specified time intervals.

punction **Start / Stop**
Starts or stops venous congestion. Inflation ends automatically after 2 minutes.

measurement **Start / Stop / Turbo**

»**Start**« Triggers manual measurement outside the automatic time interval.

»**Stop**« Stops a measurement. Or press the Start/Stop key on the parameter box.

»**Turbo**« Five simplified measurements in five minutes. This mode can also be stopped with »**Stop**«.

time interval **2 / 3 / 5 / 10 / 15**
Selects the time interval for automatic measurement in minutes. The starting time for the next automatic measurement is not affected by a measurement triggered manually between two automatic measurements.

active alarms **sys / dia**
Determines whether the systolic or diastolic pressure is to be monitored.

punction pressure **numerical**
(separate for adults and neonates)
Sets the punction inflation pressure of the sphygmomanometer cuff.

The cuff is inflated to the preset starting pressure for the first measurement; after reading off the systolic pressure, the cuff is inflated to 20 mmHg above the last measured systolic value for the next measurement. If the inflation pressure is too low for correct measurement of the systolic pressure, air is automatically released from the cuff and the measurement is

repeated 5 seconds later with a higher cuff pressure. If it is still too low, the air is released again and the measurement repeated 30 seconds later with an elevated cuff pressure.

Punction pressure numerical display
(Separate for adults and neonates). Sets the punction inflation pressure in the sphygmomanometer cuff.

Turn the rotary knob to change the value, and press to confirm.

Unit mmHg / kPa Switching over between the measuring units »**mmHg**« and »**kPa**«.

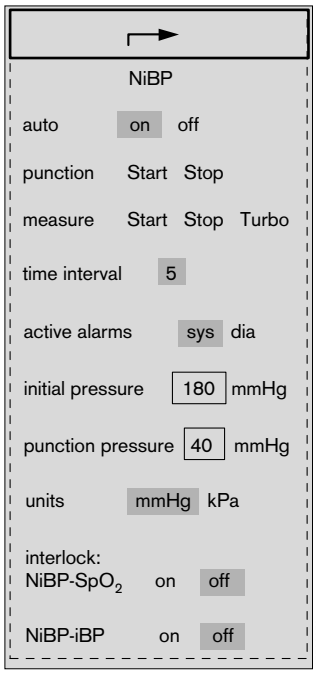
Interlock NiBP–SpO2
on / off
Activates and deactivates the interlock function between »**NiBP**« and »**SpO2**«.

When the NiBP sphygmomanometer cuff is inflated with the Interlock on, the »**SpO2 PULSE ? !!!**« alarm is deactivated in order to prevent false alarms if both measurements are taken on the same arm. Generally, »**Interlock on**« is recommendated.

Interlock
NiBP–iBP
auto / off
Activates and deactivates the interlock function

between »**NiBP**« and »**iBP**«.

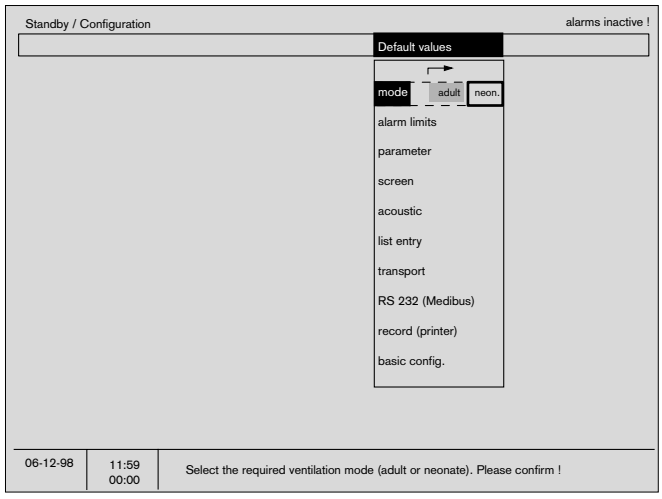
The »**iBP 1/2 PULSE ? !!!**« measurement is suppressed while the cuff is inflated.



NiBP alarms:

NiBP alarms are suppressed during invasive blood pressure measurement in an artery.

If an NiBP alarm is triggered, the alarm sound is suppressed until the next NiBP measurement by pressing  .



Measuring the blood pressure of neonates

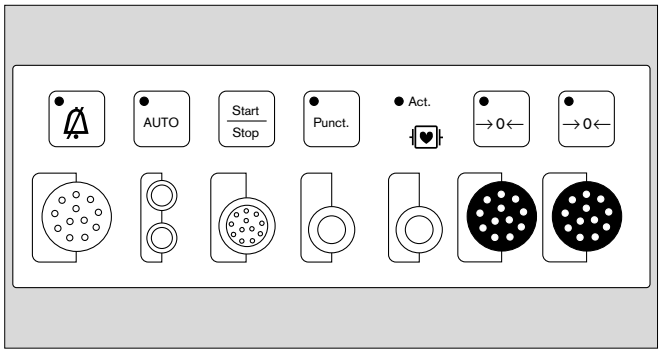
The parameter box includes special algorithms in neonatal mode for monitoring neonates. Changing over to neonatal mode is described on page 49.

Invasive blood pressure (iBP)

Start monitoring the invasive blood pressure

The invasive blood pressure can be measured on two channels simultaneously. The settings and functions of the channels are identical and are described only once below.

- Connect pressure transducer to the parameter box (colour-coded grey).
- Connect infusion system and catheter/canula to the transducer. Eliminate any air bubbles in the catheter/ transducer system, as they can impair measurement.
- Apply the pressure transducer level with the heart.
- If necessary, wait until the pressure transducer has warmed up.
- Connect the transducer dome to the catheter/infusion system and open it to atmospheric pressure.

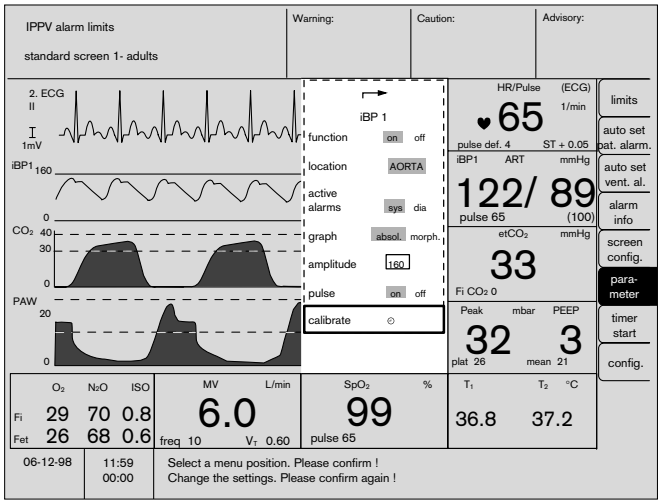


Calibrating the sensors

<u>On the system screen</u>

- Press the **»parameter«** softkey.
- Select **»iBP 1«** or **»iBP 2«** with the rotary control and press to confirm.
- Position the cursor frame over **»Calibration«** with the rotary knob and press to confirm. The system enquires whether the infusion system has been exposed to atmospheric pressure.
- Open the sensor dome and press to confirm.

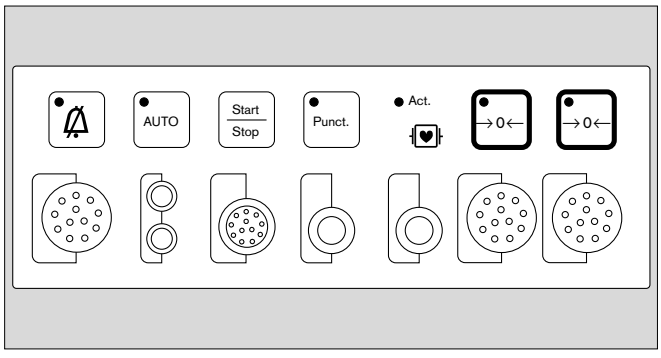
  The clock symbol ◴ appears during the calibration process. A tick (✔) then appears behind the function.
- Close the transducer dome and reopen the connection to the catheter/infusion system; the pressure trace and pressure values are displayed.



<u>Or on the parameter box:</u>

- Press the zero alignment key [→0←] of the corresponding sensor twice; a tick (✔) appears behind the menu item on the system screen.

  A question mark (?) appears after the menu item if a fault occurs during zero alignment. **»CAL ?«** is displayed instead of the measured values and the LED in the [→0←] key flashes.



Setting functions

function **on / off**
Activates and deactivates the iBP measuring function.

location The names of the following catheter site labels are programmed:

- **ART** Artery
- **AORTA** Aorta
- **A.Pulm** Pulmonary artery
- **CVP** Central venous pressure
- **ICP** Intracranial pressure
- **?** Any other site

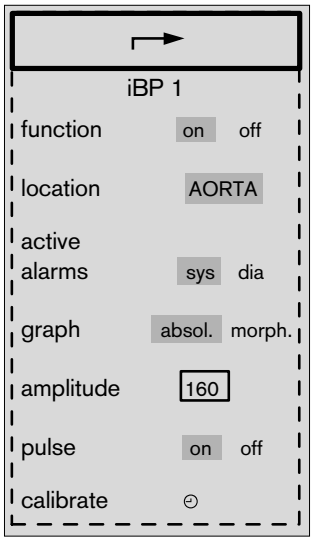
The following parameters are automatically preselected on selecting a location name:

– curve amplitude

– monitoring type (diastolic, mean pressure, systolic)

– alarm limits

– colour code of catheter site (label).



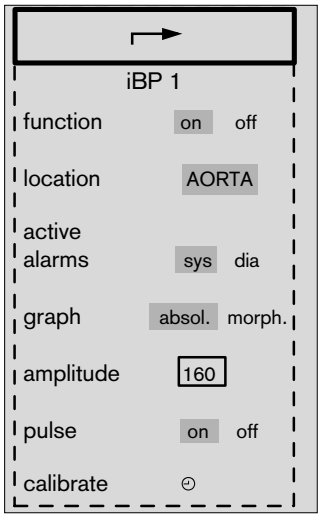
active alarms **sys / dia**
Determines whether the systole »**sys**« or diastole »**dia**« is to be used for monitoring.

graph **absol / morph**
Absolute: Bottom line equals absolute zero. Manual amplitude selection possible.
Morphological: Automatic amplitude selection. Optimum curve size. Bottom line does not equal absolute zero.

amplitude Determines the magnitude of the absolute pressure graph on the screen. The selected amplitudes depend on the location. They have been pre-configured in standby-mode under »**Default values**«, »**Parameters**«, »**iBP locations**«.

pulse **on / off**
Activates and deactivates pulse indication in the iBP module.

calibrate Sensor zero calibration.
The clock symbol (⏲) is displayed during calibration.



iBP Graph

A pressure graph appears on the screen (example):

1 Absolute graph, referred to the zero pressure (= values in the bottom reference line).

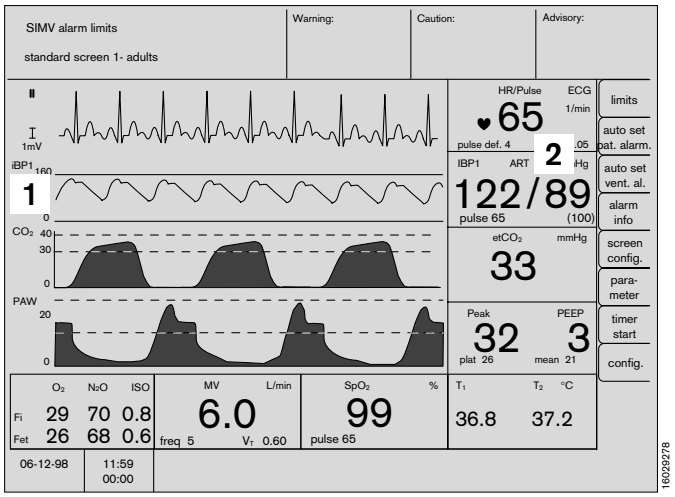
The scale of the upper reference line can be varied.

or

– Morphological graph.

The graph is automatically adjusted to the full height of the trace. Manual adjustment of the height is not possible in this case.

2 Numerical representation of systole/diastole and mean pressure (in brackets). (In CVP and ICP, the mean pressure is displayed in large figures).

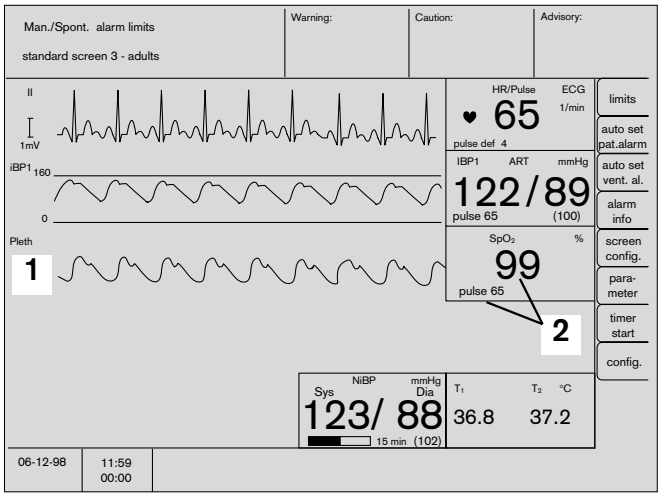


Functional oxygen saturation (SpO2)

Graph

1 Presentation of the plethysmogram as a curve.

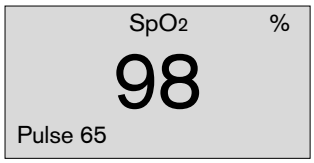
2 Numerical presentation of the saturation value and pulse rate.

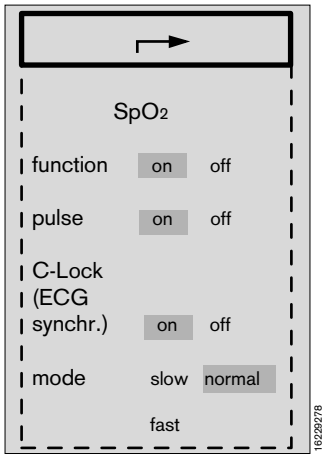


Changing settings

- Press the softkey »**parameter**« on the system screen.
- Move the cursor frame to »**SpO2 / Pleth.**« with the rotary control and press to confirm.

  The menu for setting the parameters is displayed.





Setting functions

measuring function **on / off**
Activates and deactivates the measuring function.

pulse **on / off**
Activates and deactivates indication of the pulse rate.

C-Lock **on / off**
Activates and deactivates automatic C-Lock synchronization.
C-Lock synchronizes measurement of the saturation with the ECG. Leads to better results if the patient moves or perfusion is poor.
C-Lock »**on**« automatically suppresses the pulse deficit alarm.

mode **slow / normal / fast**
changes the speed of measurement.

slow mode: The measured value responds slowly to changes in oxygen saturation. Patient movement has little or no effect.

normal mode: The mode for normal conditions with relatively quiet patients.

fast mode: This mode should be used whenever rapid reactions are required and patient movement is negligable.

Coupling with non-invasive pressure measurement

The interlock function should be activated for simultaneous measurement of SpO2 and non-invasive blood pressure on one arm. This prevents unnecessary alarms due to failure to detect a pulse during NiBP measurement (see page 171).

Temperature measurement

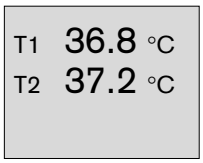
Start measurement

– Use a protective sheath for rectal sensors.
– Apply the sensor(s) to the patient and connect with the parameter box (colour-coded green).

Correct temperature values are displayed after approx. three minutes.

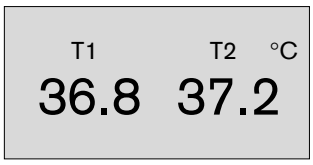
Display:

If programmed, the small temperature module is displayed under the softkeys. To set this display mode, see page 61.



Alternative:

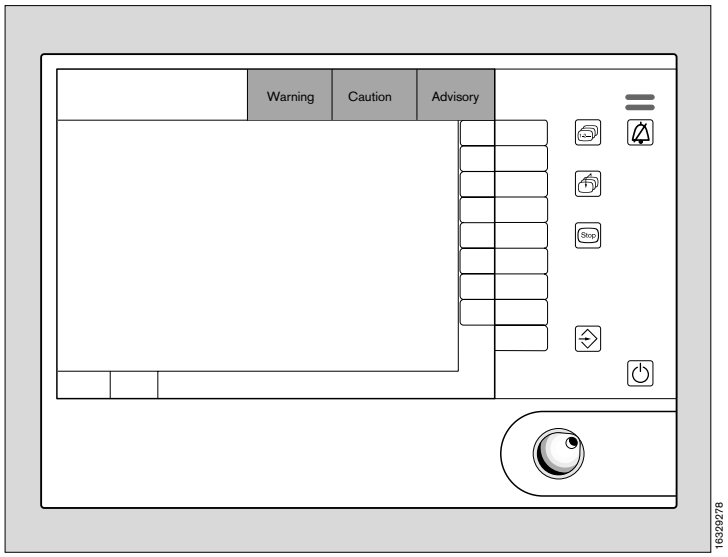
Select numerical module display with »**Screen configuration**«.



Page

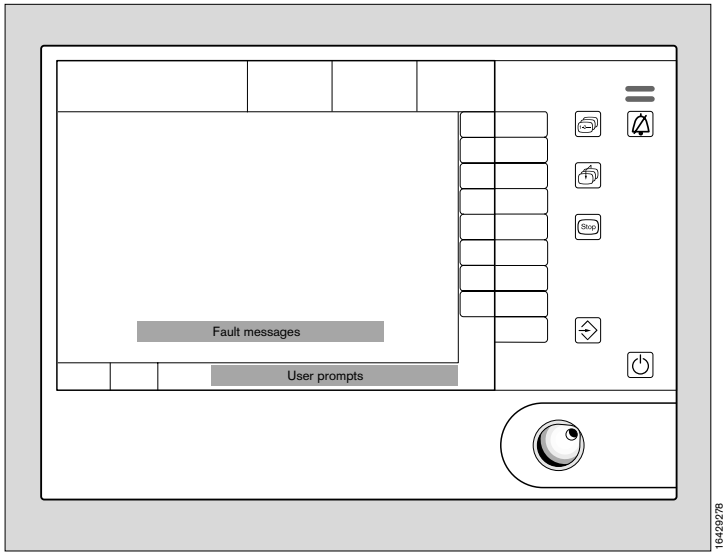
Where messages are displayed:

Warning, caution and advisory messages
These are the three types of message output by the system. They are classified in order of priority and listed alphabetically in the following tables.



User prompts
appear at the bottom of the screen.

Fault messages (only during self-test)
appear in the middle of the lower third of the screen.



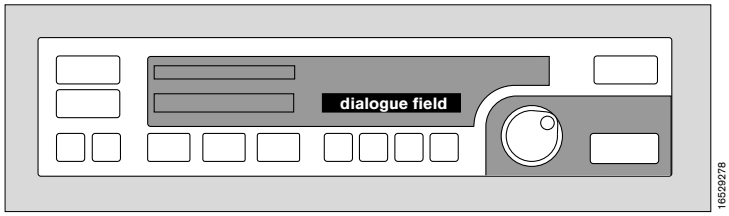
Messages on the ventilator
These are always output during operation. Refer to the chapter entitled **»Anaesthesia ventilation«**.

In exceptional cases, messages may also appear in the dialogue field during operation and the self-test. Refer to the table on page 109.

In the event of a problem with the ventilator, signalled by a message in the dialogue field of the ventilator and/or the message **»VENT INOP«** on the system screen, manual ventilation with the breathing bag is always possible with the Cicero EM.

The Ventilator then switches over automatically to **»MAN/SPONT«** mode. The volume of the breathing system increases rapidly to 1.4 litres, because the pump piston is forced back to its starting position by the gas pressure.

Remedy: Immediately increase the gas flow and/or press **»O_2 flush«** on the flowmeter block.



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.

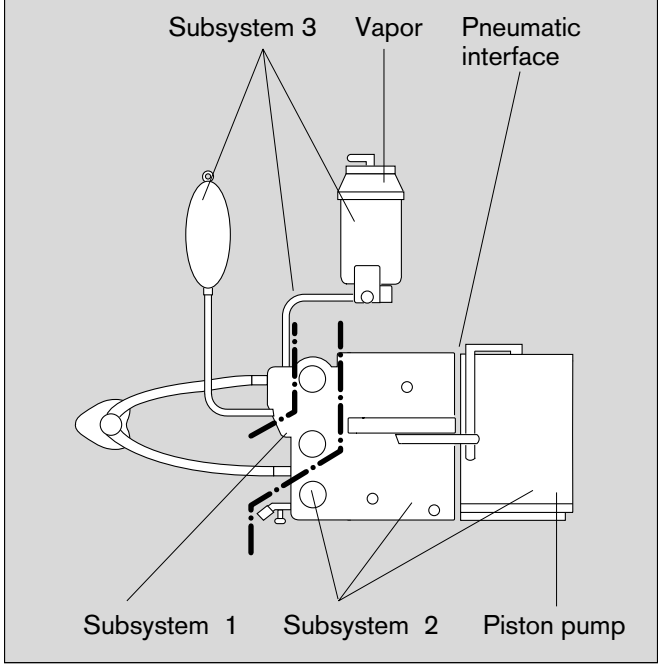
Malfunctions and system faults:

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.

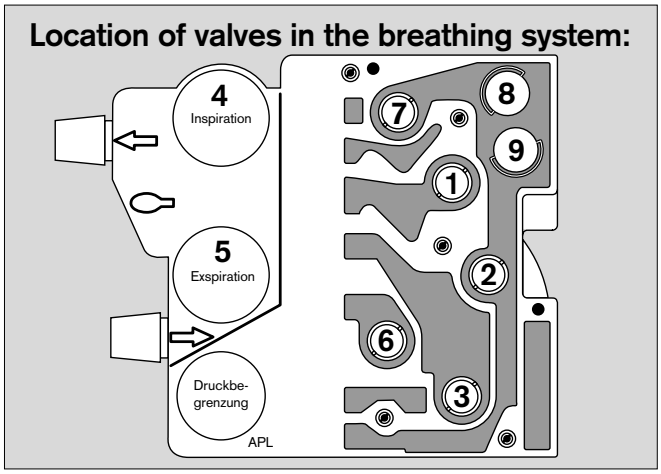
Call DrägerService if the malfunctions and/or advisory messages cannot be remedied in accordance with the descriptions or by repeatedly switching off and on again (with a delay of approx. 5 seconds in between) via the master power switch and repeating the self-test.

All malfunctions are signalled acoustically.

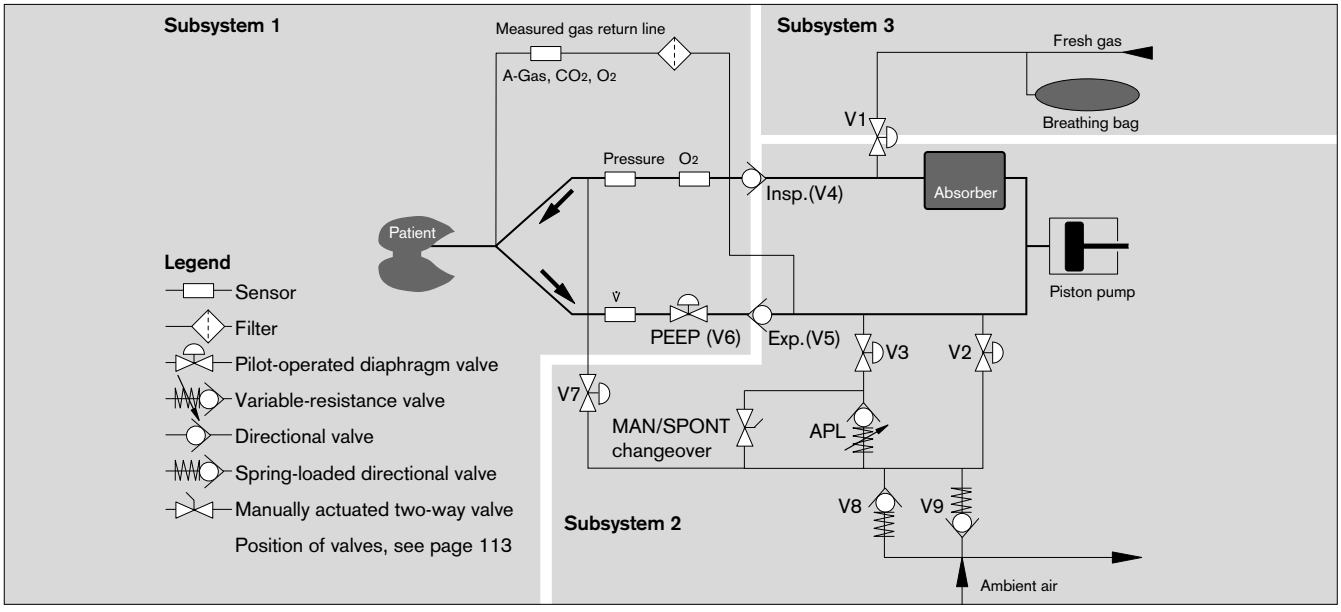
Location of the subsystems:



Location of valves in the breathing system:



Simplified pneumatic schematic showing valves and subsystems:



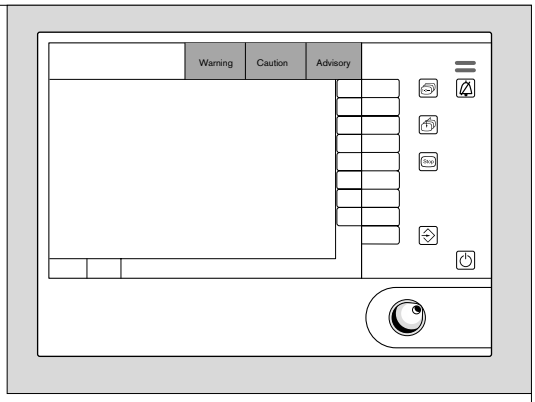
Messages on the system screen

(In alphabetical order according to priority)

Alarm messages are assigned to three priority classes (alarm priority) in the system screen of the Cicero EM:

- **Warning** »!!!« Text on red field
- **Caution** »!!« Text on yellow field
- **Advisory** »!« Text on white field

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



Messages	Cause	Remedy
Warning messages		
APNEA !!!	No breathing/ventilation. At least two measurements have failed to detect a breath for 15 seconds.	**Patient must immediately be ventilated by hand!** Check patient's spontaneous breathing ability (in Man/Spont/IPPV/PCV or SIMV). Check hoses, tube and ventilator.
APNEA CO2 !!!	No breathing/ventilation. No breath has been detected for 15 seconds by expiratory CO_2 in IPPV mode. (In »Man/Spont alarm limits« mode, no breath has been detected for 60 seconds, and in SIMV mode for 30 seconds).	**Patient must immediately be ventilated by hand!** Check patient's spontaneous breathing ability. Check hoses, tube and ventilator.
APNEA PRESSURE !!!	No breathing/ventilation. No change of pressure detected for 15 seconds. Inadequate supply of fresh gas. Leak in hose system. (In "Man/Spont alarm limits" mode, no breath has been detected for 60 seconds, and in SIMV mode for 30 seconds).	**Patient must immediately be ventilated by hand!** Check fresh gas setting on anaesthetic unit. Check hoses and tube. Check ventilator.
APNEA VOL !!!	No breathing/ventilation. No expiratory tidal volume for 15 seconds. Inadequate supply of fresh gas. Tube buckled. Leak in hose system. (In "Man/Spont alarm limits" mode, no breath has been detected for 60 seconds, and in SIMV mode for 30 seconds).	**Patient must immediately be ventilated by hand!** Check ventilator. Check fresh gas setting on anaesthetic unit. Check tube and hose system.
ASYSTOLE !!!	No QRS waves detected in ECG signal for the last 6 seconds.	**Check patient's condition!**
AW-TEMP ⩘ !!!	Inspiratory breathing gas temperature over 40 °C.	Switch off breathing humidifier and hose heater (if used). Set lower heating level when temperature has dropped to 37 °C.
FIBRILLATION !!!	Ventricular flutter detected for more than 3 seconds.	**Check patient's condition!**

Messages on the system screen

(In alphabetical order according to priority)

Messages	Cause	Remedy
FI HAL ⚠ !!! FI ISO ⚠ !!! FI ENF ⚠ !!! FI DES ⚠ !!! FI SEV ⚠ !!!	The inspiratory anaesthetic concentration exceeds the upper alarm limit in each case. The upper alarm limit has been exceeded for at least two breaths.	Check setting of anaesthetic vaporizer.
FI O2 ↓⚠ !!!	The inspiratory O_2 concentration is below the lower alarm limit.	Check O_2 supply. Check setting on O_2 flow meter.
HR RATE ↓⚠ !!!	The heart rate is below the set limit.	**Check patient's condition!** Correct alarm limit if necessary.
IBP 1 PULSE ? !!! IBP 2 PULSE ? !!!	No pulse detected during invasive measurement.	**Check patient's condition!**
PAW ⚠ !!!	Airway pressure exceeds the upper alarm limit. Ventilation hose buckled? Stenosis? Pulmonary problem? Cough?	**Check patient's condition!** Check hose system, tube and fresh gas flow.
PAW NEGATIVE !!!	Negative airway pressure measured.	Check hose system and tube on ventilator.
EXP PRESSURE ⚠ !!!	End-expiratory pressure exceeds PEEP by more than 10 mbar.	Check anaesthetic gas scavenging line. Extend the expiration time. Check the hose system and microbial filter. Drain the water traps.
PULSE IBP 1 ↓⚠ !!! PULSE IBP 2 ↓⚠ !!!	The measured invasive pulse is below the set alarm limit.	**Check patient's condition!**
PULSE SPO2 ↓⚠ !!!	Pulse rate has dropped below the set alarm limit.	**Check patient's condition!**
SPO2 ↓⚠ !!!	Oxygen saturation is below the set lower alarm limit.	Check ventilation. Check inspired O_2 concentration.
SPO2 PULSE ? !!!	No pulse signal detected by SpO_2 measurement for approx. 10 seconds.	Read ECG. Check SpO_2 sensor (dropped off? NiBP measurement on same arm?) If measured on the same arm as NiBP: Switch »**on**« Interlock!
VENT INOP !!!	Fault in ventilator pressure sensor. Filter in pressure measuring hose blocked (water absorption!) Control pressure in ventilator too low. Hardware fault in ventilator. **Machine not operational!**	**Immediately ventilate the patient manually!** If no pressure build-up in the breathing system: **immediately ventilate the patient with the separate emergency breathing bag.** Check medical gas supply. Replace filter in pressure measuring hose.

