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Dräger
MEDICAL

Vamos

Variable Anesthetic Gas Monitor

Operating Instructions
Software 2.n

MT 481-2001

NOTICE

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Important Safety Information

Operator's Responsibility for Patient Safety

For correct and effective use of the product and in order to avoid hazards it is mandatory to carefully read and to observe all portions of this manual.
The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, largely to the specifics of the Dräger design.

This publication excludes references to various hazards which are obvious to a medical professional and operator of this equipment, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. Dräger disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of this product with other products whether supplied by Dräger or by other manufacturers if such a combination is not endorsed by Dräger.

Patient monitoring

The operators of the anesthesia system must recognize their responsibility for choosing appropriate safety monitoring that supplies adequate information on equipment performance and patient condition. Patient safety may be achieved through a wide variety of different means ranging from electronic surveillance of equipment performance and patient condition to simple, direct observation of clinical signs. The responsibility for the selection of the best level of patient monitoring lies solely with the equipment operator.

Limitation of Liability

Dräger's liability, whether arising out of or related to manufacture and sale of the goods, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon Dräger's Product Warranty, is subject to and limited to the exclusive terms and conditions as set forth, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to Dräger and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

THE STATED EXPRESSED WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT.

Dräger shall not be liable for, nor shall buyer be entitled to recover any special incidental, or consequential damages or for any liability incurred by buyer to any third party in any way arising out of or relating to the goods.

Warranty

All Dräger products are guaranteed to be free of defects for a period of one year from date of delivery.
The following are exceptions to this warranty:

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Dräger or its representatives are not covered.
2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with Dräger holding the option. Dräger is not responsible for deterioration, wear, or abuse.
In any case, Dräger will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. Dräger or its authorized representative must be promptly notified, in writing, upon detection of the defective material or equipment.
2. Defective material or equipment must be returned, shipping prepaid, to Dräger or its authorized representative.
3. Examination by Dräger or its authorized representative must confirm that the defect is covered by the terms of this warranty.
4. Notification in writing, of defective material or equipment must be received by Dräger or its authorized representative no later than two (2) weeks following expiration of this warranty.

The above is the sole warranty provided by Dräger. No other warranty expressed or implied is intended. Representatives of Dräger are not authorized to modify the terms of this warranty.

Draeger Medical, Inc.

Definitions

WARNING !

A WARNING statement refers to conditions with a possibility of personal injury if disregarded.

CAUTION !

A CAUTION statement designates the possibility of damage to equipment if disregarded.

NOTE: A NOTE provides additional information intended to avoid inconveniences during operation.

Inspection	examination of actual condition
Service	measures to maintain specified condition
Repair	measures to restore specified condition
Maintenance	inspection, service, and repair, where necessary
Preventive Maintenance	maintenance measures at regular intervals

Typing conventions in this manual

Display messages are printed in bold, e. g:

Apnea !!!

Screen keys and other controls are indicated as »**Control**«, e.g:

» ⏻ **Standby**«

Abbreviations and Symbols

Please refer to “Abbreviations and Symbols” on page 48 for explanations.

Labels on the equipment

Please refer to “Labels” on page 42

Summary of WARNINGS and CAUTIONS

General WARNINGS and CAUTIONS

WARNING !

**Strictly follow this Operator's Instruction Manual!
Any use of the product requires full understanding and strict observation of all portions of these instructions.
The equipment is only to be used for the purpose specified under "Intended Use" (see page 10). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.**

WARNING !

The Vamos anesthetic gas monitor must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction.

WARNING !

**DANGER, risk of explosion if used in the presence of flammable gases or anesthetics.
This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures are likely.**

WARNING !

**Do not use in conjunction with nuclear spin tomography (MRT, NMR, or NMI)!
Equipment malfunction may result.**

WARNING !

**Do not use mobile phones within 33 feet (10 m) of the equipment.
Wireless phones may cause failure in electromedical equipment*.**

* The Vamos monitor complies with the noise immunity requirements of product-specific standards and of EN 60601-1-2 (IEC 601-1-2). However, depending on the type of mobile telephone and the situation where it is used, field strengths exceeding the values specified in these standards may be generated and can therefore lead to interference.

Precautions during preparation

WARNING !

**Always consult operating instructions of the anesthesia machine with regard to placement of the monitor.
Observe all load limits and other restrictions.
Always protect the Vamos monitor and its power adapter against falling in order to prevent personal injury and equipment damage.**

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

If there is a doubt about the grounding integrity or the condition of the power outlet:

- **Operate monitor only with internal battery (available option). Do not connect power plug.**

WARNING !

Do not use the monitor without a water trap in place, to avoid the risk of contaminating the monitor.

WARNING !

Dräger cannot warrant or endorse the safe performance of third party gas sample lines for use with the Vamos monitor. We recommend using genuine Dräger OEM sample line. Other lines may alter the technical data of the monitor.

WARNING !

Leaks in the pneumatic system can lead to wrong gas measurement values.

CAUTION !

(USA only) Federal law restricts this device to sale by or on the order of a physician.

Precautions during operation

WARNING !

**The Vamos monitor cannot automatically recognize the anesthetic agent used.
The respective anesthetic agent must always be set manually.
Otherwise, incorrect measurements will result.**

WARNING !

The Vamos monitor cannot recognize anesthetic gas mixtures. Consequently, measurements will be incorrect if anesthetic gases are mixed!

WARNING !

Use only original Nellcor SpO_2 sensors.

Follow Instructions for Use of the sensors – incorrect positioning or use can cause tissue damage.

WARNING !

Only use specified SpO_2 sensors, and position them as instructed – otherwise there is the possibility of incorrect measurements and tissue damage.

WARNING !

Damaged SpO_2 sensors with bare electric wires or contacts must be removed from service immediately – danger of electric shock.

WARNING !

Do not use self-adhesive sensors if the patient has an allergic response to the adhesive strip used.

WARNING !

Always set audible alarm volume to a level that is sufficiently loud with respect to the general noise level of the surroundings.

WARNING !

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.

WARNING !

The alarm silence button is intended to provide a way of muting audible alarms while corrective action is taken. Failure to identify and correct alarm situations may result in patient injury.

WARNING !

Do not expose the Vamos monitor to mechanical vibrations or shock during measurement. Mechanical vibrations or shock can have adverse effects on gas measurement values.

Precautions during care

WARNING !

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

WARNING !

Follow all accepted hospital procedures for disinfecting parts contaminated by body fluids (protective clothing, eyewear, etc.).

WARNING !

**Do not sterilize parts in ethylene oxide!
Patients may become exposed to EtO that may have diffused into components. Patient health risk!**

CAUTION !

Do not allow any alcohol or detergent/disinfectant to enter the water trap! It may be damaged.

CAUTION !

Do not wash or sterilize the water trap!
It can be damaged by washing/sterilizing!

CAUTION !

Certain components of the Vamos monitor consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., alkylamines, phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized.

Precautions during maintenance

WARNING !

To avoid any risk of infection, clean and disinfect the Vamos monitor before any maintenance according to established hospital procedures - this applies also when returning the Vamos monitor for repair.

WARNING !

Never operate the Vamos monitor if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to DrägerService or factory trained and authorized technical service personnel.

WARNING !

When servicing the Vamos monitor, always use genuine Dräger replacement parts.
Dräger cannot warrant or endorse the safe performance of third party replacement parts for use with the Vamos monitor.

WARNING !

Treatment of batteries:
Do not throw into fire! Risk of explosion.
Do not force open! Danger of bodily injury.
Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries.

CAUTION !
Maintenance

The Vamos monitor must be inspected and serviced at regular six month intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor.

For repairs and in any case of malfunction of the device, we recommend that you contact DrägerService.

Intended Use

Vamos – Variable Anesthetic Gas Monitor

For measuring and monitoring the CO_2 concentration, functional oxygen saturation SpO_2, pulse rate Pulse and the concentrations of N_2O and of the following volatile anesthetic agents:

- Halothane
- Enflurane
- Isoflurane
- Sevoflurane
- Desflurane

CAUTION !

(USA only) Federal law restricts this device to sale by or on the order of a physician.

Monitoring

- Inspiratory and expiratory CO_2 concentration, $FiCO_2$, $FetCO_2$
- Functional oxygen saturation SpO_2
- Pulse
- Inspiratory concentration of the selected volatile anesthetic agent

Display

- Real-time curve CO_2 (t)
- Inspiratory concentration $FiCO_2$
- End-expiratory concentration $FetCO_2$
- Functional oxygen saturation SpO_2
- Pulse rate Pulse
- Inspiratory concentration FiN_2O
- End-expiratory concentration $FetN_2O$
- Inspiratory concentration of the volatile anesthetic agent
- End-expiratory concentration of the volatile anesthetic agent

NOTE: These Operating Instructions describe the maximum level of options available for Vamos.
Depending on the chosen configuration, the monitor may be supplied either without SpO_2 measurement or without the capability of measuring N_2O and anesthetic gas or without the battery option.

WARNING !

The Vamos anesthetic gas monitor must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction.

WARNING !

DANGER, risk of explosion if used in the presence of flammable gases or anesthetics.
This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures are likely.

WARNING !

Do not use in conjunction with nuclear spin tomography (MRT, NMR, or NMI)!
Equipment malfunction may result.

WARNING !

Do not use mobile phones within 33 feet (10 m) of the equipment.
Mobile phones may cause failure in electromedical equipment*.

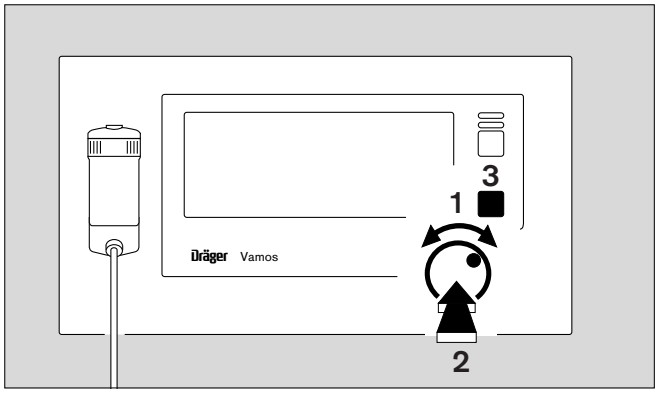
* The Vamos monitor complies with the noise immunity requirements of product-specific standards and of EN 60601-1-2 (IEC 601-1-2). However, depending on the type of mobile telephone and the situation where it is used, field strengths exceeding the values specified in these standards may be generated and can therefore lead to interference.

Operating Concept

Central Control Knob

The central control element is the turn-and-press "dial knob", which has two functions:

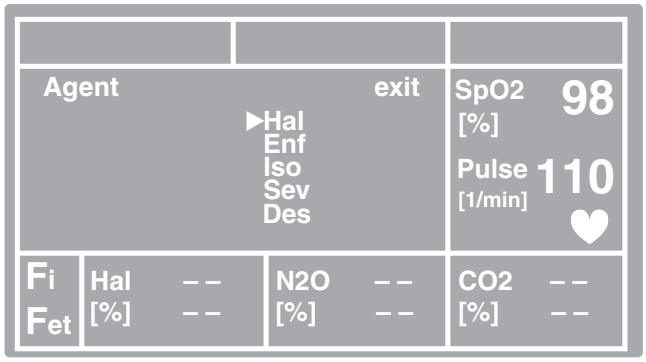
1 Turn knob for selecting/setting
2 Press knob for confirming selections/settings.



