PM 8050

Airway Monitor

Instructions for Use
Software version 2.05
or higher

MT-9-99 / MT-231-99

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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

Measuring and monitoring unit for anaesthesia

For measuring the ventilation parameters of pressure, flow and O_2 concentration.

For measuring, by continuous sampling in a sidestream, the CO_2 partial pressure, and the concentration of N_2O and anaesthetic agents. Adjustable sampling flow.

Measuring, by continuous sampling in a sidestream, of the inspiratory and expiratory O_2 concentration.

Optional:
Continuous, non-invasive measuring of functional O_2 saturation.

Measuring of the temperature of inspiratory breathing gas.

Displayed:

Continuous airway pressure curve Paw (t), peak pressure (Peak), plateau pressure (Plat.), positive endexpiratory pressure (PEEP), mean pressure (Pmean), compliance

Expiratory minute volume (MV), tidal volume (VT), breathing frequency (f)

Expiratory flow waveform

Volumeter function

Inspiratory and expiratory N_2O concentrations and anaesthetic agent concentrations

Inspiratory and endexpiratory CO_2 concentrations ($inCO_2$, $etCO_2$)

Continuous CO_2 waveform

Inspiratory/expiratory O_2 concentration

Optional:
Functional O_2 saturation (SpO_2), pulse rate, plethysmogram

Temperature of inspiratory breathing gas

Monitored:

Airway pressure (Paw)

Expiratory minute volume (MV)

Inspiratory O_2 concentration (FiO_2)

Inspiratory and expiratory CO_2 concentration – with fixed upper alarm limit (5 mmHg) for inspiratory CO_2 concentration

Inspiratory anaesthetic agent concentration

Adjusted alarm limits for manual ventilation and spontaneous breathing

Optional:
Functional O_2 saturation (SpO_2) and pulse

Temperature of inspiratory breathing gas with fixed upper alarm limit of 40 °C

With automatic activation from standby mode (Auto Wake up) following a mandatory ventilation stroke.

With automatic compliance correction of the measured values V_T, AMV and patient compliance, all of which are dependent on the equipment compliance.

- Note the Instructions for Use of the anaesthetic machine!

The airway monitor cannot differentiate between different anaesthetic agents.
Dräger cannot accept any liability for incorrect selection of anaesthetic agent!

- **The airway monitor must not be used in combination with flammable gases or flammable anaesthetic agents – fire hazard!**

- **Mobile telephones must not be used within 10 metres of the airway monitor!**

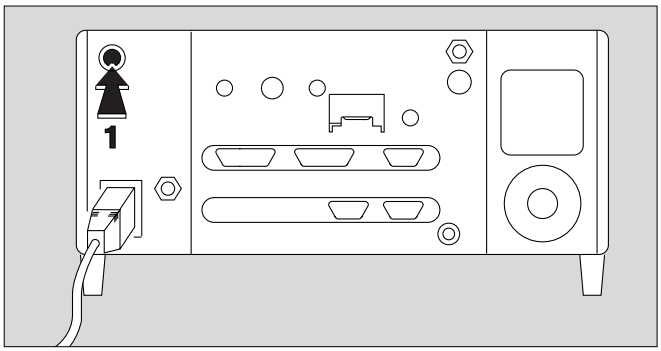
  Mobile telephones may impair the functioning of electromedical equipment and consequently endanger the patient!

- **The airway monitor must not be used while scanning (MRT, NMR, NMI)!** Correct functioning of the equipment may be impaired and the patient endangered!

How to Operate PM 8050

Switching on

1 Use mains switch at the back.

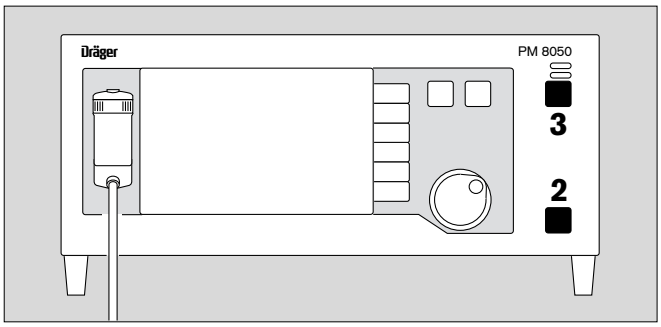


Keys with fixed functions (hard keys)

On the right-hand side of the control area with the operator elements.

2 Standby key ⏻ to change from standby to measuring mode and vice versa.

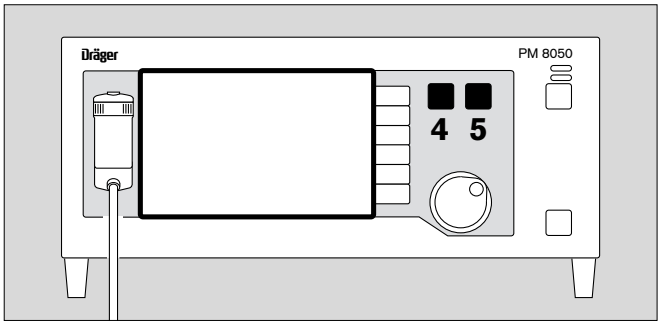
3 🔕 key to deactivate the alarm sound for 2 minutes and to reactivate it.



In the dark-coloured area there are two keys which control what appears on the screen.

4 🗐 key to call up the "basic pages": **defaults page, data page, trend page**

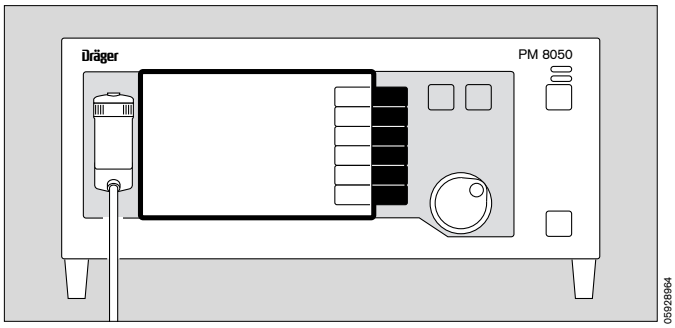
5 🗐 key to call up the **defaults page.**



Screen keys with variable functions
(soft keys)

The soft keys for fast access to certain menu functions are on the right edge of the screen.

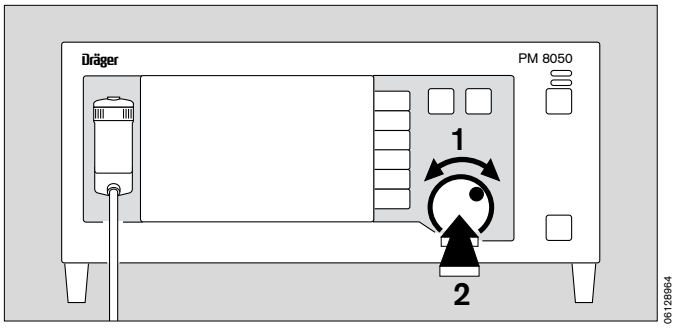
When a soft key is pressed its name is displayed dark on a light background.



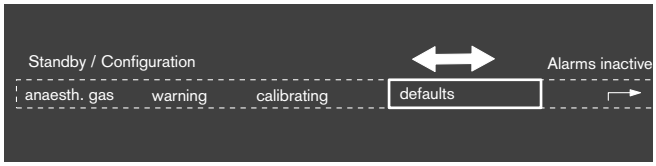
Rotary knob

Selecting/setting with a single knob.

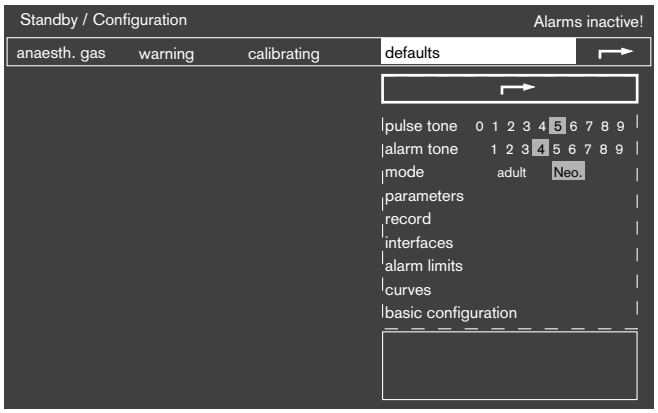
1 Rotate knob = select.
The cursor moves along the dotted area.



Example: **defaults**

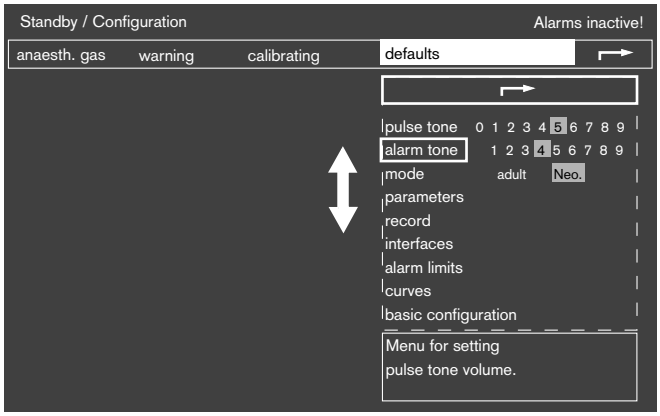


2 Press knob = confirm selection.
The value is confirmed and displayed dark on a light background.
The cursor jumps to the ⮡ symbol for the sub-menu.

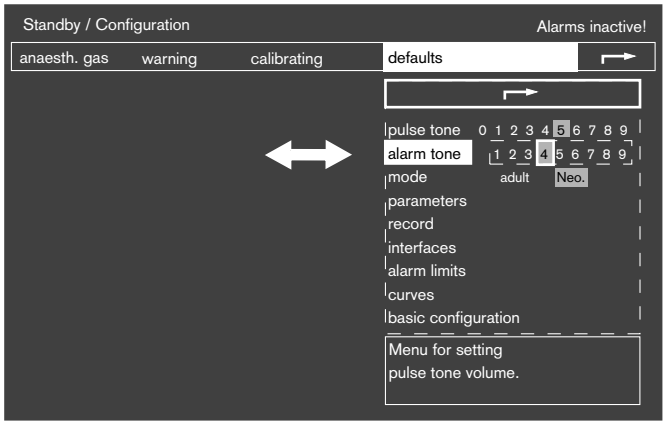


- Rotate knob = select **alarm sound.**
  The cursor moves in the dotted area.

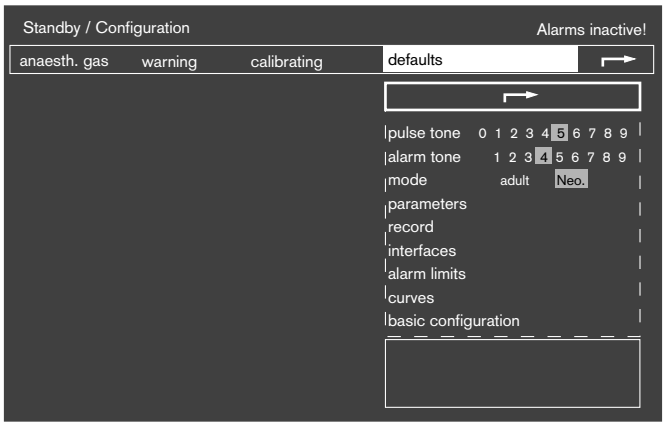
  Example: »alarm sound 4« (= medium volume)
- Press knob = alarm sound selected, displayed dark on a light background. The previous setting (example 4) is selected. Test sound commences.



- Rotate knob = change setting.



- Press knob = confirm setting,
  cursor jumps to ↦ symbol.

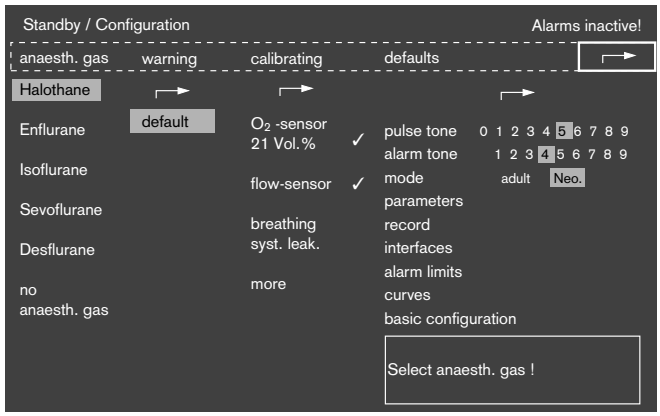


1 Rotate knob = e.g. set »pulse tone«.

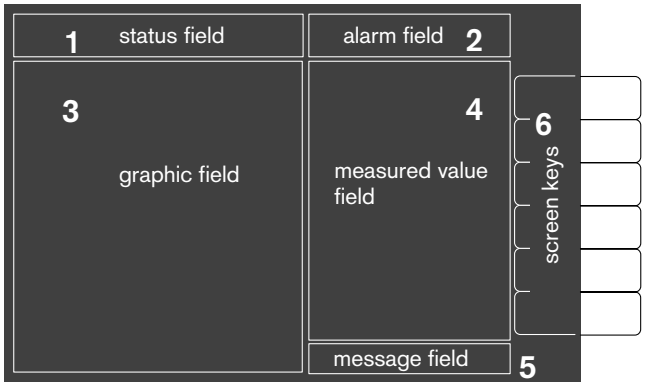
  Or:

2 Press knob again = close **setting** sub-menu, the cursor jumps to ↦ symbol in selection menu at the top.

The grey fields display the actual configuration.



Screen layout



1 Top status field:
Gives information about operating mode.

2 Top alarm field:
Gives information about alarms and their priority.

3 Graphic field left:
For waveforms or bargraphs.

4 Measured value field right:
For the most important numerical measured values.

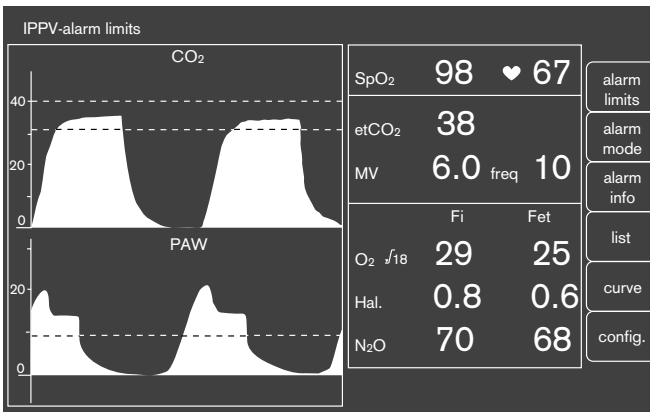
5 Message field:
Guidance for operator.

6 Screen keys:
With variable functions for fast selection of functions.

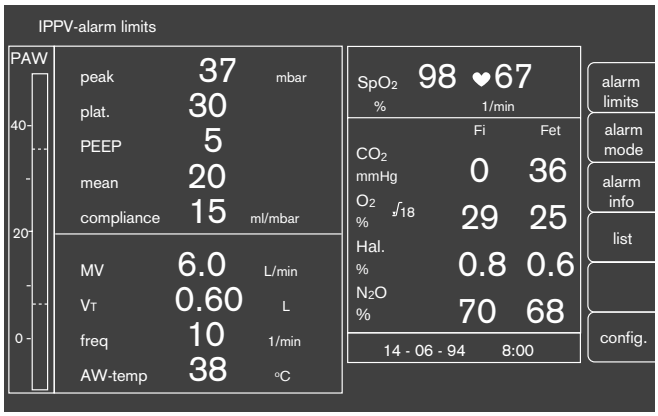
Three basic pages

The screen displays include the options »SpO_2 measurement«, »breathing gas temperature measurement« and »Fi/Fet O_2 measurement«.