Messages on the system screen (In alphabetical order according to priority)		
Messages	**Cause**	**Remedy**
Caution messages		
AMV ↓ !!	Minute volume below lower alarm limit. Tube blocked / kinked? Leak in breathing system? Pressure limited ventilation?	Check tube and hoses. Seal breathing system. Adjust ventilation pattern.
AMV ↑ !!	Minute volume exceeds upper alarm limit.	Correct tidal volume or respiration rate on ventilator.
DIA NIBP ↓ !!	Measured non-invasive blood pressure below lower alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
DIA NIBP ↑ !!	Measured non-invasive blood pressure exceeds upper alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
DIAS IBP1 ↓ !! DIAS IBP2 ↓ !!	Measured invasive diastolic pressure of the channel shown (1 or 2) below lower alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
DIAS IBP1 ↑ !! DIAS IBP2 ↑ !!	Measured invasive diastolic pressure of the channel shown (1 or 2) exceeds upper alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
ET CO2 ↑ !!	Upper alarm limit for end-expiratory CO_2 concentration has been exceeded for at least two breaths.	Check ventilation
ET CO2 ↓ !!	End-expiratory CO_2 concentration below lower alarm limit for at least two breaths.	Check ventilation. Check for leak in sample line.
EXSP-V INOP !!	Fault in expiration valve. Measured value for minute ventilation may be excessive.	Check expiration valve. Carry out another leak test.
FI O2 ↑ !!	Inspiratory O_2 concentration exceeds upper alarm limit.	Check O_2 concentration in fresh gas flow. This message is deactivated until the next leakage test by pressing the alarm suppressor key.
FI HAL ↓ !! FI ISO ↓ !! FI ENF ↓ !! FI DES ↓ !! FI SEV ↓ !!	Applicable inspiratory anaesthetic concentration below lower alarm limit. Value below lower alarm limit for at least two breaths.	Check setting of anaesthetic vaporizer.
FRESH GAS ? !!	Too little gas in manual ventilation bag.	Increase fresh gas flow. Repair any leaks in hose system.
HEART RATE ↑ !!	Heart rate exceeds set upper limit.	**Check patient's condition!** Correct alarm limit if necessary.
INSP CO2 ↑ !!	The inspiratory CO_2 concentration exceeds the upper alarm limit.	Check the soda lime. Check the valve plate in the breathing system. Correct alarm limit if necessary.

Messages on the system screen

(In alphabetical order according to priority)

Messages	Cause	Remedy
MEAN IBP1 ↓ !! MEAN IBP2 ↓ !!	The average invasively measured blood pressure of the displayed channel (1 or 2) is below the set lower alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
MEAN IBP1 ↑ !! MEAN IBP2 ↑ !!	The average invasively measured blood pressure of the displayed channel (1 or 2) is below the set lower alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
PRESS LIMIT !!, (!)	Ventilator operating with pressure limitation. Change in lung compliance? Tube buckled? Microbial filter in inspiratory line blocked?	Check tube/filter. Increase Pmax or decrease VT if necessary. If pressure-limited ventilation is intentional: press the »**config**«, softkey and select »**alarms**« ; in the alarms menu, switch »**Pmax**« to »**off**« , to reduce the warning message to a caution message with no audible alarm.
PULSE IBP 1 ↑ !! PULSE IBP 2 ↑ !!	Invasive measured pulse exceeds set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
PULS SPO2 ↑ !!	Pulse rate exceeds upper alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
S-T MV ↑ !!!	Magnitude of S-T segment exceeds upper alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
SPO2 ↑ !!	Oxygen saturation exceeds set upper alarm limit.	Check O_2 concentration in fresh gas. Check ventilator.
SYS IBP1 ↓ !! SYS IBP2 ↓ !!	Measured invasive systolic pressure of the channel shown (1 or 2) below set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
SYS IBP1 ↑ !! SYS IBP2 ↑ !!	Measured invasive systolic pressure of the channel shown (1 or 2) exceeds set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
SYS NIBP ↓ !!	Measured non-invasive systolic pressure below set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
SYS NIBP ↑ !!	Measured non-invasive systolic pressure exceeds set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
TEMP 1 ↓ !! TEMP 2 ↓ !!	Measured body temperature of the channel shown (1 or 2) below set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.
TEMP 1 ↑ !! TEMP 2 ↑ !!	Measured body temperature of the channel shown (1 or 2) exceeds set alarm limit.	**Check patient's condition!** Correct alarm limit if necessary.

Messages on the system screen

(In alphabetical order according to priority)

Messages	Cause	Remedy
Advisory messages		
AGAS MIX !!	Gas measurement has detected a mixture of two anaesthetic agents. The leading agent is recognised and quantified. The accuracy of this process is limited.	If necessary, check the anaesthetic agent concentration in the fresh gas.
AGAS INOP !	Anaesthetic gas measurement faulty.	Call DrägerService
BP CUFF ? !	Cuff hose disconnected? Leak in hose or cuff?	Check connections. Replace cuff or hose.
CAN COM INOP !	Communication via CAN interface faulty.	Check connections of data lead. Call DrägerService
CHECK IBP 1 ! CHECK IBP 2 !	No pulse detected by pressure measurement.	Check transducer, replace if necessary.
CHECK PRESSURE !	No breathing phase detected by pressure measurement.	Check pressure measurement.
CO2 🔔 OFF !	CO_2 alarm inactive.	
CO2/AGA INOP !	CO_2 / anaesthetic gas measurement faulty.	Call DrägerService
CO2 INOP !	CO_2 gas measurement faulty.	Call DrägerService
CO2 LINE ? !	Sample line blocked.	Check sample line, filter in T-piece and water separator in water trap; replace if necessary. Check sample line is not kinked. Use the Dräger sample line.
CO2 WARMUP !	The CO_2 sensor has not yet attained the required temperature with complete accuracy.	Wait (max. 6 minutes).
COOLING 8060 ? !	Temperature inside machine too high.	Clean filter at rear. Call DrägerService
ECG INOP ! or ECG NOISE !	The ECG signal is encountering interference due to electrosurgery. The heart rate and S-T segment analysis will be frozen for 15 seconds and deactivated if the interference persists.	

Messages on the system screen

(In alphabetical order according to priority)

Messages	Cause	Remedy
ECG N ? ! ECG LA ? ! ECG LL ? ! ECG RA ? ! ECG V ? !	ECG electrodes disconnected.	Secure electrodes.
FI O2 CAL ? !	The mainstream FiO_2 sensor has not been calibrated.	Change lead/sensor. Calibrate the FiO_2 sensor manually.
FI O2 INOP !	Sensor calibrated incorrectly? Sensor changed and/or not calibrated? Sensor exhausted? Sensor not plugged in? Sensor lead defective? Dräger sensor cell not used?	Calibrate sensor. Calibrate sensor. Replace and calibrate cell. Plug in sensor connector. Replace sensor housing. Use original sensor cell.
FLOW INOP !	Flow sensor / flow sensor lead defective? Flow sensor not plugged in? Flow sensor soiled?	Replace lead / sensor and calibrate sensor. Plug in sensor connector.
FLOW SENSOR ? !	No gas flow detected by flow sensor although ventilation evidently proceeding correctly.	Check flow sensor, replace if necessary. Check flow sensor lead.
FRESH GAS ? !	The econometer indicates that the fresh gas reserve in the manual breathing bag is too low. (This message is programmed by Dräger Service on request).	Increase the fresh gas flow. If necessary, repair leakage in the hose system.
HORN INOP !	Loudspeaker defective. Alarm tone deactivated.	Call DrägerService
NO S-T !	S-T analysis not possible.	Check electrode positions.
N2O INOP !	N_2O gas measurement faulty.	Call DrägerService
NIBP ARTEFACT !	Movement artefacts detected during measurement.	Secure limb if necessary. Measurement is repeated automatically.
NIBP DEFEKT !	Interner elektronischer oder pneumatischer Fehler.	Call DrägerService
PB 8800 COM !	The parameter box is disconnected.	
PBOX 🔔 OFF !	Parameter box alarms inactive.	

Messages on the system screen

(In alphabetical order according to priority)

Messages	Cause	Remedy
PRESSURE INOP !	Pressure sensor defective.	Call DrägerService
RS 232 COM !	RS 232 communication interrupted.	Check plug connection.
SELECT AGAS !	The automatically recognised anaesthetic agent does not match the manually selected anaesthetic.	Check the anaesthetic agent used or switch over to automatic recognition.
SPO2 🔔 OFF !	SpO_2 alarm inactive.	
SPO2 INOP !	SpO_2 measurement faulty.	Call DrägerService
SPO2 SENSOR? !	No pulse detected by pulsoxymeter although heart is clearly beating.	Check patient's condition (disturbed circulation?) Check SpO_2 sensor positioned correctly.
TEMP1 CALIB ! TEMP2 CALIB !	Fault found during automatic internal accuracy test.	Call DrägerService
TEMP 1 INOP ! TEMP 2 INOP !	Temperature measuring function defective.	Replace temperature sensor. Call DrägerService
WATER TRAP ? !	The water trap is full or severely fouled. No measured values are displayed for CO_2, N_2O, anaesthetic agent and O_2.	Empty the water trap. Check the fitting of the collecting jar. Remove condensate from the prism.

Messages on the ventilator

(In alphabetical order according to priority)

Messages during the self-test and leakage test

Messages	Cause	Remedy
Complete test	Attempt to cancel self-test when – a malfunction has been signalled beforehand or – self-test has already been aborted 10 times.	Run complete self-test. **Manual ventilation is always possible!**
Compliance Test	The hose compliance is being tested during the leakage test in »Standby« mode.	
Leak test IPPV	The IPPV leakage rate is being determined during the leakage test in »Standby« mode.	
Malfunction	This message precedes the message **»Malfunction No. XXX«**.	Note malfunction number and call DrägerService.
Self-test	Self-test has been started.	
Test ... x discontinued	Message displayed after cancelling the self-test. Only possible 10 times! 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!
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.
????	Internal electronic fault.	Call DrägerService

Messages during operation

Messages	Cause	Remedy
Depressurisation	A static excess pressure occurred after AutoWakeUp. The system is relieved.	Switch ventilator to »**Standby**«. Disconnect fresh gas.
Mains off	Mains power switch off. Piston pump moves to withdrawal position.	The device is switched off automatically after 10 seconds.
Pressure supply	Supply pressure inadequate.	Correct supply pressure. Use backup cylinders if necessary.
Paediatric 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!
Restart	Power supply briefly interrupted.	Check parameter settings.
Standby	Machine on Standby.	
Test stroke	The system occasionally runs a self-test to detect major leaks and faults in the inspiration valve.	

Messages in the ventilation system

General advisory messages:
These messages are displayed for about 2 seconds for information.

During the self-test and during operation:
Remedy the faults and follow the instructions. Carry out the procedure described below and acknowledge message.

Service messages:
The apparatus remains ready for operation. Acknowledge by confirming the message. Inform DrägerService of the message.

Fault messages:
Acknowledge by confirming the message. The audible warning will then be muted. Inform DrägerService of the fault.

fIPPV display:

The number of the relevant test block is displayed here. See also flow chart on page 164.

VT display:

Error Code No. for faults in the breathing system during the self-test. See page 164.

Bar display for relative piston movement:
The illuminated bar display in the self-test indicates a previous self-test that was not completed without error. Do not interrupt the self-test. Otherwise the message **»Malfunction!«** will be displayed.

Malfunctions and system faults

Switch off the alarm by pressing the acknowledge button. If necessary inform DrägerService, quoting the malfunction No. and software No.

If the malfunctions or advisory messages cannot be switched off by the procedures described above or by switching the master electric switch off and on repeatedly (waiting approximately 5 seconds with the machine "off") and repeating the self-test, inform DrägerService.

All malfunction messages are signalled by a continuous tone.

Messages during the self-test	Message must be acknowledged		
		Cause	**Remedy**
APL = 30 mbar ?	•	Dialogue during the self-test (required to test the diaphragm valve (V_3) and over-pressure valve in the breathing system).	Set APL overpressure valve of breathing system to 30 mbar.
APL → Man.?	•	Dialogue during the self-test.	Set APL overpressure valve to »MAN« position. Set pressure to 30 mbar.
BAG / Fr. Gas hose ?	•	Manual ventilation bag, corrugated or fresh gas hose faulty or not connected? Leakage at Vapor connection?	Remedy leak. Make connections.
Breathing sys. defect. Display **»105«** in VT field	•	Valve V_1 not opening correctly.	Replace breathing system or valve plate.
Breathing sys. defect. Display **»106«** in VT field	•	Valve V_2 not opening correctly.	Replace breathing system or valve plate.
Breathing sys. defect. Display **»107«** in VT field	•	Valve V_3 not opening correctly.	Replace breathing system or valve plate.
Breathing sys. defect. Display **»108«** in VT field	•	Valve V_6 not opening correctly.	Replace breathing system or valve plate.

Messages during the self-test	Message must be acknowledged		
		Cause	**Remedy**
Breathing sys. defect. Display **»109«** in V_T field	•	Valve V_6 not closing.	Replace breathing system or valve plate.
Breathing sys. defect. Display **»111«** in V_T field	•	Additional air valve not opening.	Replace breathing system or valve.
Breathing sys. defect. Display **»121«** in V_T field	•	APL (overpressure) valve faulty.	Replace breathing system or valve.
Breathing system leak	•	Major leak in breathing system (absorber missing, no valve plates, breathing system not fully locked)	Repair leak. Confirm.
Compl. test please		If the self-test is interrupted: If a malfunction message was previously stored, this message switches the device to **»Man/Spont.«** mode (mechanical ventilation is only possible after fault-free completion of the self-test)	Switch off audible alarm by acknowledging message. Restart.
Control pressure low	•	Insufficient operating control pressure. Breathing system and piston pump installed and locked? Supply pressure greater than 2.7 bar ?	Breathing system or roller diaphragm faulty. Replace defective parts.
Fresh gas off ?	•	Dialogue during the self-test.	Shut off the gas metering.
Insp. valve ?	•	Indication of possible fault: Is the valve disc in the inspiration valve faulty? Crater damaged? Leak in subsystem 1? See flow chart on page 164.	Check valve. Change faulty parts. Remedy leak.
Install piston	•	Piston pump not installed.	Install piston pump.
Leak = xxx mL/min	•	Indicates a leak in the ventilation system. For leaks greater than 300 mL/min (at 30 mbar) in subsystem 3. See flow chart on page 164.	Acknowledge. Repair any leak and repeat the test.
Leak accepted?	•	Indicates a leak in the ventilation system.	The user accepts by confirming the previously displayed leak. The test continues.
Leak IPPV = xxx mL		Displayed at the end of the leak test in subsystem 1/2 for approx. 2 seconds if the leak < 175 mL/min. See flow chart on page 164.	For information.

Messages during the self-test	Message must be acknowledged		
		Cause	**Remedy**
Leak IPPV = xxx mL	•	Indicates a leak in the ventilation system. For leaks greater than 175 mL/min (at 30 mbar) in subsystem 1/2. See flow chart on page 164.	Acknowledge. Repair any leak and repeat the test.
Leak remedied?	•	Alternative question to **»Leak accepted«**.	When acknowledged, carries out a new leak test with user prompting.
Leak test IPPV		Test is performed for subsystems 1 and 2. See flow chart on page 164.	For information.
Leak test MAN		This test is performed on subsystem 3 (Vapor, breathing bag, fresh gas branch). See flow chart on page 164.	For information.
Mains switch off		The power switch has not clicked into the ON position.	Press the switch again.
Malfunction No. ...	•	Specifies an internal malfunction.	**»MAN/SPONT.«** mode is automatically selected. Cancel the continuous alarm tone by acknowledging message. Inform DrägerService, quoting malfunction No.
Malfunction		This message is immediately followed by **»Malfunction No...«**.	See page 164.
P-sensor fault	•	Pressure difference between the breathing system and piston pump greater than 10 mbar	Connect pressure measurement to breathing system. Blow out any water in the system via the piston pump measuring port. If necessary, replace breathing system (V_6, PEEP valve does not open).
Piston defective	•	Major leak in the piston pump. Check lip seals in the housing floor.	Close the quick-release couplings. Check the roller diaphragm.
Pneumatic interface	•	Test control pressure in ventilator too low.	Check lip seals between piston pump and breathing system.
Pressure supply ?	•	Supply pressure too low or not available.	Switch on main gas switch. Check gas supply.
Remove piston	•	Piston pump incorrectly installed.	Remove, confirm and wait for message **»Install piston!«**.
Roller diaphragm faulty	•	The roller diaphragm has been tested for leaks in several positions and has been found to leak. Inserted the wrong way round?	Change piston pump or front roller diaphragm. Check lip seals and quick-release couplings. Observe the position of the manufacturing mark (see p. 126).
Self-test		Dialogue during the self-test	The ventilation system self-test is performed.
Service No. 4	•	Front panel LED faulty.	Call DrägerService.
Service No. 22	•	See »Check monitor«.	Call DrägerService.
Service No. 57	•	Battery faulty. No audible warning in event of power failure.	Call DrägerService.
Service No. 115	•	Test control pressure too low. Pneumatic interface locked?	Check lock and lip seal. Call DrägerService.

Messages during the self-test	Message must be acknowledged	Cause	Remedy
Service No. 118	•	Incorrect test control pressure. No sealing test possible for valve and roller diaphragm.	Call DrägerService.
Service No. 119	•	Test control pressure too high.	Call DrägerService.
Service No. 120	•	Operating control pressure too high.	Call DrägerService.
Service No. 214	•	Cold/warm restart recognition not guaranteed.	Call DrägerService.
Standby		The machine is ready for operation.	Select operating mode.
Subsystem 1/2 leak	•	Leak in subsystem 1 and/or 2. (Leak greater than 5 L/min at 30 mbar)	Check subsystems. (see chart on page 164).
Subsystem 1 leak	•	Leak in area of inspiration valve, valve 7, patient hose, flow sensor or O_2 sensor and PEEP valve (V_6)	Close the quick-release couplings. Connect the P-sensor. Replace the valve disc in the inspiration valve.
Subsystem 2 leak	•	Leak in area of inspiration valve, absorber, piston pump, valves 1-2-3, piston pump/breathing system interface and PEEP valve (V_6)	Close quick-release couplings.
Subsystem 3 leak	•	Leak in area of breathing bag, fresh gas hose, Vapor	Check connections and breathing bag or hoses. Check connector system and sealing rings on Vapor.
Test ..x interrupted		Displayed after the self-test is stopped.	Select operating mode.
Valve plate faulty	•	Breathing system valve plate or diaphragm of V_1 defective. Display **»112«** in V_T field	Replace breathing system or valve plate. Pneumatic interface faulty (check lip seals)
Valve plate faulty	•	Breathing system valve plate or diaphragm of V_2 defective. Display **»113«** in V_T field	Replace breathing system or valve plate. Pneumatic interface faulty (check lip seals).
Valve plate faulty	•	Breathing system valve plate or diaphragm of V_3 defective. Display **»114«** in V_T field	Replace breathing system or valve plate. Pneumatic interface faulty (check lip seals).
Version		Display at the start of the self-test	Software version No. is displayed after switching on. In the event of malfunctions, quote the version number to DrägerService.
Y-piece closed ?	•	Dialogue during the self-test	Close the Y-piece for the remainder of the self-test.
Y-piece open ?	•	Dialogue during the self-test	Open the Y-piece for the internal pressure sensor calibration. If using an external humidifier, remove the breathing hose from the inspiration cone or filter.
????		Internal electronic malfunction.	Call DrägerService.
Last interruption		The self-test has already been stopped 9 times!	For information. The next time you start up the machine, the complete self-test will have to be run.

Messages during operation	Message must be acknowledged	Cause	Remedy
Check monitor		No communication between ventilator and airway monitor. Display repeated every 10 minutes.	Switch on airway monitor manually. Check connectors. Call DrägerService if necessary.
Compliance test		Compliance test in progress.	For information.
Continue in 5 seconds		Internal malfunction.	Ready for operation again after max. 5 seconds. The set values are retained. **Manual ventilation impossible!**
Control pressure low		Insufficient operating control pressure. Automatically cancelled after the fault is remedied.	Breathing system and piston pump installed and locked? Supply pressure greater than 2.7 bar ? Breathing system or roller diaphragm defective. In this situation, if no pressure is generated in the breathing system when attempting manual ventilation: **immediately ventilate the patient with the separate emergency breathing bag.**
Exp. pressure high		Displayed for expiration pressures more than 10 mbar above PEEP	Check microbial filter in expiration hose; empty water traps; increase expiration time (I:E frequency), choke fresh gas supply.
Insufficient fresh gas		Displayed if the fresh gas flow is insufficient. Manual ventilation bag not filled.	Increase fresh gas setting. Remedy leaks, extend expiration time. Replace breathing bag connection hose in paediatric mode by adult hose.
Keyboard error		A particular key is held down continuously, or there is a short circuit.	**»Man/Spont.«** mode automatically selected. Call DrägerService.
Leak = xxx mL	•	Indicates a leak in the ventilation system. Displayed at the end of the leak test in subsystem 1/2 for approx. 2 seconds.	Acknowledge. Remedy any leak and repeat the test. Acknowledge if leak > 175 mL/min
Leak test IPPV		The leak test is performed for subsystems 1 and 2.	For information.
Malfunction No.....	•	Specifies an internal fault.	The **»Man/Spont.«** mode is automatically activated. Cancel the continuous alarm tone by acknowledging message. Call DrägerService, quoting number.
MAN./SPONT.		Displayed in Man./Spont. mode	
P-sensor fault		See **»Messages in self-test«**	Page 112.
Paediatric hoses !	•	When the V_T setting is changed from values above 200 mL to under 200 mL.	Use paediatric hoses. Otherwise, reduced precision.
Pressure limiting		Piston reaching the set pressure limit.	Reduce V_T and increase P_{max}. Remedy stenosis. Set longer inspiration time.
Pressure relief		The operating mode is switched from »Standby« to »Man/Spont.« and a continuous pressure > 30 mbar is detected for > 60 seconds	For information.

Messages during operation	Message must be acknowledged	Cause	Remedy
Prohibited		Prohibited key sequence.	Wait about 2 seconds.
Service No. 46		Defective fan	Switch off machine after end of anaesthesia due to possible overheating. Call Dräger Service. Leads to a malfunction message in the next self-test.
Service No. 120	•	Operating control pressure too high.	Call DrägerService.
Service No. 122	•	Control pressure between 40 and 70 mbar.	Call DrägerService.
Service No. 714		No cold/warm restart detection.	Call DrägerService.
Service No. 723		Does not carry out any reverse flow measurement.	Call DrägerService.
Standby		Machine ready.	Select operating mode.
Subsystem 1 Leakage	•	Operation of the inspiration valve is checked every 10 minutes; the inspiratory plateau time is thereby increased by 1.5 sec.	Replace valve disc or breathing system. Repair leaks in subsystem 1. See flow chart on page 164.
Test pressure error	•	Test pressure for leak test not attained.	Repair leak. Repeat test. Insert pressure measuring hose in breathing system.
Test stroke		Inspiratory valve being tested with extended plateau time (1.5 sec).	For information.
Warm restart		In the event of a power failure lasting less than 120 seconds or specific internal malfunctions. Settings maintained. Duration approx. 10 seconds	For information. **Manual ventilation impossible!**
Mains switch off		The device detects that it is switched off. The piston returns to the sampling position.	For information.
Breathing system faulty		Underpressure < –10 mbar is detected for longer than 20 seconds.	Briefly open the breathing system lock to increase the pressure. In this situation, if no pressure is generated in the breathing system when attempting manual ventilation: **immediately ventilate the patient with the separate emergency breathing bag.**

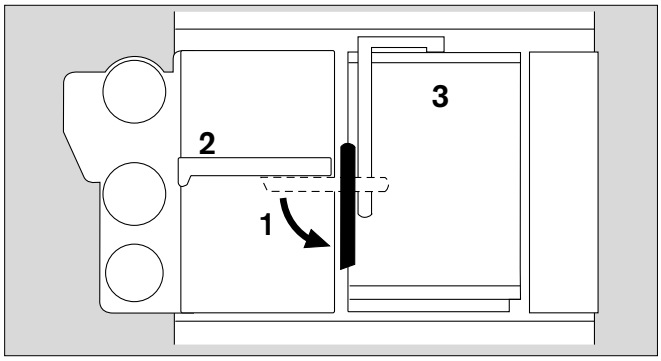
Page

Care

Stripping down machine

Swing up table top to remove piston pump:
(only possible if the device was previously in »**Standby**«)

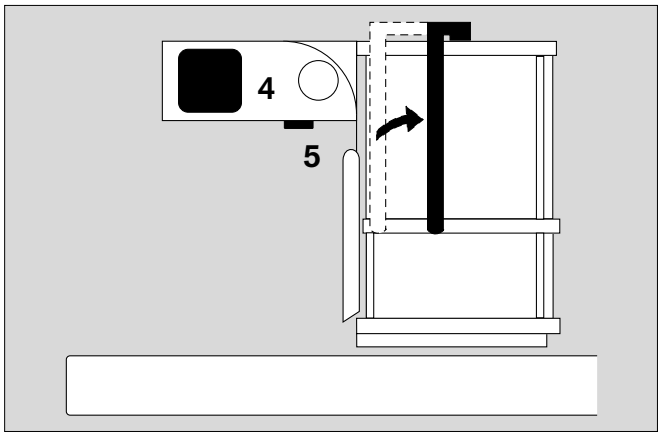
1 Swing lever as far as possible to unlock.



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.

4 Caution!

Temperature of heater for breathing system equals approx. 60 °C -



3 Handle pointing up - lift out piston pump.
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.

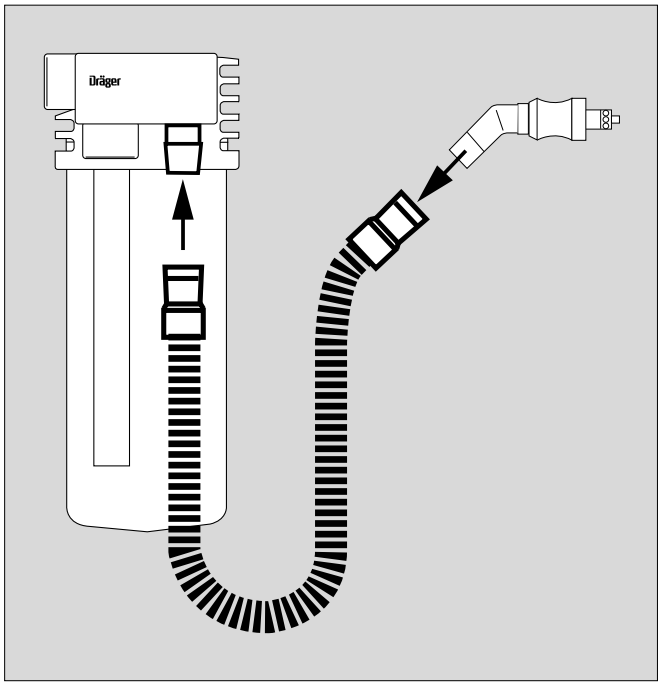
Remove anaesthetic gas scavenging system

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

- Unplug anaesthetic gas scavenging hose from wall socket -
- and remove from the anaesthetic gas scavenging system.

5 Remove the transfer hose between the breathing system and the anaesthetic gas scavenging system.
To do so:
Press button to unlock hose connector and pull downwards. Hose remains on connector.

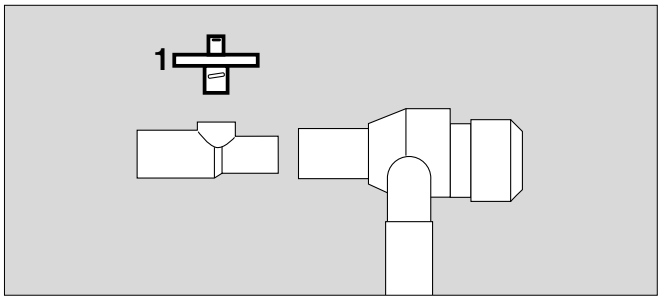
- The anaesthetic gas scavenging system can be removed from the back panel of the Cicero EM as a single unit.



Dismantling parts

Measured gas:

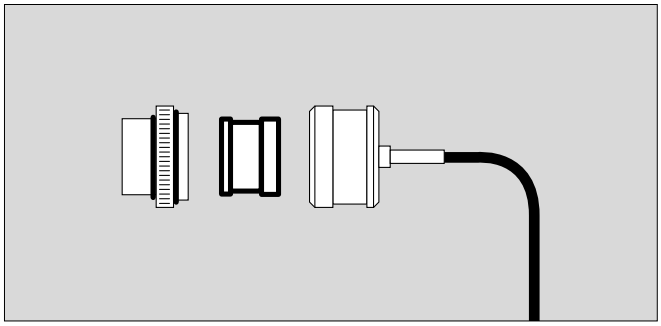
1 T-piece of measured gas hose (if used): remove filter.



Inspiratory O_2 sensor (if used)**:**

- **Must not be disinfected in liquid or autoclaved!**
- Wipe any dirt off housing or lead with damp disposable cloth.
- Unscrew O_2 sensor and remove O_2 cell. Do not touch wire mesh of O_2 cell, otherwise it loses its water-repellent property and measurement becomes inaccurate.

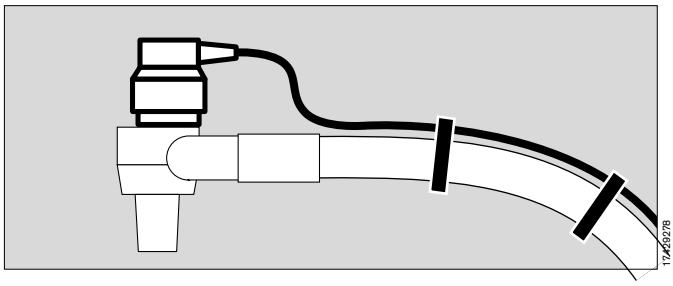
  Dirt on wire mesh of sensor cell is simply wiped off with a disposable cloth moderately soaked in distilled water.