- Switch the monitor on with the ON/OFF switch on the back panel. After the self-test, Vamos enters Standby mode.

3 The yellow LED in the »⏻« key lights up.
3 Switch to Operating mode with the »⏻« key.

The selection menu for volatile anesthetic agents is now displayed. The previously selected anesthetic agent is marked by an arrow.
The monitor prompts you to select the anesthetic agent used:
Halothane
Enflurane
Isoflurane
Sevoflurane
Desflurane



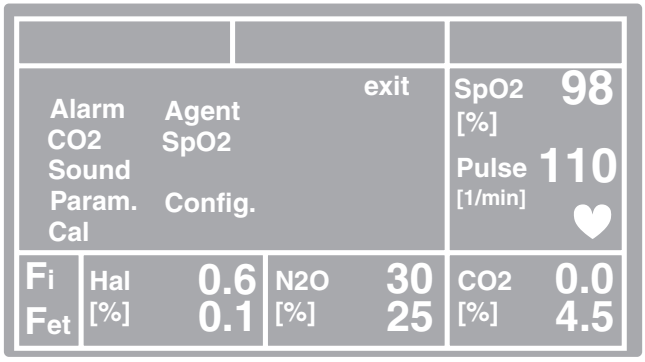
- Turn dial knob to select the anesthetic agent.
  The selected anesthetic agent is highlighted in black on an orange background.
- Press dial knob to confirm. The confirmed new anesthetic agent is now displayed in orange on black and is marked by an arrow.

To return to the main menu:

- Press dial knob.

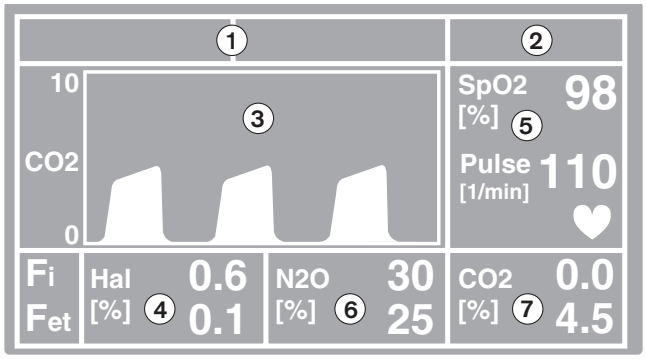
Parameters can be set from the main menu.

- Turn or press dial knob to select main menu.
- Turn dial knob to select a parameter in the main menu.
  The selected parameter is highlighted in black characters on an orange background.
- Press dial knob to open the parameter menu.
- Turn dial knob to set parameter.
- Press dial knob to confirm parameter.
  The confirmed parameter is displayed in orange on black and is marked by an arrow.
- Press dial knob to return to the main menu.
- Press dial knob to return to the display of measurements.



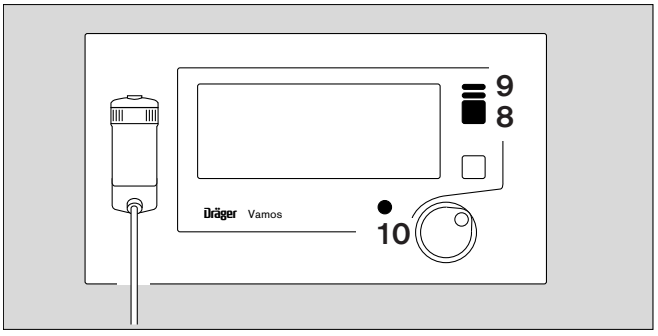
Structure of the Measurement Display

1 Fields for alarm messages
2 Field for internal battery (optional) status display
3 Graphics or menu window
4 Field for inspiratory (F_i) and end-tidal (F_{et}) concentration of the volatile anesthetic agent
5 Field for the numeric display of SpO_2 and pulse rate Pulse and for the pulse display » ♥ «
6 Field for the display of inspiratory (F_i) and end-tidal (F_{et}) N_2O concentration
7 Field for the display of inspiratory (F_i) and end-tidal (F_{et}) CO_2 concentration



Monitoring

8 Press » 🔔 « to silence the audible alarm for 2 minutes. The LED in the key lights up if audible alarm is silenced.
9 In the event of an alarm situation, one of the two warning indicator lights (yellow or red) lights up, accompanied by an audible alarm. The respective light color indicates the alarm level.
10 Power supply status light:
– green if device is mains operated,
– yellow if device is battery operated.



WARNING !

The alarm silence button is intended to provide a way of muting audible alarms while corrective action is taken. Failure to identify and correct alarm situations may result in patient injury.

Preparation

Positioning

- Place Vamos on a flat surface, e.g. on top of the anesthesia machine.
- Protect Vamos against falling.

WARNING !

Always consult operating instructions of the anesthesia machine with regard to placement of the monitor.
Observe all load limits and other restrictions.
Always protect Vamos monitor and its power adapter against falling in order to prevent personal injury and equipment damage.

Connecting the Power Supply

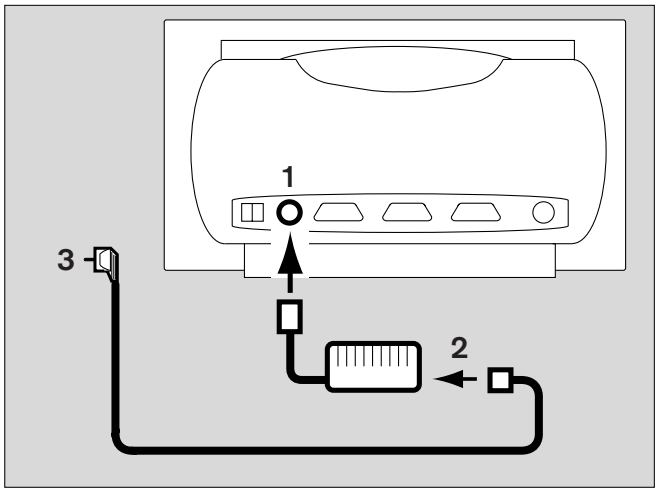
- Only use the original 100 to 240 V, 50/60 Hz desktop power adapter supplied with the monitor.
- Place the desktop power adapter e.g. next to Vamos and secure against falling.

1 Insert connecting plug of the power adapter into the »**15V** ⎓ « receptacle on the back panel of the monitor and turn to lock in place.

2 Plug the device connector into the power adapter.

3 Push power plug into shockproof socket.

- The power supply indicator light will now show green.



WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

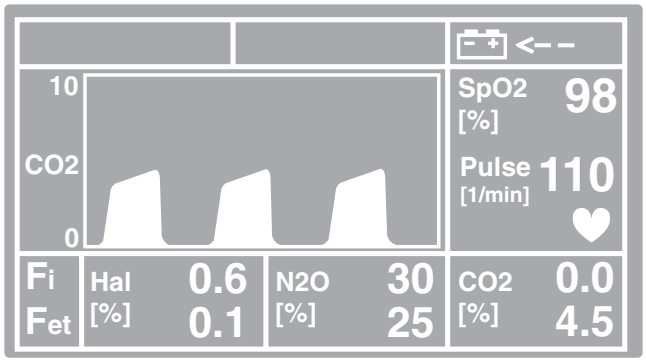
If there is a doubt about the grounding integrity or the condition of the power outlet:

- **Operate monitor only with internal battery (available option). Do not connect power plug.**

For operation with the internal battery (available option):

As soon as Vamos is connected to AC line power, it will start charging the internal battery. For this, the monitor does not need to be switched on.

If the battery is charged during operation of the Vamos monitor a battery symbol and arrow are shown in the field for the battery status to indicate the charging.



When the battery is completely discharged, the charging time to a full charge is typically 10 hours.

If the battery is completely charged the symbol disappears.

With a fully charged battery, Vamos can be used for 1.5 hours without AC power.

During operation with the internal battery (without AC power) the power supply indicator light shows yellow and the advisory message "Power fail!" appears.

A battery symbol together with the remaining capacity of the battery is shown in the field for the battery status.

 33 % (Example)

If the internal battery is completely discharged, the screen display will disappear and the power failure alarm will sound.

If the battery is discharged to a level below 10 % the following caution message appears:

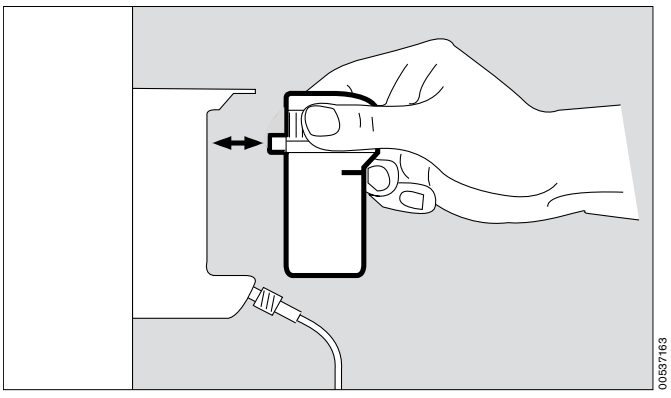
Batt. low !!

Installing the Water Trap

- Remove a new "WaterLock®" water trap from its packaging,
- Note installation date on the field marked for this purpose on the water trap,
- Grip water trap by the ridged surfaces and push it into its holder until you feel it click into place.

WARNING !

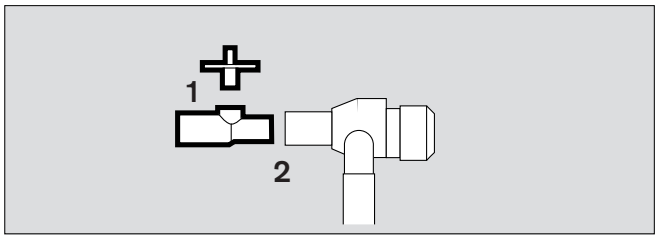
Do not use the monitor without a water trap in place, to avoid the risk of contaminating the monitor.



Connecting the Sample Line

1 Screw the filter into the T-piece.

2 Plug the T-piece into the patient connection of the Y-piece – with the filter on top to prevent it becoming clogged with liquid.



3 Screw the sample line firmly to the filter and water trap.

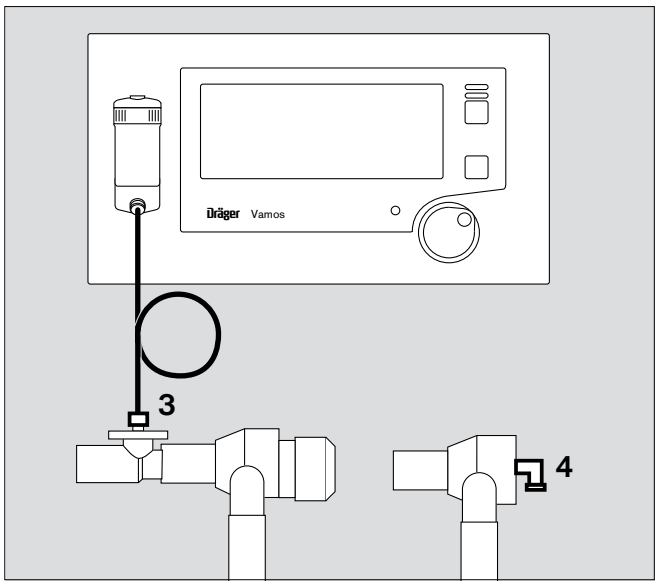
WARNING !