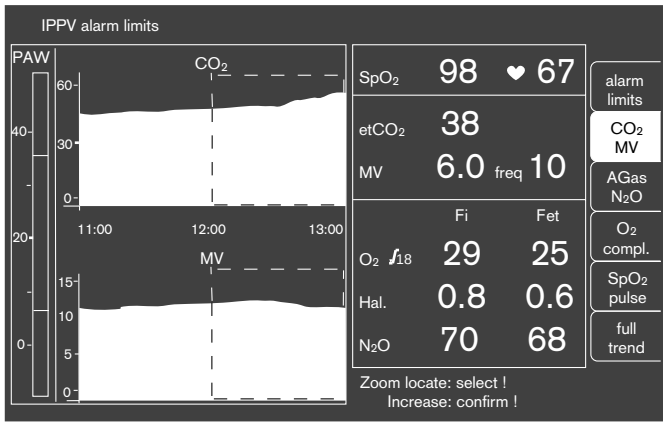
Defaults pages with CO_2 waveform and another waveform which may be selected. On the right, the most important measured values are listed in groups. Example:



Data page which lists **all** measured values plus their units of measurement. This page is intended to be of assistance when completing the anaesthetic protocol. Example:



Trend page for the graphic display of stored parameters.
Example:



Preparation

Attaching PM 8050 to anaesthetic machine

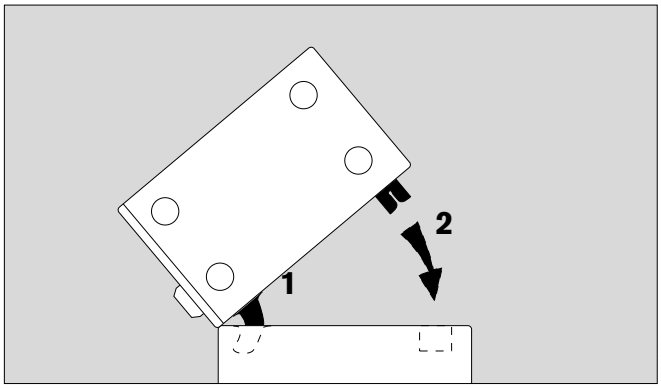
by latching mechanism onto mounting plate of Dräger medical equipment.

1 Tilt PM 8050 forward at an angle of 45°, insert front latches into the slots in mounting plate.

2 Lower PM 8050, insert rear latches into rear slots and secure with knurled screws at the back

or:

- Place on an even surface such as a monitor rack. Secure so that it cannot fall off.



Connecting sensor and pressure-measuring lines to PM 8050

At the back:

3 Connect plug on inspiratory O_2 sensor, when side-stream O_2 measurement is not taking place.

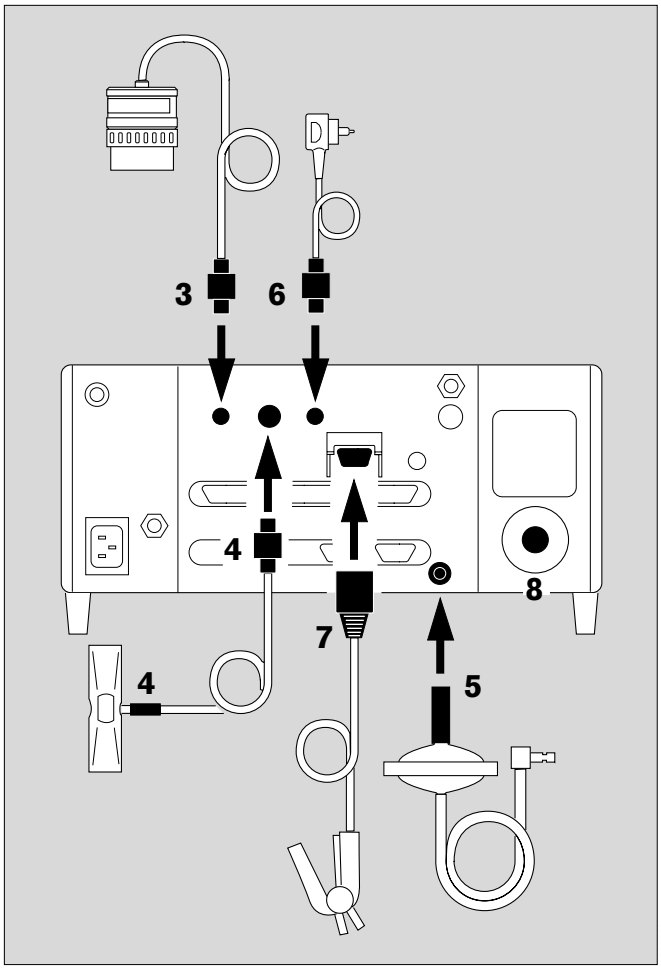
4 Connect flow sensor to cable plug and connect the other end of the cable to the machine.

5 Push hose of pressure-measuring line firmly onto nozzle.

6 Connect temperature sensor plug (optional).

7 Connect SpO_2 sensor plug (optional).
See Measuring SpO_2, page 49.

8 Socket for sidestream measurement of inspiratory and expiratory O_2 (optional).



Connecting sensors to COSY

Connecting O_2 sensor

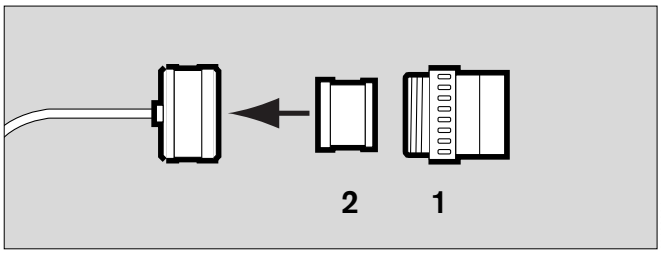
For inspiratory O_2 measurement

1 Unscrew cap from housing.

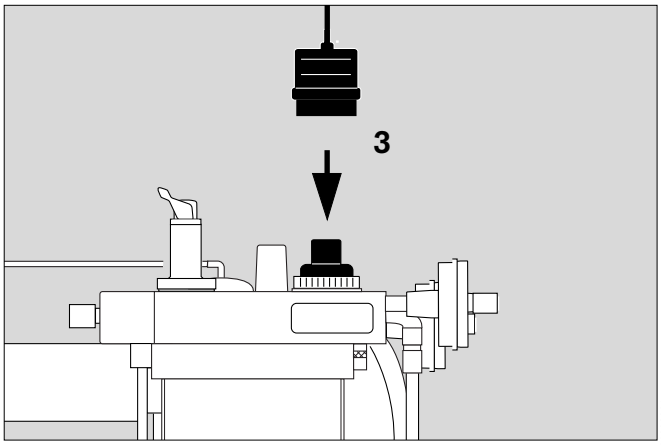
- Remove new sensor capsule from packaging.

2 Place capsule in housing – with circular conductor resting on contacts in housing.

1 Screw cap onto housing.



3 Plug O_2 sensor onto stub of inspiration valve.

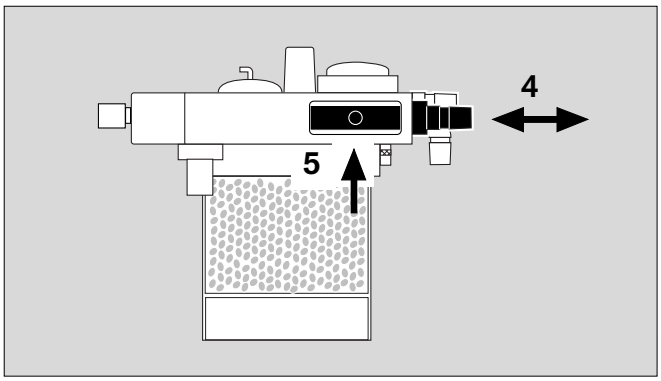


Fitting flow sensor

4 Unscrew expiration nozzle.

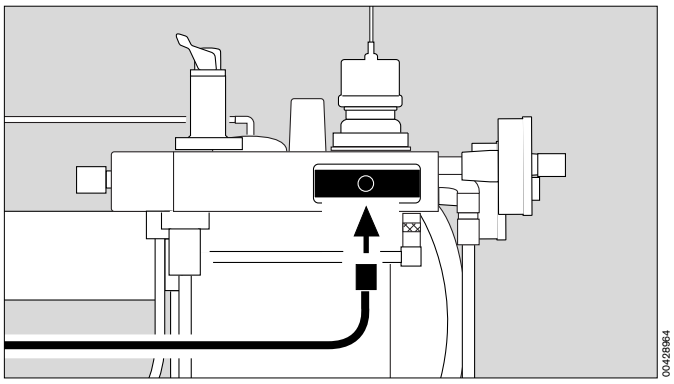
5 Insert flow sensor and

4 screw tightly into expiration nozzle.



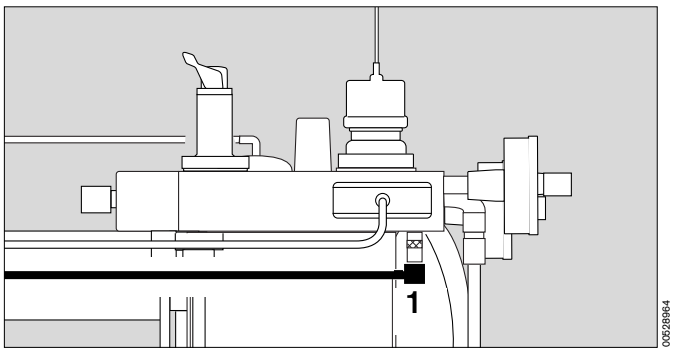
Connecting flow sensor

- Plug connector into flow sensor.



Connecting pressure measuring line

1 Insert connector of pressure measuring line in coupling on COSY – as far as it will go.



Connecting sensors to Circle System 9

Connecting O_2 sensor

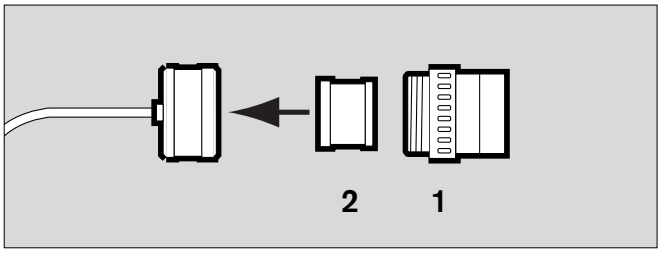
For inspiratory O_2 measurement

1 Unscrew cap from sensor housing.

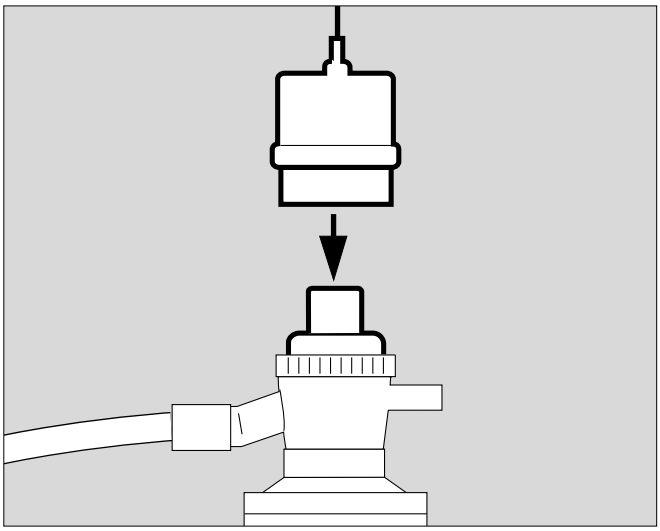
- Remove new sensor capsule from packaging.

2 Place capsule in housing – with circular conductor resting on contacts in housing.

1 Screw cap onto housing.



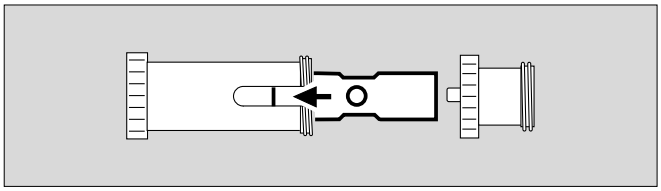
- Plug O_2 sensor onto stub of inspiration valve.



Fitting flow sensor

with flow measuring connector M 26 844.

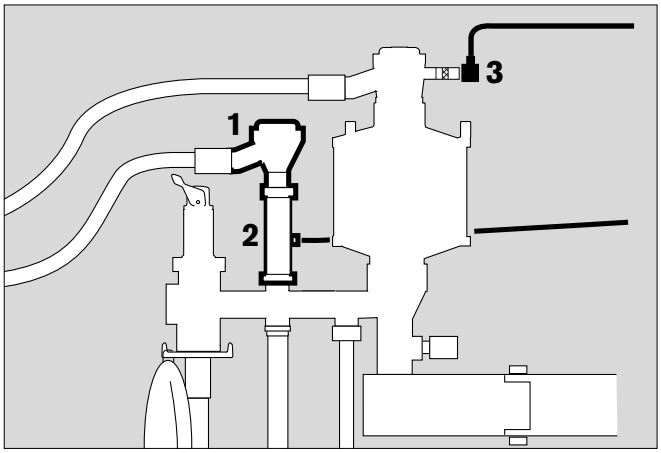
- Screw flow sensor into housing.



1 Unscrew expiration nozzle.

2 Screw on flow measuring connector.

1 Screw expiration nozzle back into place.



Connecting pressure measuring line

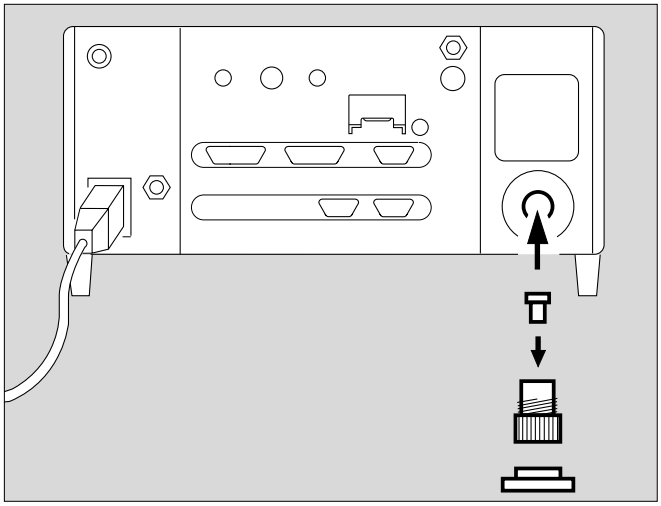
3 Insert connector of pressure measuring line in coupling – as far as it will go. Route hose upwards so that condensate can flow back.

Attaching O_2 sensor for sidestream O_2 measurement (optional)

- Unscrew cap.
- Take out screw and detach blank from the screw.
- Connect O_2 sensor to screw.
- Replace screw and tighten.
- Screw cap back into place.
- Keep blank safe.

When operating without sidestream O_2 sensor:

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

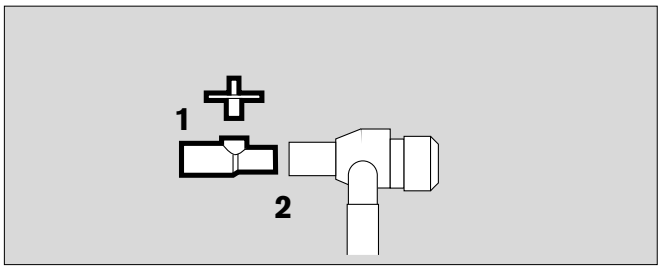


Connecting sampling hose

for sampling to measure CO_2, anaesthetic gas and O_2

1 Screw filter into T-piece.

2 Fit T-piece into the patient connection on the Y-piece – filter at the top to avoid any blockages from droplets of liquid.

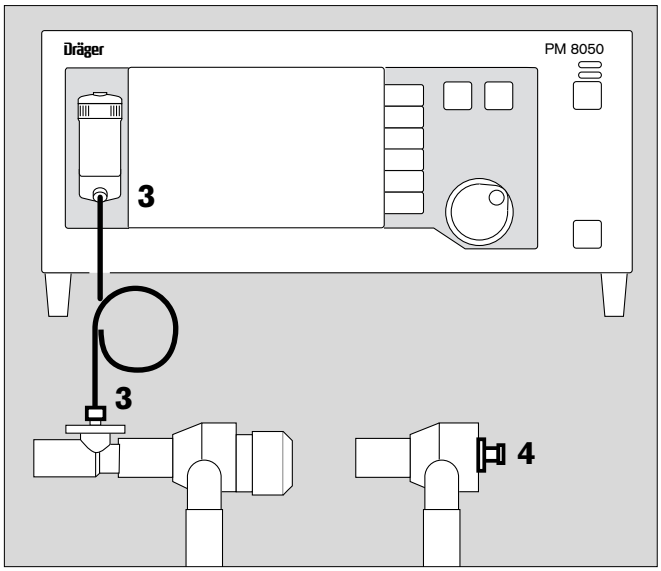


3 Screw sampling hose firmly onto the filter and the water trap.

Use only the correct sampling hose; other hoses may distort the machine's technical data.