Temperature sensor: (breathing gas; if used)

- 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.

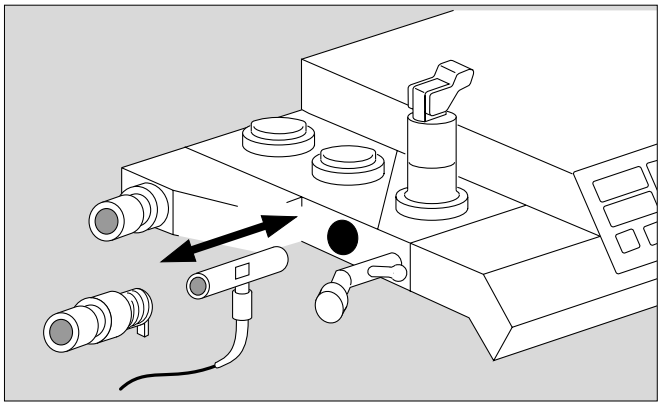


Flow sensor

Contamination by infectious patients: dispose of as directed!

If there is no risk of contamination, continue using the flow sensor until the message »**FLOW INOP !**« appears at the breathing minute volume. Then dispose of the flow sensor as ordinary domestic waste.

It can be incinerated at temperatures above 800 °C with low pollutant emissions.

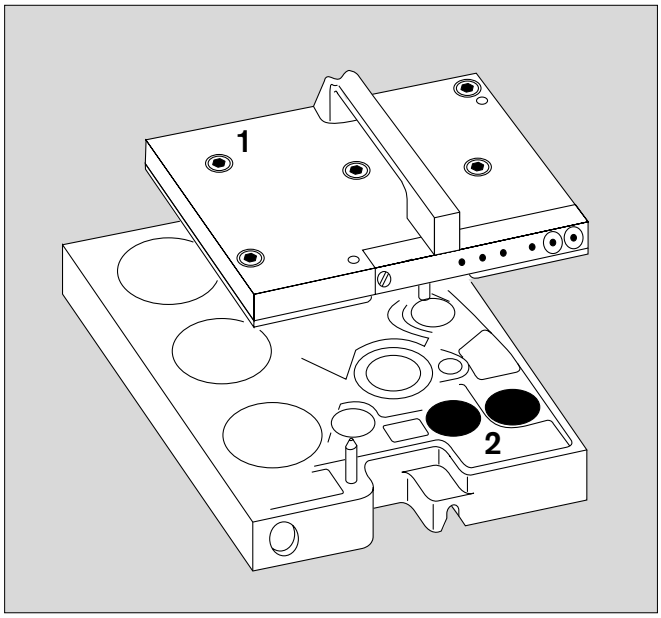


Breathing system:

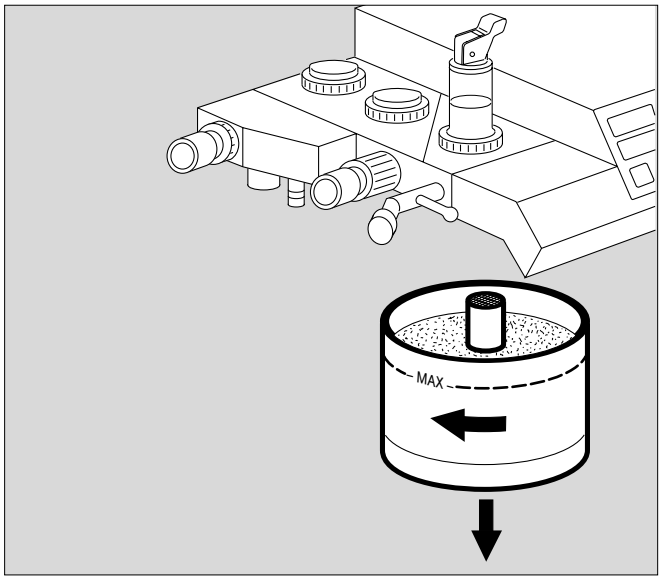
- Remove flow sensor -
- Unscrew pressure limitation valve APL -
- Dismantle breathing valves -
  valve discs must be handled with care.
- Replace measured gas return hose if contamination is possible -

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 pages 41 and 128) - Dispose of with household refuse (not when treating infectious patients!) -



Piston pump:

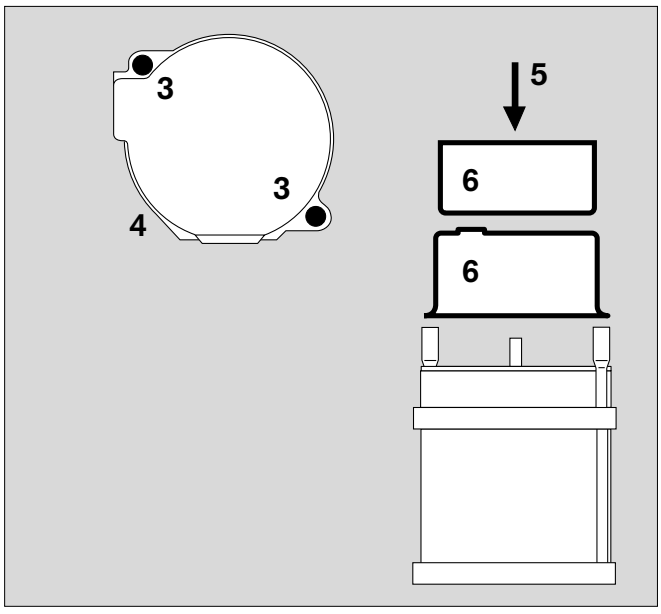
3 Release the two quick-release screws by turning through a quarter-turn with a 6 mm hexagon key -

4 Remove cylinder end cap -

5 Completely unscrew the central screw on the piston (not 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

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:

– compounds containing phenol,

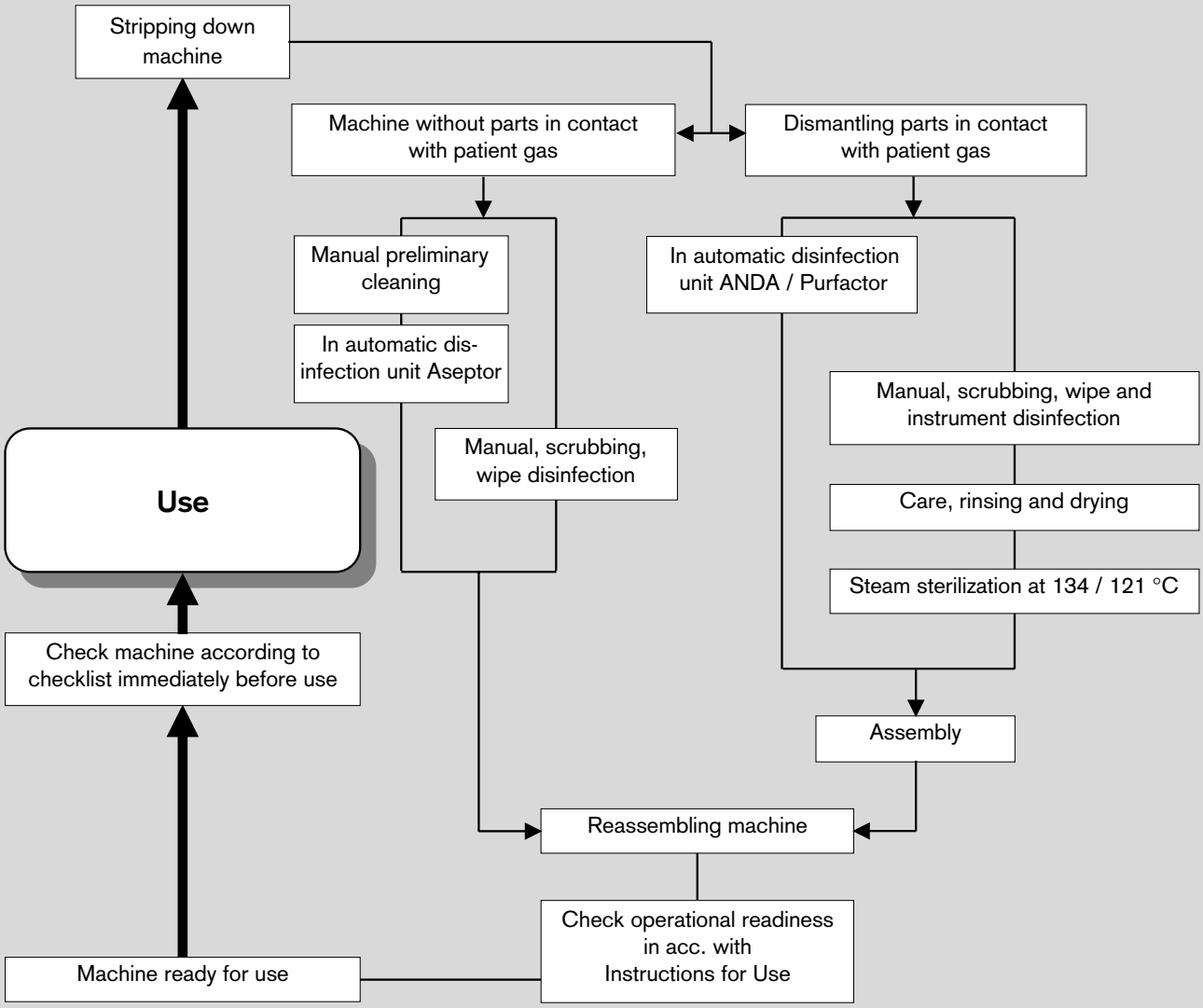
– compounds liberating halogen,

– strong organic acids and

– compounds liberating oxygen.

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

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 (breathing gas) 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 throw-away articles

Throw-away 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 of in accordance with regulations!**

Wipe cleaning

Cicero parts which can be wipe-cleaned are listed in the table on page 125.

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

Cicero parts which can be cleaned and disinfected in this way are listed in the table on page 125.

»**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

Cicero parts which can be treated in this way are listed in the table on page 125.

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.

Formaldehyde vapour may only be used to disinfect the device without system screen, parameter box and uninterruptible power supply (UPS). Other electrical devices not supplied by Dräger must be removed if you are not certain of their resistance to formaldehyde vapour.

Repeated disinfecting with formaldehyde may permanently modify paints, surface finishes and plastics!

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).

Steam sterilization at 121 or 134 °C

Cicero parts which can be sterilized in this way are listed in the table on page 125.

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. Plastic and rubber parts are subject to greater material wear when sterilized at 134 °C.

Machine components	Methode: 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	Wipe				
Rubber parts:					
Tube / mask	●	●		●	●
Y-piece	●	●		●	●
Breathing hoses	●	●		●	●
Breathing bag	●	●		●	●
Breathing bag hose	●	●		●	●
Roller diaphragm of piston pump	●	●		●	●
Anaesthetic gas scavenging syst.	●	●		●	●
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 lime container with screen	●	●		●	●
T-piece for sidestream gas measur.	●	●		●	●
Water trap for measured gas	●	●			
Water traps for airway	●	●		●	●
Filters:					
Airway filter					24 times
Sensors:					
Temperature sensor (airway temperature)	●				
Temperature sensor (skin/rectal/oesophagus)	●				
O_2 sensor (housing)	●				
Flow sensor	●				

*) without system screen

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

Filter of pressure measuring hose replace every 6 months.

Water separator in gas sampling system

Connecting hoses in gas sampling system

Filter in T-piece of gas sampling system

Reassembling machine

Reassemble cleaned, disinfected and sterilized parts

Assemble the piston pump:

- Check individual parts:
  Gaskets: pressure marks? cracks?
  Diaphragm: cracks? holes? deformation?

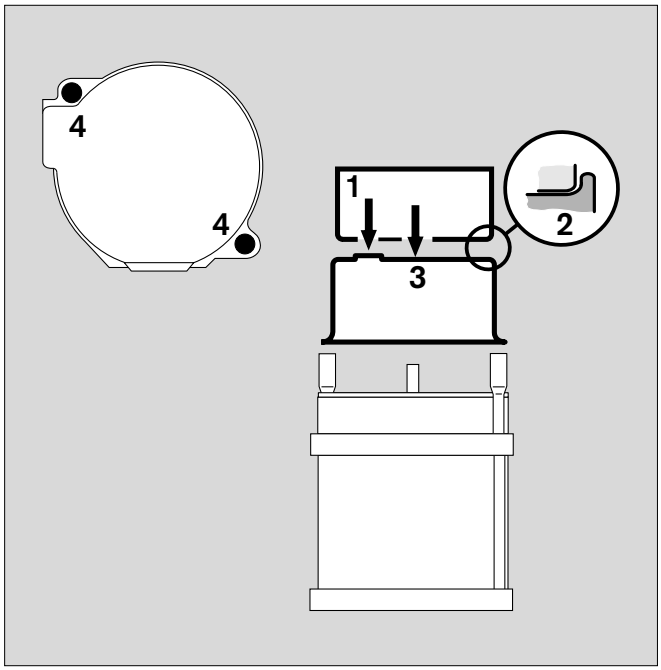
  Defective parts must be replaced!

1 Fit roller diaphragm -
production mark visible on the outside (arrow) -

2 Insert piston - carefully place the rolled edge round the edge of the piston -

3 Screw piston into position (not quick-release) -

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?

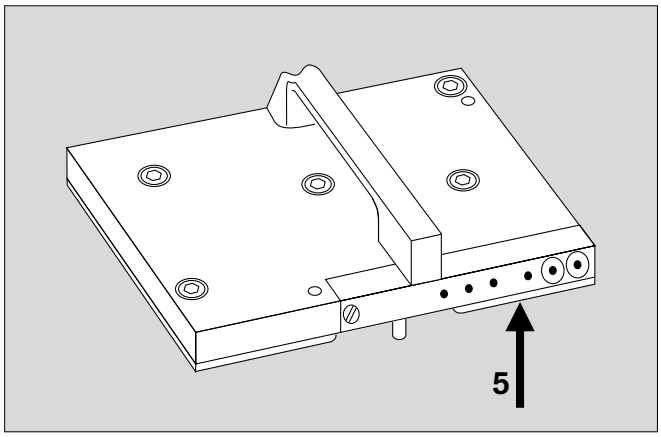
  Defective parts must be replaced!

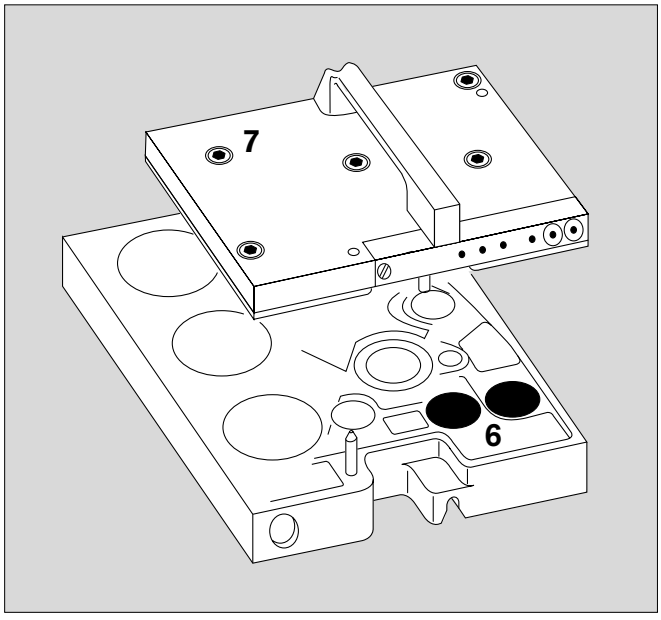
5 The six holes must be clear!

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

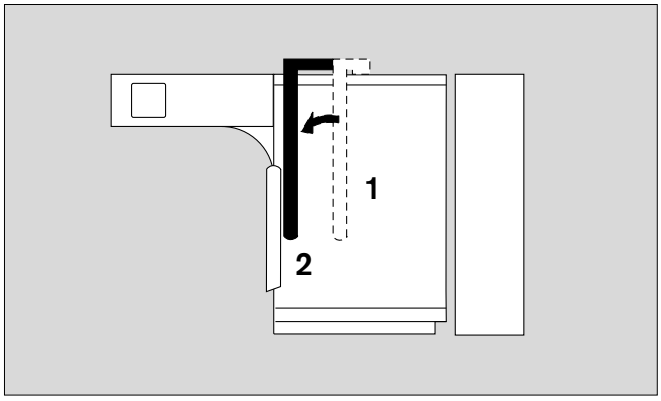
- Swing up table top

1 Handle in starting position -

Do not damage gaskets when fitting pump!

- Hold piston pump by its handle and insert in machine.

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

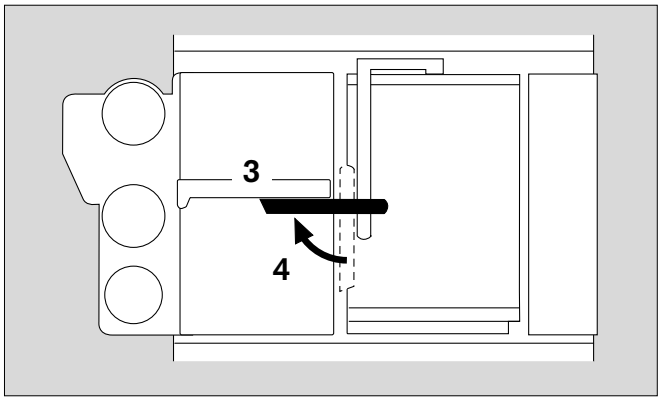


Fit the breathing system

3 Hold breathing system by its handle and insert in machine -

4 Lock in direction of arrow -
swing as far as possible (black).

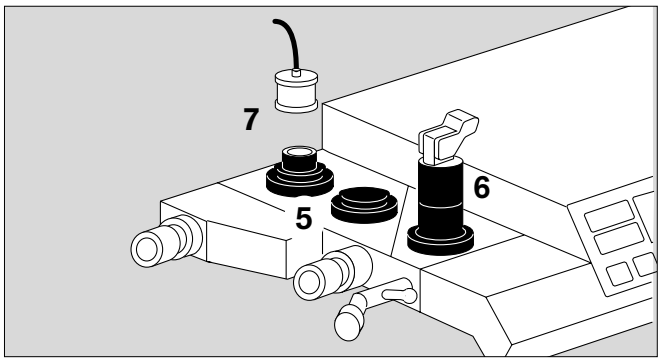
Do not damage gaskets when fitting breathing system!



Fit valves

5 Fit valve discs in expiration and inspiration valves - fit sealing rings - screw on valve caps.

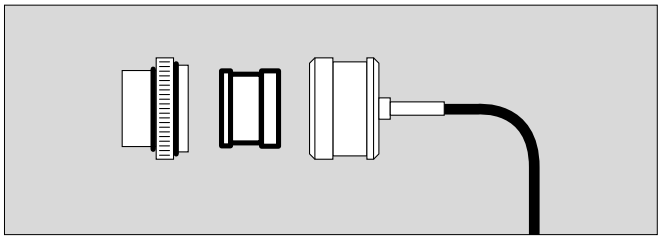
6 Screw on pressure limitation valve APL -
scale facing the front.



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 -

7 Plug sensor onto inspiration valve.

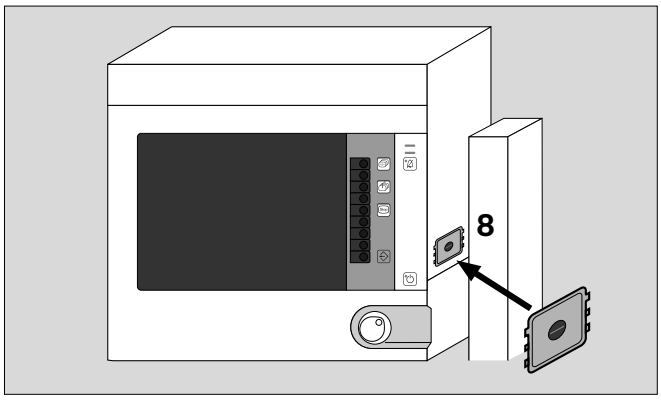


Replace O_2 sensor for gas sampling system

(Only if measuring cell is exhausted; display »**FI O_2. INOP !**«)

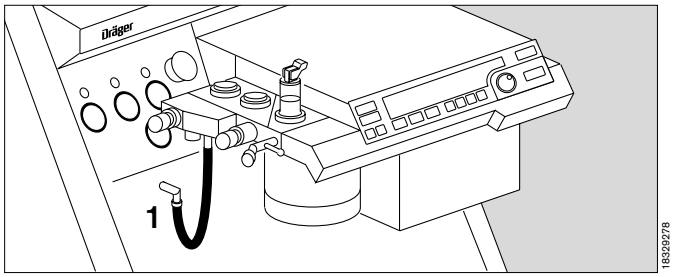
8 Unscrew the thumbscrew on the right-hand panel of the device by turning counter-clockwise -

- Draw out old sensor and insert new sensor in mount -
- Screw thumb screw back into place. The sensor is automatically calibrated.



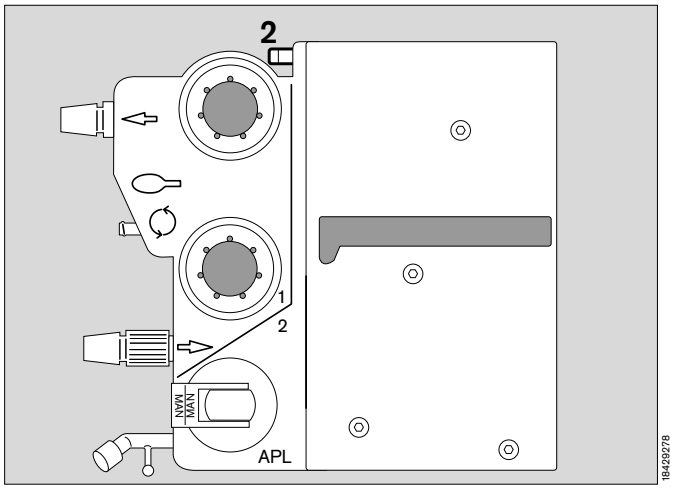
Connect fresh gas hose

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 plus**« (see separate Instructions for Use). This is sufficient to bind approx. 150 l CO_2 or for a period of at least 6 hours.

- Do not fill the soda lime until just before using!

Soda lime that has been exposed for a long time to the ambient air and/or radiant heat dries out and therefore loses some of its capacity to bind CO_2. The efficiency of the indicator substance (change of colour) is also reduced.

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

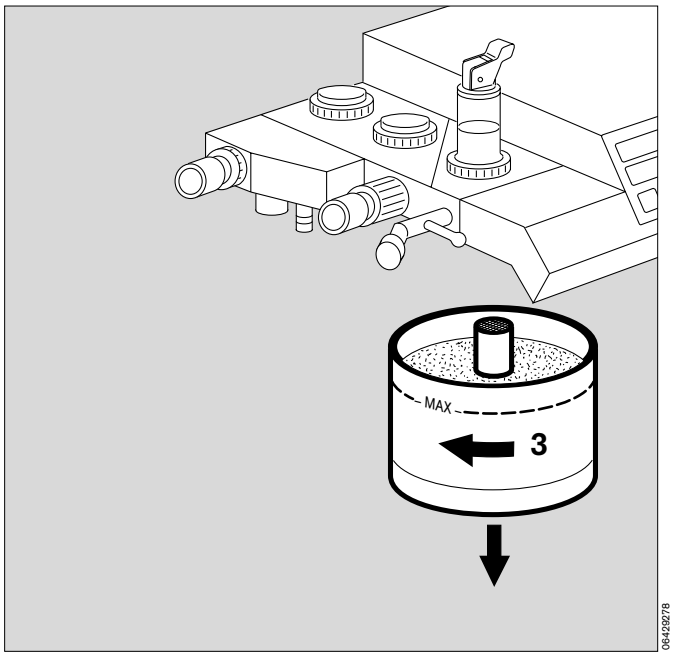
The indicator colour **changes back as it dries** although the absorption capacity is exhausted.

Absorber function

- Place the chain on the bottom of the container.
- Insert mesh - **must not be forgotten! - Absolutely essential for absorption!**
- Uniformly fill the container with 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.

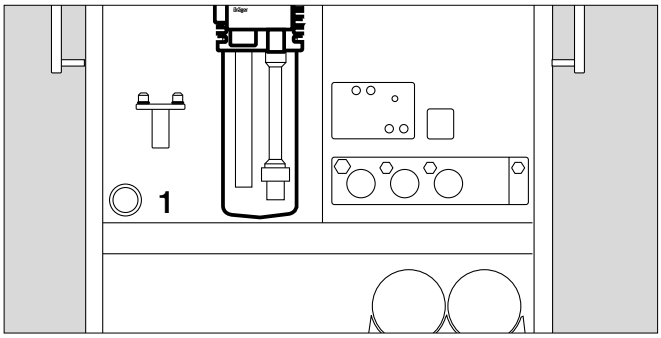


Fit the soda lime container

3 into the breathing system from below and turn clockwise as far as possible.

Connecting the anaesthetic gas scavenging system

- Hook the receiving system to the mount: position the slots of the receiving system over the two holders and slide down.



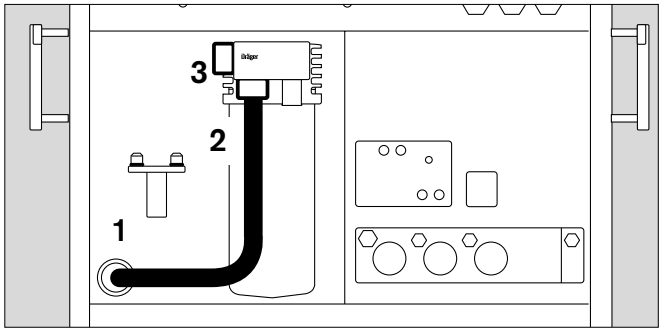
Connecting the transfer hoses

1 Pass the transfer hose from behind through the hole in the Cicero EM and connect the hose to the scavenging connector of the breathing system.

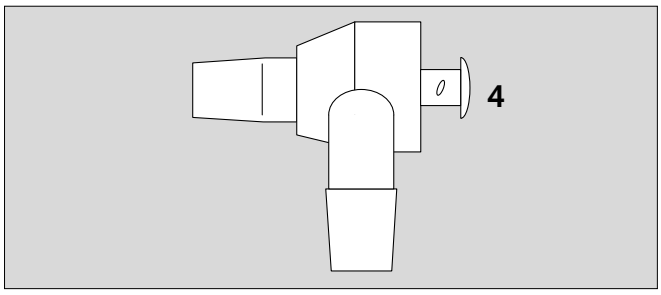
2 Connect the transfer hose to the connector on the receiving system.

- Make sure the connection is secure!

3 Make sure that the connector for the second transfer hose is sealed with a screw plug.



Do not seal the openings of the receiving system. Otherwise the breathing system may be drained!



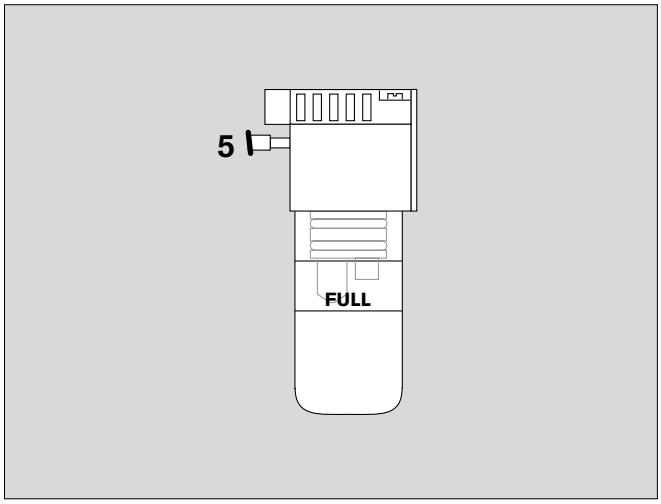
Connect sample line

for sampling CO_2 / O_2 and anaesthetic agent.

If a Y-piece with Luer lock is used:

4 Connect the sample line to the Luer lock of the Y-piece.

5 Connect the sample line to the Luer lock of the water trap.

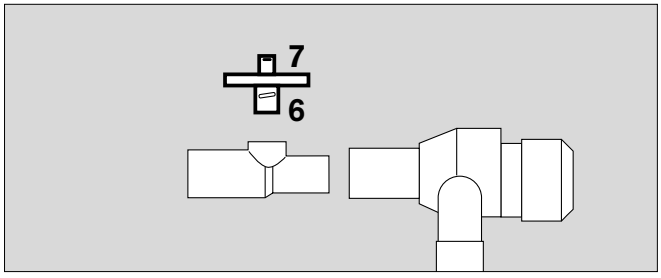


If a Y-piece without Luer lock is used:

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

7 Connect the sample line to the Luer lock of the filter in the T-piece.

5 Connect the sample line to the Luer lock of the water trap.



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

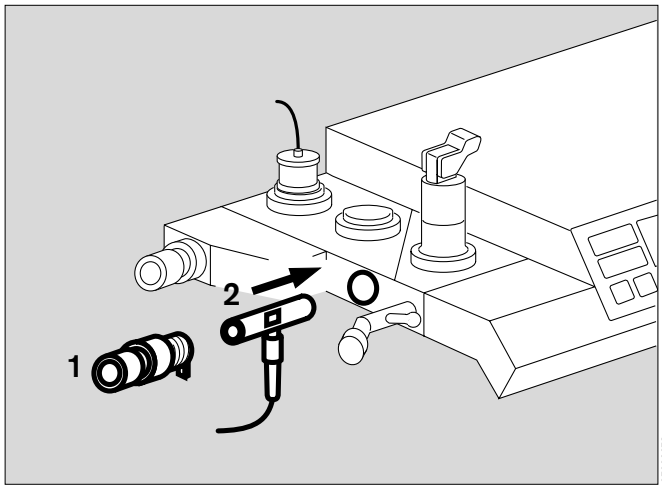
Fit flow sensor:

1 Unscrew expiration nozzle.

2 Slide flow sensor into housing.

1 Screw expiration nozzle back into place.

The sensor is automatically calibrated.