Leaks in the pneumatic system can lead to wrong gas measurement values.

WARNING !

Dräger cannot warrant or endorse the safe performance of third party gas sample lines for use with the Vamos monitor. We recommend using genuine Dräger OEM sample line. Other lines may alter the technical data of the monitor.

4 Instead of the separate T-piece and filter, a Y-piece with direct connection port for the sample line may also be used.

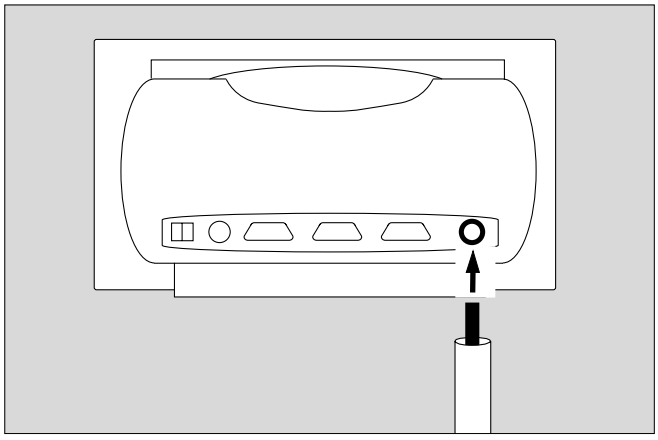


Sample Gas Scavenging

- Use hose 11 90 520, see Ordering Information on page 49.
- Connect the hose to the exhaust port » Ⓔ « on the back of the monitor.
  Push the other end of the exhaust hose into the anesthetic gas scavenging hose.
  Secure against disconnection.

  The hose of the anesthetic gas scavenging line should have an inner diameter measuring at least twice that of hose 11 90 520 (i.e., at least 0.55 inches, 14 mm).

NOTE: The sample gas taken from the Y-piece reduces the tidalvolume.



Connecting the SpO2 Sensor

Selecting the sensor

The reusable Durasensor DS-100A, 57 20 072 is included in the original delivery package – see Ordering Information, page 49.

Other optional sensors mentioned in the tables below are listed in the Ordering Information, page 49.

- Only use the SpO2 sensors described here. Strictly follow the Instructions for Use of the sensors. Incorrect positioning or incorrect use can cause tissue damage.
- Select the sensor according to the following criteria:

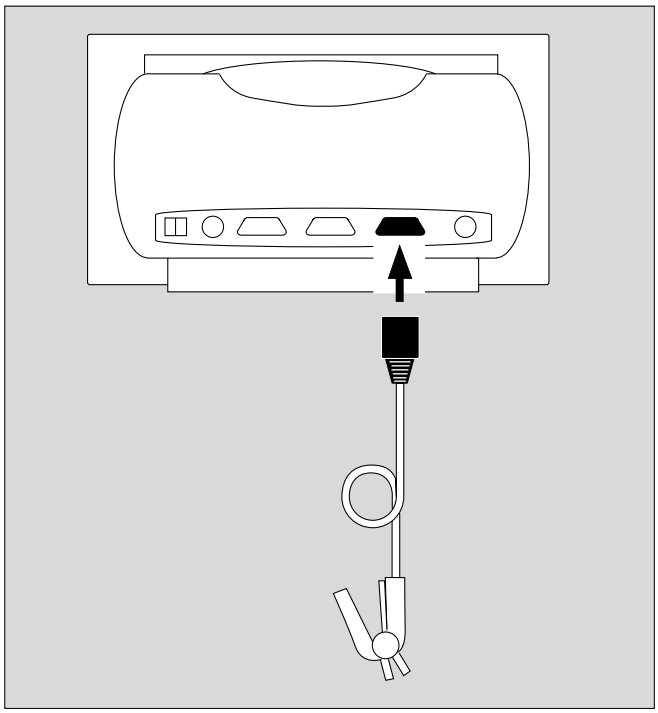
– Patient weight
– Agitation and movement of the patient
– Possible application position
– Perfusion of the patient
– Duration of use

The following table is intended to help in selecting the appropriate sensor. All available sensors with their specific characteristics are listed.

Sensor type	**OXISENSOR I-20**	**OXISENSOR D-20**	**DURASENSOR DS-100A**	**OXISENSOR D-25**
Age group	Infants	Children	Adults	Adults
Weight of patient	1 to 20 kg	10 to 50 kg	more than 40 kg	more than 30 kg
Duration of use	Short and long-term monitoring. Check application site at least every 8 hours.	Short and long-term monitoring. Check application site at least every 8 hours.	Short-term monitoring. Change application site at least every 4 hours.	Short and long-term monitoring. Check application site at least every 8 hours.
Patient activity	Limited activity	Limited activity	Inactive patients only	Limited activity
Preferred measuring point	Toe	Finger	Finger	Finger
Sterilization*	Sterile pack	Sterile pack	—	Sterile pack

* in unopened, undamaged packaging

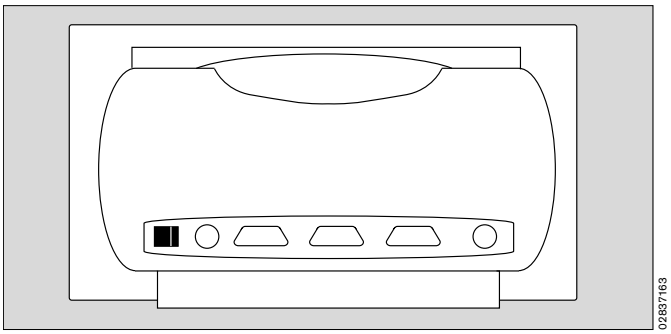
- Select sensor.
- Plug the connector of the selected sensor into the »**SpO2**« port on the back panel.



Operation in Measurement Mode

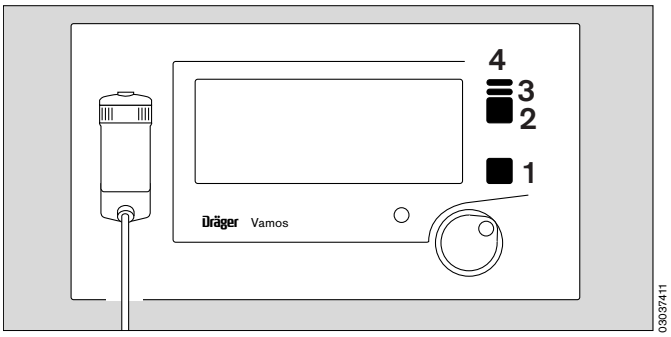
Switching On

- Switch monitor on by pressing the power switch into »⊙« position.



- This initiates start-up and test routines. Verify that:
  all LEDs light up,
  three tones sound,
  The LEDs in the keys and the alarm LEDs light up in the following sequence:

1 the yellow LED in the »⏻« key,
2 additionally the yellow LED in the »🔔« key,
3 additionally the yellow alarm LED
4 additionally the red alarm LED
  This sequence is repeated until the display first shows a pattern and lights completely afterwards, then the following text appears on the screen:
  Self Test
  please wait!



After the self-test, Vamos enters Standby mode.

The yellow LED in the »⏻« key lights up.

The following text appears on the screen:
Standby
Software X.XX
(with X.XX being replaced by the software revision number)

- To start Measuring mode, press »⏻« key. The yellow light will go out.

If Vamos is equipped with the battery option:

– if the battery is partially discharged the symbol »🔋<-- « appears in the field for the battery status to indicate that the battery is charged automatically.
– if the battery is completely charged the field for the battery status is empty.
– to test if the battery is functioning
- disconnect mains plug, »🔋 XX % « appears in the field for the battery status with XX being replaced by the remaining capacity of the battery, reconnect mains plug.

Measurement of SpO_2 and Pulse is immediately active.

During the warm up time of the gas sensor blanks (– –) are displayed instead of numbers. The CO_2 measurement values are available first.The measured values will reach the specified accuracy after a maximum time of approx. 4 minutes.

Vamos initially displays the selection menu for the volatile anesthetic agents and prompts the user to select the anesthetic agent used.

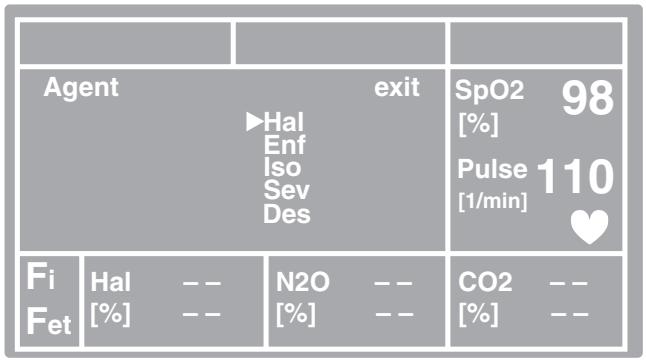
The previously selected anesthetic agent is marked with an arrow (example: ▶Hal).

- Turn dial knob to select the anesthetic agent you are using. Press dial knob to confirm.

If you wish to measure a previously selected anesthetic agent again:

- Simply press dial knob to confirm.

If Vamos has been switched off for less than 3 minutes it automatically switches to measurement mode after the start-up and test routines. In this case the »⏻« key does not have to be pressed. Vamos starts measurement with all parameters set as before it was switched off.



WARNING !

The Vamos monitor cannot automatically recognize the anesthetic agent used. The respective anesthetic agent must always be set manually.
Otherwise, incorrect measurements will result.

WARNING !

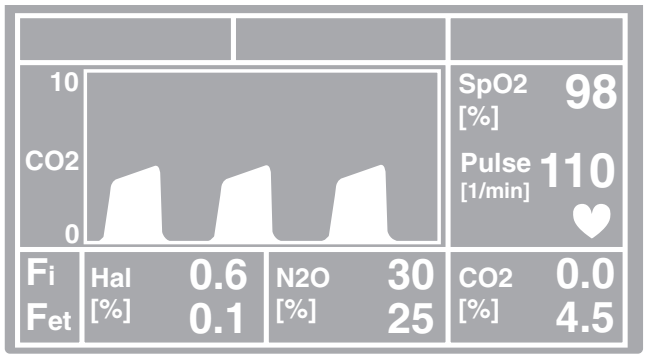
The Vamos monitor cannot recognize anesthetic gas mixtures. Consequently, measurements will be incorrect if more than one anesthetic agent are present of one time!

The CO_2 concentration is represented as a breath by breath real-time waveform.

Below this waveform, the following numeric values are displayed:

- Inspiratory concentration of the volatile anesthetic agent used,
- End-tidal concentration of the volatile anesthetic agent used,
- Inspiratory N_2O concentration FiN_2O,
- End-tidal N_2O concentration $FetN_2O$,
- Inspiratory CO_2 concentration $FiCO_2$,
- End-tidal CO_2 concentration $FetCO_2$.

To change to other units of measurement for CO_2 and a different scale for the real-time waveform, see “Selecting CO_2 Unit of Measurement/CO_2 Scale” on page 26.