4 A Y-piece with a direct connection may be usedfor a sampling hose instead of a T-piece and filter.

Do not allow any alcohol or alcohol-based agents to get into the sampling hose.
Alcohol would lead to incorrect concentration measurements.



Return flow of sampling gas

– to prevent any increase in concentration of anaesthetic agent in the operating theatre,

– to economise on anaesthetic agents,

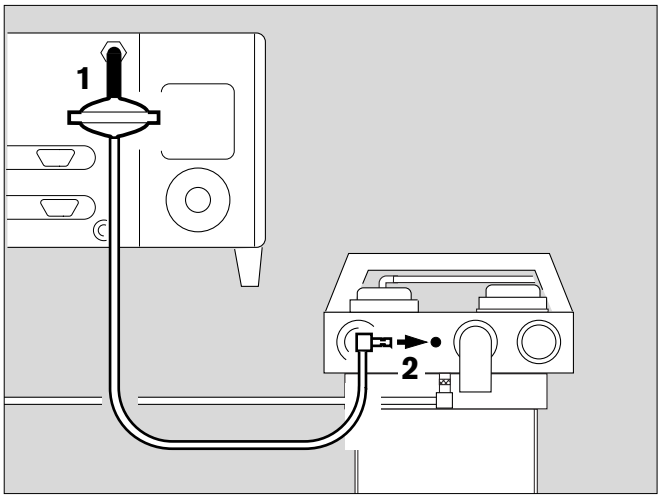
– to avoid undesirable loss of tidal volume when operating at low flow.

If a return flow is impossible, the sampling gas should be conducted to the outside by an anaesthetic gas scavenging system.

For Dräger COSY

1 Use optional hose set M 32 692.

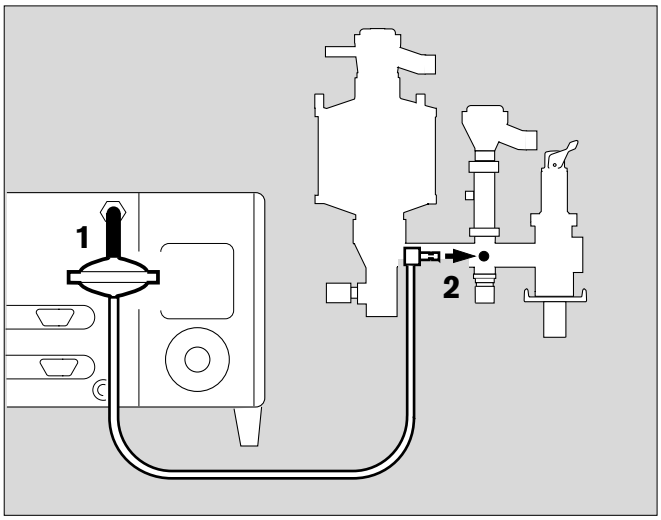
2 Plug connector into coupling on front of COSY – as far as it will go.



For Dräger Circle System 9

1 Connect optional hose set M 32 692 to sampling gas outlet on back of machine.

2 Plug connector into coupling on back of Circle System 9 – as far as it will go.



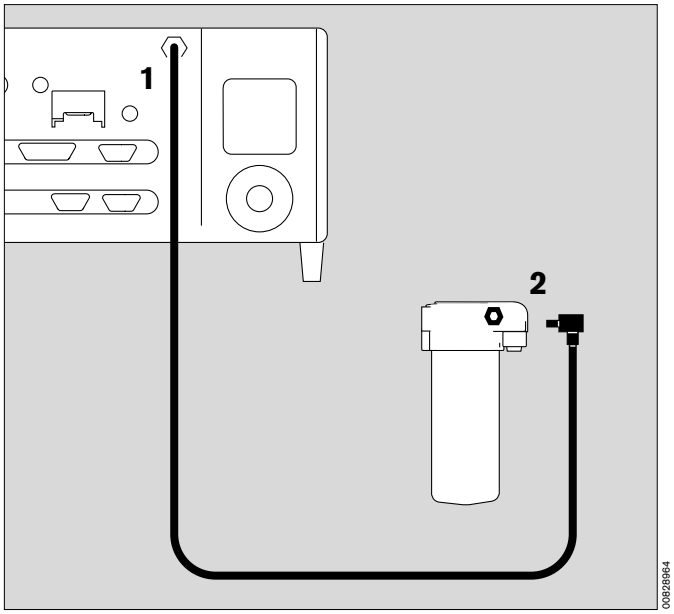
Discharging sampling gas

if a return flow is impossible.

For Dräger anaesthetic machines with Dräger anaesthetic gas scavenging system AGS

1 Connect hose set M 32 692 to sampling gas outlet.

2 Plug connector into socket on mounting system – as far as it will go.

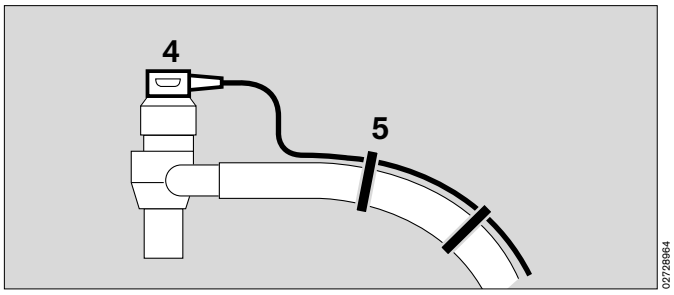


Connecting temperature sensor (optional)

use:
Y-piece, M 30 543
hose clips, 84 04 047

4 Push temperature sensor, 84 05 371, into the hole on the Y-piece as far as it will go.
After replacing the Y-piece, make sure sensor is at the top so that condensate will not be able to get into it.

5 Attach sensor cable to inspiratory hose on the anaesthetic system with hose clips.



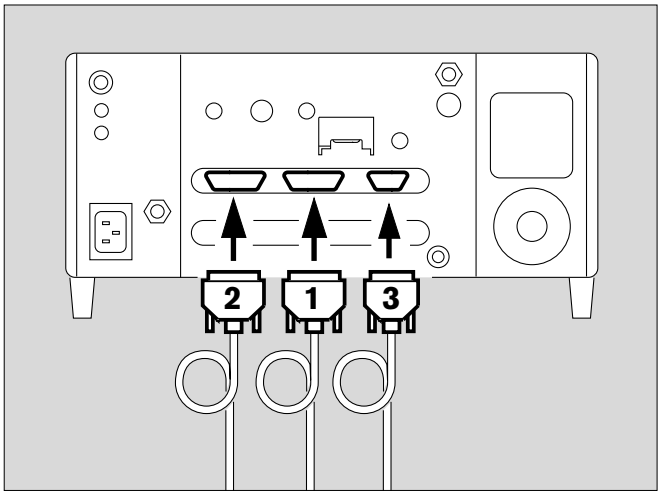
Connecting external machines

via the protocol interface

1 use data cable, 86 00 133
for printer with **serial interface**, e.g.:
Desk Jet printer (Hewlett Packard)
Think Jet printer (Hewlett Packard)

or:

e.g. for PM 8060-Vitara Patient Monitor with MEDIBUS interface.
Settings, see Configurating interface, page 60.



via RS 232 C interface

e.g. for connecting to PM 8060-Vitara Patient Monitor.

2 Connect with data cable.

Requirement:

Baudrate must be 1.2 k baud (pre-set on delivery); if this is not the case, set to 1.2 k baud, see "Configurating interface", page 60.

via the analog interface

3 Port for analog plotter

via the Monitorbus interface

4 Use 0.45 m Monitorbus cable, M 30 893
or
monitor switch, M 30 891

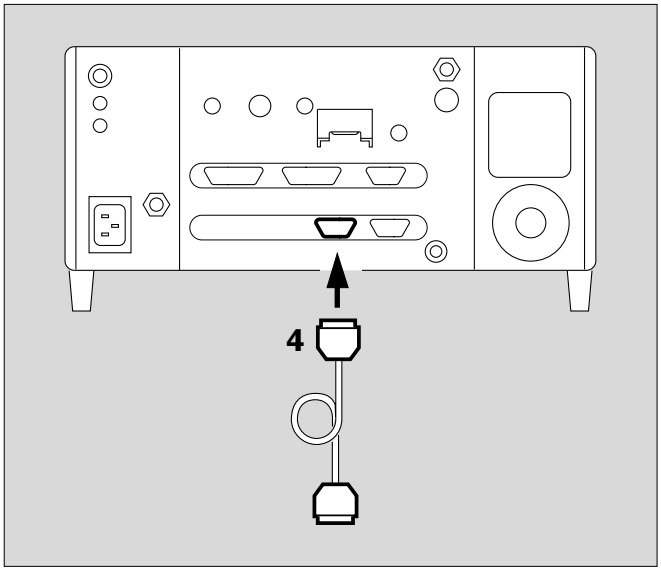
e. g.:

– to remote switch PM 8050 on from standby when switching on Dräger anaesthetic ventilators

– to transmit ventilation mode from ventilator to PM 8050

– to suppress audible alarms on Dräger machines.

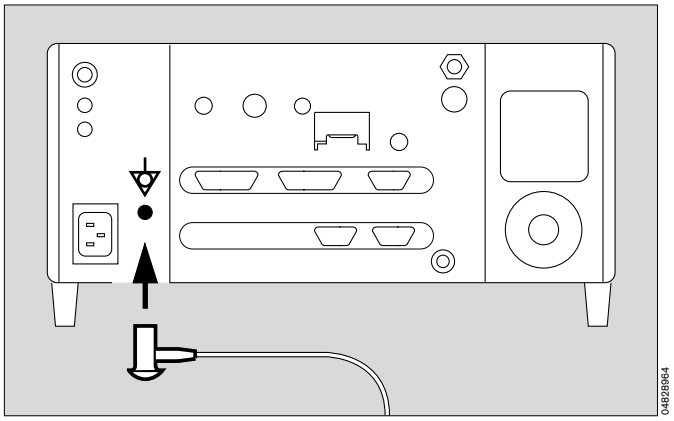
● Connect plugs to both machines and make secure.



Potential equalisation

e.g. during intracardiac and intracranial operations.

- Attach one end of the earth cable to the potential equalisation pin at the back of the machine.
- Connect the other end to a potential equalisation pin, e.g. to the operating table or to a ceiling pendant.



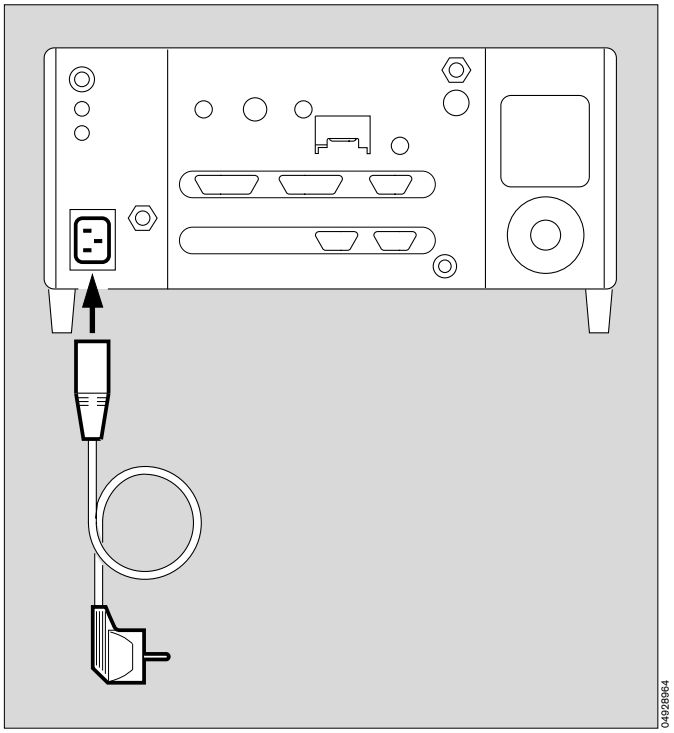
Mains power supply

The mains voltage must correspond with the voltage range given on the rating plate at the back of the unit.

Either: 85 to 140 V

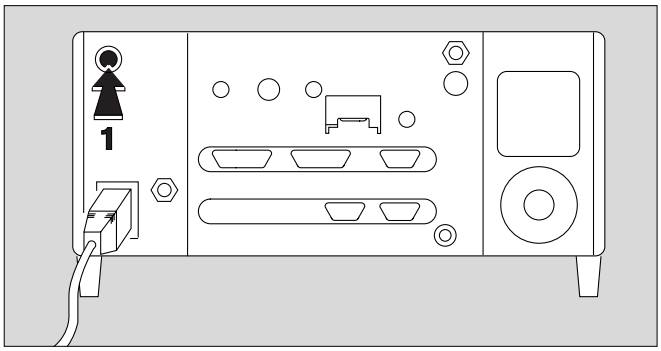
or: 195 to 265 V

- Connect plug to the back of the machine, connect mains power plug to socket on wall.



Checking mains power failure alarm

Only before using for the first time or after long periods of storage



- Disconnect mains power plug.

1 Push mains switch at the back – as far in as it will go = ON.

- A continuous sound commences and should remain at constant volume for at least 10 seconds. The sound is automatically switched off after about 30 seconds.

If the volume decreases within the 10 seconds, charge NiCd battery.

- Leave machine connected to the mains power supply and switched on in standby for 24 hours.
- Check mains power failure alarm again.

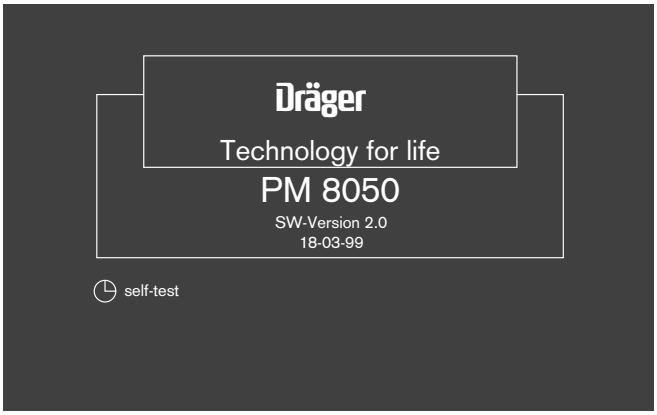
Preparing machine

Carrying out self-test

- Connect to mains power supply.

1 Push mains switch at the back – as far in as it will go = ON.

- Screen display (example):



- The machine carries out a self-test:
  All LEDs and display segments are lit about about 2 seconds.

  The LED in the ⏻ standby button continues to be lit.
  2 alarm sounds are triggered.
  The internal programme memories are tested.
- The self-test takes about 1 minute.

If the self-test has been satisfactory, display:

ready for use

If a **non-safety related fault** is discovered in the self-test which has no effect on measurement, display shows:

conditionally ready for use

with the appropriate fault message.

However, the machine is operational:

- Press knob, and then call DrägerService.

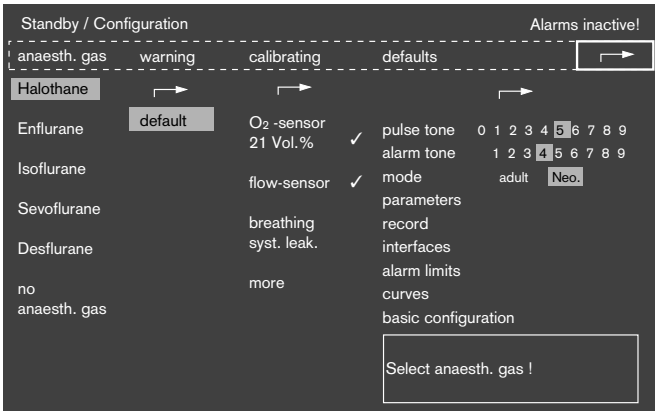
If a **safety-related fault** is discovered, display shows:

not ready for use

The machine cannot be switched to standby or to measurement.

- Call DrägerService without delay.