Fit microbial filter:

- Fit a microbial filter with 22 mm fittings on both the inspiration and expiration ports.

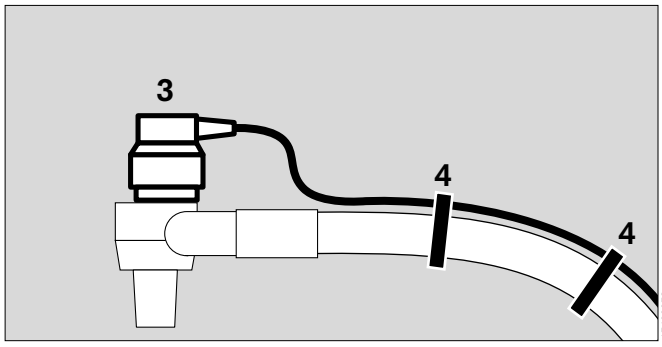
Fit temperature sensor (breathing gas):
(Optional) with Y-piece and hose clips.

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

3 Insert temperature sensor 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 bronchial aspirator

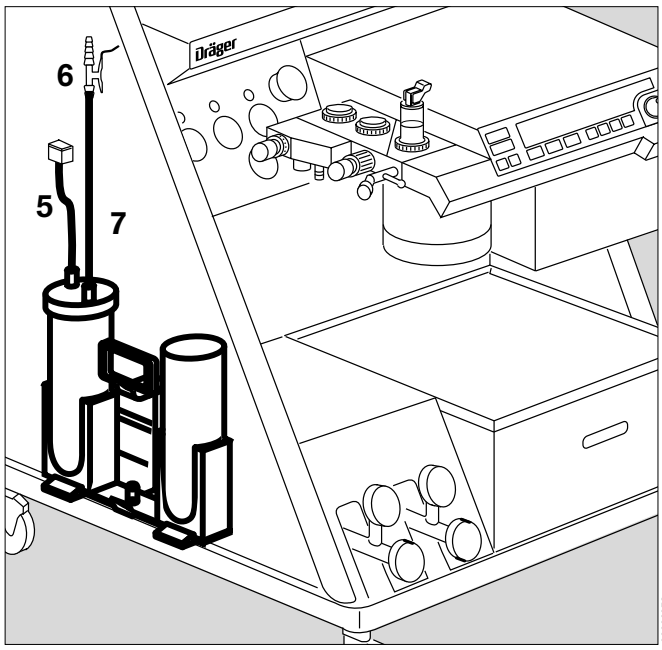
- Position the bronchial aspirator on the mount on the frame with two secretion collecting vessels.

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

6 Fit the handpiece (»**fingertip**«) on the aspiration hose.

7 Plug the aspiration hose with handpiece onto the inlet.

- Secure the aspiration hose in the clamp.



Page

Check operational readiness

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.

The following functions must be including in checking readiness for operation:

– Operation of the power failure alarm
– Checking against the checklist (as from page 21)
– Self-test immediately after the checklist check (as from page 26)
– The operation of the O_2 shortage signal and
– Manual ventilation function and
– Automatic ventilation function.

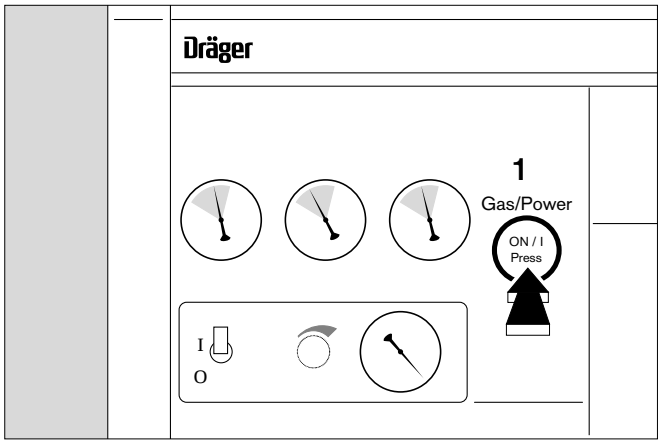
Check power failure alarm

(only if the unit does not have an uninterruptible power supply)

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

1 Set Power switch to **I** = On.
Power failure alarm sounds.
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!



1 Set Power switch to **O** = Off - turn clockwise.
Alarm stops.

- Reconnect to power supply.

Run the self-test!

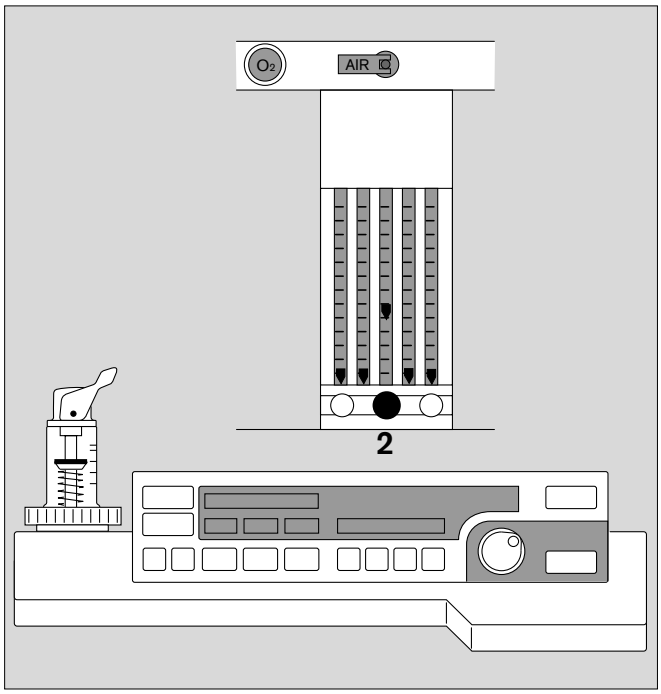
The self-test must be completed successfully in order to establish readiness for operation!
Supplementary equipment must not be switched on until after the self-test.

Start self-test:

- Set Power switch to **I** = On.

Test proceeds as described from page 26 onwards.

Check O_2 shortage signal



2 Open O_2 control valve.
- Interrupt O_2 delivery.
- O_2 shortage signal must be given after approx. 3 seconds: continuous tone for at least 7 seconds.

Check manual ventilation function

Machine in Manual/Spontaneous mode:

1 Press MAN SPONT -

2 Pressure limiting valve (APL) set to MAN -

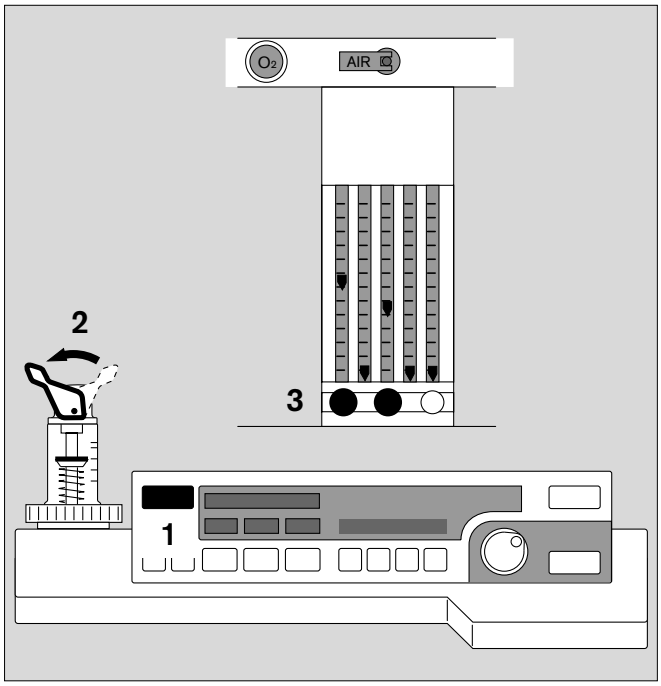
- Connect lung simulator, test thorax or breathing bag to Y-piece -

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 system screen 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.



Check automatic ventilation function

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

3 Set fresh gas flow -

4 Press IPPV -

5 Press rotary control -

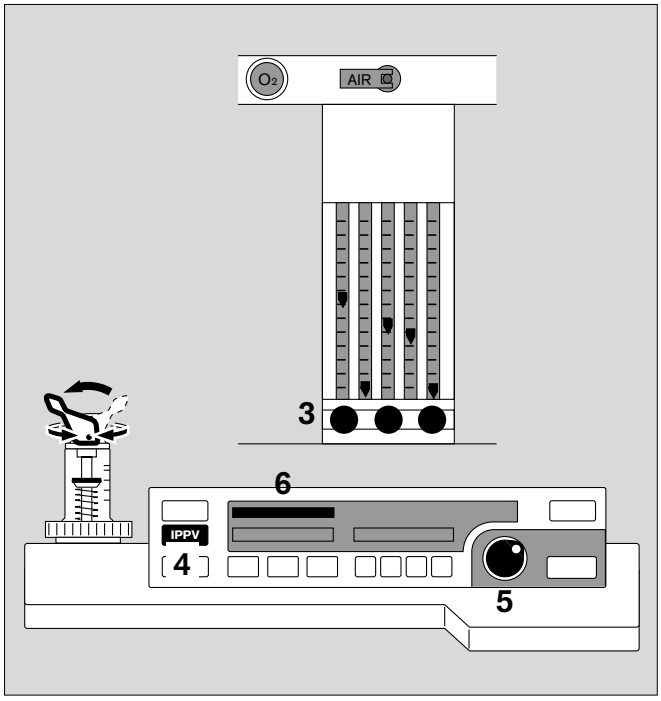
6 Piston movement is indicated on the bar graph.

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

– Lung simulator inflates regularly.

– Pressure profile is displayed on the system screen.

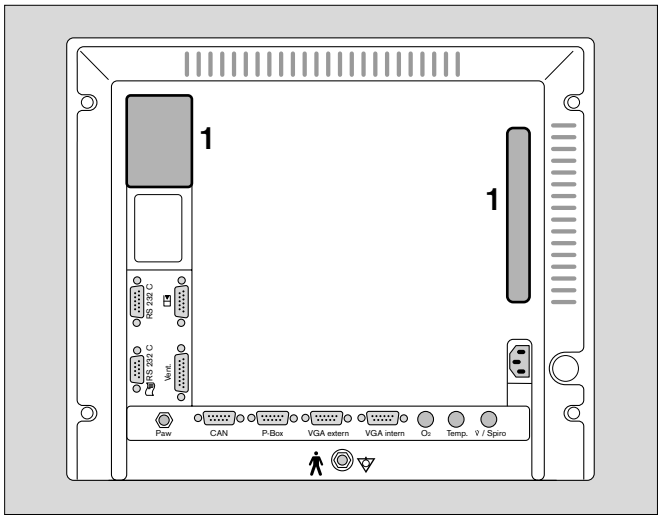
– Volume measurement yields plausible values.



Replace cooling air filter of system screen

1 Draw both cooling air filter out of its mount.

- Fit new filter or wash in warm water with detergent and dry thoroughly.
- Replace cooling air filter in mount without creasing.



Replace water separator

when contaminated or if message

CO2 LINE ? !

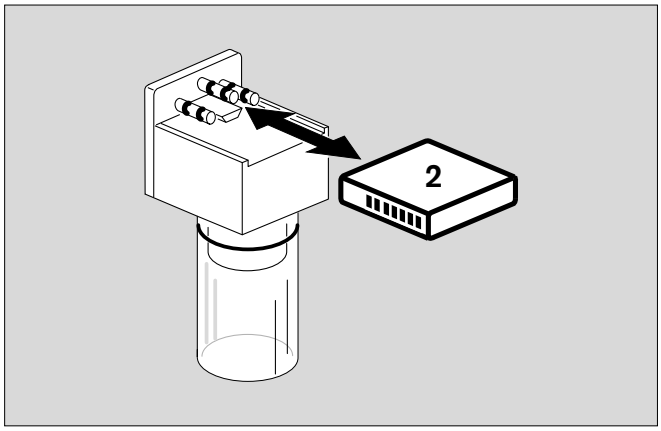
appears on system screen although sample line is not kinked and does not appear to be blocked. The typical service life of a water separator is between 2 and 4 weeks.

2 Hold the water separator by its sides and lift out.

- Slide the new water separator onto the guide as far as possible.
- Dispose of the old water separator as household refuse.

Note

Do not dry and reuse the filter. The gas permeability of the filter is impaired by secretions, nebulisers etc., thereby reducing the service life of the filter.

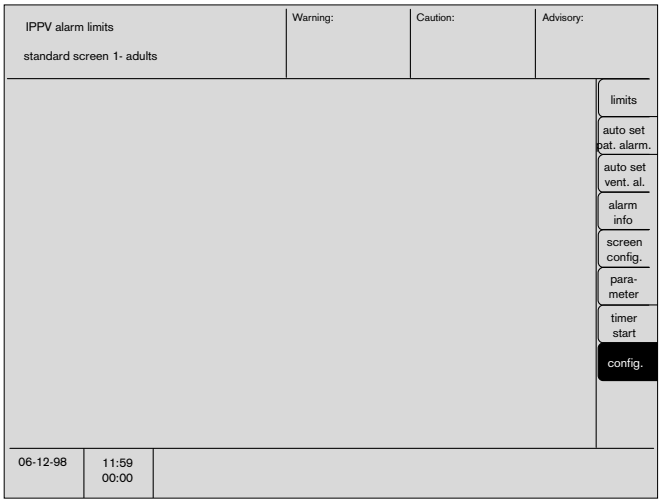


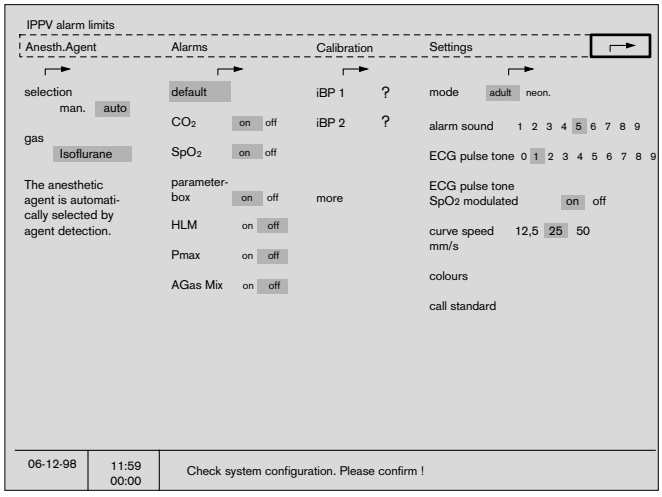
Checking the NiBP pneumatic circuit for leaks

Pull the supply hose of the sphygmomanometer cuff from the twin hose and connect it to a pump-ball via a T piece. The cuff (normal size) remains in the measuring circuit, tightly rolled up. Then proceed as follows:

- Open the venting valve in the measuring circuit. Wait at least 30 seconds.
- Press the »**config**« softkey.
- Move the cursor frame horizontally across the screen to »**calibration**« by turning the rotary control. Press the rotary control to confirm the selection.
- Move the cursor frame vertically to »**more**« by turning the rotary control. Press the rotary control to confirm the action.
- Move the cursor frame vertically to »**NiBP test**« by turning the rotary control. Press the rotary control to confirm the selection.
- The cuff pressure displayed on screen should be 0.
- Wait 30 to 35 seconds, and then press the »**AUTO**« key on the parameter box.
- Increase the pressure to the test pressure value with the pump-ball and wait at least 30 seconds for the system to settle.
- Measure the pressure drop.

  If the overpressure relief valve responds, the parameter box will be vented automatically at 300 mmHg ± 5%. It will also be vented if the pressure falls below 15 mmHg. Repeat the test.
- Quit the calibration mode by pressing the rotary control after selecting »**Check NiBP**«. Deactivate the »**AUTO**« key.





Measurement system testing

Detach the cuff supply hose from the twin hose and connect to normal pressure instead.

- Start the test mode as described above for »**Checking the pneumatic circuit for leaks**«.
- With the pump and venting valve at normal pressure, the test pressure can now be set in the system.
- Quit the test mode as described above for »**Checking the pneumatic circuit for leaks**«.

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 Medizintechnik GmbH.

Disposal of bacterial filters

Treat as infectious special waste.
Can be incinerated at temperatures above 800 °C with low pollutant emissions.

Disposal of apparatus

– at the end of its useful life.

The Cicero EM can be returned to Dräger Medizintechnik GmbH for environmentally sound disposal.

Maintenace intervals

Machine and machine parts must be cleaned and disinfected before starting any maintenance work and before returning to manufacturer for repair!

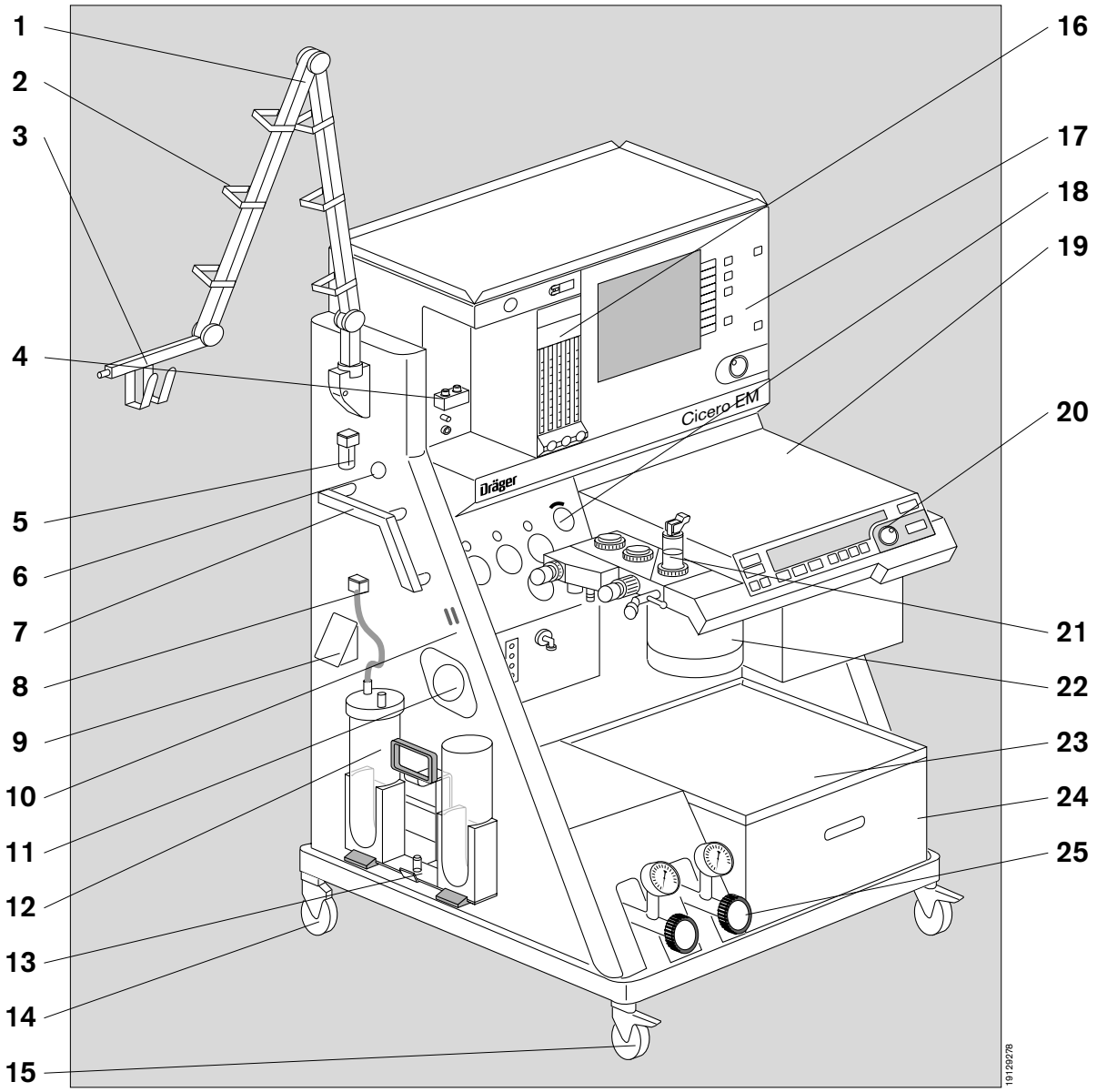
Inspection and maintenance*	Every 6 months by qualified personnel.
Pressure reducing valve maintenance	Must be serviced every 6 years by qualified personnel.
Water separator	Replace when dirty or if the message »**CO2 line**« is displayed without any problem in the sample line. Discard as domestic waste.
O_2 sensor	Replace when calibration is no longer possible or if the message »**FiO2 INOP!**« is displayed. For disposal, observe the same rules as for batteries (refer to local waste disposal regulations).
Flow sensor	Replace when calibration is no longer possible or if the message »**FLOW INOP!**« is displayed. Can be incinerated with low emissions at temperatures above 800 °C.
Bacterial filter for secretion aspiration	Replace after 14 days. Discard as infectious special waste. Can be incinerated with low emissions at temperatures above 800°C.
Bacterial filter for sample gas return	Replace every 6 months. Can be incinerated with low emissions at temperatures above 800 °C.
Bacterial filter for pressure measuring line	Replace every 6 months. Can be incinerated with low emissions at temperatures above 800 °C.
Cooling air filter (x2)	Every month clean and dry thoroughly or replace the filter. Replace at the latest after 1 year. Discard as domestic waste.
Lithium battery for data backup (ventilator)	Must be replaced every 2 years by qualified personnel. Discard in conformity with local waste disposal regulations.
Lithium battery for data backup (screen)	Must be replaced every 3 years by qualified personnel. Discard in conformity with local waste disposal regulations.
Lead gel battery in power adapter (if used)	Must be replaced every 3 years by qualified personnel. Discard in conformity with local waste disposal regulations.
Optical gauge tube bank	For measuring the anaesthetic gas concentration, must be checked every 6 months by qualified personnel
Time Keeper RAM	Must be replaced every 3 years by qualified personnel. Discard in conformity with local waste disposal regulations.

* According to DIN 31 051:

Inspection = examination of the actual condition
Service = measures to maintain the specified condition
Repair = measures to restore the specified condition
Maintenance = inspection, service and repair

Page

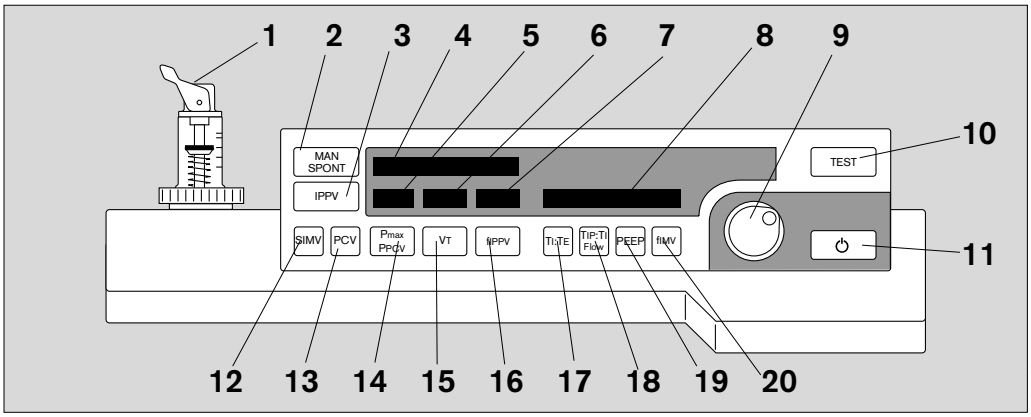
Overall view of the machine



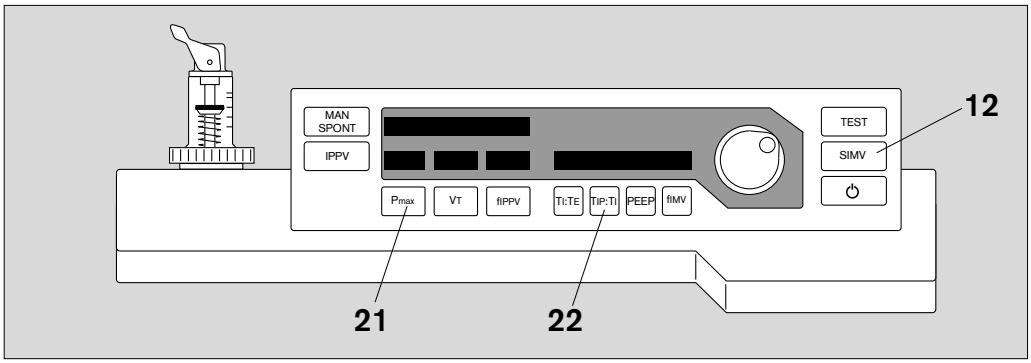
1 Hinged arm (optional)
2 Guides for hoses and leads
3 Support for NiBP cuff and other items of equipment
4 Plug connection for Dräger Vapors
5 Water trap for sample gas
6 Plug connector to parameter box
7 Handle for transport / standard rail for supplementary equipment
8 Vacuum port for bronchial aspiration
9 Power socket for desflurane Vapor
10 Hose clip for bronchial aspiration
11 Microbial filter for bronchial aspiration. Optional central supply inlet for vacuum.
12 Set of cylinders for bronchial aspiration (optional)
13 Retaining pin
14 Swivelling transport castor (2 units)
15 Locking transport castor (2 units)
16 Gas delivery (details on page 144)
17 System screen (details on page142)
18 Gas control panel (details on page 143)
19 Folding table top
20 Ventilator control panel (details on page 141)
21 Breathing system (details on page 147)
22 Soda lime cannister
23 Shelf
24 Drawer for accessories and small items
25 Optional backup gas cylinders

Operating elements and displays on ventilator

With PCV:

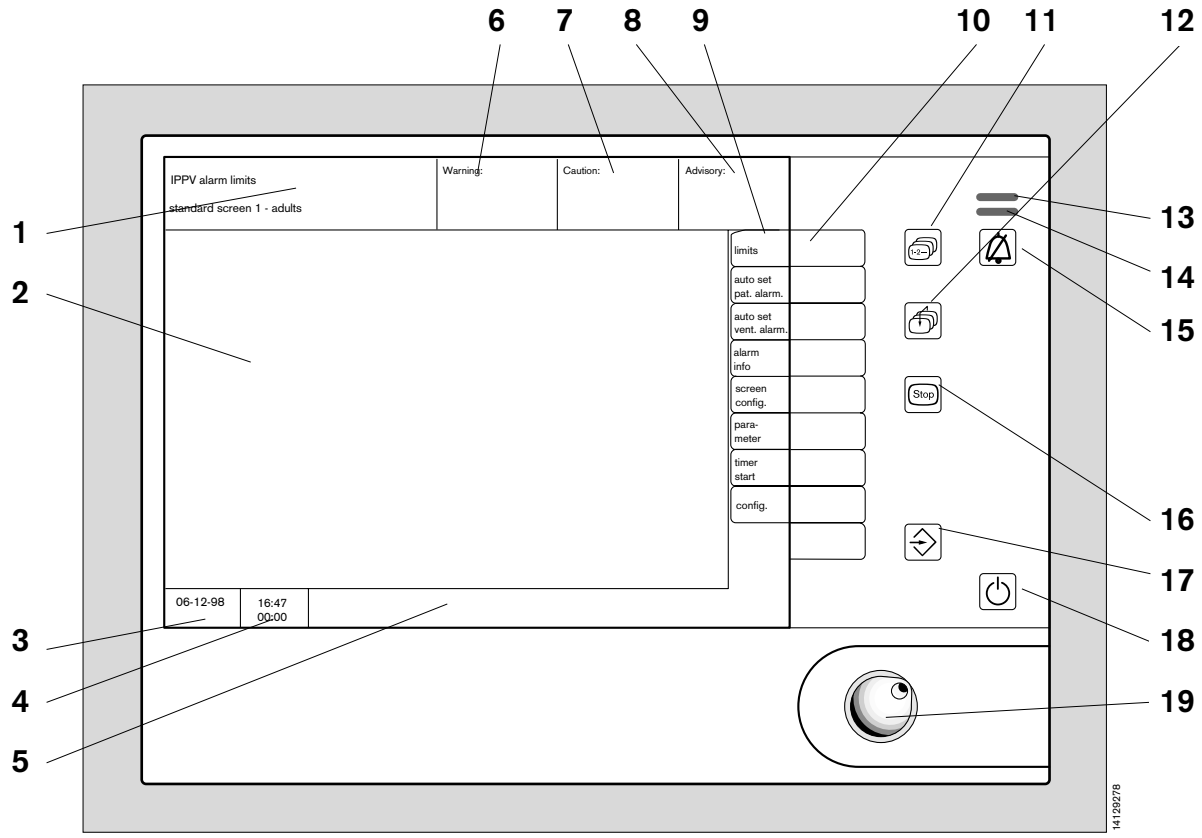


Without PCV:



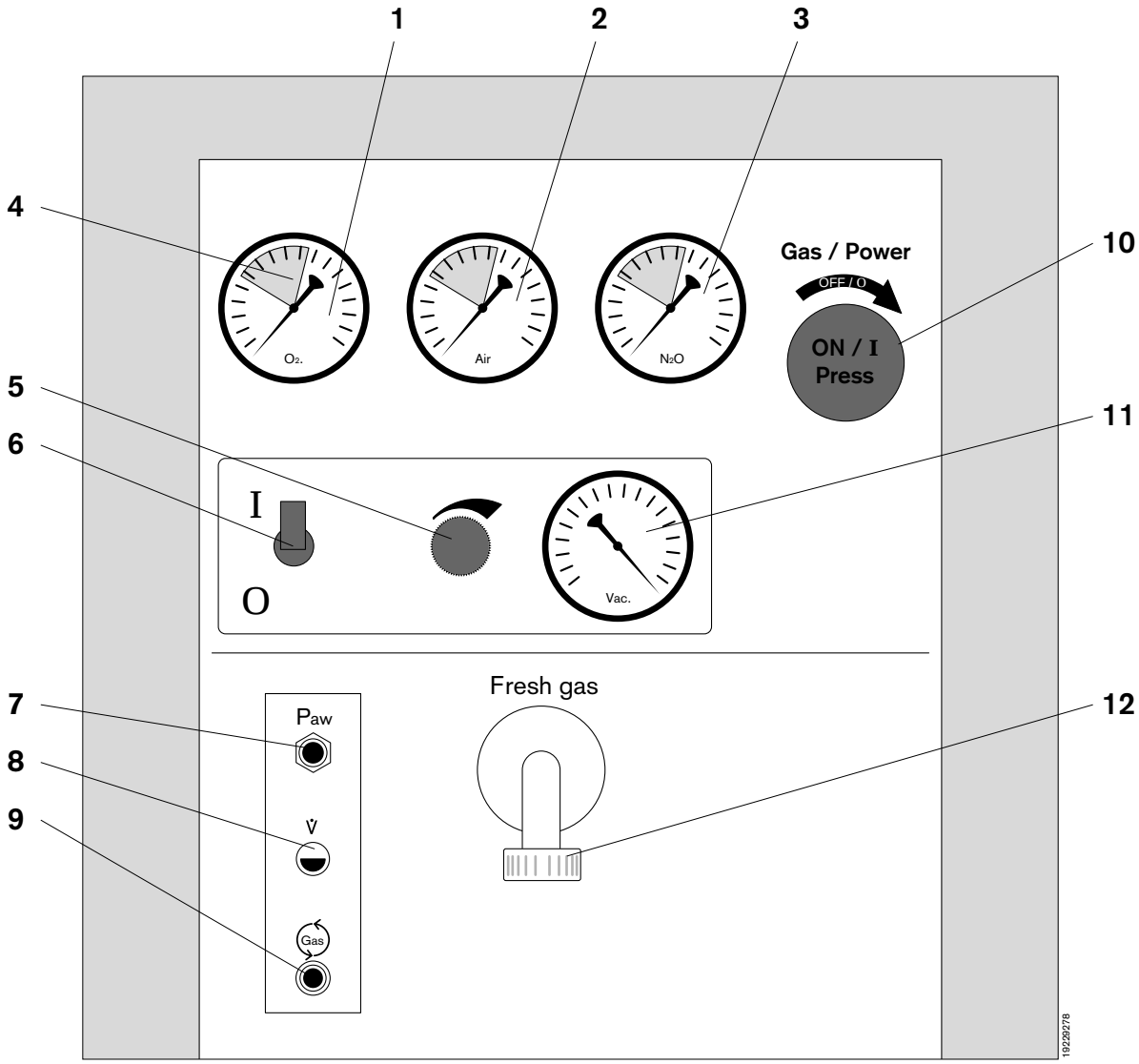
1 Pressure limiting valve (APL) with Manual/Spontaneous changeover
2 MAN/SPONT key for manual ventilation/spontaneous breathing
3 Key for automatic ventilation (IPPV)
4 Bar graph of relative piston movement [%]
5 Indication of the set maximum pressure (P_{max}) or of the P_{PCV} working pressure in PCV mode
6 Indication of the set tidal volume (V_T)
7 Indication of the ventilation frequency (f_{IPPV}). Only for IPPV and PCV.
8 Window for interactive settings and selection
9 Rotary control for settings and selection (confirmation)
10 Key for leakage test and compliance measurement
11 Key for invoking Standby mode
12 Key for mechanically-aided spontaneous breathing (SIMV)
13 Key for pressure controlled ventilation (PCV)
14 Key for setting the maximum pressure (P_{max}) or of the P_{PCV} working pressure in PCV mode
15 Key for setting the tidal volume (V_T)
16 Key for setting the ventilation frequency (f_{IPPV}). Only for IPPV and PCV.
17 Key for setting the ratio of inspiration time to expiration time (T_I:T_E)
18 Key for setting the proportion of inspiration pause time to inspiration time (T_{IP}:T_I) or the insp. Flow in PCV mode
19 Key for setting the positive end-expiratory pressure (PEEP). Only possible with IPPV!
20 Key for setting the frequency for mechanically-aided spontaneous breathing (f_{IMV})
21 Key for setting the maximum pressure Pmax.
22 Key for setting the time ratio between inspiration pause and inspiration (T_{IP} : T_I).