To the right of the CO_2 real time waveform, the following numeric measurement values are displayed:

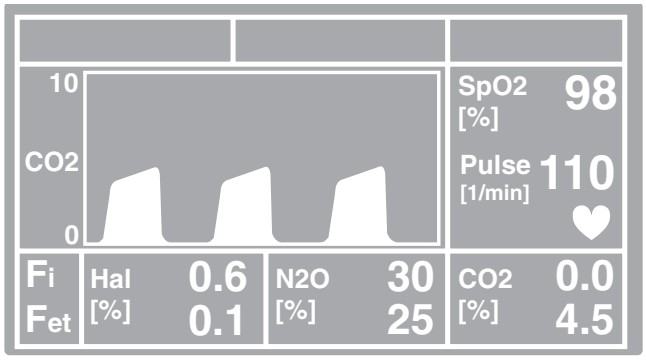
– Functional oxygen saturation SpO_2
– Pulse rate Pulse

Below the heart rate reading, the pulse display in the shape of a heart symbol appears in synchrony with the pulse tone. The display can vary between an "unshaded" and a "shaded" heart symbol. The extent of shading indicates the strength of the SpO_2 signal.

Strong SpO_2 signal:

Weak SpO_2 signal:

No SpO_2 signal, no pulse:



If the SpO_2 signal is weak:

- Check position of the SpO_2 sensor.

"Setting the Volume of the Pulse Tone/Alarm Tone" – see page 27,

"SpO_2 Measurement" – see page 21,

"Selecting Other SpO_2 Averaging Intervals" – see page 27.

SpO2 Measurement

Tips for avoiding artifacts

WARNING !

Only use specified SpO2 sensors, and position them as instructed – otherwise there is the possibility of incorrect measurements and tissue damage.

WARNING !

Damaged SpO2 sensors with bare electric wires or contacts must be removed from service immediately – danger of electric shock.

- Do not reuse adhesive strips – correct adhesion is no longer guaranteed.
- Do not fit the adhesive strip too tightly.
- Never use two adhesive strips – this can lead to pulsation. The pulse signal may fail.

High intrathoracic pressure, blood pressure tests, or other rhythmically occurring adverse effects on venous circulation can cause venous pulsation. The pulse signal may fail.

In the event of shock, low blood pressure, severe vasoconstriction, severe anemia, hypothermia, arterial blockage proximal to the sensor, or asystolia, the pulse signal may fail.

NOTE: Protect the sensor from exposure to bright light sources (e.g. surgical lamps and direct sunlight). Otherwise the pulse signal may fail, or measurements may be inaccurate.

NOTE: Do not position the sensor at extremities with arterial catheters, sphygmomanometer sleeve or intravascular venous infusion – otherwise the pulse signal may fail and measurements may be inaccurate.

Significant concentrations of dyshemoglobins, e.g. carboxyhaemoglobin or methemoglobin can lead to inaccurate measurements.

Intravascular dyes, such as methylene blue, can lead to inaccurate measurements.

Electrosurgery can affect measurement precision.

- Position the cables of the gas monitor and sensor as far as possible from the electrosurgery equipment and its neutral electrode.

The performance of the sensor can be impaired in the event of significant movement by the patient, leading to inaccurate measurement.

- In such cases, change sensor location in order to reduce movement artifacts.

WARNING !

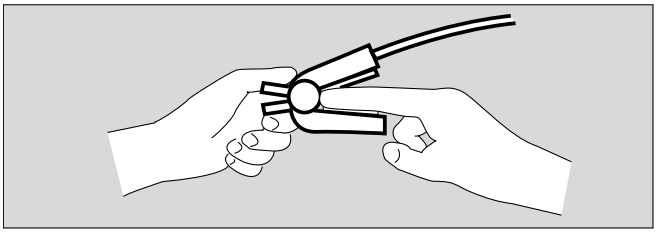
Do not use self-adhesive sensors if the patient has an allergic response to the adhesive strip used.

- Regularly check the blood circulation in locations distal from the sensor application site. Regularly check the correct positioning of the sensor, the condition of the skin and the correct position of the optical elements at the application site.
  Select a different measuring location if the patient's skin is affected.

Applying the Durasensor DS-100A

Reusable sensor supplied with the monitor and intended for short-term monitoring of relatively calm patients with a body weight of more than 40 kg (88 lbs).

Preferably place on the index finger or another finger. For large or obese patients, choose the little finger.

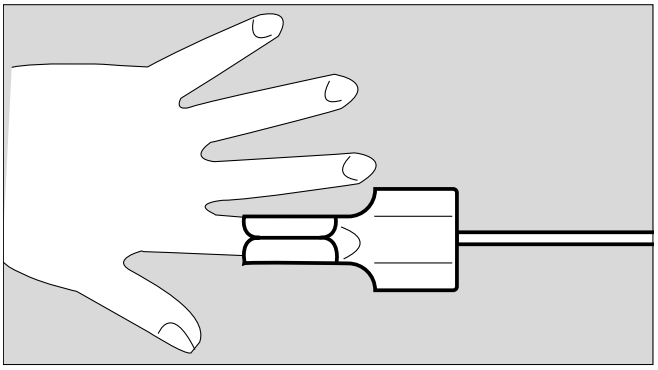


- Open the clip slightly and push it onto the finger. The end of the finger must touch the end stop, and the soft pads must rest on the nail and the fingertip. Route leads over the top of the fingers.
- Make sure that the clip does not pinch or cause pressure points.

Applying the Oxisensor D-25 and D-20 (Option)

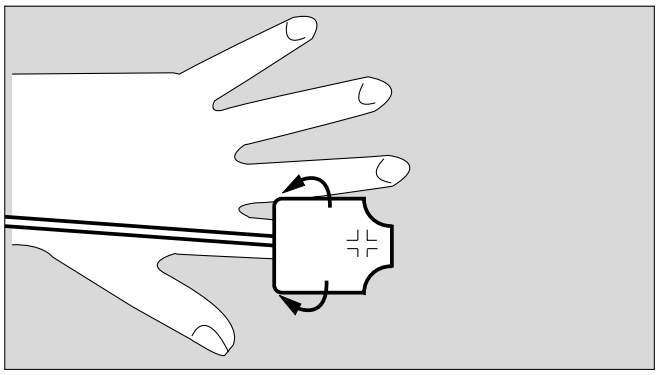
Self-adhesive sensors for short and long-term monitoring of patients with limited movement and activity and with a body weight ranging from 15 kg (33 lbs) to more than 50 kg (110 lbs).

NOTE: Long fingernails impede the application of this sensor. Nail varnish adversely affects measurement precision.



- Cut nails if necessary.
- Remove nail varnish where applicable.
- Remove the protective backing from the adhesive patch.
- Place the sensor with the sticky side up on a flat surface.
- Place the fingertip of the index finger centrally over the optical element on the opposite side of the sensor to the lead, and wrap the lateral adhesive tabs around the finger.
- Bend the other side of the sensor over the fingertip and position it on the underside of the finger so that the markings line up exactly.
  Press on the sensor, and wrap the lateral adhesive tabs around the finger.

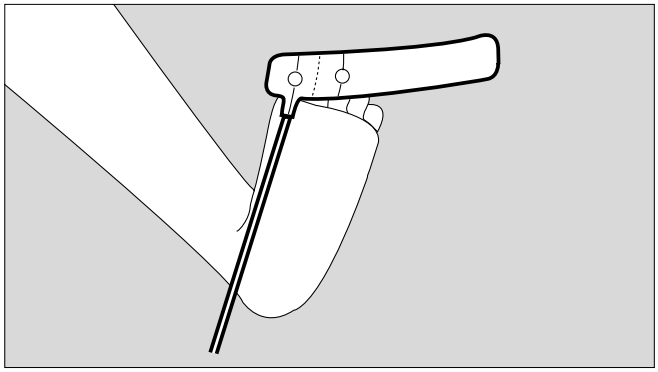
NOTE: With very obese patients, a thinner finger might be more suitable than the index finger.



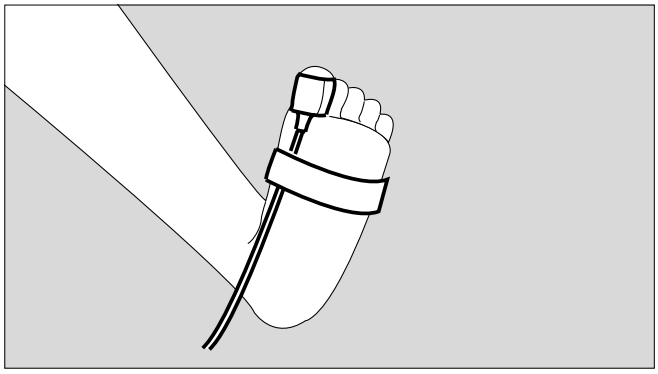
Applying the Oxisensor I-20 (Option)

Self-adhesive sensor for short and long-term monitoring of patients with limited movement and activity and a body weight ranging from 3 kg to 15 kg (6.6 to 33 lbs).

- Remove protective backing from the adhesive strip.
- Position sensor on the underside of the big toe, so that the dotted line is aligned along the inner edge of the toe, and the marking is over the middle of the toe.



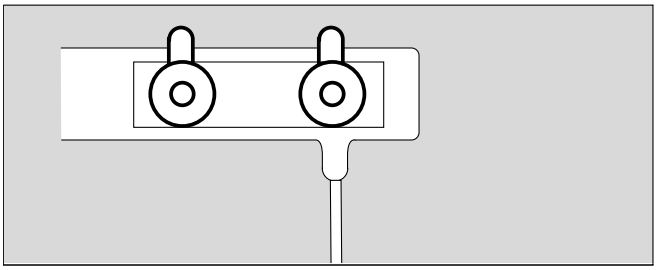
- Wrap sensor around the toe, so that the other marking point lies directly over the toenail.
- Fix sensor lead to the foot with the additional adhesive strip.



Reusing sensors

If the strip is still sufficiently adhesive, the sensor can be reused on the same patient. Small additional adhesive patches improve the adhesion.

- Hold adhesive patches by the blue tab and tear off the paper backing.
- Place a patch concentrically over the middle of each optical element.
- Remove the protective backing.

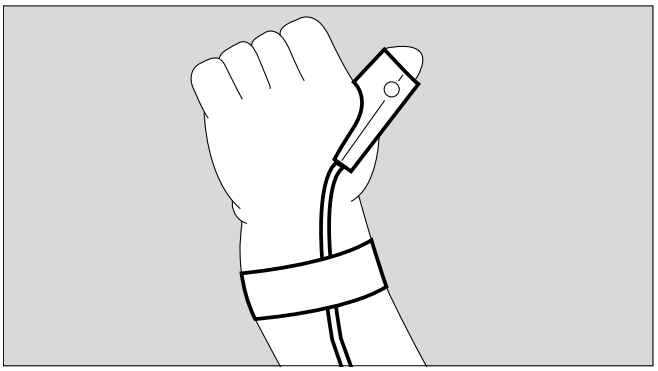


- Apply sensor as described above.

Other measuring point

The preferred application site is the big toe, because it moves less than the hand. If the big toe is not available, the thumb can also be used.

- Remove protective backing from the adhesive tab.
- Place sensor under the thumb, so that the dotted line overlaps the edge of the thumb, and the marking is centered over the surface of the thumb.
- Wrap the sensor around the thumb, so that the other marking comes to lie directly over the thumbnail.
- Affix sensor lead to the hand with the additional adhesive strip.