- After a satisfactory self-test, the configuration menu is displayed (example):



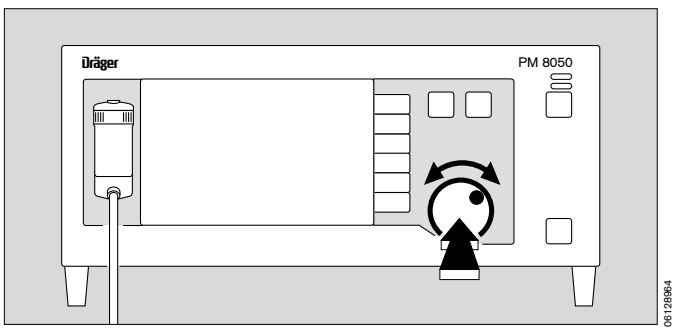
The machine then asks that the following actions be done:

calibrate sensor

select anaesth. gas

- Select appropriate menu = rotate knob.
- Confirm = press knob.

  The menu is selected and is displayed dark on a light background.



If the sensors are not yet due for calibration – shown by the tick (✓) at the end of the lines **O_2 sensor 21 vol.%** and **flow sensor** – and if
it is not necessary to re-select the anaesthetic gas, the configuration menu can be closed:

- With knob, move the cursor to the ↦ symbol and confirm.

  The machine switches to standby and is ready for use:

- Press standby key ⏻ ; its yellow LED goes out. The machine is now in measurement.

In an emergency
measurement can be switched on immediately – bypassing configuration – using the ⏻ standby key. The measured values of any sensors which have not yet been calibrated are displayed in grey.

Machine's reaction to power failure

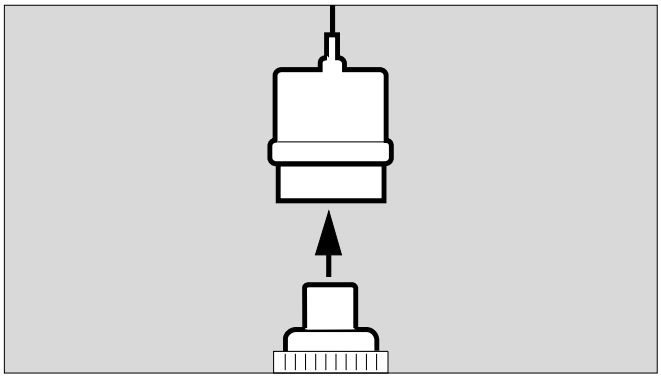
If a mains power failure has lasted for less than 2 minutes the machine will continue to operate as before:
the existing configuration values will continue to apply.

If a mains power failure has lasted more than 2 minutes the machine will behave as it would for a cold start:
the default values will apply.

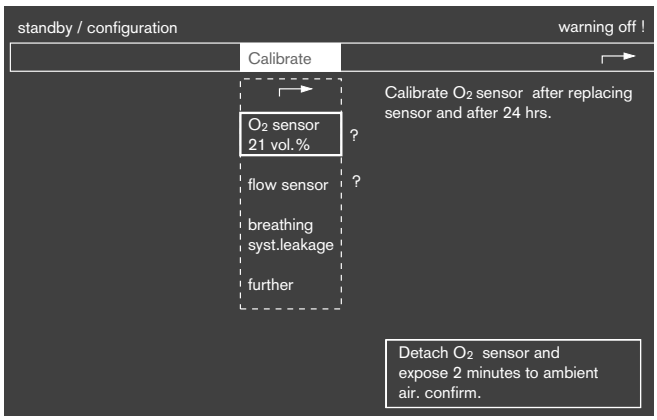
Calibrating inspiratory O2 sensor with air

Only required when sidestream O2 measurement not being used.

– when the sensor has been replaced (allow sensor to warm up for 15 minutes)
– every 24 hours, and before each use
– every 1 month: check linearity, page 27.



- Detach O2 sensor and expose to ambient air for 2 minutes.
- Select the **calibration** column in the **standby/configuration** menu and confirm.
- Select **O2 sensor 21 vol.%** with knob.
- Display:



Sensor must be exposed to ambient air for at least 2 minutes:

- Confirm using knob: calibration is started and carried out automatically.

The O2 sensor being used for sidestream O2 measurement is automatically calibrated with air.

When calibration is finished, a tick (✓) is displayed instead of the clock symbol.

- Put O2 sensor back.

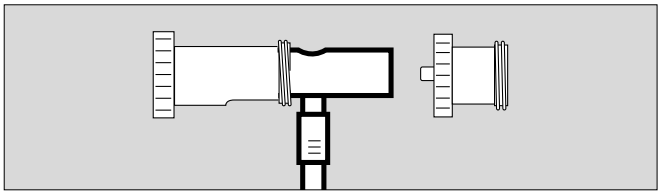
If there is a question mark (**?**) is the display instead of a tick, calibration must be repeated because the preceding calibration was faulty.

Calibrating flow sensor

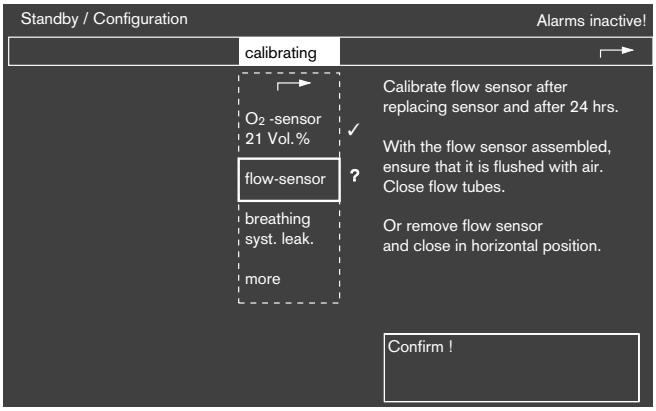
– when sensor has been replaced

– every 24 hours and before each use.

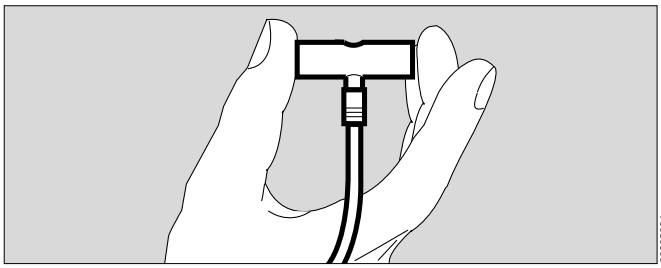
The flow sensor can be calibrated during O_2 calibration.



- Unscrew flow measuring connector and remove flow sensor.
- Select **calibration** column in **standby/configuration** menu and confirm.
- Select **flow sensor** line in **calibration** column.
- Display:



- Hold flow sensor in horizontal position in ambient air and close both openings, preferably using middle finger and thumb.



With sensor sealed:

- confirm using knob, calibration starts.

The clock shows the course of flow calibration. When calibration is finished, a tick (✓) is displayed instead of the clock symbol.

- Put flow sensor back into flow measuring connector; put flow measuring connector back into anaesthetic system.

If there is a question mark (**?**) in the display instead of a tick, calibration must be repeated because the preceding calibration was faulty.

If the anaesthetic machine has a flowmeter for Air, the flow sensor can be calibrated while still in place.

On the anaesthetic machine:

- Close O_2 and N_2O flow valves, open Air flow valve and flush breathing system thoroughly with Air.
- Close Air flow valve.
- Start calibration.

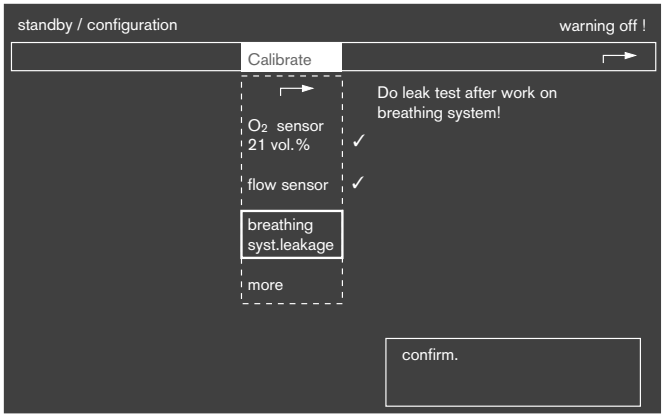
The accuracy given in "Technical Data" on page 79 can only be achieved when calibration is carried out with sensor in position.

Leak testing

for quantitative leak testing of anaesthetic system.

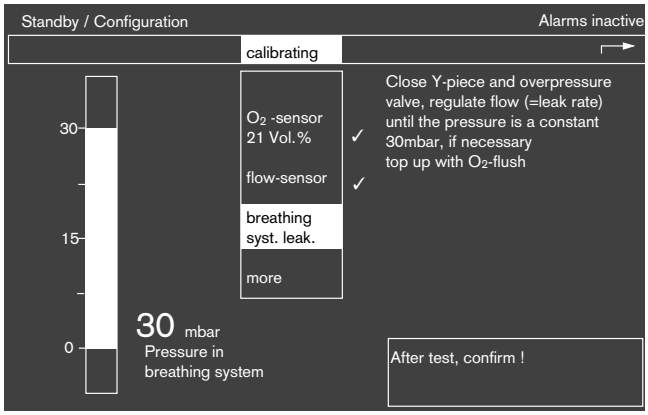
The leak test can only be carried out when O_2 and flow sensors have been calibrated and put back in the anaesthetic system.

- Select **calibration** column in **standby/configuration** menu with knob, and confirm.
- Select **breathing syst. leak** line in **calibration** column.
- Display:



In the anaesthetic system:

- Keep Y-piece closed, with thumb for instance.
- Confirm **breathing sys. leak** with knob.
- Display (example):



In the anaesthetic system:

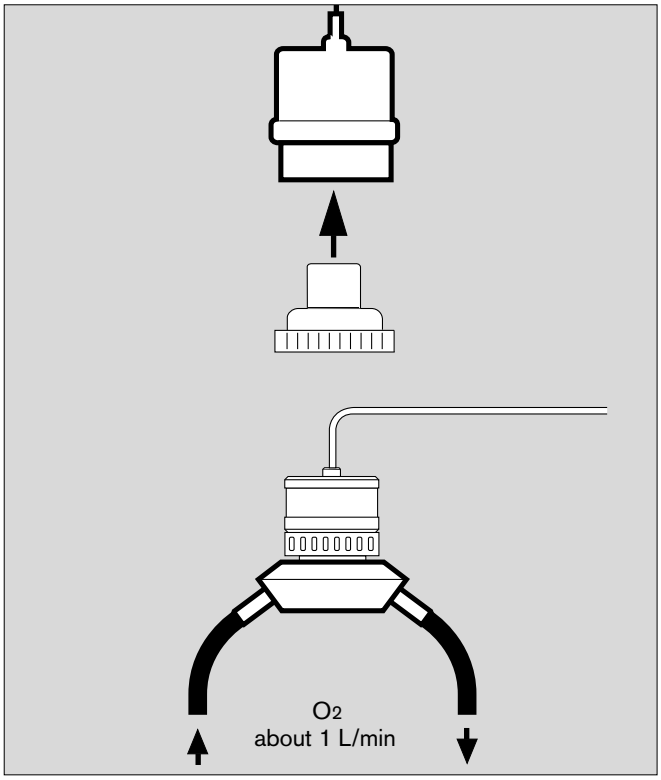
- **Slowly** open O_2 flow valve, having first filled system using O_2 flush, if necessary.
- Watch rise in pressure on PM 8050 bargraph and regulate O_2 flow until a constant pressure of 30 mbar is displayed.

  The leakage read on the O_2 measuring tube will now be X.X L/min at 30 mbar.
- When leak test has been completed, confirm with knob.

Calibrating inspiratory O_2 sensor with O_2

Only required when sidestream O_2 sensor is not being used.

- Detach O_2 sensor and fit test adaptor, 68 01 349, to it.
- Allow oxygen to flow over the O_2 sensor at a rate of about 1 L/min for about 2 minutes.
- Select **more** with knob.
- Select **O_2 sensor 100 vol.%** with knob.
- Display:

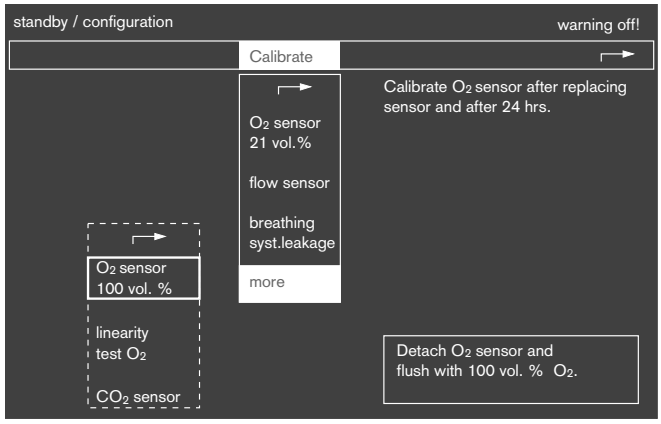


After flushing the O_2 sensor with O_2 for about 2 minutes:

- Confirm with knob; calibration is started and carried out automatically.

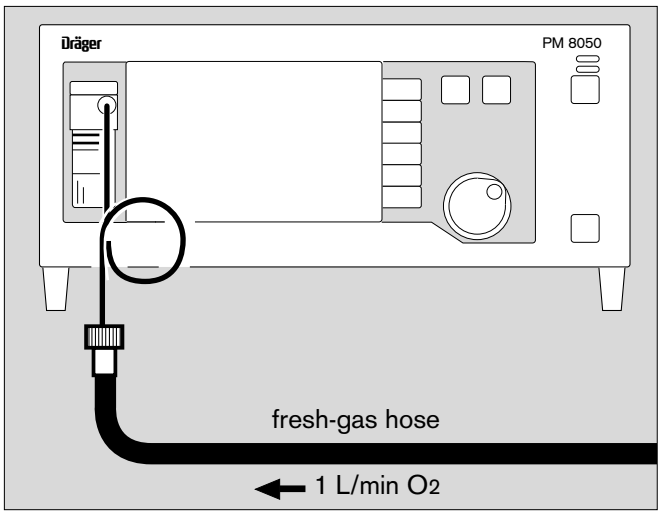
When calibration is finished, a tick (✓) is displayed instead of a clock symbol.

- Put O_2 sensor back.



Calibrating O_2 sensor for sidestream O_2 measurement

Required for monthly check of linearity.

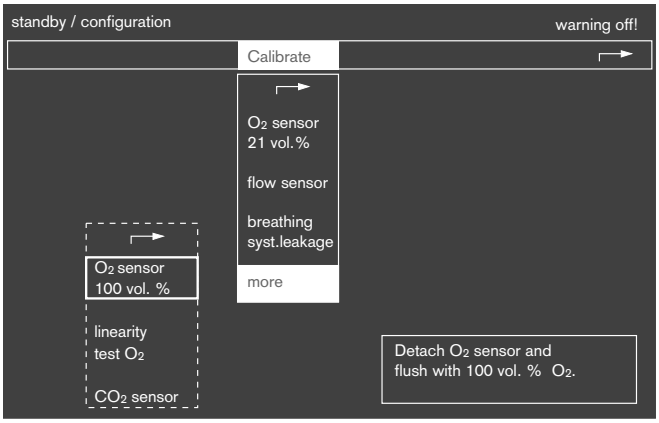


Prepare a special sampling hose:

- Cut sampling hose in half.
- Unscrew original sampling hose from water trap, screw special sampling hose to water trap.

On the anaesthetic machine:

- Unscrew fresh-gas hose on Circle System 9.
- Set an O_2 flow of 1 L/min on O_2 flowmeter and push special sampling hose into fresh-gas hose as far as it will go.
- Select **more** with knob.
- Select **O_2 sensor 100 vol.%** with knob.
- Display:



- Allow O_2 to flow for about 2 minutes.
- Confirm with knob; calibration is started and carried out automatically.

When calibration is finished, a tick (✓) is displayed instead of a clock symbol.

- Screw original sampling hose back onto water trap.
- Screw fresh-gas hose back onto Circle System 9.

Checking linearity

– carry out monthly.

First calibrate with O_2, either:

the inspiratory O_2 sensor, see page 25,
or
the O_2 sensor for sidestream O_2 measurement, see page 26.