Operating elements and displays on system screen



1 Status field with indication of alarm mode
2 Screen for graphs and measured values
3 Date field
4 Field for time and timer
5 User advisory field
6 Field for warning messages
7 Field for caution messages
8 Field for advisory messages
9 Designation of softkeys
10 Softkey actuation fields
11 Key for invoking preconfigured screens
12 Key for recalling the last standard screen used
13 Yellow LED for caution messages
14 Red LED for warning messages
15 Key for suppressing the alarm sound
16 Key for freezing real-time graphs on screen
17 Key for triggering a list entry
18 Standby key
19 Rotary control

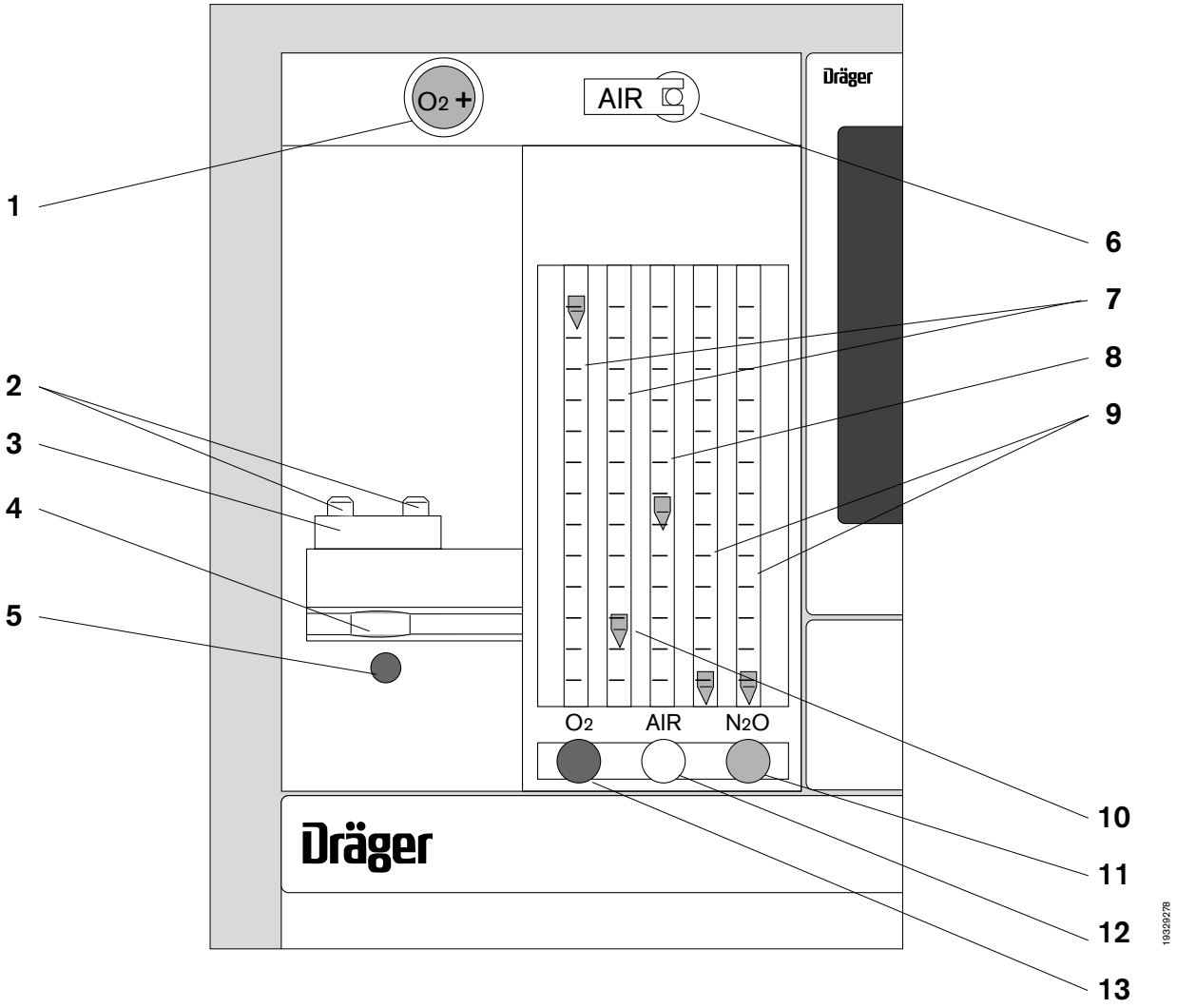
Operating elements and displays on gas control panel



1 Pressure gauge for oxygen (O_2)*
2 Pressure gauge for air (AIR)
3 Pressure gauge for nitrous oxide (N_2O)*
4 Green area indicating adequate gas pressure
5 Control knob for negative pressure for bronchial aspiration
6 Switch for generating negative pressure
7 Hose connection for measuring airway pressure (P_{aw})
8 Connector for flow sensor ($\dot{V}$)
9 Hose connector for sample gas return line
10 Master switch for power and gases
11 Pressure gauge for negative pressure
12 Fresh gas connection

* The positions of these gauges are swapped in some countries

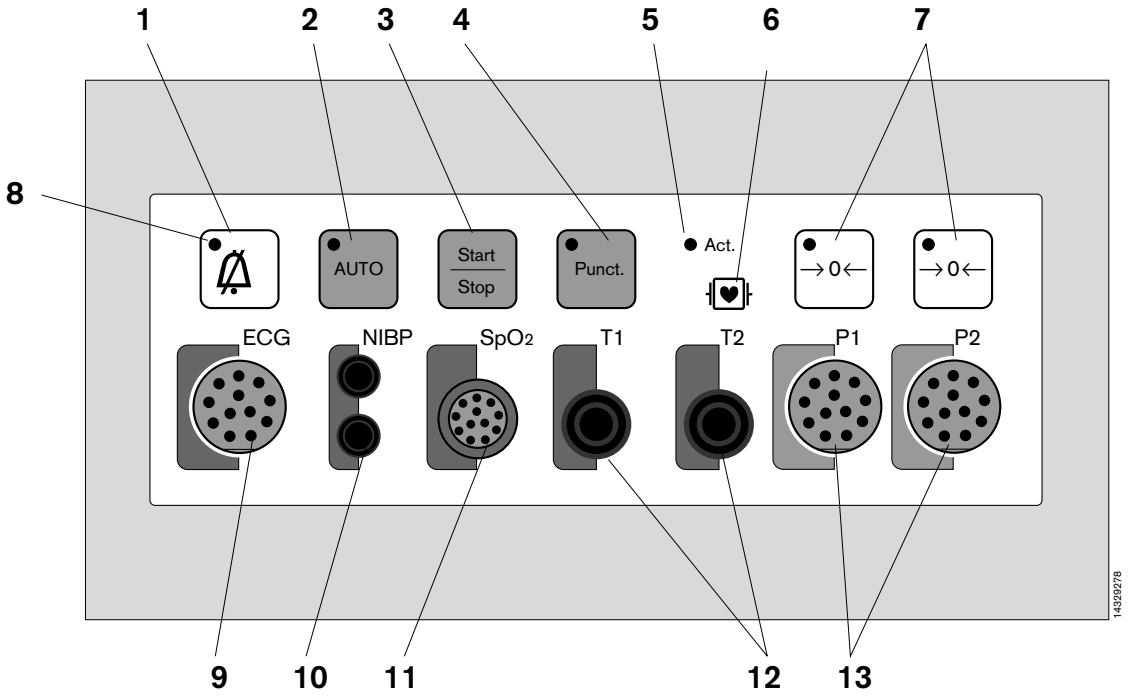
Operating elements and displays on flowmeter bank



1 Key for O_2 flush (O_2 **+**)
2 Connection ports for Vapor
3 Vapor plug-in connection system
4 Support block for Vapor
5 Acoustic outlet for O_2 shortage signal (whistle)
6 N_2O / AIR changeover switch
7 Oxygen flow tubes*
8 Air flow tube
9 Nitrous oxide flow tube*
10 Float for reading off gas flow
11 Control valve for nitrous oxide
12 Control valve for air
13 Control valve for oxygen

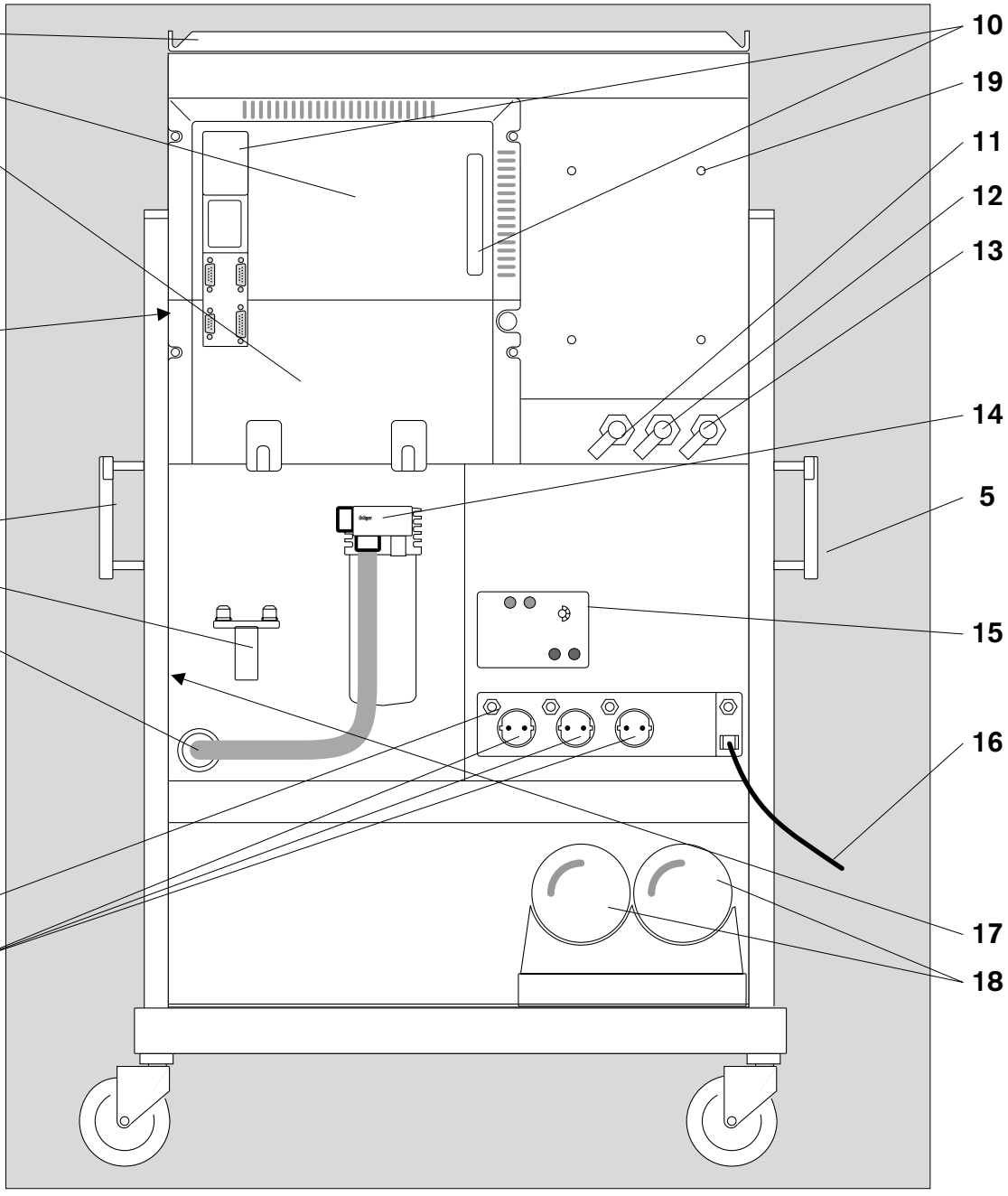
* The positions of these gauges are swapped in some countries

Operating elements and displays on parameter box



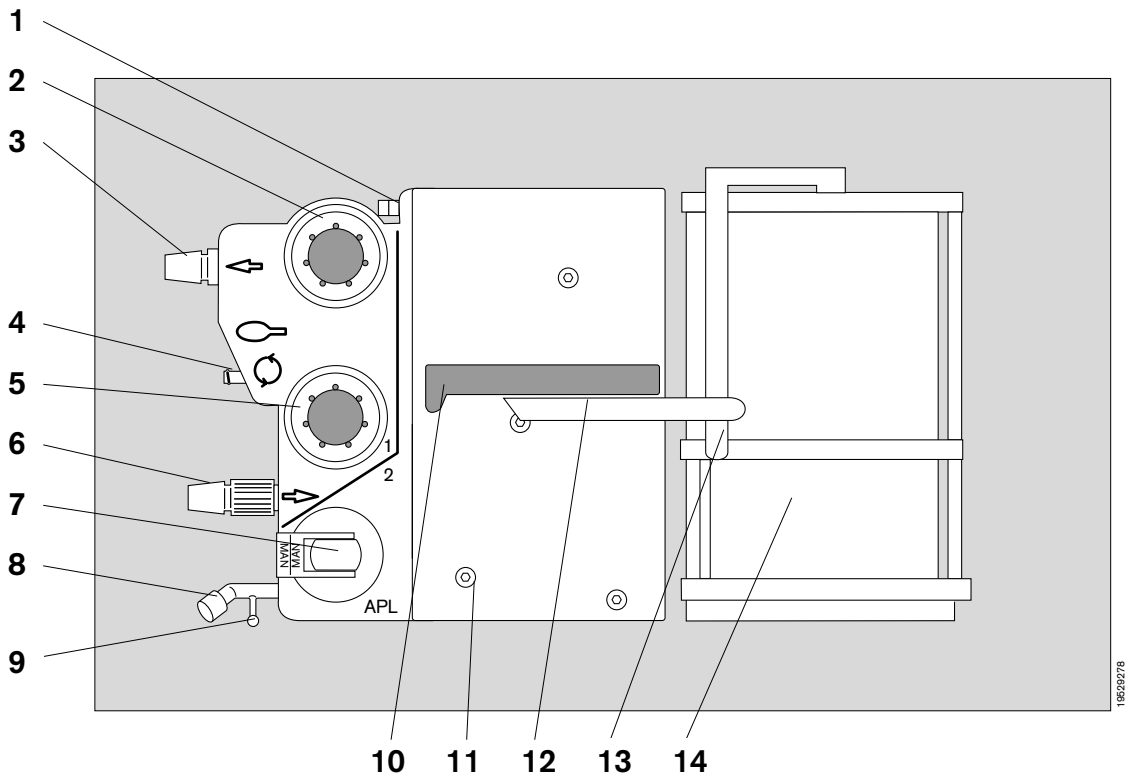
1 Key for suppressing alarm sound
2 Key for starting automatic NiBP measurement
3 Key for starting and stopping manuall NiBP measurement
4 Key for starting inflation of the NiBP cuff
5 LED lights up when parameter box active
6 Indicator for defibrillator strength
7 Keys for zero alignment of each individual measuring channel for invasive blood pressure measurement (iBP)
8 LEDs in the keys light up when the corresponding function is active (in this case: alarm sound suppressed)
9 Socket for ECG cable, colour-coded red
10 Hose connectors for NiBP cuff, colour-coded purple
11 Socket for SpO_2 sensor, colour-coded brown
12 Sockets for temperature sensors, colour-coded green
13 Sockets for invasive blood pressure (iBP) measuring sensors, colour-coded grey

Elements on the rear of the machine



1 Shelf
2 Rear of monitor (details on page 148)
3 Holder for coiled cables and hoses
4 O_2 sensor for sampled gas measurement
5 Transport handle / standard rail for supplementary equipment
6 Plug-in system for spare Vapor (no gas connector)
7 Opening for anaesthetic gas scavenging
8 Grounding pin for equipotential bonding (⏚)
9 Sockets
10 Cooling air filter for monitor
11 Pressurized gas port for oxygen hose
12 Pressurized gas port for air hose
13 Pressurized gas port for nitrous oxide hose
14 Anaesthetic gas scavenging system (AGSS)
15 Mains voltage setting
16 Power lead
17 Rating plate and serial number
18 Optional backup gas cylinders
19 Fixing of the power supply unit for the passive air conditioning

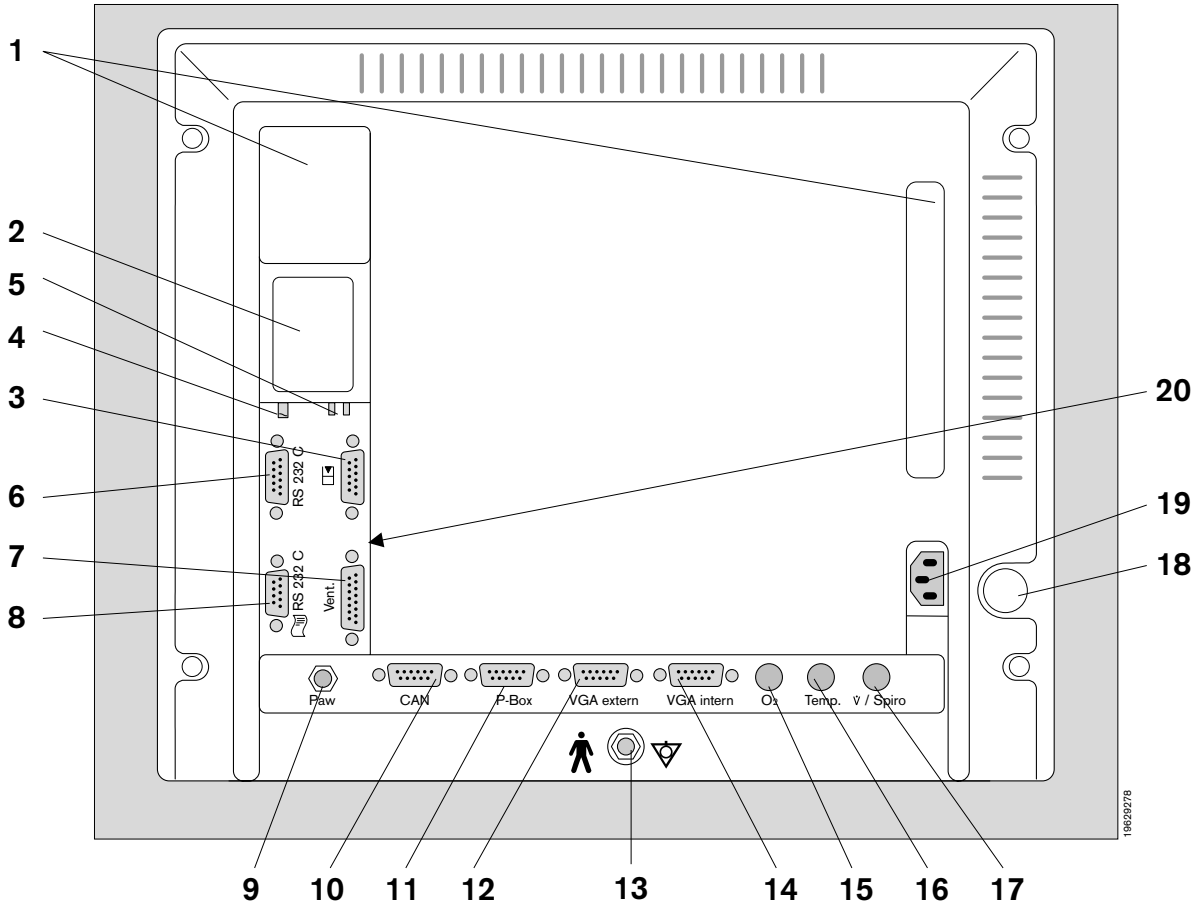
Elements of breathing system



1 Plug-in connection for pressure measurement (P_{aw})
2 Inspiration valve with mount for O_2 sensor (optional)
3 Inspiration port (ISO cone 22mm)
4 Quick-release coupling for measured gas return line
5 Expiration valve
6 Expiration port (ISO cone 22mm) 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 101 for
– position of subsystems
– gas flow chart and
– position of valves in breathing system.

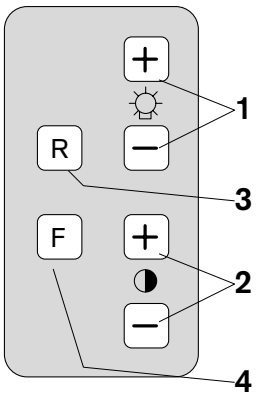
Sockets and connectors on the rear of the system screen:



Itmes 9 to 20 are accessible after removing the outer back panel of the Cicero EM.

1 Cooling air filter of the system screen
2 Nameplate
3 Connection for level gauge in water trap of measured gas sampling system
4 Connection for sample gas return
5 Connections for sample gas measurement
6 RS 232 C interface (Dräger MEDIBUS)
7 Connection for data line to ventilator
8 RS 232 C interface for connecting a printer
9 Connection for pressure measuring line
10 CAN bus connection
11 Connection for parameter box
12 Connection for external screen
13 Grounding pin for equipotential bonding
14 Connection for internal screen
15 Connection for O_2 sensor
16 Connection for temperature sensor
17 Connection for flow sensor
18 Master switch (with Cicero EM always »**on**«)
19 Power socket
20 Panel for basic screen settings (details on page 149)

Basic screen settings:




5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11


12


13

A1 14

A2 15


16

The contrast and background brightness of the screen can be set directly with the keys. The keypad is located on the back of the monitor (item 18 on page 148).

1 Keys for adjusting the background brightness of the screen.
»+« increases the brightness
»–« reduces the brightness

2 Keys for adjusting screen contrast
»+« increases the contrast
»–« reduces the contrast

3 Key »R« (»Reset«) resets all the user settings to the factory settings.

4 Key »F« (»Function«) calls up other setting facilities that are required less often.

After pressing »F« for the first time, invariable frequency displays are shown on screen.

After pressing for the second time, a menu appears in the top third of the screen with the corresponding symbols.

Use the brightness key (**1**) to select parameters within this menu;
Use the contrast key (**2**) to change the settings.

Meanings of the individual symbols:

5 Change picture width

6 Change picture height

7 Change horizontal picture position

8 Change vertical picture position

9 Adjust pin-cushion or barrel distortion

10 Brightness after reset

11 Contrast after reset

12 Background blue (inactive)

13 Background red (inactive)

14 Background green (inactive)

15 Unused (inactive)

16 White balance between colours R, G and B

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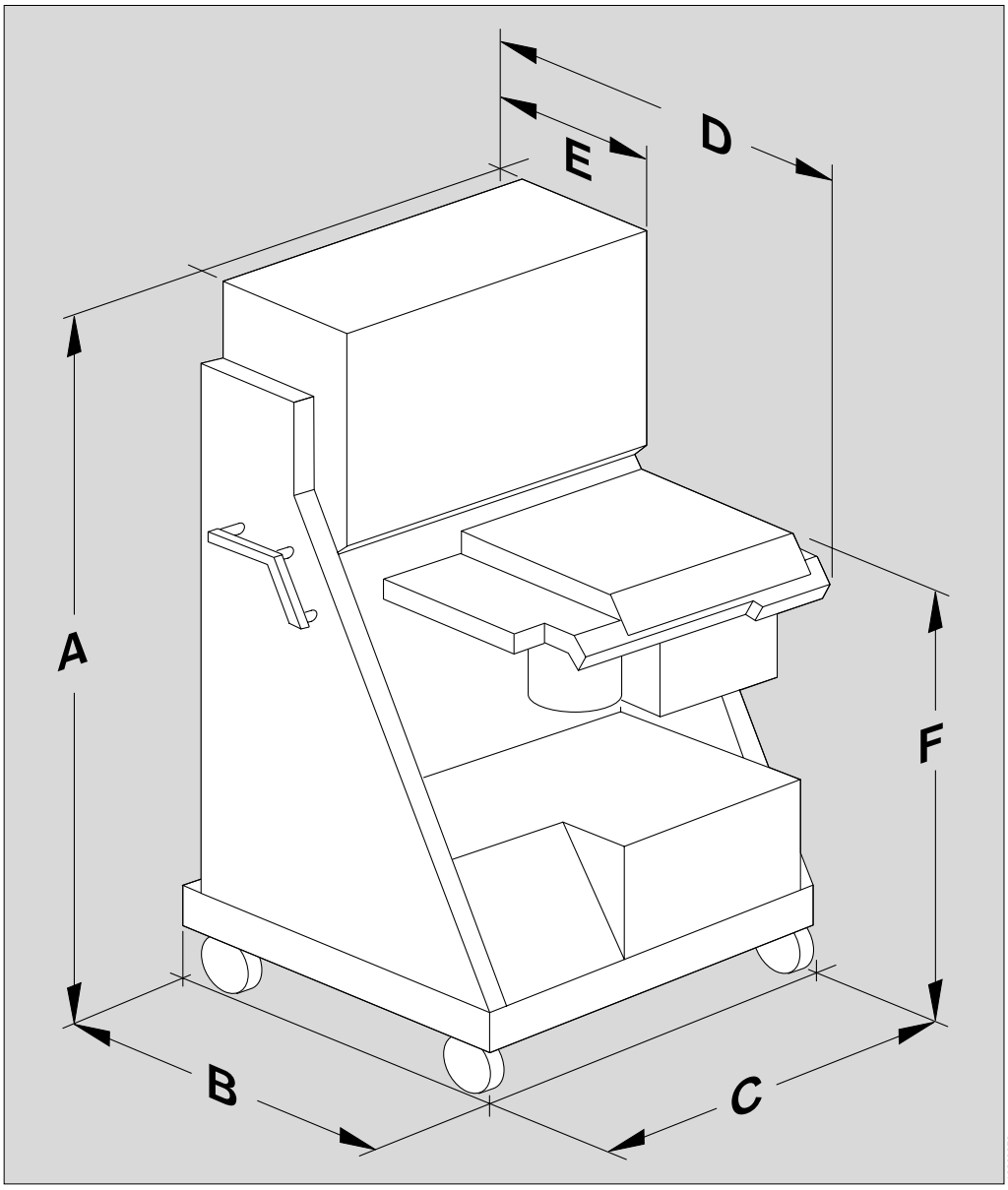
Dimensions



Trolley version (illustrated)

A = 1342 mm
B = 708 mm
C = 747 mm
850 mm incl. transport handle on both sides
D = 775 mm
E = 385 mm
F = 835 mm

Ceiling version
(not illustrated, dimensions apply accordingly)

A = 1010 mm
B = 570 mm
C = 745 mm
840 mm incl. transport handle on both sides
D = 805 mm
E = 440 mm
F = 520 mm

The maximum dimensions may differ after upgrading the machines with optional accessories!