Setting Alarm Limits

When switching the monitor on, and after Standby mode, the default alarm limits listed below are active.

lo = Lower alarm limit

hi = Upper alarm limit

– – = Alarm limit deactivated

The adjustable alarm limits are listed in the right-hand column of the table:

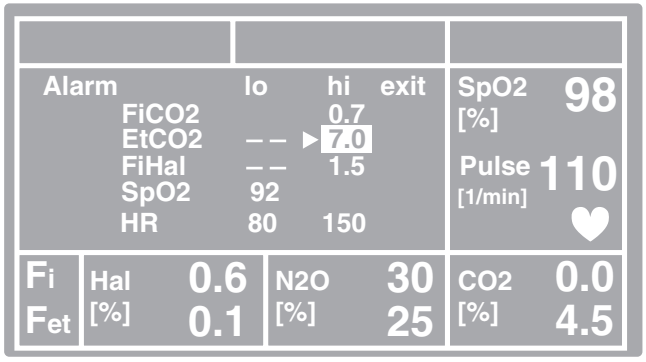
		Default value	Adjustment range
$FiCO_2$	hi	5 mmHg 0.7 Vol.%, 0.7 kPa	– –, 1 to 20 mmHg – –, 0.1 to 2.6 Vol.%, kPa
$FetCO_2$	hi	50 mmHg 6.6 Vol.%, 6.6 kPa	– –, 1 to 75 mmHg – –, 0.1 to 9.9 Vol.%, kPa
	lo	– –	– –, 0 to 74 mmHg – –, 0 to 9.8 Vol.%, kPa
FiHal	hi	1.5 Vol.%	0.1 to 7.0 Vol.%
FiEnf	hi	3.4 Vol.%	0.1 to 7.0 Vol.%
FiIso	hi	2.3 Vol.%	0.1 to 7.0 Vol.%
FiSev	hi	3.4 Vol.%	0.1 to 9.9 Vol.%
FiDes	hi	12.0 Vol.%	0.1 to 21.9 Vol.%
FiHal	lo	– –	– –, 0 to 6.9 Vol.%
FiEnf	lo	– –	– –, 0 to 6.9 Vol.%
FiIso	lo	– –	– –, 0 to 6.9 Vol.%
FiSev	lo	– –	– –, 0 to 9.8 Vol.%
FiDes	lo	– –	– –, 0 to 21.8 Vol.%
SpO_2	lo	92 %	– –, 50 to 99 %
Pulse	hi	150	– –, 31 to 300
	lo	50	– –, 30 to 299

After standby SpO_2 and Pulse alarm monitoring is disabled until at least 6 pulses with a minimum pulse rate of 30 1/min have been detected. The "SpO_2 Sensor?" and "SpO_2 INOP" alarms are always monitored.

After standby the gas concentration related alarms are disabled until the first complete breath has been detected.

To set alarm limits :

- Turn or press dial knob to select main menu.
- Turn dial knob to select the »**Alarm**« parameter.
- Press dial knob to open the parameter menu.
- Turn dial knob to select the alarm limit to be edited.
- Press dial knob to confirm selection.
  The selected alarm limit will be marked with an arrow.



- Turn dial knob to set the alarm limits.
- Press dial knob to confirm settings.
- Press dial knob to return to the main menu.
- Press dial knob again to return to the measurement display.

Selecting CO_2 Unit of Measurement/CO_2 Scale

On power-up, the monitor uses the following default values:

– CO_2 unit: as set during last power-on.
– 0 to 50 mmHg (0 to 6 Vol.%, kPa) for the CO_2 scale.

The following units can be selected as units of measurement for CO_2:

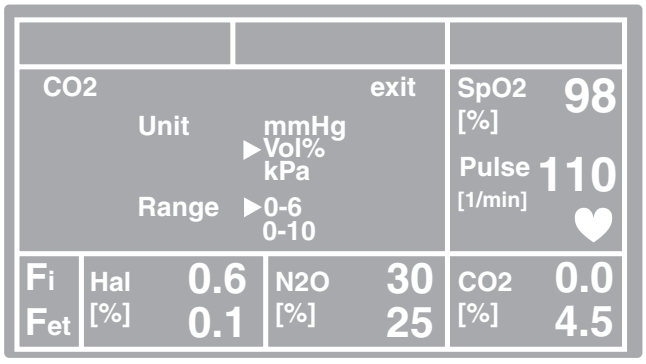
– mmHg
– Vol%
– kPa

The following ranges can be selected for the CO_2 measurement scale:

– 0 to 50 mmHg (0 to 6 Vol.%, kPa)
– 0 to 75 mmHg (0 to 10 Vol.%, kPa)

- Turn or press dial knob to select main menu.
- Turn dial knob to select »**CO_2**« parameter.
- Press dial knob to open the parameter menu.
- Turn dial knob to set units for CO_2, and, if necessary, also set the scale of the CO_2 waveform.
- Press dial knob to confirm the settings.
  The selected unit of measurement and the selected scale are marked with an arrow.
- Press dial knob to return to the main menu.
- Press dial knob again to return to the measurement display.

The set unit will be used until it is changed by the user again.



Selecting Other SpO2 Averaging Intervals

The user can choose between the following three averaging intervals:
normal, slow, fast.

Upon switching Vamos on, the default setting is "**normal**".

Depending on the degree of agitation of the patient, two other averaging intervals can alternatively be selected:

Long averaging interval: "slow"

The long averaging intervals are suitable for patients with increased movement activity.

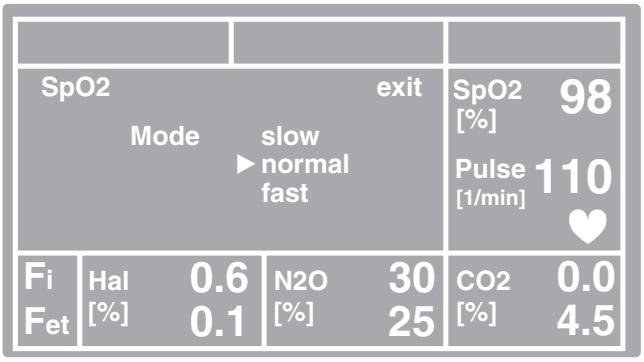
NOTE: With the "**slow**" averaging interval, no pulse rate is displayed (Pulse ––) and the pulse tone is muted.

Short averaging interval: "fast"

The short averaging intervals are suitable for situations in which the patient is calm.

To set:

- Turn or press dial knob to select main menu.
- In the main menu, turn dial knob to select »**SpO2**«.
  Press dial knob to confirm.
- Turn dial knob top select the desired averaging interval.
  Press dial knob to confirm.
  The selected averaging interval is marked with an arrow.
- Press dial knob to return to the main menu.
- Press dial knob again to return to the measurement display.



Setting the Volume of the Pulse Tone/Alarm Tone

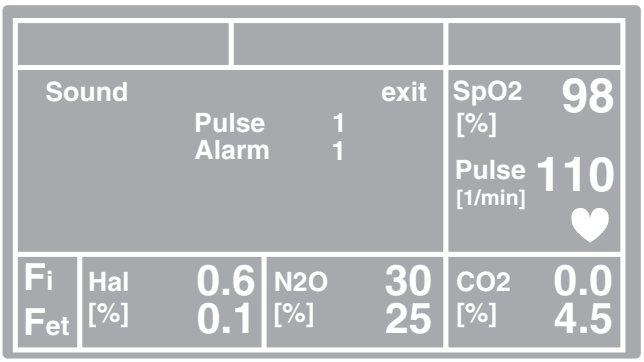
The volume for the pulse indicator is selectable from 0 to 9.

The volume for the alarm is selectable from 1 to 4.

Upon switching Vamos on, the default settings are "**2**" for Pulse and "**1**" for Alarm

- Turn or press dial knob to select main menu.
- Turn dial knob to select »**Sound**« in the main menu.
  Press dial knob to confirm.
- In the »**Sound**« menu, turn dial knob to select item »**Pulse**« or »**Alarm**«.
  Press to confirm item.
- Turn dial knob to set new value.
  Press dial knob to confirm.
- Press dial knob to return to the main menu.

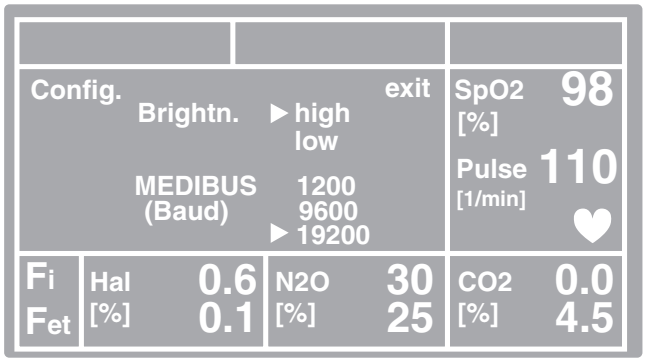
Press dial knob again to return to the measurement display.



Configure Display Brightness and MEDIBUS Baud Rate

The brightness of the display can be adjusted in two steps:
high, low

The following baud rates of the MEDIBUS RS 232 interface can be selected:
1200, 9600, 19200



To set:

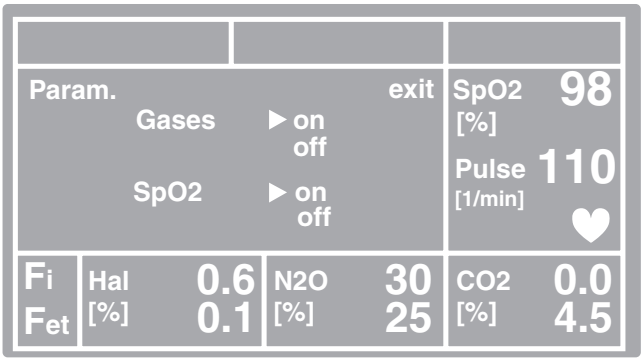
- Turn or press dial knob to select main menu.
- Turn dial knob to select »**Config.**« parameter.
- Press dial knob to open the configuration menu
- Turn dial knob to set display brightness
- Press dial knob to confirm the setting.
  The selected brightness is marked with an arrow.

- Turn dial knob to set baud rate.
- Press dial knob to confirm the setting.
  The selected baud rate is marked with an arrow.
- Press dial knob again to return to the measurement display.

The settings for brightness and baud rate will be used until they are changed by the user again.

Selecting parameters to measure

Monitoring and presentation of anesthetic agents, N_2O, CO_2 values and SpO_2, Pulse values can be switched on and off. The default for both settings on power-up is »**on**«.



To set:

- Turn or press dial knob to select main menu.
- Turn dial knob to select »**Param.**« parameter.
- Press dial knob to open the parameter menu.
- Turn dial knob to select setting for gas measurement parameters.
- Press dial knob to confirm setting.
  The setting is marked with an arrow.
- Turn dial knob to select setting for SpO_2 and Pulse measurement.
- Press dial knob to confirm setting.
  The setting is marked with an arrow.
- Press dial knob to return to the main menu.
- Press dial knob again to return to the measurement display.

If a parameter is switched off, the respective values are replaced by "**XX**". If the gases measurement is switched off, the field for the CO_2-curve shows "**XX**" in its center.

Calibration

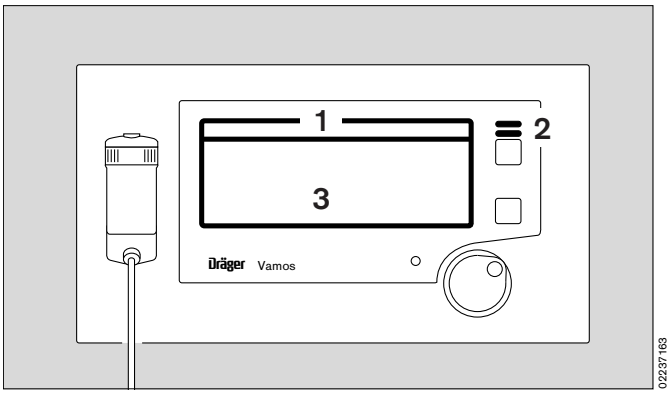
SpO_2 measurement does not need to be calibrated.
Gas measurement is calibrated every 2 hours by the monitor. During calibration, which lasts approximately 30 seconds, the reading »**CAL**« appears in place of the gas measurement values.