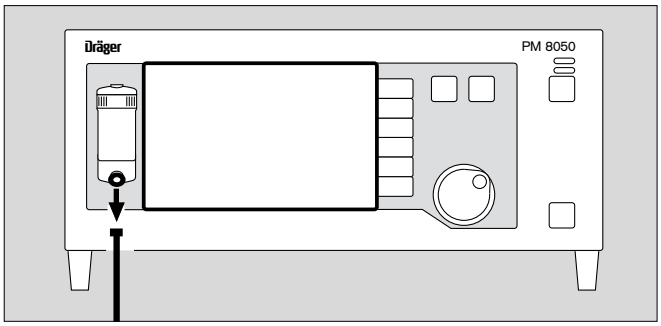
Then:

- expose inspiratory O_2 sensor to ambient air for about 2 minutes.

or

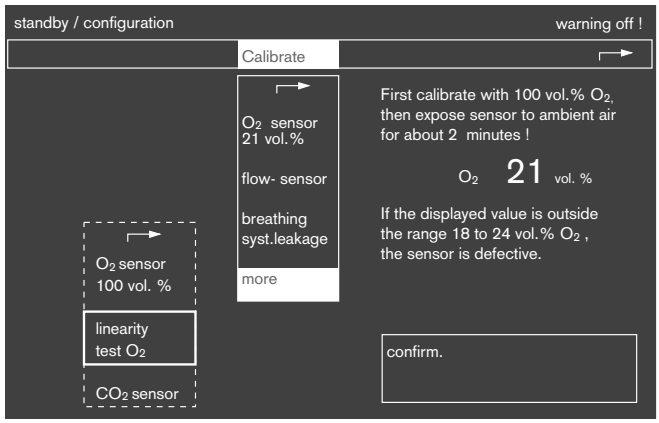
O_2 sensor for sidestream O_2 measurement:

- unscrew sampling hose on water trap and allow air to be drawn in for 2 minutes.



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

- Display (example):



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

Then:

- Put inspiratory O_2 sensor back, see p. 11 and calibrate, see p. 22

  or

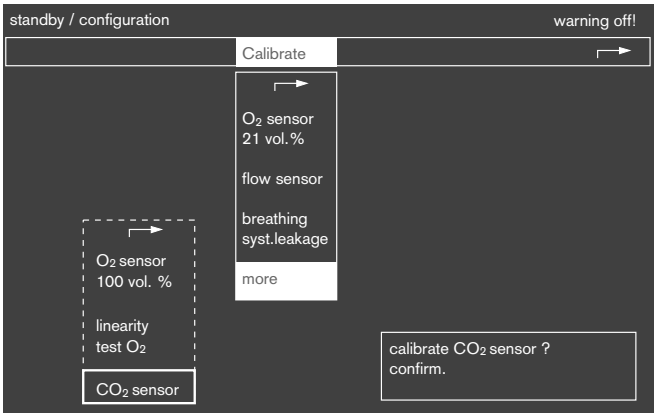
- Put O_2 sensor for sidestream O_2 measurement back, see p. 14, and calibrate, see p. 26.

- Put O2 sensor back, and
- screw sampling hose back onto water trap.

Calibrating CO_2

Zero calibration is carried out for CO_2, N_2O and anaesthetic gas measurement. The machine carries out calibration automatically once an hour. Because of this preventive calibration, measuring can continue for another hour, for instance, without an interruption for calibration.
Starting calibration manually does not, however, shorten the machine's warming-up phase.

- In **calibration** column, select **more** line and confirm.
- Select **CO2 sensor** and confirm.
- Display:

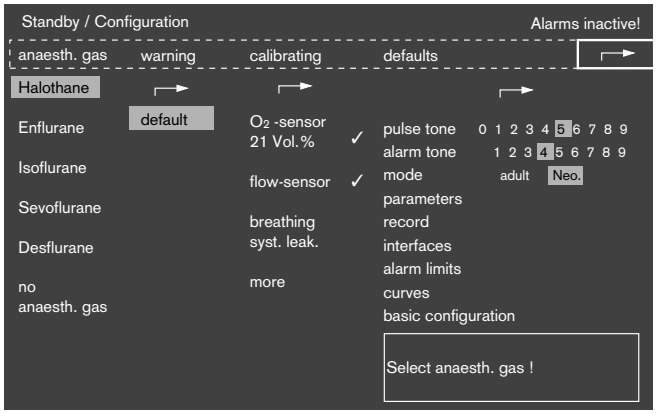


- The machine calibrates automatically.

Selecting anaesthetic gas

On switching on, the anaesthetic gas selected for default is displayed on a grey background in the **standby/configuration** menu.

- Select **anaesth. gas** column and confirm.
- Display (example):



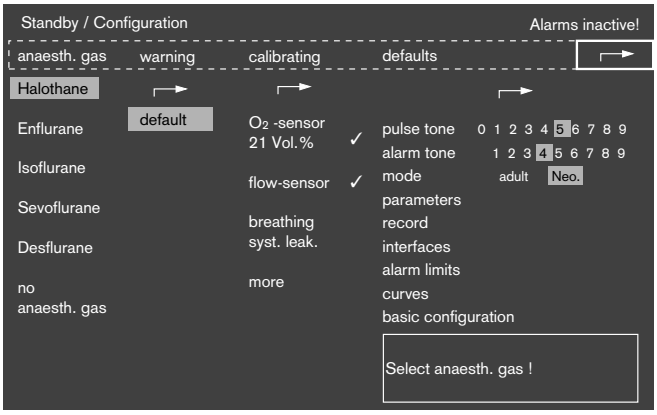
- Select anaesthetic gas desired and confirm. Selection is displayed on grey background.

If no change is made, the machine uses the anaesthetic gas shown on grey when measuring concentration.

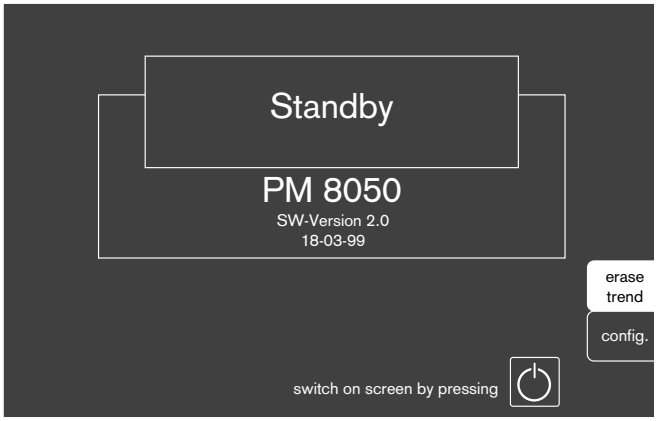
Default alarm limits

On switching on (cold start) the alarm limits are set to default values.
The **defaults** line has a grey background.

- Display (example):



- Confirm with knob.
- Display:



Measurement

Checking before use

Immediately before daily measurement, as part of the checklist procedure for anaesthetic machine.

- Switch on machine.
- Calibrate sensors, p. 22 – 24.
- Switch machine to standby.

Checking remote switch

When using machines linked with a Dräger anaesthetic ventilator.

- Switch on anaesthetic ventilator:
  the yellow LED in the ⏻ standby key on PM 8050 should go out.
- PM 8050 should begin measurement automatically.

If there is no remote switch

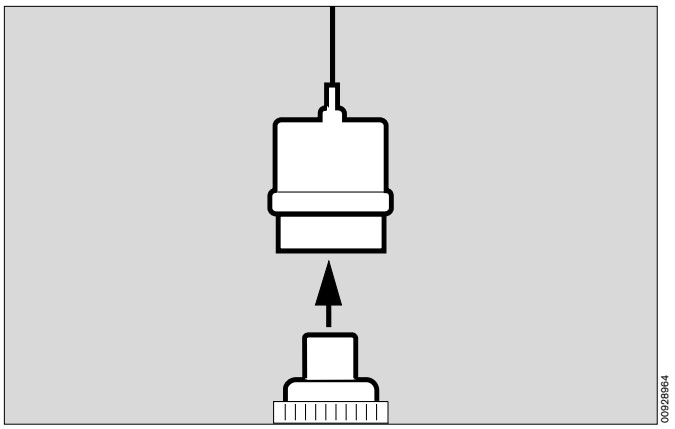
Switch PM 8050 to measurement:

- Press ⏻ standby key; yellow LED should go out.

Checking O_2 measurement

When sidestream O_2 measurement is switched off:

- Remove inspiratory O_2 sensor from assembly and expose to ambient air for 2 minutes.



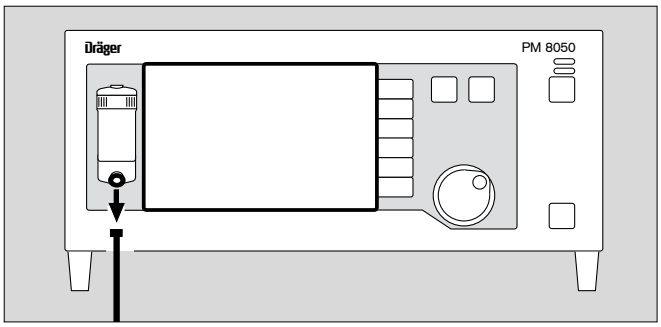
Or

O_2 sensor for sidestream O_2 measurement:

- Detach sampling hose from the water trap and allow ambient airm to be drawn in for 2 minutes.

- Defaults page should show:

  O_2 between 18 and 24 vol.%



- Put O_2 sensor back, or
- screw sampling hose back into the water trap.

Checking flow measurement

on PM 8050

- Select **data page**.

On anaesthetic ventilator

- Switch off automatic ventilation, keep Y-piece sealed and fill breathing bag with O_2.
- Keep Y-piece sealed and squeeze out breathing bag.
- The **data page** on PM 8050 should show a measured value for V_T greater than 0.

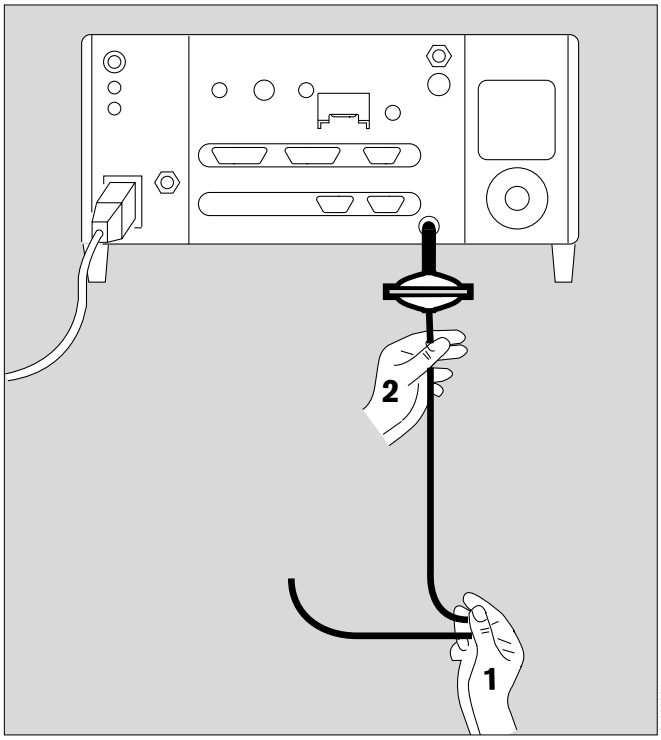
Checking pressure measurement

1 Kink pressure measurement hose near the coupling, then

2 squeeze hose:

- The bargraph on the **data page** should show a value greater than 0 mbar.

- Release hose:
- the bargraph should show 0 mbar.



Leak testing sampling hose

- Remove T-piece from Y-piece and keep sealed,

or

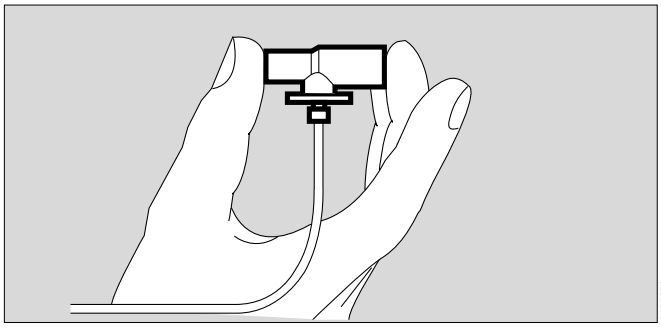
- unscrew sampling hose from Y-piece and keep sealed.
- In less than 30 seconds the machine has to display the message:

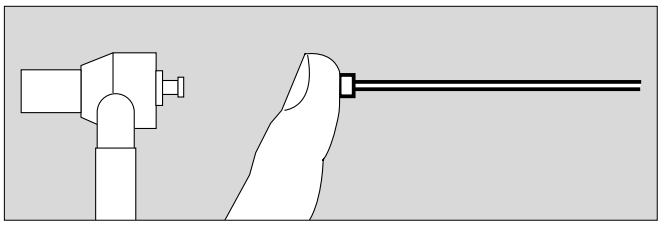
  CO2 LINE? !

- Re-connect T-piece to Y-piece.

or

- Screw sampling hose back into Y-piece.





If other alarm messages are displayed:

- Press **alarm info** screen key for comprehensive information on all alarms.

If – due to leakage – the sealing of the T-piece has not been accepted,

proceed to check the sampling hose item by item:

- Unscrew T-piece from filter, keep filter sealed – test.

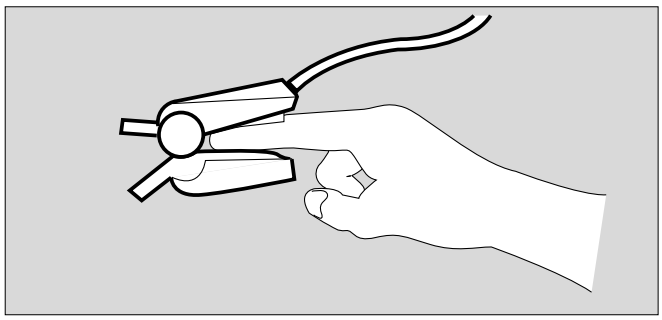
  Unscrew filter from sampling hose, keep sampling hose sealed – test.

  Unscrew sampling hose from water trap, keep water trap sealed – test.

- Replace any parts which leak and re-test. If the machine connector is leaking, call DrägerService.

Checking SpO_2 measurement (optional)

- Place DS 100 A Durasensor on finger of own hand.
- Display must be appropriate.



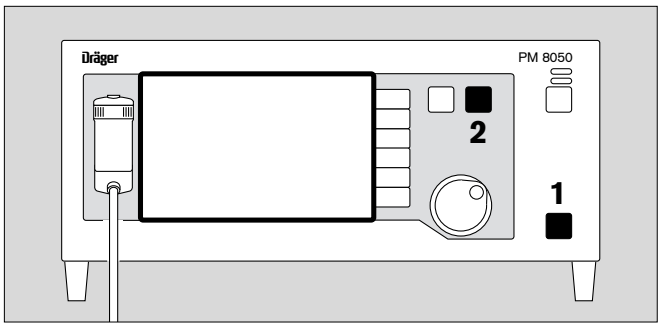
The machine is ready for use when all the checks have been satisfactory.

Defaults page

1 Press ⏻ standby key; the yellow LED goes out and machine is in measurement.

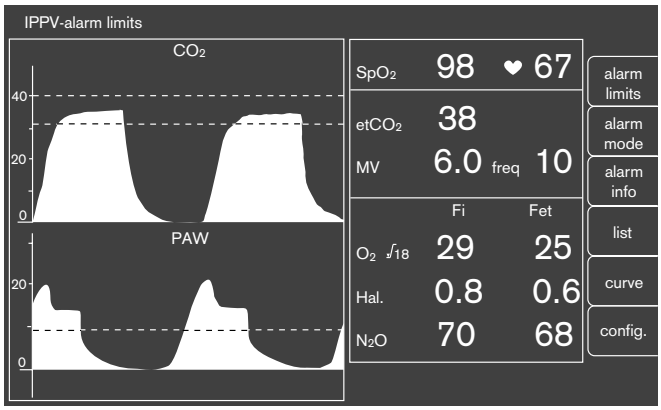
or

PM 8050 automatically switches from standby to IPPV alarm mode after detecting an automatic or manual mandatory ventilation stroke of more than 40 mL.



- The screen displays the **defaults page** with the important basic parameters for anaesthetic ventilators.