Page

Technical data

Where tolerances are given in percent and as absolute values, the higher value applies in each case!

Identification .....: The serial number and article number of the Cicero EM and the CE–symbol are located on the rating plate (nameplate) fixed to the back of the machine (ref. No. 17 on page 146).

Dimensions.....: See dimensional drawing on page 150.

Classification .....: Class IIb conforming to Directive 93/42/EEC for medical devices, Appendix IX.

UMDNS code.....: 10 - 134 (Medical Device Nomenclature)

Weight .....: Standalone version approx. 190 kg. Max. 260 kg in maximum configuration. Ceiling version approx. 180 kg.

Power supply

Operating voltages .....: Settable on the 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.

Power consumption .....: Max. 370 W without auxiliary sockets and without accessories

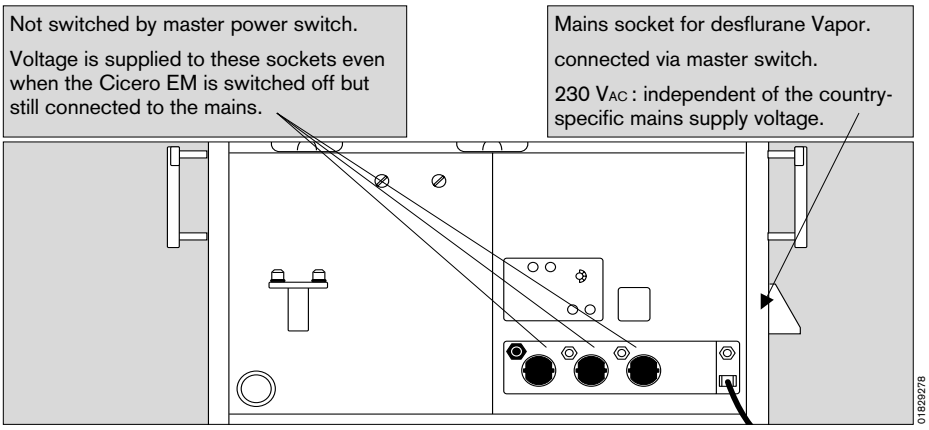
If the device is equipped with a UPS (uninterruptible power supply, i.e. Cicero Power-Pack), the power consumption of the auxiliary mains sockets is limited to 300 W.

Fuses .....: 2 x T7A UL 230/240 VAC and 2 x M15 A UL 100/127 VAC
In the power adapter: 2 x 0,25 A DIN 41 662, 230/240 VAC.
Additional fuses in power packand master switch-on contactor are only accessible to qualified personnel with tools!
Two fuses in each auxiliary mains socket (2 A DIN 41 622, 230/240 VAC).
Desuflorane Vapor: DIN 41662 T2A.

Auxiliary mains sockets .....: Do not connect HF surgery devices to the auxiliary power sockets, because high interference peaks may adversely affect the operation of the Cicero EM! (Not fitted to ceiling version)

Do not connect any additional multiple socket-outlets or socket strips to the auxiliary mains sockets. The connection of devices to the auxiliary sockets increases the leakage current. The risk of shock due to the overall leakage current cannot be excluded, in particular in the event of a grounding failure in the mains power connection to the Cicero EM.

Connecting devices to the auxiliary power sockets may increase the risk of electric shock in the event of grounding failure!



Ambient conditions

Temperature	+15 to +35 °C	(operation)
	–20 to +50 °C	(storage / transport)
Humidity	20 to 90 %, no condensation	(operation)
	0 to 98 %, no condensation	(storage / transport)
Air pressure	80 to 106 kPa	(operation)
	50 to 106 kPa	(storage / transport)
CO_2 content of ambient air in room	300 to 800 ppm	(operation)

Medical gas supply

Pneumatic connections: Piped medical gas supply: O_2, N_2O, AIR.
Spare gas cylinders 2 x 3 litres (O_2, AIR) optional
Anaesthetic gas scavenging.
Connection to central vacuum supply system (optional)

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)

Vacuum pressure

Generating principle: Ejector system

Power:
Supply (ZV) 3.5 ±0.5 bar: vacuum –0.1...–0.95 bar, delivery rate 8 L/min (free air intake)
Supply (ZV) 5 ±0.5 bar: vacuum –0.1...–0.95 bar, delivery rate 13 L/min (free air intake)

Piped vacuum supply (ZV): Vaccum –0.1...–0.95 bar.
Delivery rate approx. 20 L/min (free air intake)
Values dependent on vacuum supplied by piped system (ZV)

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 plus
Binds approx. 150 L CO_2, sufficient for at least 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 resistance.....: 4 mbar at a flow of 60 L/min (conforming to EN 740).

Inspiratory resistance.....: 4 mbar at a flow of 60 L/min (conforming to EN 740).

Non-return valves.....: Back-pressure of a wet valve < 1 mbar
Opening pressure of a wet non-return valve < 1 mbar

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 (as from software version 7.2)
20 to 100 mL ± 10 % or ± 10 mL
100 to 1400 mL ± 5 % or ± 15 mL

Frequency (f_{IPPV}).....: 6 to 80 per minute (as from software version 7.2)
6 to 60 per minute (software version < 7.2)

Minute ventilation ($\dot{V}_E$).....: Up to 25 L/min

T_I:T_E .....: 1:3 to 2:1 ± 5 %

T_{IP}:T_I .....: 0 to 60 % ± 5 %

Inspiratory flow $\dot{V}_I$ max.....: Max. 75 L/min

f_{IMV} .....: 3 to 80 per minute ± 5 % (f_{IMV} < f_{IPPV}) (as from software version 7.2)
3 to 60 per minute ± 5 % (f_{IMV} < f_{IPPV}) (software version 7.2)

PEEP.....: 0; 2 to 15 mbar ± 10 % or ± 2 mbar
(P_{max} - PEEP > 5 mbar, as from software version 7.2)
0; 2 to 15 mbar ± 10 % or ± 2 mbar
(P_{max} - PEEP > 10 mbar, software version 7.2)

Trigger pressure.....: – 1 mbar ± 0,5 mbar (invariable)

Inspiration flow in PCV mode....: 5 to 75 l/min (PCV ventilator)

Operating pressure in PCV mode : 10 to 70 mbar (PCV ventilator)

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

System monitor

Test regulations .....: EN 60601-1, EN 60601-1-2, EN 60601-2-27, EN 60601-2-30, EN 60601-2-34, pr-EN 864, pr-EN 865.

Pressure measurement

Airway pressure, measuring range..: – 10 to 80 mbar

Resolution: .....: 1 mbar

Accuracy .....: better than ± 4% of measured value or at least 1 mbar

O_2 sidestream measurement (sampling measurement)

Measuring range.....: 5% to 100% by volume

Sample rate .....: 60 mL/min or 200 mL/min

Resolution for FiO_2 and FeO_2...: 1% by volume

Resolution for ΔO_2.....: 0.1% by volume

Accuracy .....: when calibrated with air: ±3 Vol.% in the measuring range from 5 to 50 Vol.%
±5 Vol.% in the measuring range from 50 to 100 Vol.%

when calibrated with 100% O_2: ±3 Vol.% in the measuring range from 5 to 100 Vol.%

Response time $t_{10\ ...90}$ .....: better than 500 ms.

Flow measurement

Tidal volume V_T.....: Range: 0.01 to 9.99 L

Resolution .....: 0.01 L

Accuracy .....: better than 0.01 L or ±8%* of 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%* of the measured value under calibration conditions and BTPS (BTPS = body temperature, current atmospheric pressure, saturated gas)
(* When using a microbial filter on the expiratory side, the tolerance is increased to ±15 %)

Respiration rate .....: Range: 0 to 99 per minute

Resolution .....: ± 1 per minute

Accuracy .....: ± 1 per minute

CO_2 measurement

Special feature .....: When the CO_2 alarm is active during IPPV ventilation, the inspiratory CO_2 concentration of the breathing air is monitored with the preset upper limit of 5 mmHg (adults) or 8 mmHg (neonates).

Adjustment range.....: 0 to 10 mmHg

Sampling rate .....: 60 mL/min or 200 mL/min

Measuring range.....: 0 to 9.9% by volume (equivalent to 0 to 9.9 kPa or 0 to 80 mmHg)

Accuracy .....: ± 0.2% by volume or 5% of measured value

Resolution .....: 1 mmHg, 0,1 kPa, 0.1% by volume

Response time $t_{10\ ...90}$ .....: At 200 mL/min: 300 ms
At 60 mL/min: 1 s

Warm-up phase.....: 4 minutes (ISO/DIS 11196 accuracy requirement attained)

Zero drift: .....: Within the specified accuracy, without limitation in time.

Anaesthetic agent measurement

N_2O

Display range.....: 0% to 100% by volume

Accuracy .....: ± 2.5% by volume or 4% of measured value

Resolution .....: 1 %

Halothane and isoflurane

Display range.....: 0 to 8.5% by volume

Accuracy .....: In the range from 0 to 4%: better than ±0.2% by volume absolute

In the range from 4 to 8.5%: better than ± 10% of measured value

Resolution .....: 0.1% by volume

Enflurane and sevoflurane

Display range.....: 0 to 9.9% by volume

Accuracy .....: In the range from 0 to 4%: better than ± 0.2% by volume absolute

In the range from 4 to 8.5%: better than ± 10% of measured value

Resolution .....: 0.1% by volume

Desflurane

Display range.....: 0 to 22% by volume

Accuracy .....: In the range from 0 to 8%: better than ± 0.2% by volume absolute

In the range from 8 to 22%: better than ± 10% of measured value

Resolution .....: 0.1% by volume

All gases

Response time $t_{10...90}$ .....: at 200 mL/min: 350 ms

at 60 mL/min: 1 s

Warm-up phase.....: 4 minutes (ISO/DIS 11196 accuracy requirement attained)

Zero drift .....: Within the above accuracy, without limitation in time

Automatic

anaesthetic gas recognition.....: The specified measurement accuracy is attained at the latest 4 minutes after switching on the device. The minimum concentration required for automatic recognition is 0.15% by volume. Anaesthetic gas mixtures are recognised from a minimum concentration of 0.4% by volume. In the case of a mixture, the gas with the higher concentration is measured.

Breathing gas temperature measurement

Breathing gas temperature.....: Range: 20 to 50 °C

Resolution .....: 1 °C

Accuracy .....: ±0.5 °C in range from 30 to 41 °C

Data communication

RS 232 C (MEDIBUS)

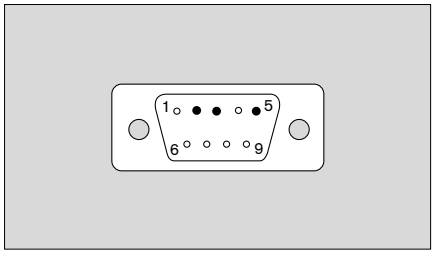
Socket.....: 9-pin sub-D, electrical isolation 1.5 kV

Pin assignment .....: 2 ≙ TxD, 3 ≙ RxD, 5 ≙ GND

Record (printer)

Socket.....: 9-pin sub-D, electrical isolation 1.5 kV

Pin assignment .....: 2 ≙ TxD, 3 ≙ RxD, 5 ≙ GND



Parameter box

Electrocardiogram (ECG)

Input: Isolated; IEC type CF; for ECG leads with 3, 4 or 5 electrodes; colour-coded red.

Input impedance: > 20 MΩ at 10 Hz
> 4 MΩ at 40 Hz

Leads: 1, 2, 3 or I, II, III, AVR, AVL, AVF, V

Display: Position can be configured as required.

Input voltage: Max. 6 mV peak

Graph display: 0.5 to 8 mV

DC offset: Max. 300 mV (only if filter set to »**On**«)

Bandwidth: 0.5 to 30 Hz (–3 dB) with filter set to »**On**«
0.05 to 70 Hz (–3 dB) with filter »**Off**«

Interference suppression (50/60 Hz): With ECG lead and 5 kohm unbalanced: > 127 dB

Output impedance: < 10 Ω, output current < 1 mA, short-circuit-proof.

Noise: < 25 µVpp with an impedance of 51 kΩ // 0.047 µF to each neutral line per electrode.

Zero stabilization: Automatic; when mean peak value exceeds display range.

Stabilization time: < 0.5 s; artefact message and alarm after 15 seconds.

Pacemaker pulses: Automatically magnified on display when detection function active. Not counted in the majority of cases.

Defibrillator: Protected against defibrillation shocks; synchronization pulse available.

Socket receptacle, outer contact:	Ground
Socket receptacle, inner contact:	TTL output with 15 ms pulse duration
Maximum retardation relative to R-wave:	26 ms

Heart rate/pulse rate

Source of heart rate/pulse rate: Derived from the 1st ECG, SpO_2, and iBP.

Heart beat indication: Acoustic and visual; acoustic indication derived from SpO_2 value (can be programmed).

Frequency: Over approx. 10 beats on average.

Measuring range: 30 to 300 beats per minute.

Accuracy: 1 beat/minute or 1%.

Resolution: 1 beat/minute

Pulse deficit indication: Difference between heart rate (derived from ECG) and pulse rate (derived from SpO_2).

Detection of asystole/ventricular fibrilation: Cannot be deactivated; asystole alarm after 6 seconds; ventricular fibrillation detected after approx. 3 seconds; not available for children.

S-T segment analysis:

Amplitude:	±3 mV
Resolution:	0.01 mV
Max. heart rate:	150 beats per minute

Only active in adult mode and only if **»S-T segment analysis«** has been selected.
Must not be undertaken with HF-shielded ECG leads!

Non-invasive blood pressure (NiBP)

Input ..... : IEC type CF, floating, Colour-coded purple

Measuring method ..... : Oscillometric

Measuring range ..... : Adult mode: 20 to 290 mmHg (3.0 to 38.6 kPa)
Neonatal mode: 5 to 150 mmHg (0.6 to 20 kPa)

Resolution: ..... : 1 mmHg (0.1 kPa)

Accuracy ..... : 1 mmHG (0.1 kPa)

Unit of measure ..... : mmHg or kPa

Inflation of cuff ..... : The cuff is inflated to the preset starting pressure for the first measurement; after reading off the systolic pressure, the cuff is inflated to 20 mmHg above the last measured systolic value for the next measurement. If the inflation pressure is too low for correct measurement of the systolic pressure, air is automatically released from the cuff and the measurement is repeated 5 seconds later with a higher cuff pressure. If it is still too low, the air is released again and the measurement repeated 30 seconds later with an elevated cuff pressure.

Release air from the cuff ..... :
- Upon completion of the measurement.
- When measurement is interrupted by pressing »**Stop**« button.
- When the maximum measuring time is exceeded.
- When the maximum cuff pressure is reached.
- In the presence of undue artefacts.
- In the event of a power failure / when switching off the monitor.
- When NiBP function deactivated.

Max. cuff pressure ..... : 300 mmHg (40 kPa) for adults
150 mmHg (20 kPa) for neonates

Max. measuring time ..... : 90 seconds for adults
60 seconds for neonates

Intervals for automatic measurements ..... : Every 2, 3, 5, 10, 15 minutes. Manually triggered interim measurement does not affect the time between automatic measurements.

Venous congestion ..... : Adjustable cuff pressure

Invasive blood pressure (iBP)

Input ..... : Floating, IEC type CF; colour-coded grey.

Input sensitivity ..... : 42.5 and 50 µV/V/10 mmHg

Input impedance ..... : 90 kΩ (can be changed to 1 MΩ)

Bridge voltage ..... : 5 V DC

Bridge impedance ..... : 200 Ω to 10 kΩ

Zero alignment ..... : Semi-automatic; not possible while pressure continues to fluctuate (with site label »**ART**« or »**AORTA**«);
range ± 70 mmHg. Inaccuracy < 0.5 mmHg.

Bandwidth ..... : 0 to 7 Hz (–3 dB)

Measuring ranges
for graph display ..... : 20, 40, 80, 160 and 320 mmHg

Max. pressure signal ..... : – 10 to 320 mmHg for undistorted display

Measured parameters ..... : Systolic, diastolic and mean pressure

Measuring range ..... : – 10 to 320 mmHg

Resolution ..... : 1 mmHg

Unit of measure ..... : mmHg

Site labels ..... : ART, AORTA, APulm, CVP, ICP, ?
adjustment of the measuring label, alarm limits and display configuration are automatically controlled by the site label.

Oxygen saturation (SpO_2)

Measurement of functional SpO_2 saturation.

Input ..... : IEC type CF, floating, Colour-coded brown.

Cable type ..... : without preamplifier.

Wavelengths ..... : 660 nm (red) and 920 nm (infrared)

Measuring range ..... : 0 to 105 %

Saturation resolution ..... : 1%

Accuracy ..... : Adults:

0 to 50 %	undefined
50 to 70 %	± 3 %
70 to 100 %	± 2 %

Neonates:

0 to 70 %	undefined
70 to 95 %	± 3 %
95 to 100 %	not specified

Accuracy of Durasensor ..... : ± 3 % (additional)

Measuring modes ..... :

Normal:	measurement over 5 to 7 seconds
Fast:	2 to 3 seconds
Slow:	10 to 15 seconds
Off:	Module deactivated

Plethysmogram ..... : Automatic amplitude control.

Pulse rate ..... : Derived from plethysmogram; no pulse rate tone in slow mode. The pulse rate tone is controlled by the SpO_2 measurement when programmed accordingly.

Pulse rate resolution ..... : 1/min

Pulse rate accuracy ..... : ± 1/min

Body temperature measurement

Inputs ..... : Floating, IEC type CF, colour-coded green.

Parameter ..... : Two temperature values (T1, T2); both are monitored by alarm limits.

Measuring ranges ..... : 0 °C to 45 °C;

Resolution ..... : 0.1 °C.

Accuracy ..... : ±0.1 °C.

Self-test ..... : A fault message is output when one of the automatically tested fault limits is exceeded.

Transport function

The transport function permits uninterrupted documentation even when moving the patient, for example between bed, pre-op, operating theatre and recovery room.

The haemodynamic parameters are stored in Parameter Box PB 8800 and transferred between this box and the connected PM 8060 monitors or the Cicero EM Anaesthetic Workstation.

The following data can be transferred:

Parameters	Settings	Measured value for the list	Alarm limit
ECG	 3 or 5-lead cable Selected lead Amplitude Pacemaker identification function on/off	Heart rate Pulse rate	Upper and lower alarm limit Upper and lower alarm limit
NiBP	Function on/off Automatic on/off Interval (time) Cuff inflation pressure Punction pressure	 Systolic pressure Diastolic pressure Mean pressure	 Upper and lower alarm limit Upper and lower alarm limit Upper and lower alarm limit
IBP 1/2	Function on/off Pressure sensor zero Pressure sensor sensitivity Curve amplitude Absolute/morphological curve display Catheter position Interlock with NiBP on/off	 Systolic pressure Diastolic pressure Mean pressure	 Upper and lower alarm limit Upper and lower alarm limit Upper and lower alarm limit
SpO_2	Function on/off Mode C-lock on/off Interlock with NiBP on/off	O_2 saturation	Upper and lower alarm limit
Temp. 1/2	Function on/off	Temperature T1 and T2	Upper and lower alarm limit T1

Parameters	Setting	Measured value for the list
General	Application mode Location name Start and end time of monitoring phase Patient name	Times at which saved Memory flags

Data transferred from the anaesthetic unit or ventilation device:

Parameters	Measured value for the list	Alarm limit
None	Inspiratory CO_2 End-expiratory CO_2 Inspiratory O_2 Expiratory O_2 Minute volume AMV Anaesthetic agent Inspiratory anaesthetic concentration Expiratory anaesthetic concentration Airway pressure Paw Peak pressure Ppeak Pressure level Pplat PEEP pressure level Ventilation frequency Breathing gas temperature AW Temp Compliance Resistance	None

Data transferred from the pEEG:

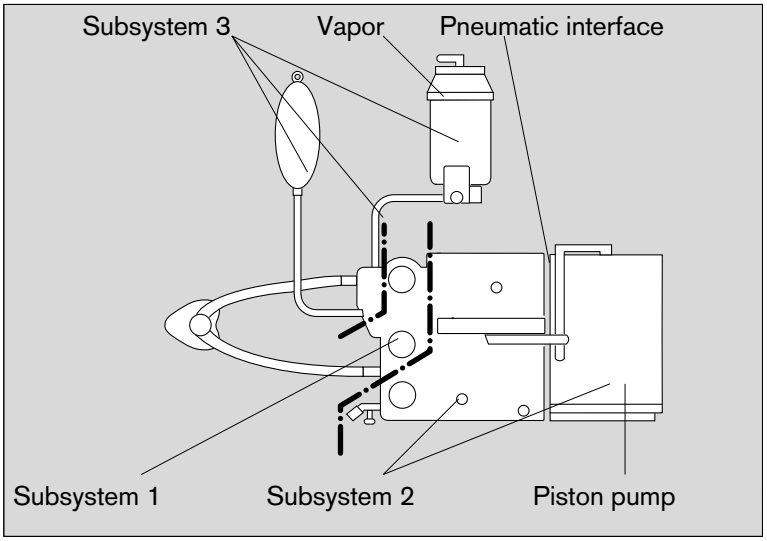
Parameters	Measured value for the list	Alarm limit
None	SEF 90 EMG	None

Page

Flow chart of self-test in anaesthesia 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



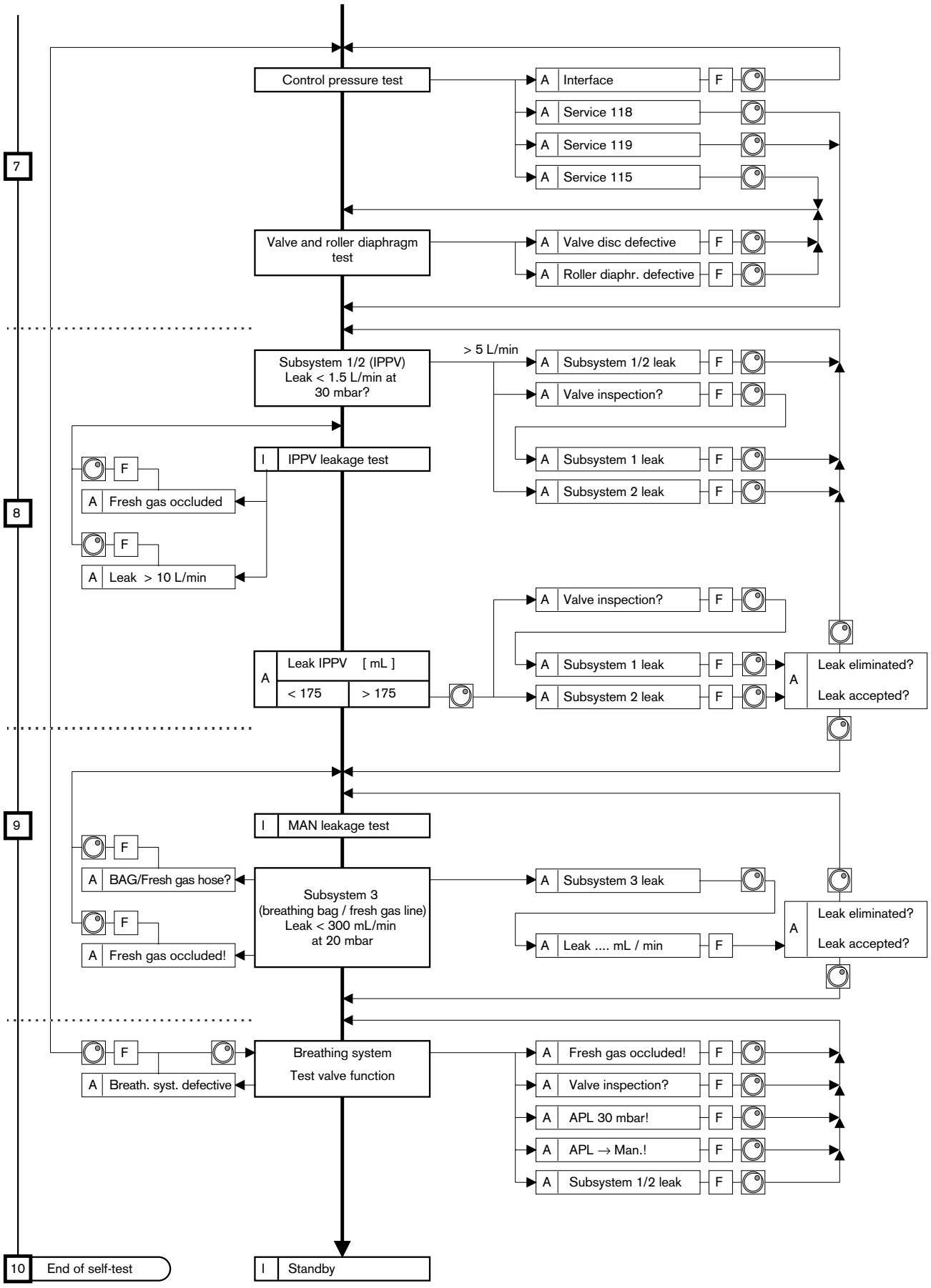
Test sequence

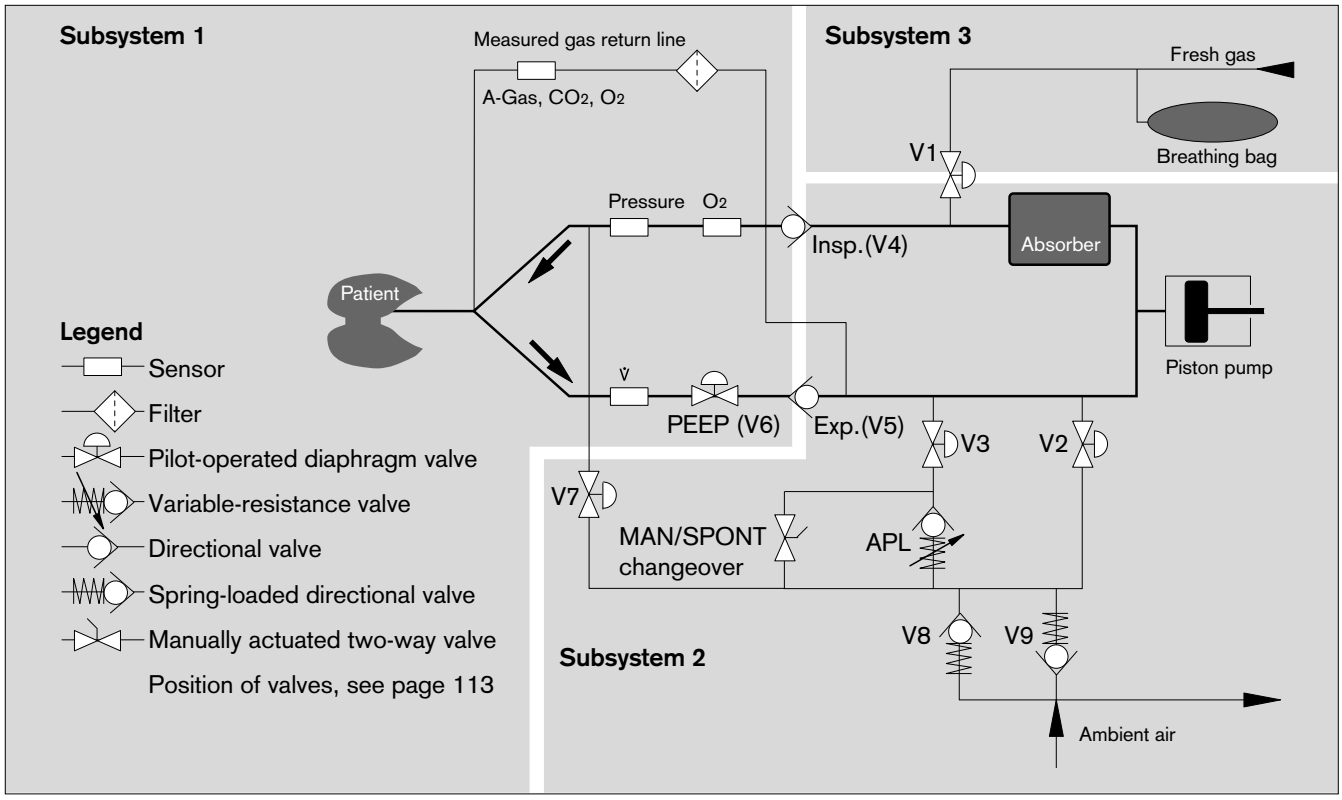
1 Start – self-test
Various electrical tests
2 Make contact with system monitor
Monitor ↔ I Calib. sensors!
A Test ventilator
A Fresh gas occluded?
A APL 30 mbar?
A Y-piece open?
Test operating control pressure
A Piston cyl. unit defective F
A Pressure supply F
A Control pressure low F
A Service 120
3
Check piston
A Breathing system leak F
A Remove piston cyl. unit
A Insert piston cyl. unit
Zero pressure sensor
A Y-piece open F
A Sensor fault F
A Breathing syst. defective F
Y-piece occluded
4 / 5
Various electrical tests
6
Position piston
A Control pressure low F
A Breathing syst. defective F

Continued overleaf

Flow chart of self-test in anaesthesia 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 Cicero EM 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 end-expiratory pressure has dropped below approx. –0.3 mbar.

This shortage of fresh gas is signalled by the Cicero EM 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 Cicero EM 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 TI:TE. The effective leakage value varies with the value measured in the leakage test as P_{mean} : P_{test}

Example:

Test leakage **= 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 Cicero EM 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 (as from software version 7.n 20 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 VT = 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 Cicero EM.

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 Cicero EM 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:

BW	=	Body weight	in kg
O_2 uptake	=	$10 \times BW^{0.75}$	in mL/min

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.