Gas measurement calibration may also be started manually from the main menu:

- Turn or press dial knob to select main menu.
- Turn dial knob to select »**Cal**« in the main menu.
- Press dial knob to confirm.

The device calibrates automatically; the next automatic calibration is carried out again after 2 hours.

In the Event of an Alarm



1 An alarm message is displayed in the top of the display. Its priority is indicated by the number of exclamation marks.
2 One of the two alarm lights (or both) will be flashing or remain continuously lit, accompanied by a specific audible alarm.
3 All measuring parameters where the alarm limits have been exceeded, will begin to flash.

Vamos can display a maximum of two alarm messages at the same time, side by side. The alarm message on the left is the one with the highest priority.

To display additional alarm messages:

- Remedy the cause of the alarm or change alarm limit. If another alarm message has been activated, this will be displayed now.

Alarm priorities

All alarms are weighted with a priority according to their importance. The priority levels are visually/acoustically distinct.

Warning messages are indicated by 3 exclamation marks (!!!) and have top priority. They indicate a condition requiring immediate action. The red (upper) alarm LED flashes, accompanied by a double sequence of 5 tones each, which is repeated approx. every 7 seconds.

Caution messages are indicated by 2 exclamation marks (!!). They indicate a condition requiring prompt action.
The yellow (lower) alarm indicator LED flashes, accompanied by a sequence of 3 tones, which is repeated approx. every 30 seconds.

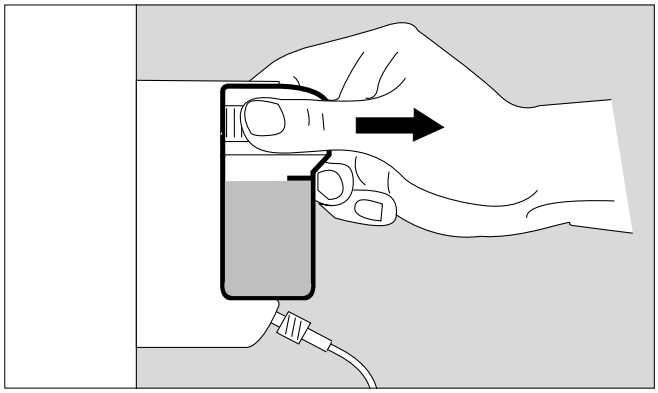
Advisory messages are indicated by 1 exclamation mark (!). They indicate a condition that requires operator awareness but not necessarily action. The yellow (lower) alarm LED lights up continuously, accompanied by a single sequence of 2 tones.

A list to help you remedy any faults is provided on page 39 "Troubleshooting".

Replacing/Emptying the WaterLock® Water Trap

– When the level has reached the full mark,
– or in the event of an **»Occlusion!«** error message on the monitor:

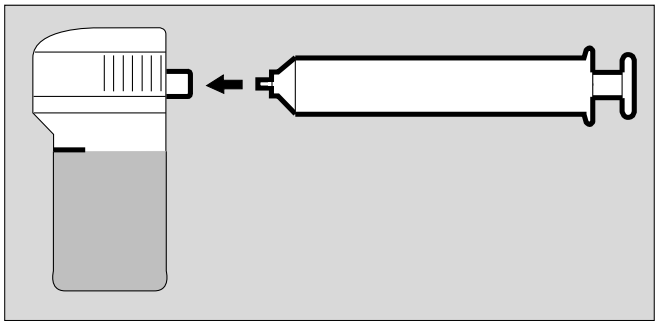
- Switch Vamos monitor to Standby mode.
- Grip water trap by the ridged surfaces and pull it out of its holder.



- Replace water trap:

– if it is severely fouled,
– if emptying the water trap does not remove the error message,
– if its maximum operating period of 4 weeks has been exceeded.

- Emptying the water trap:
  Connect an empty syringe, without needle, to the port. The syringe capacity must be at least 20 mL.
- Draw off the water. Remove syringe and discard the full syringe with domestic waste.
- Push water trap back into its holder – until it tangibly clicks into place.



CAUTION !
Do not allow any alcohol or detergent/disinfectant to enter the water trap!
It may be damaged.

CAUTION !
Do not wash or sterilize the water trap!
It can be damaged by washing/sterilizing!

Disposal

- Water traps can be disposed of as domestic waste (see also page 38).

Terminating Operation

- Remove the SpO_2 sensor from the patient.

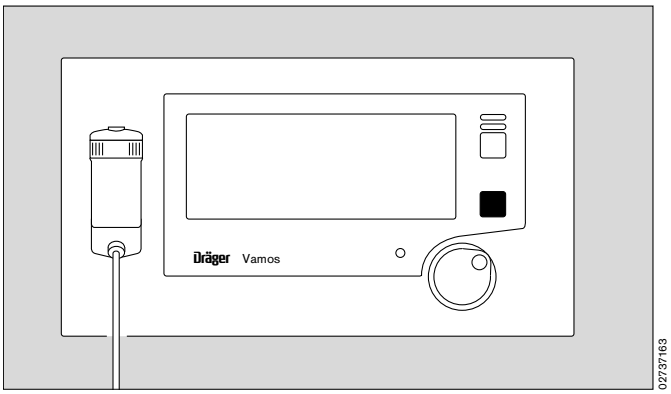
To keep the monitor ready for further use:

- Press Standby key »⏻« to switch monitor to Standby mode. The yellow LED in the key lights up.

The next time the monitor is operated, the following individually set will again be activated:

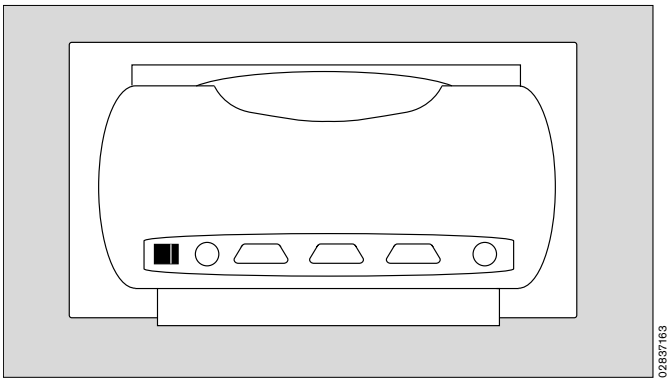
– CO_2 unit
– display brightness
– MEDIBUS baud rate
– language

For all other parameters the default values will be activated.



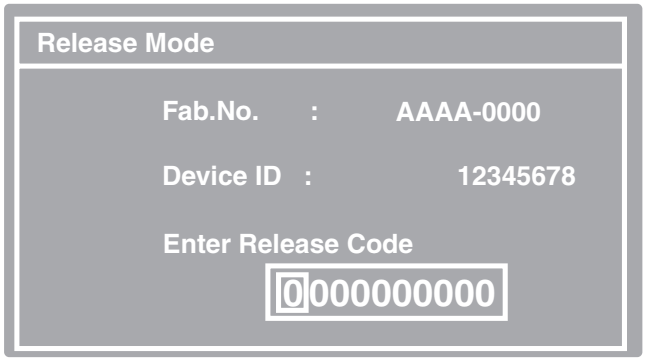
To shut down the monitor:

- Switch the ON/OFF switch in the back of the unit to »○« in order toswitch off the monitor.



Enabling Anesthetic Agent Measurement (Release Mode)

The Release Mode can be used to enter the release code to enable the anesthetic agent measurement option. If the Vamos is not equipped with this option initially, it can be updated separately.



To enter Release Mode:

- Adjust in the following sequence:
- Switch Vamos to Standby Mode with the »⏻« key,
- Keep pressed the »🔔« key,
- Keep pressed the »⏻« key,
- Release »🔔« key,
- Release »⏻« key.

The following information is shown:

- fabrication number of the device
- device identification number

This information has to be given for ordering the anesthetic agent measurement option.

After ordering a device specific 10 digit Release code will be sent by Dräger:

- Please, write down the Release code here:

To enter the Release Code:

- Turn dial knob to set first digit of Release code
- Press dial knob to confirm setting
- Repeat this procedure for all digits of the Release code.

After the last digit has been entered Vamos verifies the entered code. If the correct code has been entered the following message is shown:

Agent option released

- Switch Vamos off and on to enable the option.

If a wrong code has been entered, the following message is shown:

Wrong Code

- Press »🔔« key, enter Release Mode again and repeat the procedure.

RETURN TO THIS MANUAL'S TABLE OF CONTENTS
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Care

WARNING !

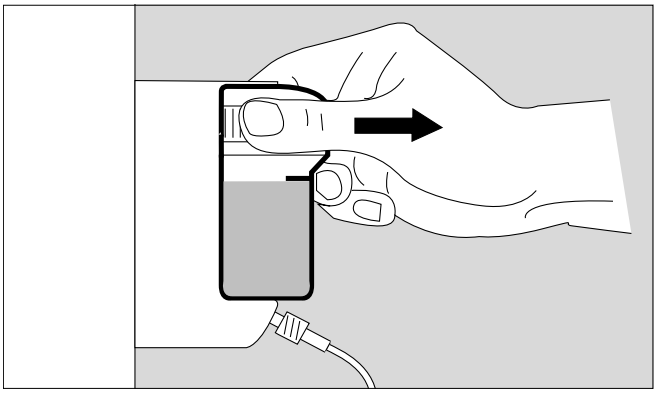
Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

Dismantling

- Disconnect the power plug of the desktop power adapter from the AC power outlet. Unlock cable connector in the back of the monitor and detach.
- Unscrew sample line from the water trap and T-piece or wye. Disconnect T-piece and filter from the wye.
  The sample line together with T-piece and filter are disposable parts and can be discarded together with domestic waste.
- Disconnect the hose of the sample gas scavenging line or sample gas recirculating line from the back of the unit and remove its other end from the anesthetic gas scavenging line or from the breathing system.

Replacing/Emptying the WaterLock® Water Trap

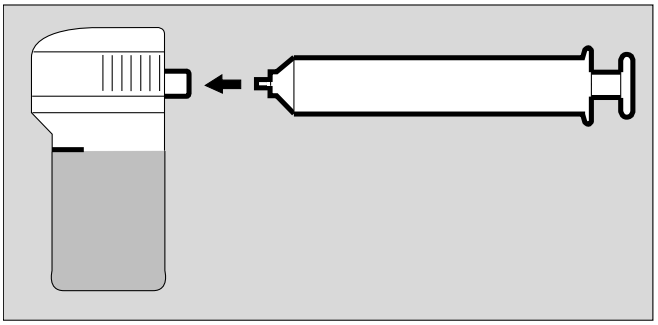
– When the level has reached the full mark,
– or in the event of an **»Occlusion!«** advisory message on the monitor:



- Grip water trap by the ridged surfaces and pull it out of its holder.

- Replace water trap:
– if it is severely fouled,
– if emptying the water trap does not remove the error message,
– if its maximum operating period of 4 weeks has been exceeded.