  Example:



The **defaults page** can be selected during operation at any time:

2 Press ⏻ key.

If measured values are displayed in grey
this means that their accuracy may be less than that given in the "Technical Data". This is true of flow measurement and inspiratory O_2 measurement when calibration has not been carried out.

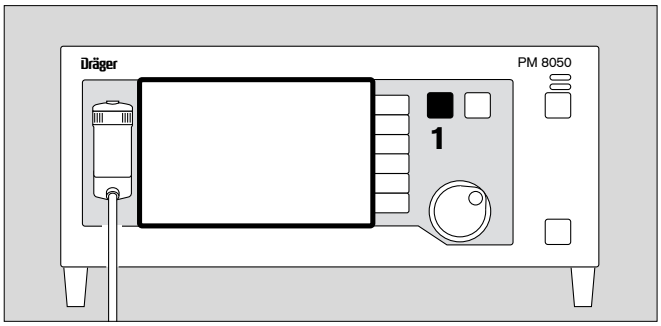
- For maximum accuracy, the sensors must be calibrated.

When CO_2, anaesthetic gas and nitrous oxide are being measured, the measured values are displayed in grey during the warming-up phase each time the machine is switched on.

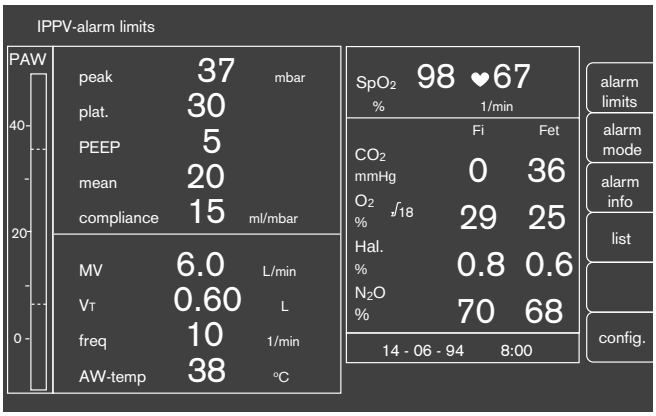
Selecting data page

for a display of measured values for PM 8050.

1 Press key repeatedly until **data page** appears.



- Display (example):



The bargraph on the left of the screen displays airway pressure (Paw) continuously.

Compliance correction

PM 8050 takes account of a breathing hose compliance of 0.4 mL/mbar and automatically corrects the compliance-dependent measured values for MV, VT and patient compliance.

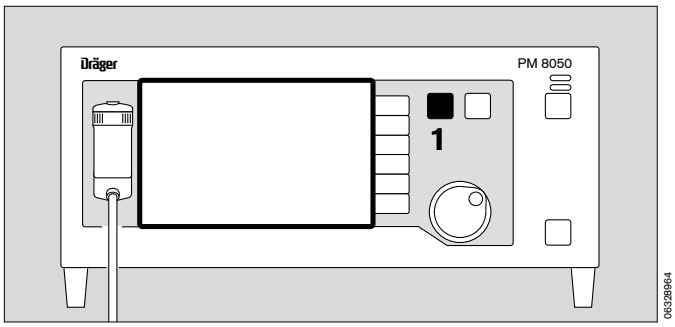
Selecting trend page with zoom

for a display of the chronological course of measured values since measurement started.

Maximum storage time: 8 hours.

Combinations which may be selected for display:
– CO_2/MV
– AGas/N_2O
– O_2/compliance*
– SpO_2/pulse rate

2 Press key repeatedly until the **trend page** appears.



- Display (example):

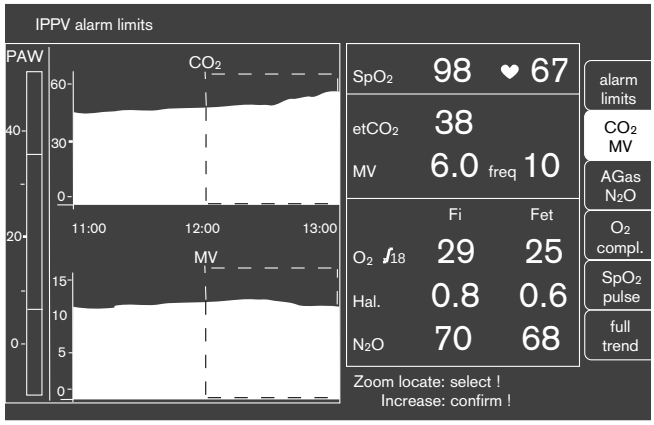
Once the machine has been in operation for more than half an hour, zoom can also be used. A section of the time covered can be enlarged (several times). This section is marked by a dotted area. Earlier time is shown on the left.

Example:

- Rotate knob – the dotted area moves – until the section outlined.
- Press knob – the dotted area is enlarged to the full display width.

  After an appropriate length of time a new dotted area appears, which can then be enlarged as above.

  The maximum has been reached when no further dotted area appears.

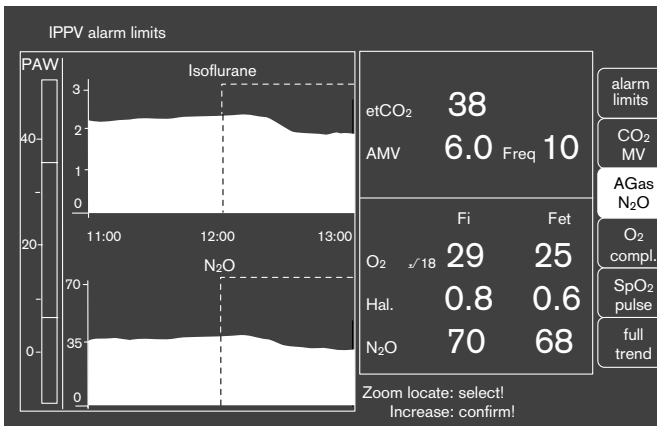


* Calculation of compliance, see p. 85

Displaying other trend combinations

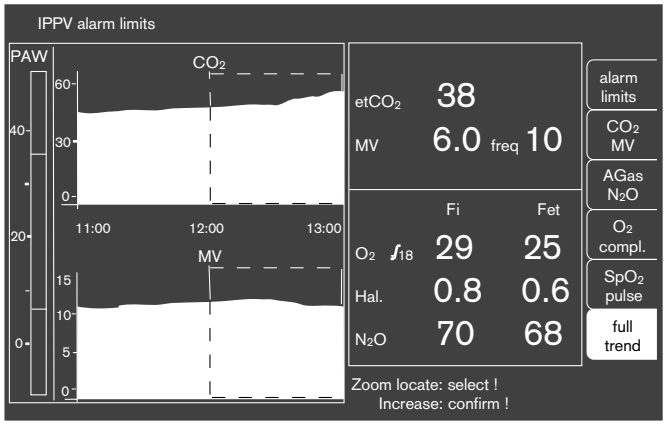
- Press appropriate screen key (the example shows **AGas/N2O**), the descriptions are displayed dark on a light background. The new trend waveforms are shown on screen.

  If a measuring function is not available, the screen key remains blank.



Return to full trend

- Press **full trend**. The trend re-appears on screen in full.

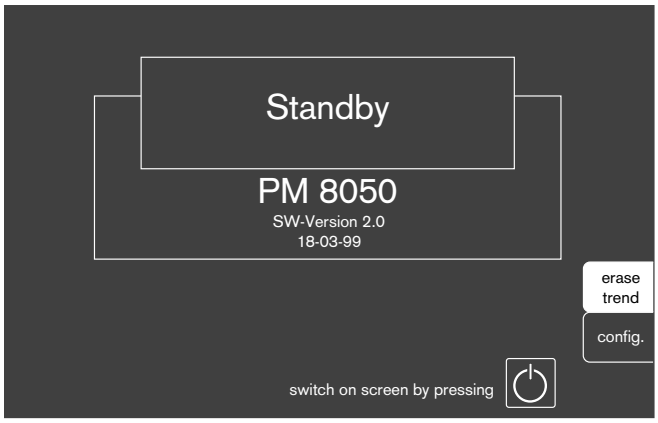


Erasing trend memory

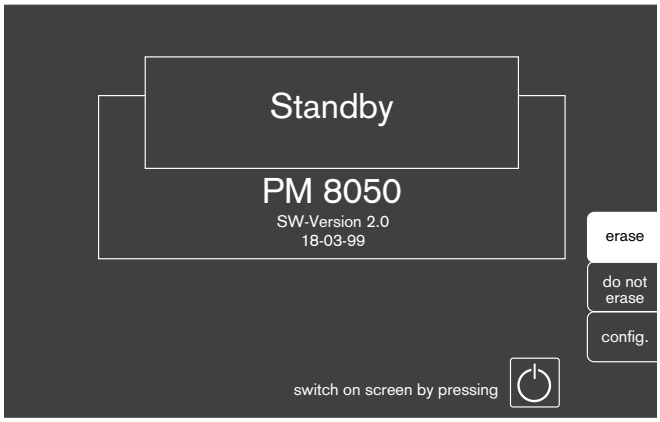
Trend memory and list are erased together. This can only be done in **standby**.

- Press ⏻ standby key; the yellow LED is lit.
- Press **erase trend** screen key.

  The machine asks whether trend should be erased or not.



- Press **erase** screen key to confirm.



To return to unchanged screen, use **do not erase** screen key.

When a new anaesthetic gas is selected, the stored trend of anaesthetic agent concentration is automatically erased.

Setting and displaying alarm limits

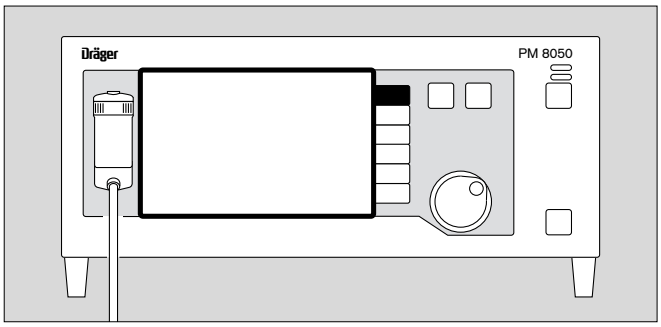
during operation

May be done from all three basic pages.

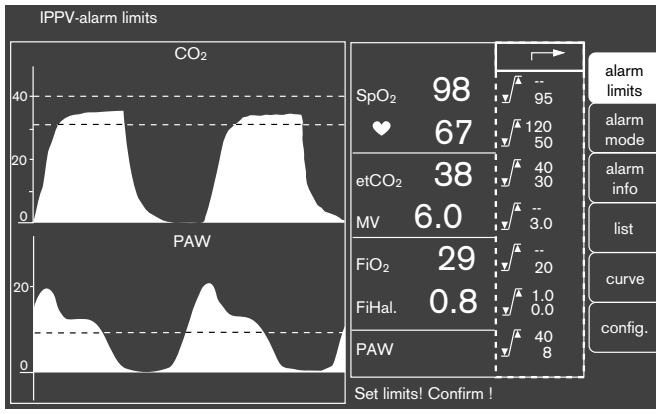
– For displaying measured values and their alarm limits together.

– For correcting alarm limits because of changed measured values.

- Call up with **alarm limits** screen key



- Display (example):



The display shows a description of the measured value (example shows $etCO_2$), the value measured on the patient as a large-sized number (38) and the set upper and lower alarm limits in smaller-sized numbers, after the alarm limit symbol ( ).

Two dashes in the display field represent an alarm limit which is switched off.
Example: upper alarm limit OFF

Alarm limit settings made during measurement are not permanent. They are overwritten by the default alarm limits if

– PM 8050 is switched off and switched on again after an interval of more than 2 minutes (cold start)

– the **default** setting is selected under **alarms** and confirmed.

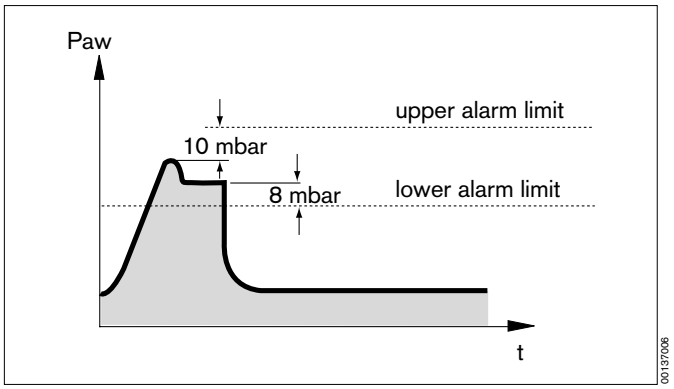
To set an alarm limit

- Select each alarm limit with knob and confirm:
  alarm limit is displayed dark on a light background.
- Set value using knob and confirm:
  new alarm limit is effective.

  The cursor jumps to the ⌐→ symbol.
- Confirming a second time closes the alarm limit menu.

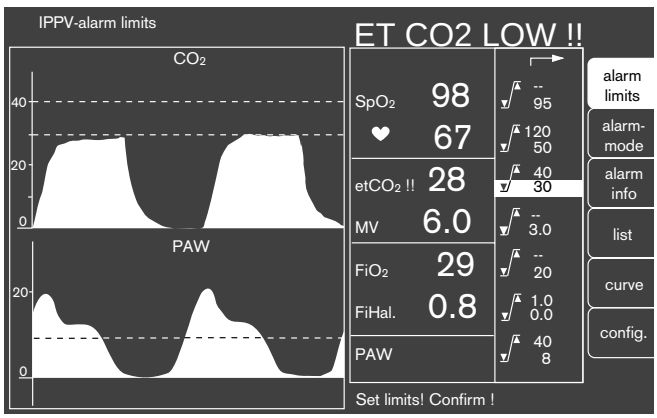
Setting Paw alarm limits

- Set lower alarm limit (= apnea pressure) about 8 mbar below plateau pressure.
  If no plateau pressure is available, set about 8 mbar below peak pressure.
  The lower alarm limit is switched off in the Man./spont. alarm mode.
- Set the upper alarm limit about 10 mbar above peak pressure.



The waveform display shows active alarm limits as a dotted line.

Example: CO_2 and Paw waveforms.



Selecting alarm mode

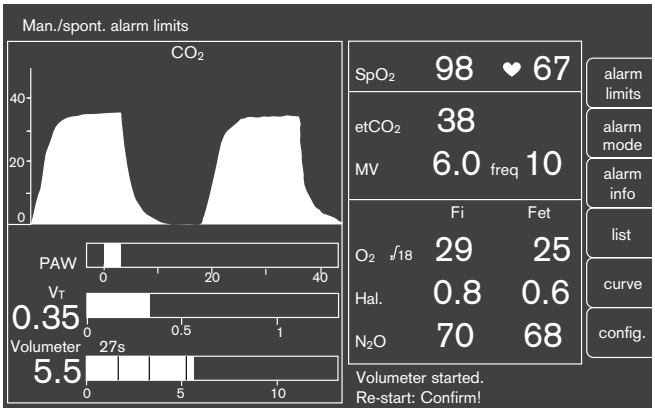
PM 8050 has 2 different alarm modes:
IPPV alarm limits
or
Man./spont. alarm limits

During controlled ventilation (IPPV) PM 8050 must be operated in the **IPPV alarm limits** alarm mode.

If PM 8050 is connected to a ventilator via the Monitorbus, selection is automatic.

The alarm modes can be selected from the defaults page and from the data page:
The alarm mode selected is always shown in the top left-hand status field. Any change is shown by flashing letters and a single sound.

- Press **alarm mode** screen key.
- Display (example):



The **Man./spont. alarm limits** have been specifically designed for the induction and recovery phase in anaesthesia and can be fixed in the configuration menu. To suit this operating mode monitoring is less comprehensive in this alarm mode:

FiO_2 with lower alarm limit

Insp. anaesth. gas with upper alarm limit

Paw with upper alarm limit

$etCO_2$ with upper alarm limit

$etCO_2$ with lower alarm limit

Apnea time: 60 seconds
(monitored by CO_2 measurement)

The alarm limits for SpO_2 and pulse remain unchanged.

Alarm mode for heart/lung machine (HLM)

The HLM alarm mode can be used for monitoring when PM 8050 is being used with a heart/lung machine independently of the alarm mode that is currently operating.