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]	+
Fresh gas required	**≥**	**350**	**[mL/min]**	

This example shows that the fresh gas flow (O_2 and N_2O) must be set to at least 350 mL/min. If the measured gas return line is not used, the fresh gas requirement is increased by the volume of the aspirated measured gas.

Relationship between fresh gas flow and gas concentration in the 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 patient's airway as possible in this mode.

The measuring system is integrated into the system monitor.

Relationship between fresh gas flow and time constants in the 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.

Tips for reducing condensation

Water vapour is released when CO_2 is absorbed on the soda lime.
Moisture generation increases with the proportion of rebreathed gas (low-flow mode).

The Cicero EM is optimised for this low-flow mode:

– the electric heater prevents condensation in the breathing system,

– a large water container is integrated in the bottom of the absorber vessel to collect condensate,

– the large cross-sections of the gas-conducting pipes and valves minimise the danger of functional deterioration due to condensate.

The following points must be observed for the practice of low-flow anaesthesia, especially in the event of long operations at low room temperatures:

- Route the hoses so that the condensate can collect at the lowest point and not run to the patient or into the breathing system.
  Regularly drain the condensate from the hoses.
- Use water traps when performing operations longer than 1.5 hours. Position the water traps at the lowest point in the system, so that the condensate can flow into the water traps.
  Regularly empty the water traps.

  If condensate enters the breathing system, it can adversely affect pressure and flow measuring.
- In such cases, replace the breathing system with a dry breathing system.
- Protect the microbial filter from condensate. Although the filter is insensitive to moisture, condensate in the microbial filter increases its resistance!
  Replace the microbial filter.

  If condensate has entered the pressure measuring line –
- Replace the pressure measuring line and its filter.
- Install the T-piece with the sample line filter, with the connection at the top.
  Replace the T-piece after every patient.
- Fit the Y-piece with the Luer lock connection – measuring connection at the top.
  If microbial filters are used on the breathing system: replace the Y-piece and hoses after every patient.
  If microbial filters are used on the Y-piece: replace the Y-piece and hoses daily.
- If droplets of condensate form in the sample line – replace the sample line.
- If condensate has collected in the anaesthetic scavenging line, empty the hose.

Recommendation

If condensate is expected:

- Replace the breathing system and piston/cylinder unit daily.
- Replace the soda lime daily.

ECG in the operating theatre

The following measures are necessary to ensure an effective ECG, reliable heart rate calculations and patient safety:

- Only use ECG leads with HF protection for electro-surgery.
- Never use ECG needle electrodes in the operating theatre when an electro-surgical unit is being used!
- The ECG electrodes must be positioned as far away as possible from the area of surgery and from the neutral electrode of the electro-surgery equipment.
- The ECG electrodes must lie as close together as possible.
- Avoid looping the ECG leads and crossing or routing them in parallel to electro-surgery leads.
- The distance between active and neutral electro-surgery electrodes should be kept as small as possible.
- Deactivate pacemaker pulse detection.
- Activate the filter.
- Conductive parts of the electrodes, including the neutral electrode, must not touch other conductive parts, including earth.

Pacemaker pulse detection

Pacemaker pulse detection must be activated if the patient has a pacemaker (see page 48 »**ECG settings**«, »**Pacemaker**«)

The heart rate is normally only calculated on the basis of the ECG complex and not on the basis of the pacemaker pulse.

Particular care must be taken in the case of pacemaker patients, since the pacemaker pulses may be mistaken for ventricular complexes. In such a case, calculation of the heart rate would be continued even in the absence of an ECG!

The following points must also be noted:

- The R-waves of the ECG must be greater than 0.5 mV in order to ensure reliable functioning. If this is not the case, the ECG lead must be changed or the ECG electrodes repositioned.
- Pacemaker pulse detection should be deactivated if it is not required.
- Pacemaker pulse detection should be deactivated in the operating theatre when using electro-surgery equipment.

Applying electrodes

- Carefully prepare the areas of skin to which the electrodes are to be applied.
- The electrodes should be positioned in areas in which patient movement will not have a negative effect on the ECG (i.e. not on top of muscles).
- Appropriate points of contact for the electrodes when using 3, 4 or 5 electrodes can be seen from the diagrams alongside.

Abbreviations used in the diagrams:

Rd = Red electrode
Ye = Yellow electrode
Gn = Green electrode
Bl = Black (neutral) electrode

Figures 1 and 2
Points of contact when using three ECG electrodes. The points of contact shown in Figure 1 are also suitable for monitoring thoracic breathing, and the positi-ons in Figure 2 are suitable for monitoring both thoracic and abdominal breathing.

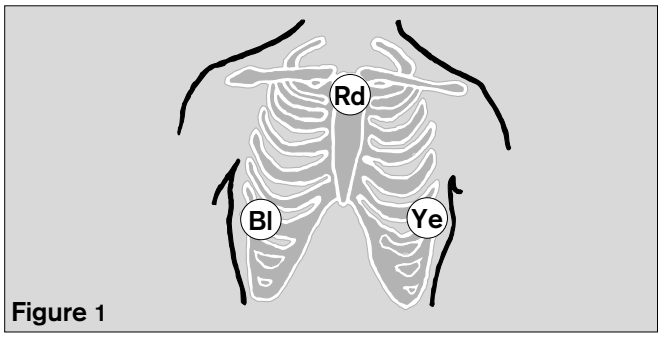


Figure 1

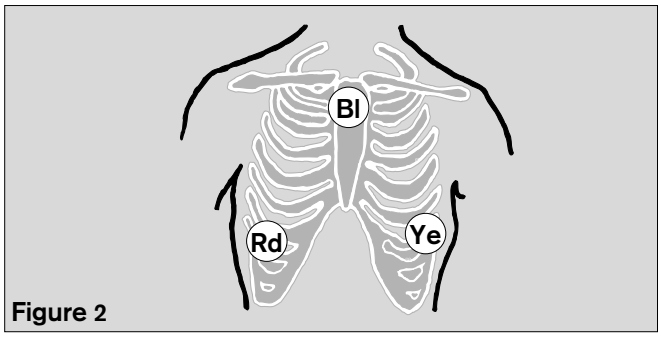


Figure 2

Figure 3
Points of contact when using four or five ECG electrodes. (e.g. for ST-segment analysis).

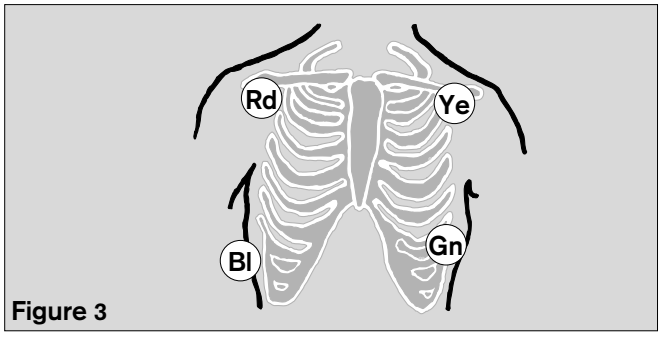


Figure 3

Tips for NiBP measurement

Applying the sphygmomanometer cuff

Correct application of the cuff and use of the correct size are essential prerequisites for reliable measurement without artefacts.

- Only use Dräger cuffs!
- The cuff is normally applied to the upper arm. It can also be applied to the forearm or ankle for prolonged monitoring (less patient discomfort).
- Use the largest possible cuff size.
- Press the remaining air out of the cuff.
- The inflatable part of the cuff must enclose the limb completely (overlapping has only a marginal effect on the measurement), otherwise a disproportionately high systolic pressure will be obtained.
- The cuff must fit snugly in order to minimize tissue movement under the cuff.
- Apply the cuff horizontally level with the heart. If this is not possible, the difference in level must be corrected by adding/subtracting 0.75 mmHg per cm above/ below the level of the heart.
- If the cuff is applied to the upper arm, ensure that it does not compress the ulnar nerve.
- If the arm rests beside the patient, turn the palm of the hand upwards to reduce the pressure on the elbow and ulnar nerves and vessels.
- Ensure that the patient does not speak or move his arm during the measurement. Movement of every kind extends the measuring time and may lead to incorrect results.
- Ensure that nothing presses, knocks or bumps against the cuff or hose during measurement.
- The cuff has a negative effect on an SpO_2 sensor applied to the same limb. Measure the blood pressure at a different point or activate »**Interlock**« to avoid a false alarm (see pages 93).
- Do not inflate the cuff while loose.
- The cuff must not be applied to a limb that is required for an intravascular canula.
- The hose length must not be changed. Only use the original Dräger hose material.

Limitations of the method

The oscillometric method used here is based on measuring the change of pressure in an inflated cuff due to blood streaming through a partly occluded artery.

This means that the change in pressure must be sufficiently large for measurement to be reliable and due exclusively to pulsation in the artery.

Unreliable results or no results at all are therefore to be expected in the following cases:

- Patients in a state of severe shock (low blood and pulse pressure with vasoconstriction).
- Patients whose blood pressure changes rapidly and considerably during the measurement.
- Patients with arrhythmias. These can have a negative effect on measurement if the pressure pulses per heart beat vary considerably. Such changes in oscillation may also be due to spontaneous breathing/ assisted ventilation, hypovolaemia or talking.
- Patients with conically shaped arms (use a different site, such as the forearm or ankle).
- Patients with sclerotic arteries.
- Patients who move violently or tremble constantly (try to stabilize the limb).173

Tips for SpO2 measurement

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

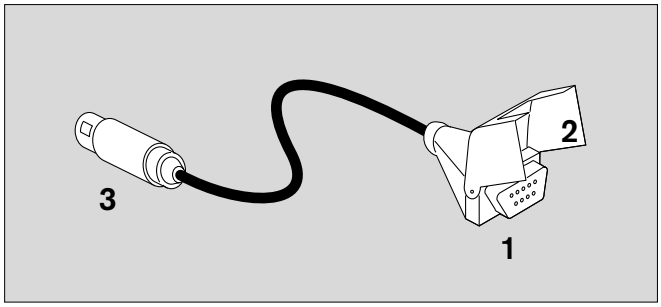
The following table listing the various sensors available and their specific characteristics may prove useful here.

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.

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

1) in undamaged, unopened packaging



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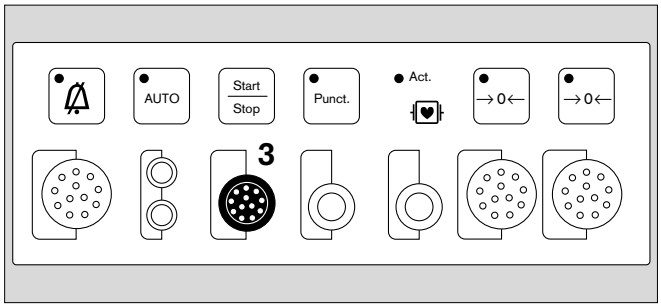

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- Choose the appropriate sensor. (See table above)

1 Plug the sensor into the socket of the adapter lead.

2 Press the flap down over the connector (strain relief and to prevent it being pulled out).

3 Plug the round connector of the adapter lead into the brown port on the parameter box.

Do not use an amplifier cable, because the device already has a built-in preamp!

Tips to avoid artefacts during SpO_2 measurement

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 must not be reused: they may not adhere properly. The strips must not be stretched unduly and never use two 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, as well as of intravascular dyes, such as methylene blue, can also make the measurement inaccurate.

Electrocautery (HF surgery devices) 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.

Coupling with non-invasive pressure measurement

The interlock function should be activated for simultaneous measurement of SpO_2 and non-invasive blood pressure on an arm. This prevents unnecessary alarms due to failure to detect a pulse during NiBP measurement (see page 171).

Definitions and instructions

Functional saturation compared with fractional saturation

The functional saturation is calculated as follows:

$$\%\ SpO_2\ (func) = \frac{100 \times HbO_2}{HbO_2 + Hb}\ \%$$

The functional oxygen saturation is defined as the percentage of oxygen-laden haemoglobin capable of carrying oxygen in relation to the total haemoglobin.

The oxygenated and reduced haemoglobin values are measured. Substantial amounts of dysfunctinal haemoglobins, such as carboxyhaemoglobin and methaemoglobin, are disregarded. The fractional saturation can be measured in a variety of ways.

The percentage indicates the ratio of oxyhaemoglobin to total haemoglobin, regardless of whether or not the haemoglobin is available for oxygen transport. The measured dysfunctional haemoglobin is included.

It is important to know the method applied in each case when comparing the results obtained by different module manufacturers. The functional saturation can be calculated from the fractional saturation as follows:

$$\text{Funct. sat.} = \frac{\text{Fract. sat.} \times 100}{100 - (\%\ \text{CO haemoglobin} + \%\ \text{methaemoglobin})}$$

Measured saturation in relation to calculated saturation

The oxygen saturation calculated from the partial pressure of the arterial oxygen (PaO_2) in blood pressure measurements may differ from the values actually measured. This may be due to the fact that such parameters as temperature, pH value, $PaCO_2$, 2,3-DPG value and concentration of foetal haemoglobin were not corrected when calculating the blood gas value.

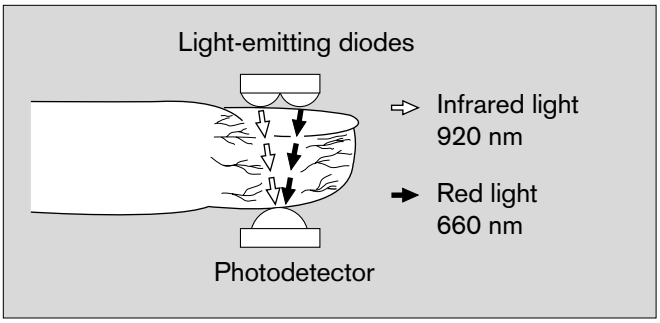
Measuring principle

The light absorption properties of oxygenated arterial blood (oxyhaemoglobin HbO_2) differ from those of unsaturated venous blood (reduced haemoglobin Hb).

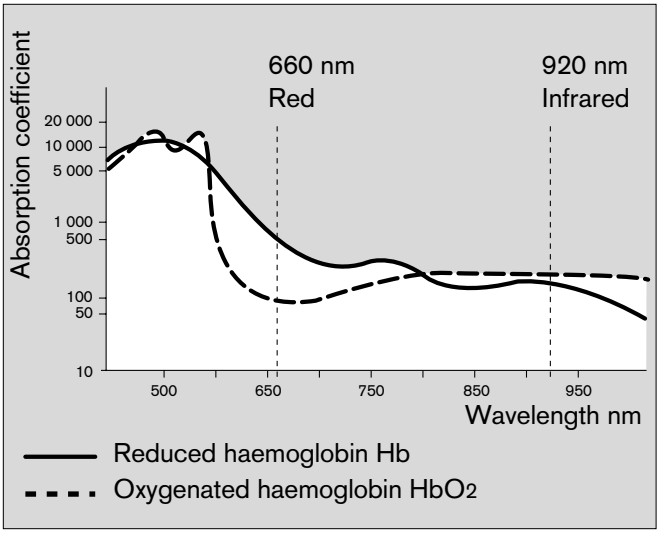
O_2 saturation is a logarithmic function of the irradiated light intensity (Lambert-Beer's law).

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.



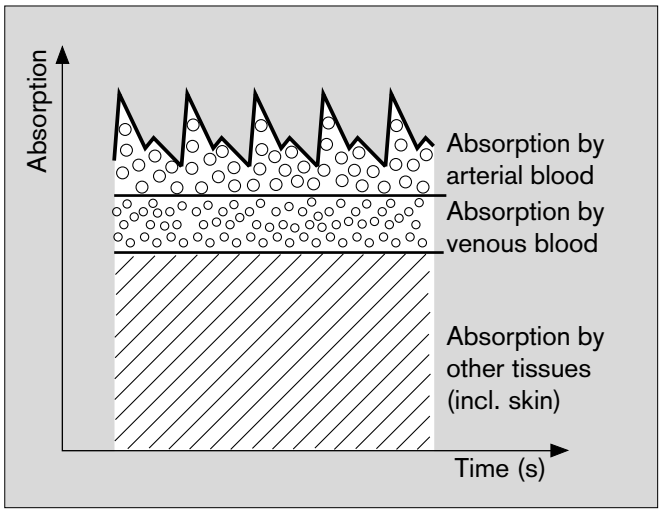
These two wavelengths – 920 nm and 660 nm – are used because meaningful absorption values are still obtained for oxygenated and reduced blood, even in the presence of slight perfusion, and because they differ significantly.



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.

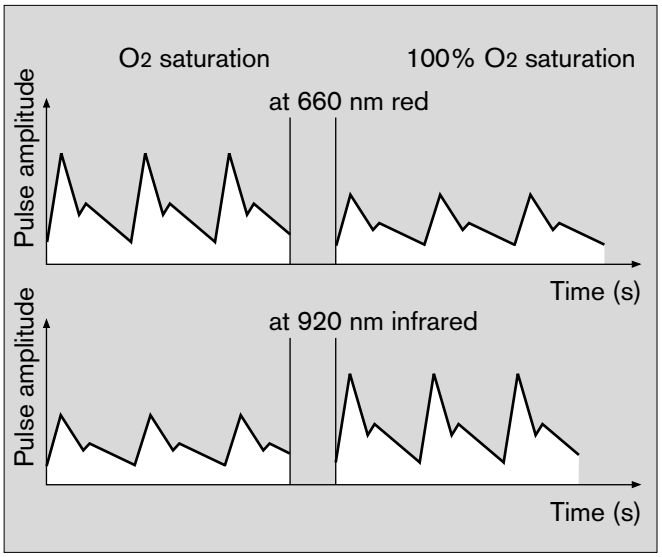
The arterial blood pulsating with every beat of the heart, however, produces a change of volume synchronous with the pulse in the irradiated tissue. In other words, absorption of the irradiated light also changes in time with the pulse.



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:

$$\%\ SpO_2\ (func) = 100 \times \frac{HbO_2}{HbO_2 + Hb}$$

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

Measuring principle

Temperature-dependent change in resistance of an NTC resistor (NTC = negative temperature coefficient) with linearization circuit.

Pressure measurement

Measuring principle

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.

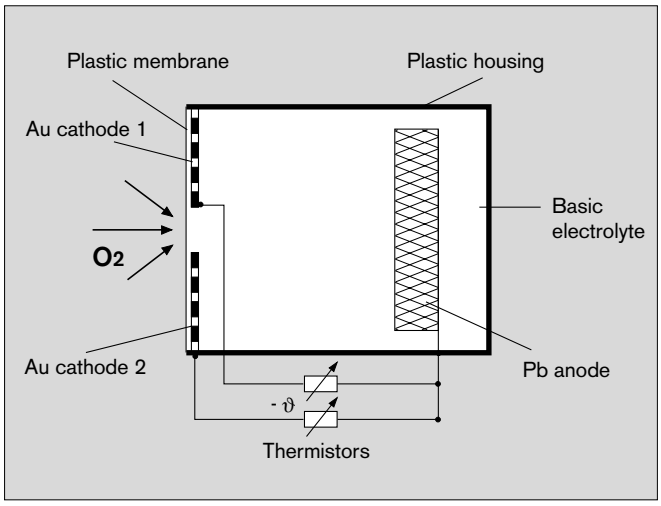
The plateau pressure is the airway pressure measured 16 milliseconds before expiration begins.

O_2 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.



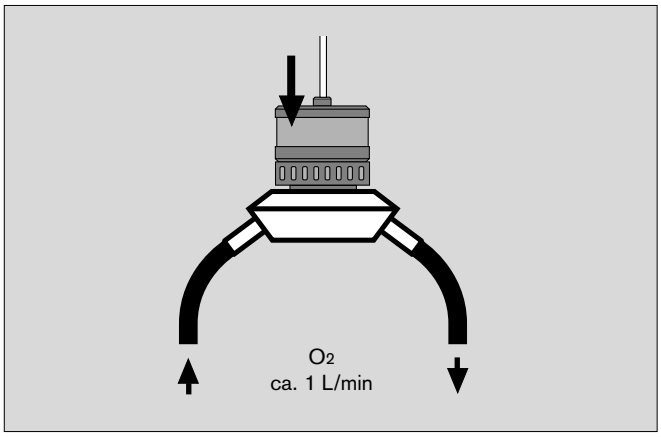
A base electrode is oxidized at the same time. It is depleted by the oxidation process and essentially determines the service life of the sensor. The current flowing through the cell is proportional to the partial oxygen pressure in the gas mixture to be measured.

At constant pressure and constant temperature of the gas mixture to be measured, the measured value is directly proportional to the partial oxygen pressure.

Calibrating the inspiratory O2 sensor with 100% O2 by volume

(Only necessary if sampling O2 measurement is not used)

- Remove the O2 sensor and fit test adapter 68 01 349 to the sensor.
- Allow a pure O2 flow of about 1 L/min to flow across the O2 sensor for about 2 minutes.



- Select the »Config.« screen key.
- Turn the rotary control to move the cursor from »**Calibrate**« to »**continue**«, and then select and confirm »**O2 sensor 100 Vol.%**«.
- The clock symbol (⏲) appears after the text. The tick (✔) indicates the end of calibration.
- Plug the O2 sensor back into the measuring site.
- Restore the settings appropriate to the patient.

Checking linearity

– Check linear response monthly.

– First carry out calibration with 100% O2 by volume (see illustration)

– Then expose the sensor to the atmosphere for at least two minutes (approx. 21% O2 by volume).

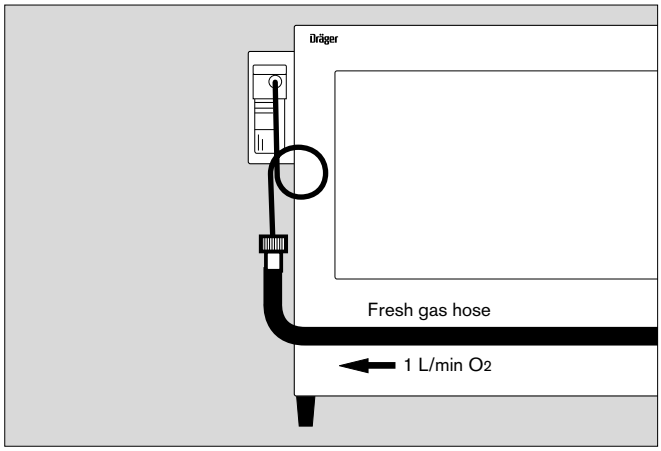
– If the values of this measurement are not within the range 18 to 24% O2 by volume after a reasonable time (at least 90 seconds for the inspiratory sensor, and at least 20 seconds for the sidestream sensor), the sensor capsule is worn and must be replaced by a new capsule.

Calibrating the O2 sensor for sampling measurement with 100% by volume O2

Required for the monthly linearity check.

Prepare a replacement sample line:

- Cut a sample line hose into two equal halves.
- Unscrew the original sample line from the water trap and screw the cut replacement line to the water trap.



At the anaesthetic workstation:

- Unscrew the fresh gas hose from the breathing system/circle system.
- Deliver an O2 flow of 1 L/min to the O2 measuring tube of the anaesthetic workstation and push the hose of the replacement sample line deep into the fresh gas hose.
- Set a pure sampling O2 flow of about 1 L/min. for about 2 minutes.

On the monitor:

- Select the »Config.« screen key.
- Turn the rotary control to move the cursor from »**Calibrate**« to »**continue**«, and then select and confirm »**O2 sensor 100 Vol.%**«.
- The clock symbol (⏲) appears after the text. The tick (✔) indicates the end of calibration.
- Rescrew the original sample line to the water trap.

On the anaesthetic workstation:

- Reconnect the fresh gas hose.
- Restore the patient settings.

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.

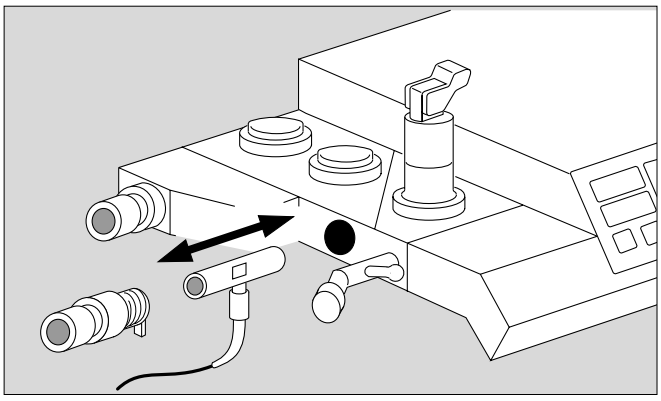
Gas type compensation

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.

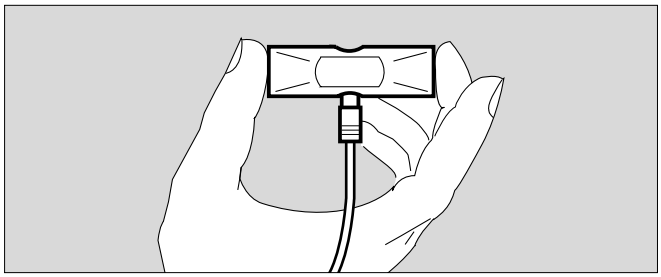
To calibrate the flow sensor:

- Remove the sensor.

  To do so, remove the expiration cone and pull out the flow sensor complete with connecting cable (breathing system of the Cicero EM).



- Shake the sensor briefly in the ambient air to purge it of any residual breathing system gases. Tightly seal the sensor openings (on at least one side).



- In »**Standby**« mode, call up the configuration menu. Then, using the rotary control, select and confirm the »**Flow Sensor**« option in the screen menu under »**Calibrate**«.

Measurement of CO_2 and anaesthetic agent

Measuring principle

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.

The Cicero EM is equipped with an automatic anaesthetic agent recognition system. Mixtures will be identified and the main component recognised and quantitatively evaluated. Accuracy may be restricted in this case.

Disturbance variables in sidestream gas measurement

When assessing 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 sidestream 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%	—

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)

Econometer

The econometer can be configured as a numerical module on the screen. It helps the anaesthetist assess the fresh gas balance during anaesthesia with reduced fresh gas flow (low-flow or minimal-flow anaesthesia).

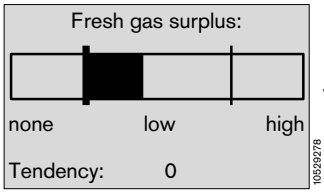
If there is a danger of fresh gas shortage, an advisory message is displayed before the caution message "FRESH GAS? !!" appears on the screen.

In the case of excess fresh gas flow, the Cicero EM ventilator releases the excess gas by actuating the gas overflow valve (V_2). This valve is opened during the expiration period and is automatically adapted to the fresh gas flow.

Three measured values are used to calculate the econometer reading:

– Valve V_2 opening ratio
  = valve opening period as a percentage of the expiration period.
– Opening pressure
  Pressure in the breathing system immediately before valve V_2 is opened.
– End-expiratory piston pressure
  This value permits conclusions to be drawn on the filling level of the breathing bag.

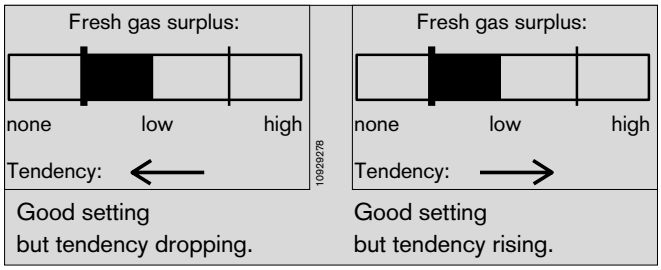
These three values are compressed by a specific algorithm into the value displayed as a bar in the econometer module, giving a qualitative assessment of the fresh gas reserve. Depending on the reserve of fresh gas, the indicator bar moves from its starting point (thick vertical line) to the right or left between the extreme values of fresh gas excess and fresh gas shortage, passing through the ranges »none«, »low« and »high«.



Example of a good setting with stable tendency.

In the event of significant changes, tendency arrows pointing in the relevant direction are displayed under the bar indicator (to indicate rising or falling fresh gas reserve). The reason for these changes may be changed settings or leakage in the breathing system.

If the system is so stable that no major changes in measured values are indicated for several minutes, no tendency arrow is displayed.



The qualitative assessment of the econometer reflects the prevailing conditions in the breathing system most accurately when anaesthetic ventilation for adults is carried out with a rate of 6 to 25 strokes per minute. The econometer is optimised for frequencies between 6 and 25 strokes per minute - but it can be used up to 40 strokes per minute if a slight instability can be accepted.

The size of the breathing bag should be in a specific ratio to the stroke volume in order to accept a buffer volume for the patient expiration gas in addition to its basic filling.

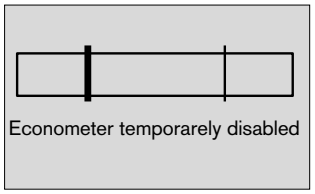
The table below gives guideline values:

Ventilation volume	Bag size
V_T < 200 ml →	0.5 litre bag
200 ml < V_T < 500 ml →	1.5 litre bag
500 ml < V_T < 800 ml →	2.3 litre bag
800 ml < V_T →	3.0 litre bag

If the appropriate breathing bag is not available, select the next larger bag.

With certain settings on the ventilator, the econometer cannot generate any useful display and is therefore automatically switched off.

For example, if the ventilation parameters are set so that the piston only stops at the end of expiration, the pressure values are no longer usable for the econometer due to the influence of piston movement. Similar problems arise with high ventilation frequencies or inverse T_I:T_E ratio. The message »The econometer cannot display measurement data at present« is then displayed.



The econometer is switched off.

SIMV
Synchronized Intermittent Mandatory Ventilation

Mixture of mechanical ventilation and spontaneous breathing.