- Emptying the water trap:
  Connect an empty syringe, without needle, to the port. The syringe capacity must be at least 20 mL.
- Draw off the water. Remove syringe and discard the full syringe in accordance with local requirements.
- Push water trap back into its holder – until it tangibly clicks into place.



CAUTION !
Do not allow any alcohol or detergent/disinfectant to enter the water trap!
It may be damaged.

CAUTION !
Do not wash or sterilize the water trap!
It can be damaged by washing/sterilizing!

Disposal

- Water traps can be disposed of as domestic waste (see also page 38).

Disinfecting/Cleaning/Sterilizing

CAUTION !

Certain components of the monitor consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., alkylamines, phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized.

To prevent any damage, we recommend that only detergents and disinfectants are used that are compatible with the device, e.g. surface disinfectants on the basis of

– aldehydes,
– alcohol, or
– quarternary ammonium compounds.

Ensure that all disinfectants are registered with the U.S. Environmental Protection Agency for use as intended. Always follow the instruction labels specifically with respect to prescribed concentrations and the necessary exposure times.

Disinfectants often contain – besides their main active agents – additives that can also damage materials. If in doubt, ask the supplier/manufacturer of the disinfectant/cleaning agent.

WARNING !

Do not sterilize parts in ethylene oxide!
Patients may become exposed to EtO that may have diffused into components. Patient health risk!

WARNING !

Follow all accepted hospital procedures for disinfecting parts contaminated by body fluids (protective clothing, eyewear, etc.).

Desktop power adapter and Vamos

- Wipe off visible soiling with a damp, disposable cloth.
- Wipe-disinfect.

Sample gas scavenging hose

- Wipe off visible soiling with a damp disposable cloth.
- Steam-sterilize at 134 °C (273 °F).

Before reusing:

- Reassemble the unit – see page 13 and following.

Maintenance

CAUTION !
Maintenance

The device must be inspected and serviced at regular six month intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor.

For repairs and in any case of malfunction of the device, we recommend that you contact DrägerService.

WARNING !

To avoid any risk of infection, clean and disinfect the Vamos monitor before any maintenance according to established hospital procedures - this applies also when returning the Vamos monitor for repair.

WARNING !

Never operate the monitor if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to DrägerService or factory trained and authorized technical service personnel

WARNING !

When servicing the monitor, always use genuine Dräger replacement parts. Dräger cannot warrant or endorse the safe performance of third party replacement parts for use with the Vamos monitor

Maintenance Intervals

WaterLock® water trap	Replace if fouled or if the message **Occlusion !** is displayed (if the sample line is known to be open and correctly routed) or at the latest after 4 weeks, see page 31.
Inspection and maintenance	Every 6 months by factory trained and authorized technical service personnel
Internal battery	Have the battery replaced by DrägerService or factory trained and authorized technical service personnel if the unit cuts out after operating for only a short time after the battery had been fully recharged.

Disposal Procedures

WaterLock® water trap

The WaterLock water trap may be discarded together with regular domestic waste.

Internal batteries

WARNING !

Treatment of batteries:
Do not throw into fire! Risk of explosion.
Do not force open! Danger of bodily injury.
Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries.

Vamos contains built-in rechargeable batteries containing harmful substances. They must be removed and disposed of by DrägerService or factory trained and authorized technical service personnel.

Further information may be obtained from local environmental and public health authorities or from approved waste disposal companies.

Disposal of the gas monitor

— at the end of its useful life.

- Contact a licensed waste disposal company for appropriate disposal of Vamos.
  Follow all local, state, and federal regulations with respect to environmental protection when disposing of the monitor.

Troubleshooting

Vamos divides alarm messages into 3 priority, identified by exclamation marks:

Warning = !!! Top priority message
Caution = !! Medium priority message
Advisory = ! Low priority message

The table below is intended to help identifying possible causes of an alarm message and to assist with prompt corrective action.

Messages are listed in alphabetical order.

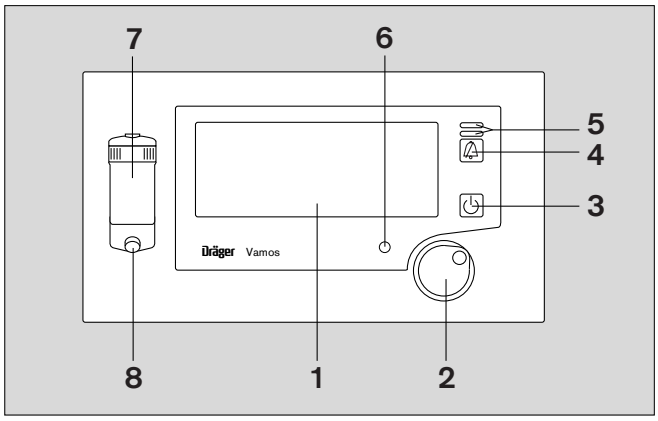
Fault		Cause	Remedy
Apnea	**!!!**	Breathing/ventilation stopped: No breath detected by CO_2 measurement for 30 seconds	Immediately ventilate the patient! Check that the breathing hoses are not disconnected
Batt. low Option	**!!**	Capacity of the optional internal battery is less than 10 % of full capacity	Connect device to mains power
Cal Error	**!**	Automatic gas calibration failure	Check that sample gas can flow freely from » Ⓔ « port. Route sample line without kinking.
CO_2 INOP	**!**	CO_2 measurement failure	Call DrägerService
Des INOP	**!**	Anesthetic gas measurement failure	Call DrägerService
Enf INOP	**!**	Anesthetic gas measurement failure	Call DrägerService
Fan	**!**	The internal exhaust fan is not operating correctly.	Call DrägerService
FetCO_2 hi	**!!**	FetCO_2 measured value high than max. alarm limit	Check ventilation
FetCO_2 lo	**!!**	FetCO_2 measured value lower than min. alarm limit	Check ventilation Check that the sample line (Luer Lock) is firmly connected
FiCO_2 hi	**!!**	FiCO_2 measured value higher than max. alarm limit	Replace the soda lime in the patient system. Check that both inspiratory and expiratory valves (valve diaphragms) are functioning correctly
FiDes lo	**!!**	The inspiratory measured value of the set anesthetic gas is lower than the min. alarm limit	Check vaporizer setting Check that the sample line (Luer Lock) is firmly seated
FiDes hi	**!!!**	The inspiratory measured value of the set anesthetic gas is higher than the max. alarm limit	Check vaporizer setting
FiEnf lo	**!!**	The inspiratory measured value of the set anesthetic gas is lower than the min. alarm limit	Check vaporizer setting Check that the sample line (Luer Lock) is firmly connected
FiEnf hi	**!!!**	The inspiratory measured value of the set anesthetic gas is higher than the max. alarm limit	Check vaporizer setting

Fault		Cause	Remedy
FiHal lo	!!	The inspiratory measured value of the set anesthetic gas is lower than the min. alarm limit	Check vaporizer setting Check that the sample line (Luer Lock) is firmly connected
FiHal hi	!!!	The inspiratory measured value of the set anesthetic gas is higher than the max. alarm limit	Check vaporizer setting
FiIso lo	!!	The inspiratory measured value of the set anesthetic gas is lower than the min. alarm limit	Check vaporizer setting Check that the sample line (Luer Lock) is firmly seated
FiIso hi	!!!	The inspiratory measured value of the set anesthetic gas is higher than the max. alarm limit	Check vaporizer setting
FiSev lo	!!	The inspiratory measured value of the set anesthetic gas is lower than the min. alarm limit	Check vaporizer setting Check that the sample line (Luer Lock) is firmly seated
FiSev hi	!!!	The inspiratory measured value of the set anesthetic gas is higher than the max. alarm limit	Check vaporizer setting
Gas INOP	!	Gas measurement failure	Call DrägerService
Hal INOP	!	Anesthetic gas measurement failure	Call DrägerService
Iso INOP	!	Anesthetic gas measurement failure	Call DrägerService
N_2O INOP	!	N_2O measurement failure	Call DrägerService
Occlusion	!	Sample gas supply line or scavenging line blocked	Water trap: check level and replace if necessary. Sample line: check and replace if necessary. Check scavenging line and replace if necessary.
Power fail	!	Power supply failure	Check power supply
Pulse lo	!!!	The pulse rate is below the set minimum alarm limit	Check condition of patient
Pulse hi	!!	The pulse rate is higher than the set maximum alarm limit	Check condition of patient
Pulse ?	!!!	No pulse signal detected for 10 seconds	Check condition of patient Check SpO_2 sensor
Sensor INOP	!!!	Internal device failure	Call DrägerService
Sev INOP	!	Anesthetic gas measurement failure	Call DrägerService
SpO_2 lo	!!!	Functional oxygen saturation below the set minimum alarm limit.	Check ventilation Check O_2 concentration in breathing system and in fresh gas
SpO_2 INOP	!	SpO_2 measurement failure	Call DrägerService
SpO_2 Sensor ?	!	No SpO_2 sensor connected	Connect suitable SpO_2 sensor.

What's What

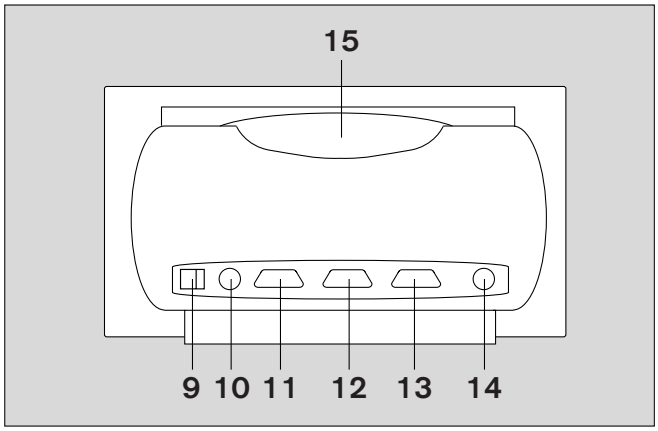
Front View

1 Screen
2 Central control knob for selecting and confirming
3 Standby key »⏻«
4 » 🔔 « key for silencing audible alarms for 2 minutes
5 Indicator lights for alarm
6 Power supply indicator light
7 WaterLock® water trap
8 Connection port for sample line



Rear View

9 ON/OFF switch
10 »15V ⎓« connection for desktop power adapter
11 Connection for RS232 interface – MEDIBUS
12 Connection for RS232 interface
(For maintenance purposes only)
13 »SpO2« connection for SpO2 sensor
14 » Ⓔ « port for sample gas scavenging
15 Carrying handle



Labels

Main WARNING/CAUTION label
left side

CAUTION !
RISC OF ELECTRIC SHOCK, DO NOT REMOVE COVER. REFER SERVICING TO A DRAEGER MEDICAL INC. QUALIFIED TECHNICAL SERVICE REPRESENTATIVE.

ATTENTION !
RISQUE DE CHOC ELECTRIQUE, NE PAS ENLEVER LE COUVERCLE. NE FAIREREPARER QUE PAR UN REPRESENTANT TECHNIQUE AUTORISE DE DRAEGER MEDICAL INC.

CAUTION (USA ONLY) !
FEDERAL LAW RESTRICTS THIS DEVICE TO SALE BY, OR ON THE ORDER OF A PHYSICIAN.