In HLM alarm mode

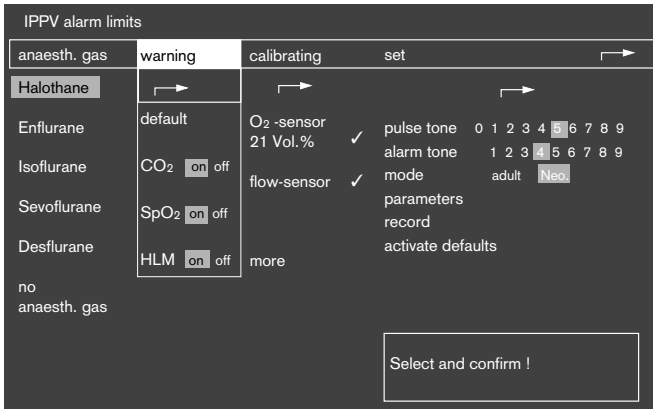
– all apnea alarms are switched off,

– the displays of values for breathing gas are not coupled to the breathing phases,

– the SpO_2 alarms are switched off, but are reactivated automatically if, after the HLM alarm mode has been switched off, the machine detects pulsation again.

Selecting HLM alarm mode

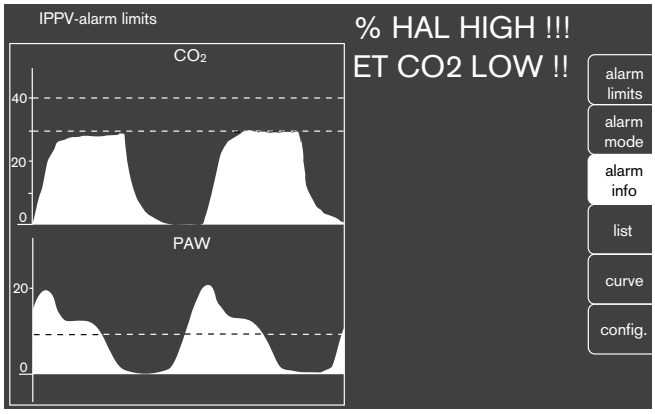
- Press screen key **config.**
- Select **alarms** column with knob and confirm.
- Select **HLM** on with knob and confirm.



- Display (example):

Selecting alarm information

- Press screen key **alarm info**.
- Display (example):



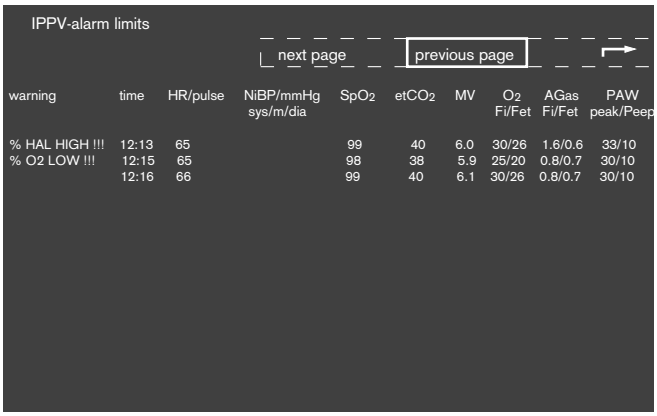
This screen key erases the measured value field and lists all activated alarms.

The display can only be seen while the key is being pressed.

Selecting list display

for subsequent documentation of earlier measured values and alarms.
The control criteria for entries can be configured, "Configuration of protocol", p. 59.

- Press **List** screen key.
- Display (example):



warning	time	HR/pulse	NiBP/mmHg sys/m/dia	SpO2	etCO2	MV	O2 Fi/Fet	AGas Fi/Fet	PAW peak/Peep
% HAL HIGH !!!	12:13	65		99	40	6.0	30/26	1.6/0.6	33/10
% O2 LOW !!!	12:15	65		98	38	5.9	25/20	0.8/0.7	30/10
	12:16	66		99	40	6.1	30/26	0.8/0.7	30/10

To "scroll" previous page

- Select **previous page** with knob and confirm.

To "scroll" next page

- Select **next page** and confirm.

Erasing list

List and trend memory are erased together.
This can only be done in **standby**.

- Press ⏻ standby key; the yellow LED is lit.
- Press **erase trend** screen key.
  Machine asks if trend is to be erased.
- Press **erase** screen key to confirm.

Selecting waveforms

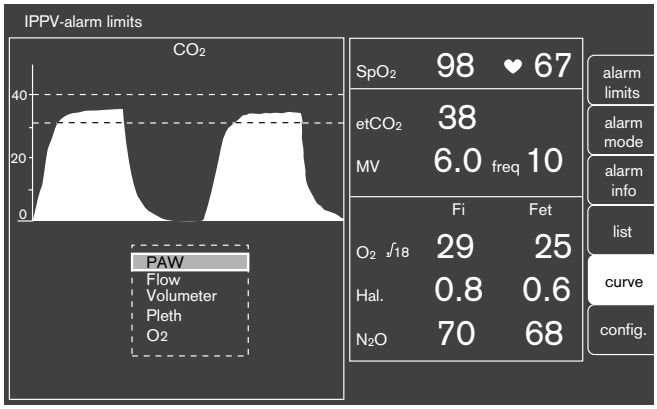
This can only be done from the defaults page.

In this menu, a second waveform can be selected for the bottom area of the screen in addition to the existing curve for CO_2 concentration (CO_2).

The following can be selected:

PAW	airway pressure
Flow	expiratory flow
Volumeter	display which shows tidal minute volume and also Paw and V_T as a bargraph display.
Pleth.	plethysmogram (option, derived from SpO_2 measurement)
O_2	concentration of oxygen breathing gas (option for sidestream measurement).

- Press **waveforms** screen key
- Display (example):



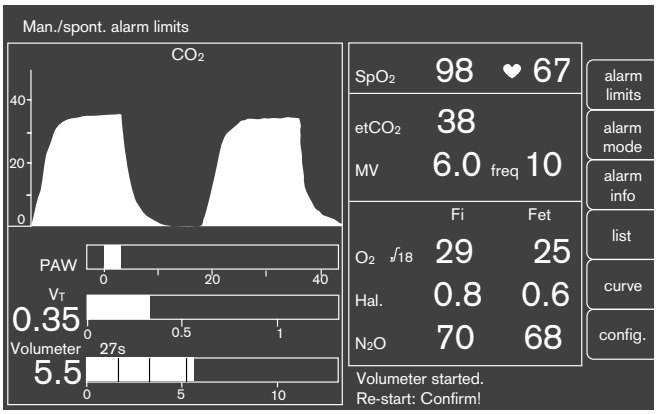
In the selection menu shown **Paw** appears on a grey background = previous selection.

- Select waveform parameter desired with knob and confirm.

Using volumeter

In **waveform** menu:

- Select **volumeter** with knob and confirm.
- Display (example):



Top bargraph display:
Actual airway pressure, **Paw**.

Middle bargraph display:
Actual tidal volume, **VT**, with digital display next to it on the left.

Bottom bargraph display:
Actual **volumeter** display (minute volume function) with digital display next to it on the left.

The scale of the bargraph display depends on the patient mode set:

	Tidal volume VT L	Minute volume MV L/min
Neonate mode	0,2	2
Adult mode	1,0	10

The time which has already elapsed is shown in seconds above the bargraph; the calculated volume is shown next to it on the left. The individual tidal strokes are separated by segments in the bargraph. The volumeter stops automatically after 60 seconds and gives an advisory sound.
The measured values are displayed for 4 minutes and are then erased.

Starting volumeter

- Press knob.
  If the knob is pressed again before the 60 seconds are up, the values are erased and the volumeter is restarted.

Configuration during operation

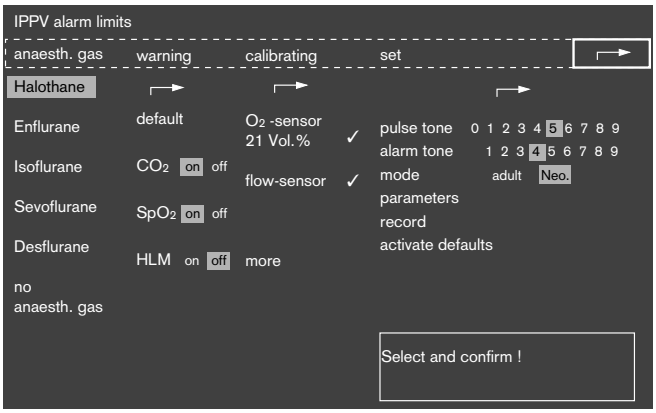
During measurement, the operator is given a configuration menu which is adapted to suit the measurement functions. This is operated as has already been described. The settings made during this time are only valid while measurement continues.

From the **defaults page** and/or from the **data page**:

- Call up **config.** with screen key.

The configuration menu/operation appears.

- Display (example):



The values shown on a grey background are appropriate for a valid setting.

- Select with knob, set and confirm as for "Changing configuration in standby", see p. 55.

The alarms for CO_2 and SpO_2 can be switched off and on again during operation.

Alarms which are switched off are identified with the  symbol.

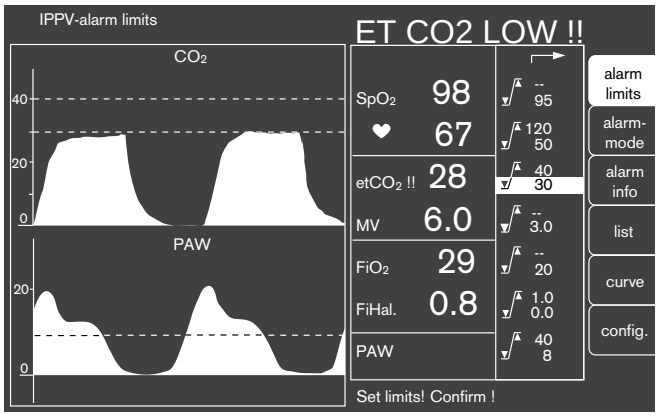
For HLM, see p. 42.

Default values configured in standby can be re- activated by pressing call up default.

Alarms

If an alarm occurs PM 8050 automatically switches to a display of alarm limits.

- Display (example lower alarm limit etCO2 has been exceeded):



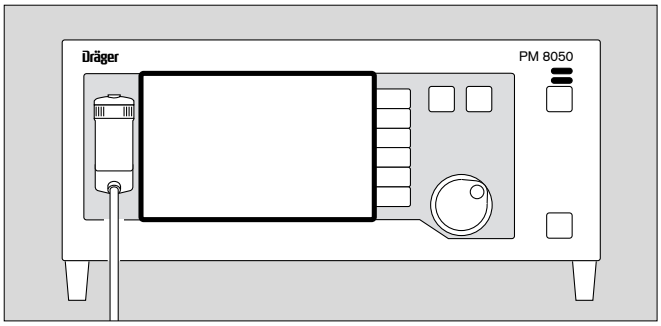
Alarm priorities

All alarms are coded according to their importance and priority and are clearly distinguished visually/audibly.

Warning messages are identified with 3 exclamation marks (**!!!**) and given priority in the display. The red (top) LED flashes and there is a sound pattern at 2.5 second intervals.

Caution messages are identified with 2 exclamation marks (**!!**). The yellow (bottom) LED flashes and there is a sound pattern at 30 second intervals.

Advisory messages are identified with 1 exclamation mark (**!**). The yellow (bottom) LED is lit and a single sound given.



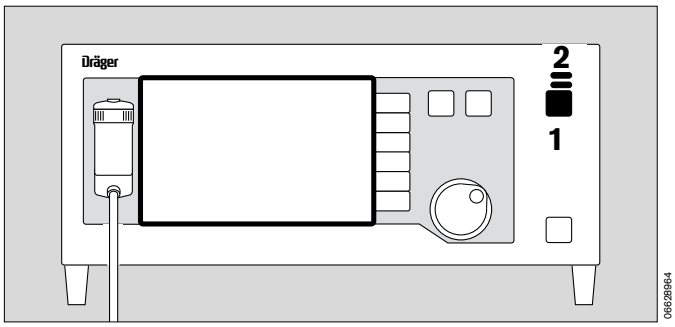
The alarm message is displayed in the alarm field on the screen and identified with the appropriate number of exclamation marks.

The exclamation marks are displayed in the measured value field after the relevant parameter. The alarm limit which has been crossed is displayed dark on a light background – it can be changed directly.

If other alarms occur at the same time, their alarm limits have a grey background. When the first alarm has been confirmed, the alarm limit which is next in priority is activated and displayed.

A "Fault – Cause – Remedy" chart, which offers help in dealing with faults, can be found on p. 72.

Suppressing alarm sound



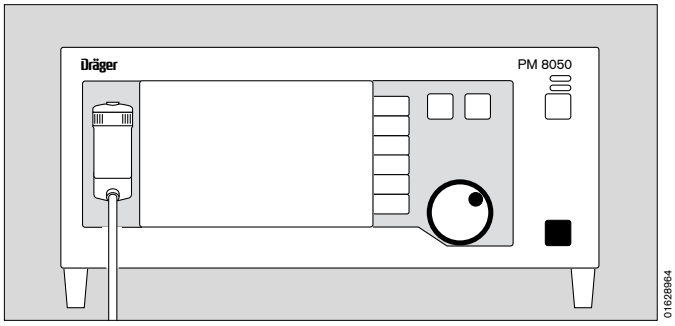
1 Press key with yellow LED lit; alarm sound is switched off for 2 minutes. However, any alarms which occur during this time will be signalled with a single sound pattern.

2 Red (top) or yellow (bottom) LED will continue to flash and alarm text stays on screen, as do exclamation marks.

To switch alarm sound on again before the 2 minutes are up:

2 Press key again; yellow LED goes out.

Change of patient



If the default settings (e.g. for alarms) have to be checked or changed during operation or between 2 anaesthetic episodes:

- Press standby key; yellow LED in key is lit.
- In **standby/configuration** menu, use knob to select **alarms** column and confirm.
- Select **defaults** line and confirm.

  The default alarm limits are re-activated.

  To configure default alarm limits, see p. 61.

Measuring SpO2 (optional)

Selecting sensor

Use Nellcor sensors only.
Observe Instructions for Use of sensors – incorrect positioning or use can damage tissues.

Select sensor according to the following criteria:

– patient's weight
– patient's movement
– possible attachment point
– patient's perfusion
– period of use

Helpful advice is provided by the table below which summarises the specific sensors available and their characteristics.

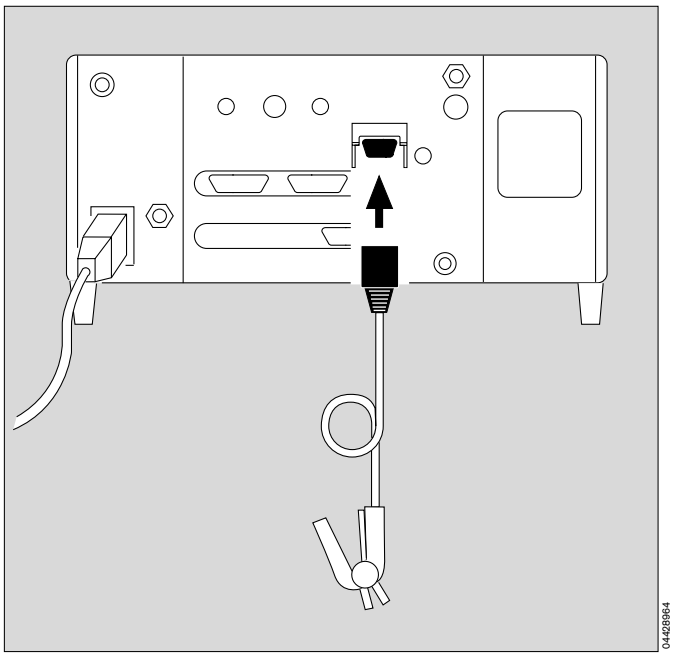
Type of sensor	OXISENSOR I-20	OXISENSOR D-20	DURASENSOR DS-100 A	OXISENSOR D-25	OXISENSOR R-15
Age grupe	Infants	Children	Adults	Adults	Adults
Patient's weight	1 to 20 kg	10 to 50 kg	>40 kg	>30 kg	>50 kg
Periode of use	Short and long-term monitoring	Short and long-term monitoring	Short-term monitoring	Short and long-term monitoring	Short and long-term monitoring
Patient's movement	Limited activity	Limited activity	Inaktive patients only	Limited activity	Inaktive patients only
Preferred measurement point	Toe	Finger	Finger	Finger	Nose
Sterility[1)]	Sterile package	Sterile package	____	Sterile package	Sterile package

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

1) in unopened, undamaged packaging

- Select suitable sensor.
  Lift flap at back of machine; connect sensor plug.