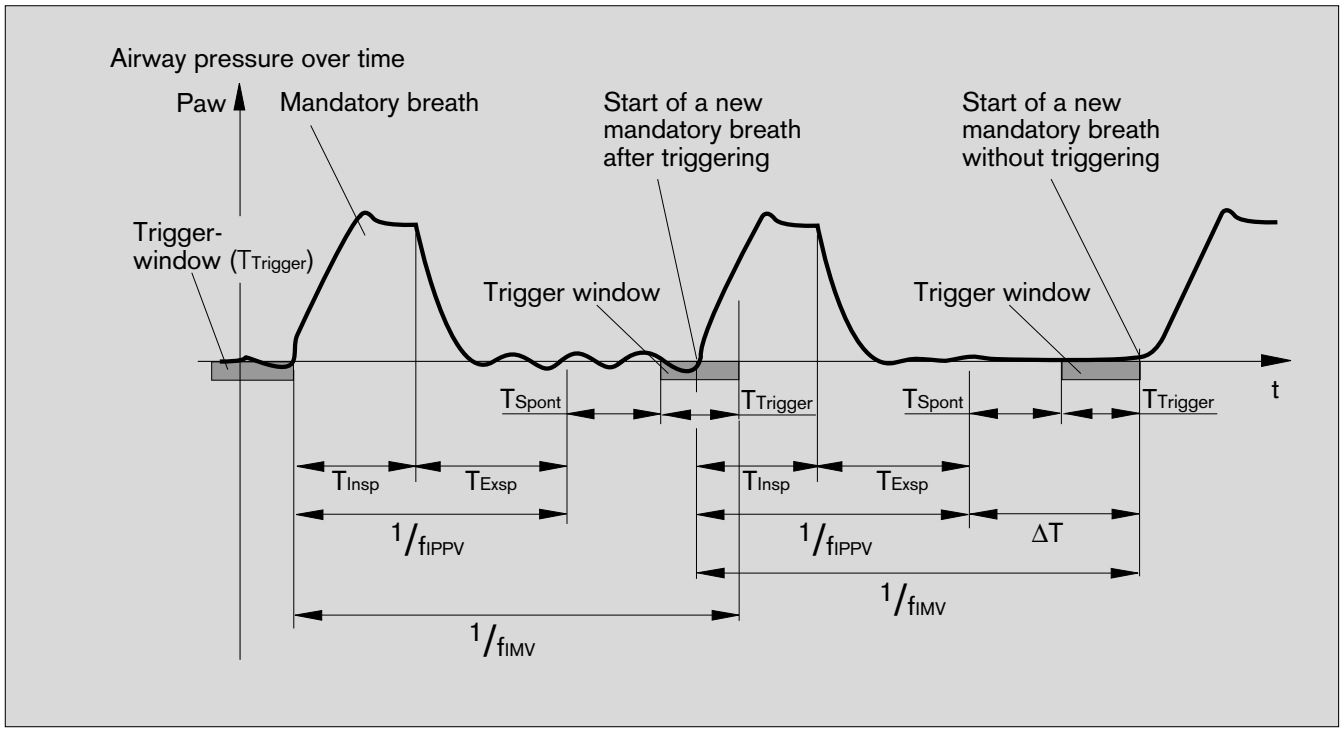
In SIMV mode, the patient can breathe spontaneously at specified regular intervals. Between these intervals, mandatory (i.e. automatically delivered) ventilation strokes ensure a minimum degree of ventilation.

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}.

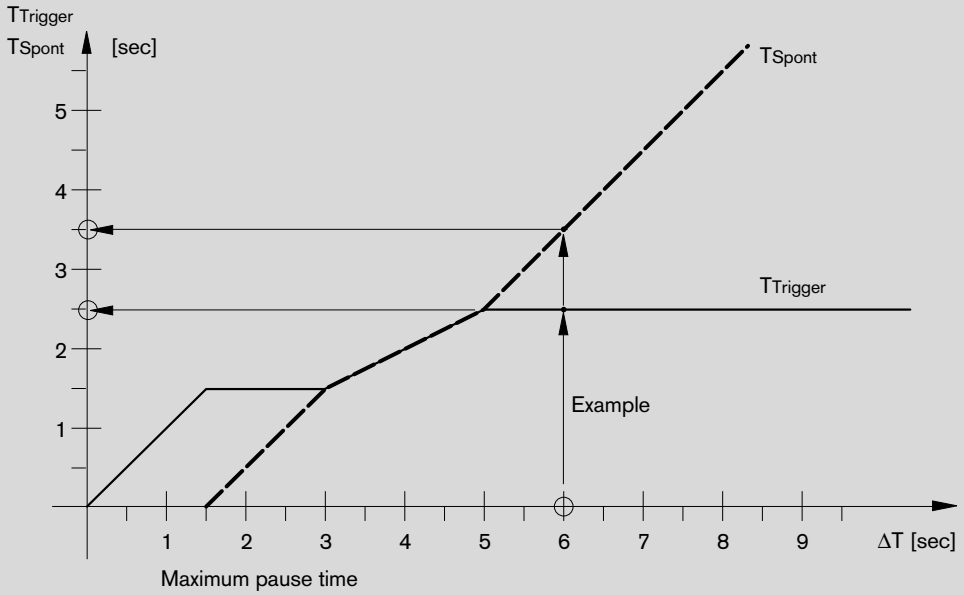
Each mandatory breath is followed by a pause in which the patient can breathe spontaneously.

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 $T_{Trigger}$.



Trigger and spontaneous breathing times for SIMV mode:



Example:

f_{IMV} = 5 / min

f_{IPPV} = 10 / min

$$\Delta T = \frac{1}{f_{IMV}} - \frac{1}{f_{IPPV}} = \frac{1}{5 \text{ per min}} - \frac{1}{10 \text{ per min}} = 6 \text{ s}$$

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.

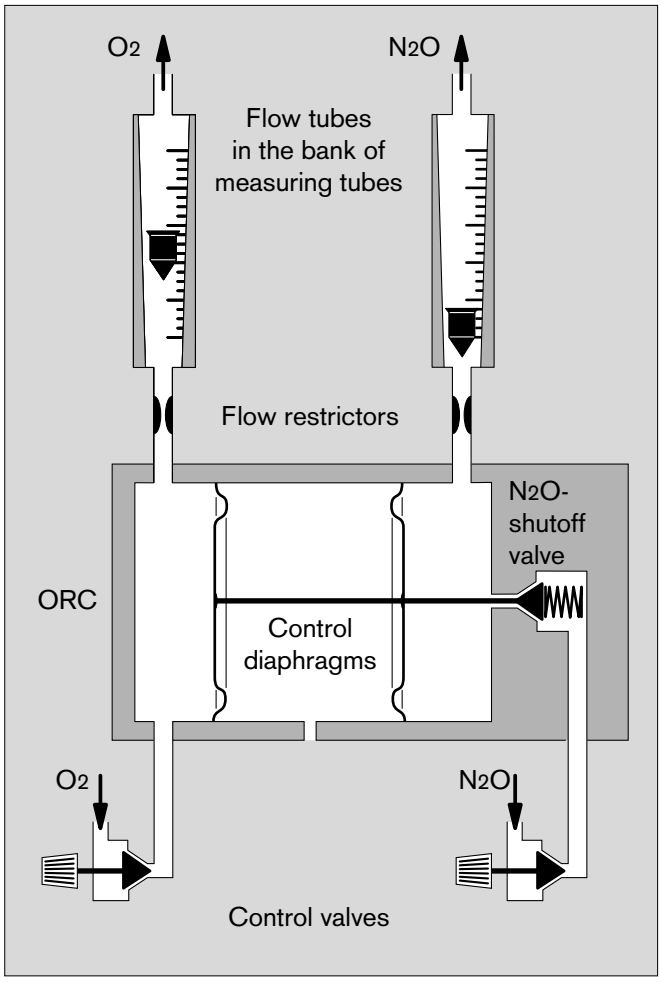
Oxygen Ratio Control – S-ORC

To prevent the setting of hypoxic gas mixtures, Cicero EM has an O_2 ratio control system (SORC = Sensitive Oxygen Ratio Control).

The O_2 and N_2O flows build up control pressures for a switching diaphragm in a flow restrictor. The pressure ratio on the switching diaphragm controls the N_2O flow.

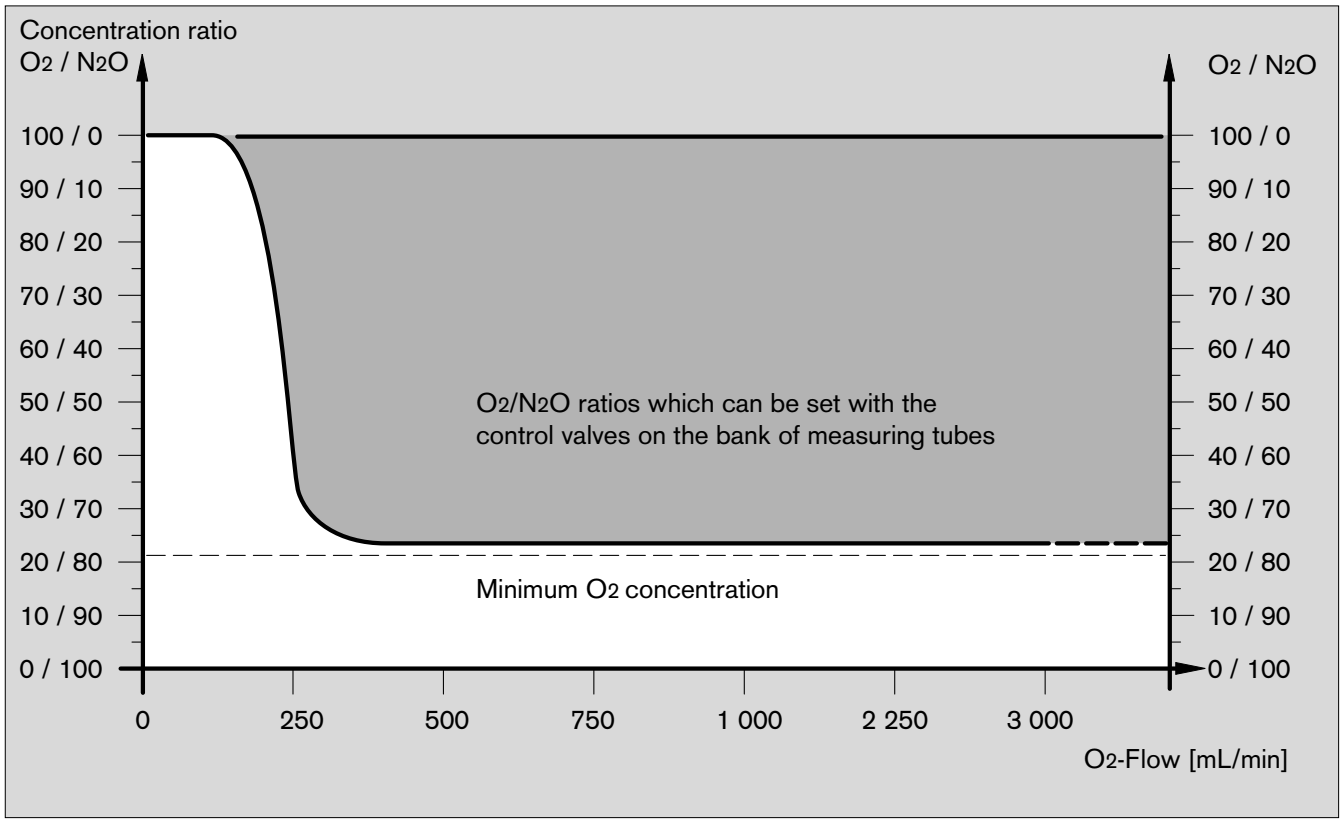
N_2O is disabled when the O_2 flow drops below approx. 200 mL/min; it is slowly re-enabled as the value rises. When the O_2 flow reaches approx. 300 mL/min, the proportion of N_2O contained in the fresh gas can be freely varied between 0 and 75 %.

Since the maximum delivery capacity of both flow tubes is limited (but at least 9 L/min, depending on the pressure in the gas supply), the minimum O_2 concentration increases above approx. 2500 mL/min until both flow tubes are completely open and the mixing ratio of O_2 : N_2O is approx. 50 : 50.



The principle is illustrated in the diagram:

The curves are displaced when anaesthetic vapours (by up to 18% in the case of desflurane!) are delivered!



Safety features of gas supply

Switch-on lock

A safety mechanism prevents gas from being delivered if the machine is switched on although there is no O_2 delivery pressure. The ventilator indicates »Pressure supply?« in this case. The O_2 supply must be connected and the message confirmed on the ventilator.

N_2O cut off 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.

Principles of the processed EEG (pEEG)

The electrical activity of the cortical neurone causes potential variations that can be measored on the surface of the scalp by electrodes (EEG, electroencephalography). These signals have amplitudes in the order of 10 µV to 100 µV, i.e. roughly 100 times less than ECG signals. Another difference compared to ECG signals is the high complexity and variability of the EEG signals. Intensive training is therefore required in order to interpret unprocessed EEG signals reliably.

It is not practically feasible for the anaesthetist to evaluate the unprocessed EEG of patients under anaesthesia. However, with pEEG measurement, special frequency analysis methods are used to reduce the volume of data, in order to provide the anaesthetist with EEG characteristics relevant to anaesthetic management.

With Dräger pEEG measurement, two EEG signals derived by electrodes from the left and right hemispheres of the brain are processed. The frequency content and amplitudes of these signals contain important diagnostic information which can be determined with the aid of Fourier transformation and displayed on the monitor.

The amplitudes are determined for specific time slots (epochs). Characteristic values are then calculated from the frequency spectrum. These calculations take place in "real time", i.e. they are performed at the same time as the signals are received, so that the results are available after completion of the next epoch.

To provide a visible illustration of the trend of the EEG data, the frequency spectra of the individual epochs are represented in "Density Special Array" format (DSA). Here, together with time and frequency, amplitude is represented as the third dimension by colour shading.

Clinically significant EEG parameters include the 90% spectral edge frequency (SEF90) and the spectral median frequency SMF.

SEF90 is the frequency below which 90% of the frequency spectrum output is situated.

SMF is the frequency below which 50% of the frequency spectrum output is situated.

Both parameters are sensitive indicators of changes in EEG activity. The parameters correlate with the depth of hypnosis of the patient and can therefore support the control of anaesthesia by the anaesthetist. The information is represented as relative band power values output values of the four conventional EEG bands:

δ: 1 to 4 Hz,
ϑ: 4 to 8 Hz,
α: 8 to 12 Hz and
β: 12 to 30 Hz.

High **delta activity** is typical of adequate anaesthesia or sleep.

Theta activity indicates light anaesthesia, sleepiness or certain pathological conditions.

Alpha activity occurs in healthy awake adults with closed eyes.

Beta activity predominates in healthy, mentally active adults.

The "burst suppression ratio" (**BSR**) is useful when EEG activity is heavily suppressed. This ratio gives the percentage of EEG silence over the last 60 seconds.

The ratio of the alpha + beta band outputs to delta (**delta ratio**) is another parameter that can be represented as trend.

In addition to the EEG data, pEEG measurement determines a mean value of **EMG activity** from the EEG signal of the left pair of electrodes. This parameter, which is represented as the numerical value and trend, provides information on the spontaneous muscular activity of the frontalis muscles.

Operation of the ceiling version

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 Cicero EM.

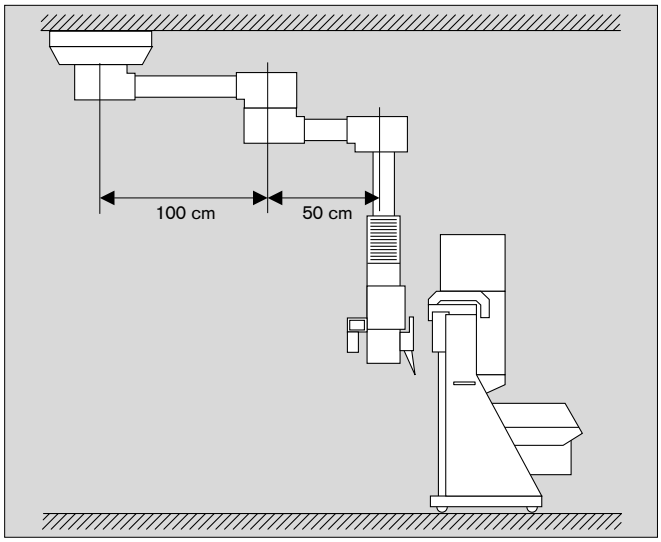
The DVE is turned and pivoted manually after releasing the brakes.

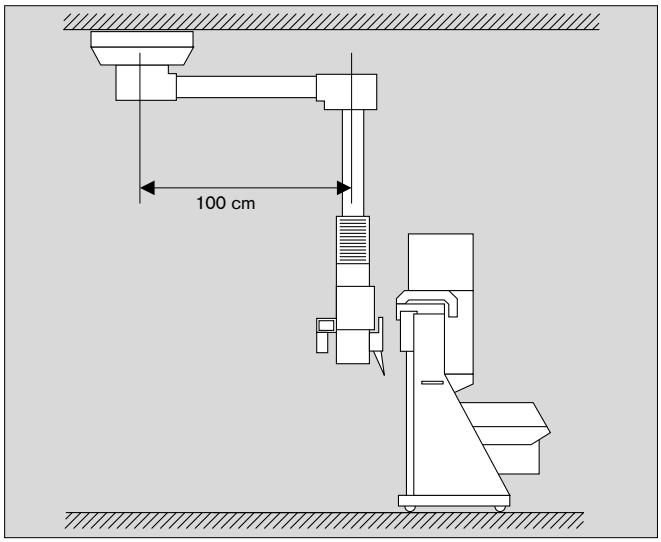
On the rear of the ceiling version of the Cicero EM there is a mounting arm with which the machine is coupled to the mount on the DVE. Both the mounting arm and the mount are equipped with sensors ensuring that the Cicero has been correctly fitted and coupled. Readiness for operation is signalled by green LEDs on the touch-sensitive keypad of the pendant control panel.

The main arm of the DVE 808X with Cicero may have a maximum length of 100 cm plus 50 cm for the extension arm.

The worktop on the ventilation part of the Cicero is normally 83 cm above the floor. The height adjustment of the DVE permits a relative adjustment of ± 30 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.





General requirements

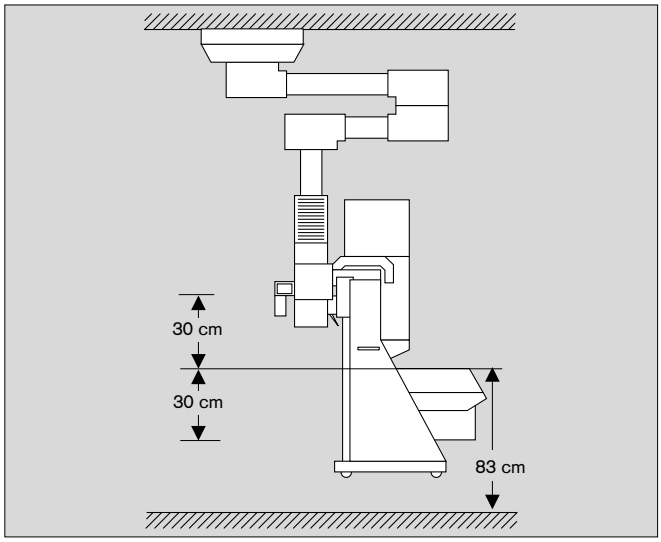
DVE units equipped for connection of a Cicero EM must be capable of carrying a load of 200 kg with the safety specified by DIN/VDE 0750 Part 1.

If the Cicero EM is equipped with an uninterruptible power supply (UPS), the ceiling mount must be capable of carrying a load of about 250 kg.

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.

Depending on the DVE used and on the prevailing conditions, the Cicero EM 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!



Backup gas cylinders

Backup gas cylinders are not installed.

Auxiliary mains sockets

The auxiliary mains sockets are not installed on the ceiling version.

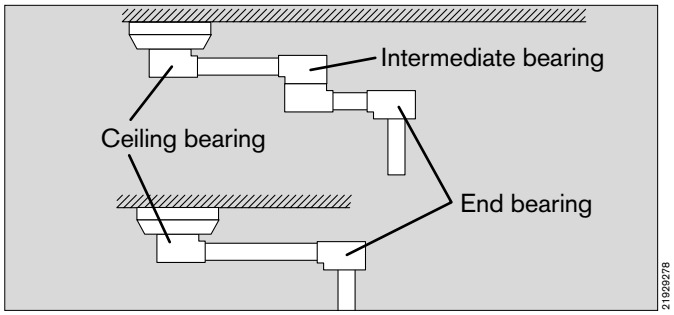
Articulated arm

The articulated arm is attached to the journal of the support at the left-hand side.

Dimensions

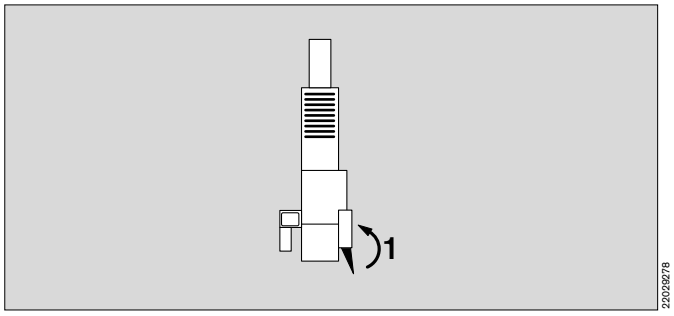
See page 150.

- The designation of the bearings is shown in the diagram.



Connecting the Cicero EM ceiling version

1 Swing supporting flap upwards!

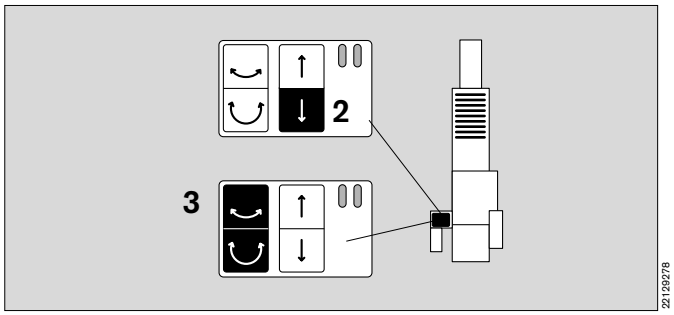


2 Press key until DVE reaches lower limit stop.

3 Press key to release bearings.
The DVE can be pivoted into the required position.

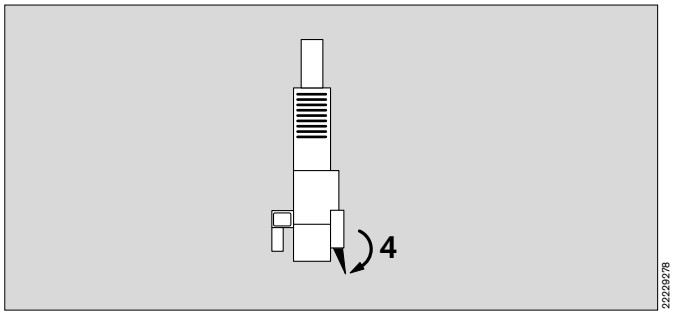
Single-arm DVE units:
Upper key for ceiling bearing
Lower key for end bearing

Two-armed DVE units with extension arm:
Upper key for ceiling and end bearings
Lower key for intermediate bearing



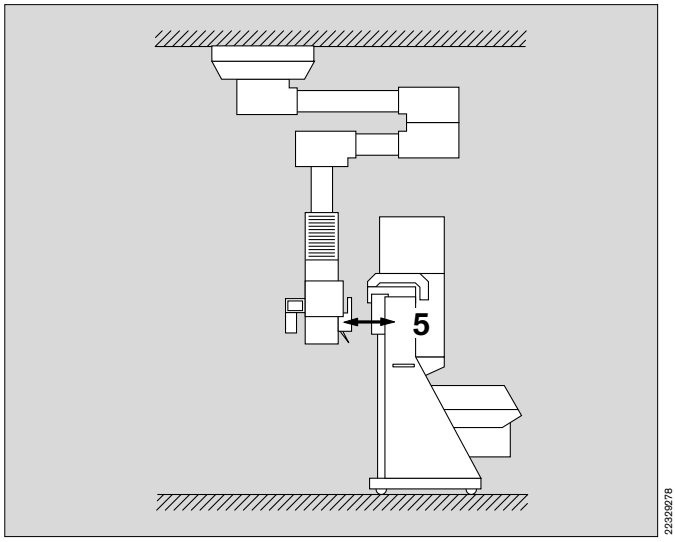
4 Swing supporting flap down again.

The DVE can no longer be operated via its own keypad.



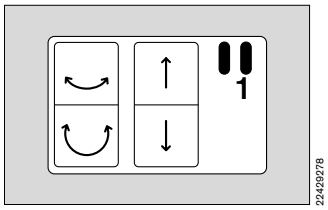
- Plug the mains connector of the Cicero EM into the socket on the DVE.
- Plug the pipeline probes of the Cicero EM into the corresponding outlets on the DVE.

5 Move Cicero right up to the mount on the DVE.



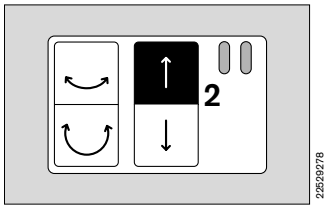
1 Both green LEDs on the touch-sensitive keypads on the Cicero EM mounting arm and on the DVE light up when correctly positioned.

- The DVE can now be controlled via the keypad on the Cicero EM!



2 Press key until Cicero EM reaches the required working height.

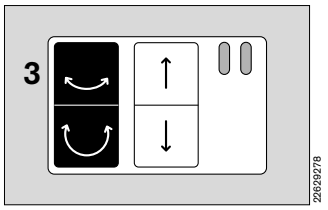
When Cicero EM has been raised approx. 5 cm, the keypad on the DVE also becomes active in parallel to that on the Cicero EM mounting arm. Operation can then be continued from there.



3 Press key to release bearings.
The DVE can be pivoted into the required position.

Single-arm DVE units:
Upper key for ceiling bearing
Lower key for end bearing

Two-armed DVE units with extension arm:
Upper key for ceiling and end bearings
Lower key for intermediate bearing



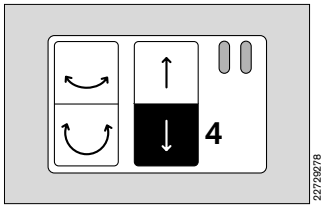
Disconnecting the Cicero EM ceiling version

- **Any obstacles in Cicero EM's path as it descends will be subject to Cicero EM's full weight (approx. 150 kg) and may be crushed.**

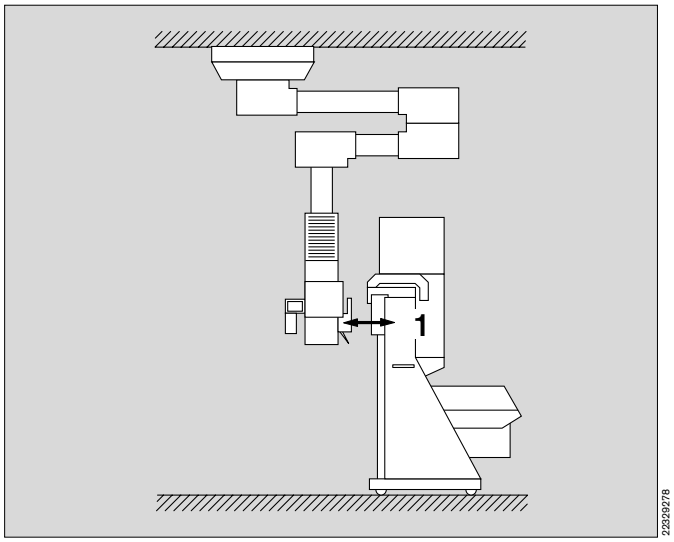
  Before lowering Cicero EM, always ensure that there is nothing to prevent it from being deposited directly on the floor!

4 Press key until lower limit stop is reached.

- Disconnect mains plug and gas supply lines of the Cicero EM.



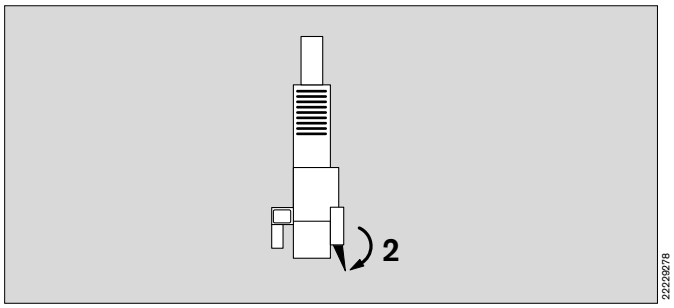
1 Move Cicero EM away from the DVE.



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 Cicero EM.

  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 Cicero may crash to the ground when raised again!

Maintenance and care

- The windows on the optical sensors must be cleaned!

  They are resistant to all cleaning agents and disinfectants usually used in hospitals.

  Abrasive agents must not be 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
CAL	Calibration has been performed
CSA	Canadian Standard Association
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 mode
in CO_2	Inspiratory CO_2 concentration
INOP	Malfunctioning
IPPV	Automatic ventilation mode: intermittent positive pressure ventilation
KG	Body weight
KZE	Piston-cylinder unit (PCU)

Abbreviation	Significance
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
S-ORC	Oxygen Ratio Control
P_{aw}	Airway pressure
PC	Personal computer (IBM-compatible)
PCV	Pressure controlled ventilation
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
P_{PCV}	PCV working 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
UMDNS Code	Universal Medical Device Nomenclature System
$\dot{V}$	Inspiratory and expiratory flow
$\dot{V}_E$	Expiratory 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)

Symbol	Significance
♥	Heart rate
	Approval for intracardial surgery
	Lower alarm limit
	Upper alarm limit
	Alarm monitoring inactive
	Cursor frame in menus
	Close menu, return to preceding menu level
	Important note!
	Connection for equipotential bonding
	Protection class type B (DIN IEC 601)
	Protection class type BF (DIN IEC 601)
?	Request for action
✓	Action has been completed successfully
	Action is being carried out
!!!	Warning message
!!	Caution message
!	Advisory message
– –	Alarm limit inactive
CE 0123	Conformité Européenne Cicero EM conforms to the relevant EC requirements.

These Instructions for Use apply only to
Cicero EM
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.

CE 0123
Directive 93/42/EEC
concerning Medical Devices

Dräger Medizintechnik GmbH
Germany
Moislinger Allee 53 – 55
D-23542 Lübeck
(4 51) 8 82 - 0
26 80 70
FAX (4 51) 8 82-20 80
http://www.draeger.com

90 29 238 - GA 5131.107 en
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