Main WARNING/CAUTION label
right side

DANGER !
POSSIBLE EXPLOSIVE HAZARD IF USED IN THE PRESENCE OF FLAMMABLE ANAESTHETIC

DANGER !
RISQUE D'EXPLOSION EN CAS D'UTILISATION EN PRÉSENCE D'ANESTHESIONES INFLAMMABLES

⚠ **CAUTION !**
DO NOT BLOCK AIR INTAKES

⚠ **ATTENTION !**
NE PAS OBSTRUER LES ENTRÉES D'AIR

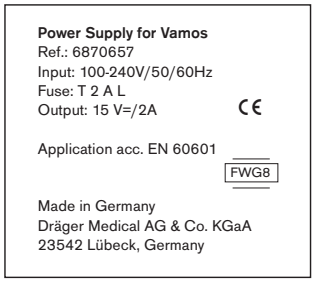
⚠ BEFORE USE, CONSULT OPERATOR'S INSTRUCTION MANUAL.
⚠ AVANT DE L'UTILISIER CONFERER AVEC LE MANUAL D'OPERATION.

Device identification label top

REF 6870750
SN ARPN-002
Opt.:A-GAS/SpO2/-
Rated Voltage 15 VDC
Rated Power 2 A
CE 0123
(Barcode)

Made in Germany
Dräger Medical AG & Co. KGaA
23542 Lübeck, Germany

Power supply label



Accuracy label front

Accuracy (Per ASTM F 1452 & ASTM F 1456):

Agent:	±(0.15 Vol.% + 15 % rel.)
N_2O:	±(2 Vol.% + 8% rel.)
CO_2:	±4 mmHg, ±0.5 Vol.% / kPa or ±12 % rel. which ever is greater

Technical Data

Environmental Conditions

In operation:	
Temperature	10 to 40 °C (50 to 104 °F)
Atmospheric pressure	570 to 1100 hPa
Rel. humidity	5 to 90 %
In storage:	
Temperature	–20 to 70 °C (–4 to 158 °F)
Atmospheric pressure	115 to 1100 hPa
Rel. humidity	5 to 95 %

Performance Characteristics

CO_2 measurement

Sidestream sample flow rate	150 mL/min ±20 mL/min
Measuring range	0 to 10.0 Vol.% / kPa, 0 to 75 mmHg
Precision	±0.5 Vol.% / kPa or ±12 % rel., which ever is greater
	±4 mmHg or ±12 % rel., which ever is greater
Resolution	1 mmHg / 0.1 Vol.% / 0.1 kPa
Response time $t_{10...90}$	<350 ms
Delay time	<4 sec (with original sample line)
Warm-up phase	4 min
Drift	
Zero point	within the required specifications

NOTE: CO_2 accuracy is maintained up to a respiratory rate of 40 BPM with an I/E ratio of 1:1 and up to a respiratory rate of 75 BPM with an I/E ratio of 1:2

Anesthetic gas measurement

Sidestream sample flow rate	150 mL/min ±20 mL/min
Response time $t_{10...90}$	<500 ms
Display range for N_2O	0 to 99 Vol.%
Precision	±(2 Vol.% + 8 % rel.)
Resolution	1 Vol.%
Display range for Halothane	0 to 8.5 Vol.%
Precision	±(0.15 Vol.% + 15 % rel.)
Resolution	0.1 Vol.%
Display range for Isoflurane	0 to 8.5 Vol.%
Precision	±(0.15 Vol.% + 15 % rel.)
Resolution	0.1 Vol.%

Display range for Enflurane	0 to 10 Vol.%
Precision	±(0.15 Vol.% + 15 % rel.)
Resolution	0.1 Vol.%
Display range for Sevoflurane	0 to 10.0 Vol.%
Precision	±(0.15 Vol.% + 15 % rel.)
Resolution	0.1 Vol.%
Display range for Desflurane	0 to 22 Vol.%
Precision	±(0.15 Vol.% + 15 % rel.)
Resolution	0.1 Vol.%
Warm-up phase	4 min
Drift	
Zero point	within the required specifications

Measurement of functional oxygen saturation SpO_2

Oxygen saturation SpO_2	1 to 100 % SpO_2
Resolution	1 % SpO_2
Precision (adults)	
in the range 70 to 100 % SpO_2	Min. ±3,5 % SpO_2
in the range 1 to 69 % SpO_2	not specified
Precision (neonates)	
in the range 70 to 100 % SpO_2	Min. ±4,5 % SpO_2
in the range 1 to 69 % SpO_2	not specified
Pulse rate	20 to 250/min
Resolution	1/min
Precision	±3/min
Trigger point	<1 s
Averaging	
Slow	10 to 15 seconds
Normal	5 to 7 seconds
Fast	2 to 3 seconds
Sensors	
Type	Compatible with the following Nellcor sensors: Oxisensor, Oxiband and Durasensor
Wavelengths	660 nm (red), 920 nm (infrared)
Light energy	<10 mW
Acoustic pulse signal	A tone is generated for each pulse beat.

Operating Characteristics

AC line power supply	100 to 240 V, 50/60 Hz 15 V DC output
Sound emission corresponding to free field measurement over a reflective plane	max. 45 dB (A)

Duration of power fail alarm	>20 sec
Power input	<25 W during warm-up <15 W in operation
Dimensions (W x H x D) (with water trap)	240 x 166 x 165 mm (9.4 x 6.5 x 6.5 inches)
Weight	
without internal battery	1.9 kg (4.2 lbs)
with internal battery	2.4 kg (5.3 lbs)

Interfaces

RS 232 C

Connector	9-pin, sub-D, electrical isolation 1.5 kV
Pin assiqnment	1 shield 2 T x D 3 R x D 5 GND

MEDIBUS RS 232 C

Connector	9-pin, sub-D, electrical isolation 1.5 kV
Pin assiqnment	1 shield 2 T x D 3 R x D 5 GND

MEDIBUS Settings

Databits	8
Stopbit	1
Parity	even
Handshake	none

Classifications

Enclosure protection class	Class I
with SpO_2 option	Type BF
Electromagnetic compatibility (EMC)	Tested to EN 60601-1-2
EC Classification conforming to Directive 93/42/EEC Appendix IX	Class II a
UMDNS Code Universal Medical Device Nomenclature System	17- 445

Theory of Operation

Measuring CO_2 and Volatile Anesthetics

CO_2 and volatile anesthetics absorb light in the infared spectrum. By means of a sample pump, a small quantity of the breathing gas is drawn through a measuring vessel, which is penetrated by infrared light. With the aid of various filters, frequency bands are chosen in which only one of the gases to be tested absorbs light. The optical characteristics of the sensor guarantees a quasi-continuous measurement of all gases. Light absorption thus serves as a measurement of gas concentration in the vessel. By simultaneously measuring temperature and absolute pressure in the vessel, the anesthetic gas concentration of the breathing gas can be calculated.

Cross sensitivity of gas measurement:

Vapors of organic substances in the ambient air, sample gas hose or T-piece, (such as are present in detergents or disinfectants), can distort the measurement of the concentration of volatile anesthetics.

Measuring SpO_2

Oxygenated, arterial blood (HbO_2) shows different light absorption properties to when compared to unsaturated, venous blood (with reduced hemoglobin Hb).

The SpO_2 sensor consists of two light-emitting diodes, which alternately send out infrared light at wavelenghts of 920 nm and 660 nm. A photo detector facing the light source measures radiation intensity. The sensor is placed on a part of the body, where light can penetrate arterial blood vessels, e.g. in a finger, toe, accross the bridge of the nose.

The two particular wavelengths were selected, because they allow to have usable absorption values even with less perfusion for both oxygenated and reduced blood. At the same time the absorption characteristics at those wavelenghts differ significantly for the two types of hemoglobin.

Total absorption of the light alternately emitted by the diodes is determined by the pulsating arterial blood, the skin, fingernails, muscle tissue, bones, and venous blood. As opposed to the pulsating arterial blood, however, the proportion of absorption of the other components is constant during a defined unit of time both with regard to quantity and optical density.

The arterial blood, which pulsates with every heartbeat, causes a change of volume in the tissue penetrated in synchrony with pulse and consequently a change in the absorption of the light sent through it, again in synchrony with pulse.

Light absorption is determined first when no pulsating blood is present (diastole). This measurement indicates the amount of light absorbed by the tissue and by the non-pulsating blood.

Normally the amount absorbed does not change during the pulse phase. It represents the reference for the pulsating part of the absorption.

Absorption is then measured after the next heartbeat, when the pulsating blood enters the tissue. In this measurement the light absorption of both wavelengths changes due to the pulsating arterial blood. Whereas at 660 nm absorption and also the amplitude of the pulse decreases with increasing oxygen saturation, at 920 nm it increases. Since the absorption coefficients of HbO_2 and Hb are known for both wavelengths, the device calculates the amount of both types of hemoglobin. The quotient of oxygenated hemoglobin (HbO_2) and the sum total from oxygenated and reduced hemoglobin is termed functional saturation and refers to the hemoglobin capable of transporting oxygen. Higher concentrations of dyshemoglobin, HbCO and MetHb, that can normally be ignored at low levels, can however influence measurement accuracy.

Accuracy Limitations

Due to the response time of the sensor and the gas sample flow rate, the stated accuracy of CO_2, N_2O and volatile anesthetics is limited by respiratory rate and inspiratory to expiratory (I/E) ratio settings.
For CO_2 measurement, the stated accuracy of the Vamos is maintained to a respiratory rate of 40 BPM with an I/E ratio of 1:1 and to a respiratoy rate of 75 BMP with an I/E ratio of 1:2.
For N_2O and volatile anesthetic gas measurement, the stated accuracy of the Vamos is maintained to a respiratory rate of 75 BPM with an I/E ratio of 1:1 or 1:2.

The effects of respiratory rate and I/E ratio settings on accuracy were determined in a simulated breathing system using square gas concentration waveforms.

Abbreviations and Symbols

Agent	Volatile anesthetic agent
CAL	Calibration in progress
Cal	Start calibration
CE 0123	Conformité Européenne Directive 93/42/EEC on medical devices
Des	Desflurane
Enf	Enflurane
exit	Return-to-menu
fast	Short SpO_2 averaging interval
Fet	End-expiratory concentration
Fi	Inspiratory concentration
Hal	Halothane
hi	Upper (max.) alarm limit
Iso	Isoflurane
lo	Lower (min.) alarm limit
normal	Normal SpO_2 averaging interval
Pulse	Heart rate, pulse frequency
Sev	Sevoflurane
slow	Long SpO_2 averaging interval
SpO_2	Functional oxygen saturation


Standby key


Key for silencing audible alarms for 2 minutes


Exhaust: outlet for sample gas scavenging


Pulse symbol, appearing together with the pulse tone


Direct voltage (DC)


Protection Class Type BF

Ordering Information

Name/Description	Order No.
WaterLock® water trap (12 piece set)	6870567
Sample gas line (set of10)	8290286
T-piece	8600224
Bacteria filter	8600225
Sample gas scavenging hose	1190520
SpO_2 sensors	
Dura Sensor DS 100 A	5720072
Adhesive sensor D-25 (24 piece set)	8201002
Adhesive sensor D-20 (24 piece set)	8201003
Adhesive sensor I-20 (24 piece set)	8201004
Adhesive sensor N-25 (24 piece set)	8201005
Sensor extension cable (1.3 m)	5720071
Technical documents on request	

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These Instructions for Use apply only to
Vamos
with Serial No.:

If no Serial No. has been filled in by Dräger these Instructions for Use are provided for general information only and are not intended for use with any specific machine or device.

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