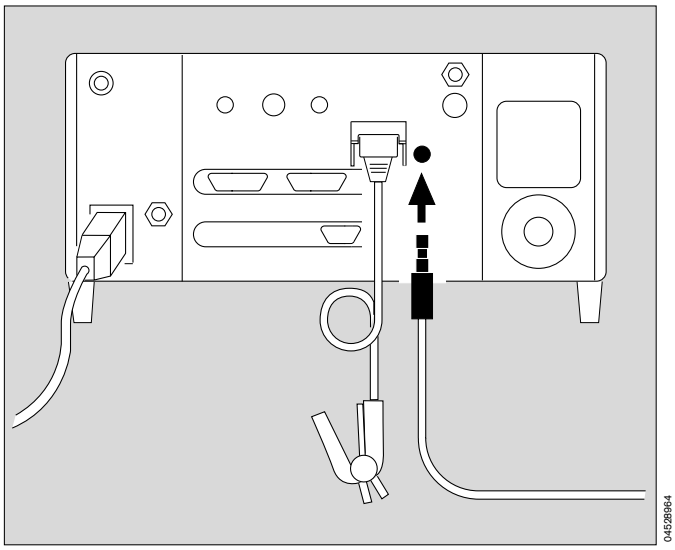
Do not allow the sensor cable to trail across the screen as SpO_2 measurement may be affected.



C-Lock ECG synchronisation (optional)

If the patient's movements are pronounced or arterial flow is very low, the SpO_2 measuring signals can be amplified with C-lock ECG synchronisation. PM 8050 receives two separate signals which show heart activity:
– an optical signal from the SpO_2 sensor
and
– an electrical signal from the ECG monitor.
PM 8050 uses the R-wave of the ECG signal for detecting the pulse and for synchronising with SpO_2 measurement.

- Connect ECG signal of ECG monitor to the back of PM 8050 with cable and latching probe.
  For requirements for connecting electrical signal and for probe layout see "Technical Data", p. 81.



Delayed ECG signal

If the ECG signal to the QRS complex is delayed by more than 40 milliseconds, synchronisation can be impaired.
If there is any suspicion that this malfunction could occur, PM 8050 must be used without C- lock ECG synchronisation.

How to avoid artefacts

Use only Nellcor sensor and position them properly – otherwise there will be a danger of incorrect measurement and damage to tissue.

Do not use damaged sensors with exposed electrical contacts – these could cause an electric shock.

Do not re-use adhesive strip from Oxiband OXI- A/N and OXI-P/I sensors, since proper adhesion could no longer be guaranteed.
Do not fix adhesive strip too tight.
Never use two adhesive strips. Doing so might cause venous pulsation and cause the pulse signal to fail.

A high intrathoracic pressure, attempted resuscitation or other consecutive impairments of the venous return flow can result in venous pulsation and the failure of the pulse signal.

Failure of the pulse signal may occur if there is shock, low blood pressure, severe vasoconstriction, severe anaemia, hypothermia, an arterial blockage in the vicinity of the sensor or asystole.

Cover the sensor if there are bright light sources (such as surgical lamps or direct sunlight), otherwise the pulse signal may fail or inaccurate measurements occur.

Do not position the sensor on limbs where there is an arterial catheter, blood pressure cuff or intravascular venous infusion as the pulse signal may fail and measurement may be inaccurate.

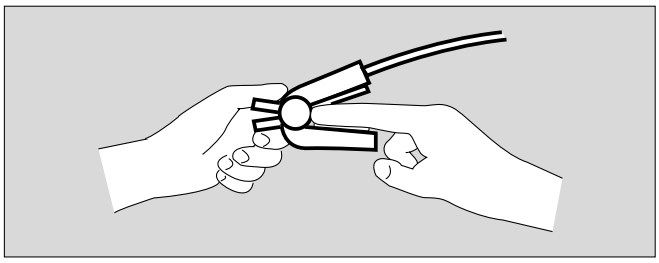
Considerable amounts of dyshaemoglobin, such as carboxyhaemoglobin or methaemoglobin, can produce inaccurate measurement.

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

The accuracy of measurement may be affected by electro-cauterisers. Position mains cable and sensor as far away as possible from electro- cauteriser and its neutral electrode.

Pronounced movement of the patient can impair the performance of the sensor and result in inaccurate measurements. In these circumstances, change the attachment point in order to reduce movement artefacts.

Attaching DS-100A Durasensor

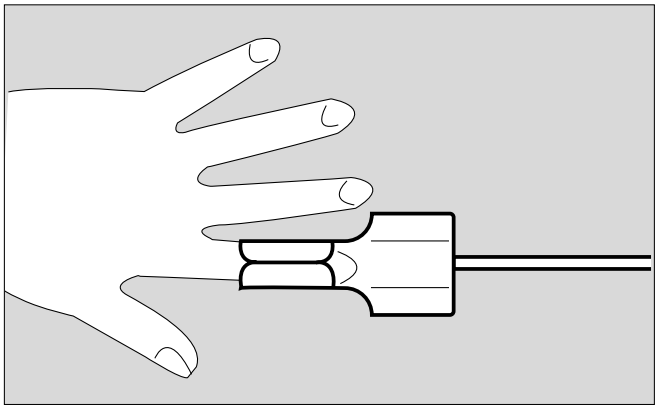


Re-usable sensor for short-term monitoring of relatively immobile patients with a body weight of more than 40 kg.

Preferably put sensor on index finger, but another finger may be used. Use little finger for large or obese patients.

- Open clip and slip it on to finger. End of finger must make contact with stop. Put soft padding around nail and tip of finger. The cable should be above finger.
- Make sure that clip is not too tight and that it does not cause pressure marks.

Attaching D-25 and D-20 Oxisensors

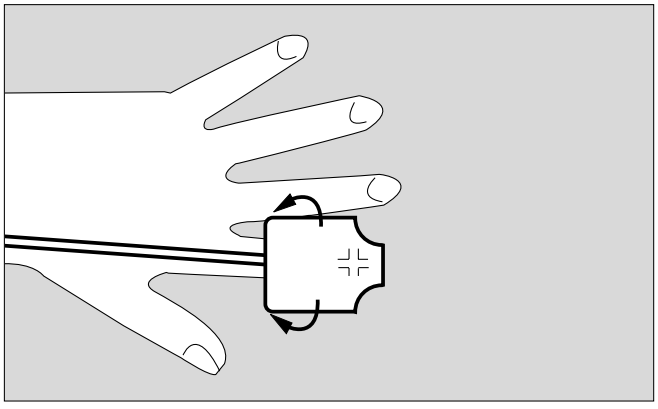


Adhesive sensors for short-term and long-term monitoring of patients with limited activity and a body weight of more than 15 kg, or more than 50 kg.

Long finger nails make it difficult to attach a sensor. Coloured nail varnish affects the accuracy of measurement.

- Trim nail, if necessary.
- Remove nail varnish, if necessary.
- Remove protective foil from adhesive surface.
- Place sensor on flat surface with adhesive side uppermost.

- Place tip of finger over centre of optical element of sensor on side opposite cable, wrap lateral adhesive strips around finger.



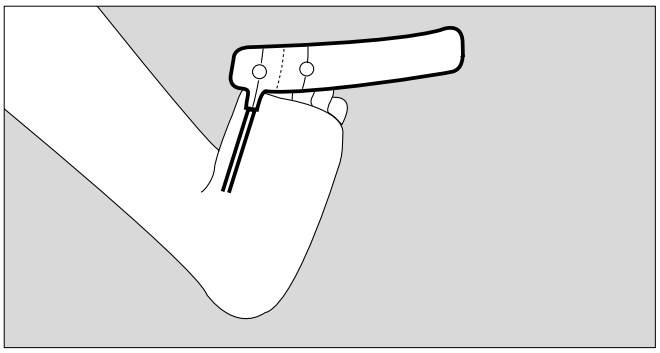
- Bend other side of sensor right over finger tip to cover under side of finger taking care that the marks are exactly opposite one another. Press on sensor and wrap lateral adhesive strips around finger.

  If the patient is extremely obese it is better to use a finger which is thinner than the index finger.

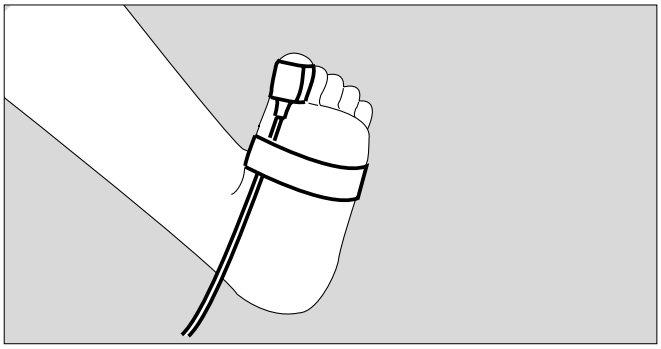
Attaching I-20 Oxisensor

Adhesive sensor for short-term and long-term monitoring of patients with limited activity and a body weight of between 3 and 15 kg.

- Remove protective foil from adhesive surface.



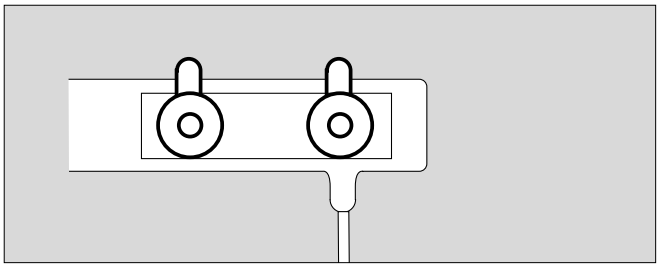
- Put sensor on underside of big toe with dotted line along inside of toe and mark on centre of toe.



- Wrap sensor around toe placing other mark on centre of toe nail.
- Attach sensor cable firmly to foot with extra adhesive strip.

Re-using sensor

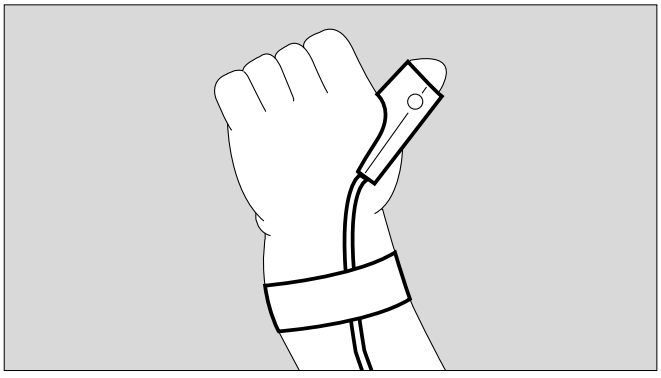
The sensor can be re-used if the plaster still holds. Extra small stickers may help to improve adhesion.



- Grasp hold of stickers on blue strip, detach backing paper and remove protective foil.
- Attach one sticker to each optical element.
- Position sensor as previously described.

Another measuring point

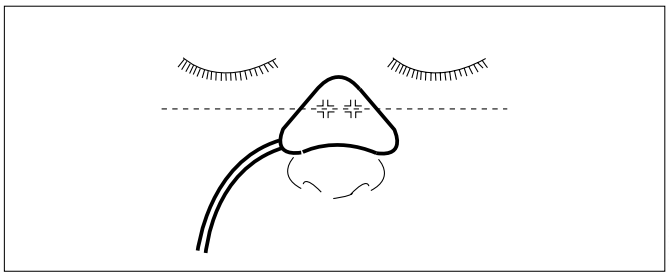
The big toe is the best place to attach this sensor because it moves less than the hand, but if the big toe is not available, the thumb can also be used.



- Remove protective foil from adhesive surfaces.
- Put sensor on top part of thumb with dotted line along the edge of thumb and mark underneath thumb directly opposite nail.
- Wrap sensor around thumb placing other mark on centre of thumb nail.
- Attach sensor cable to wrist with extra adhesive strip.

Attaching R-15 Oxisensor

A single-use adhesive sensor for short-term and long-term monitoring of **inactive** patients with a body weight of over 50 kg. This sensor should be used when patients have severe vascular constriction or poor circulation.



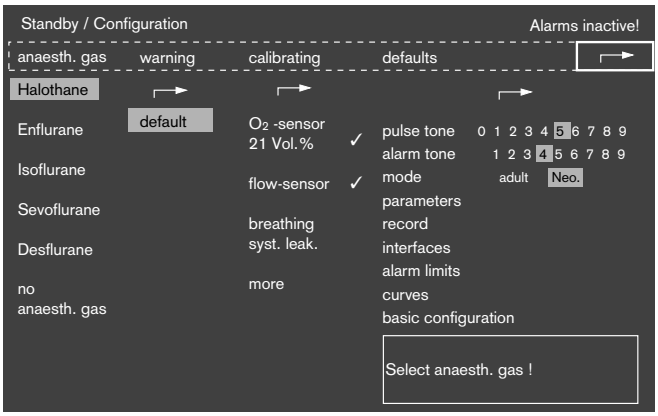
- Clean bridge of nose with contents of ampoule supplied – protect eyes.
- Remove protective foil on sensor.
- Place sensor symmetrically on bridge of nose: the two symbols should rest on border between bone and cartilage.
- Press sensor firmly into position: hold for 10 seconds – to ensure adhesion.
- Do not use the R-15 sensor if patient is nasally intubated or wearing a mask.

Changing configuration in standby

Configuration changes which have been carried out in standby under »defaults« remain active every time the machine is switched on – and during measurement after »call-up defaults«.

In contrast, configuration changes during operation only remain valid until the machine is switched off.

- Press **config.** screen key.
- Display (example):



The menu offers the following settings:

– **defaults**

– **calibration**

– **alarms**

– **anaesth. gas**

Select, set and confirm with knob.

Fields with a grey background display current valid settings.

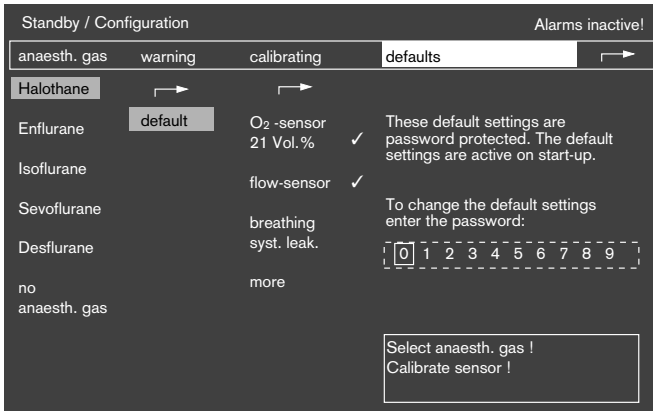
Fields with a white background show which menu steps have already been used to open the field.

↱ symbol means return to menu at previous level.

Setting default values

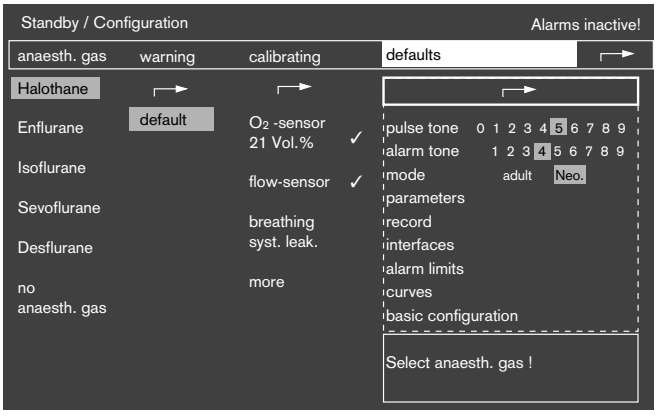
Default values remain valid every time the machine is switched on and during measurement after »call-up defaults«.

- Select **defaults** line and confirm, using knob.
- Display (example):



The machine requests entry of a four-digit password (made known during machine training) to prevent unauthorised changes to basic functions. This function can be switched off by DrägerService.

- Select digits individually from line on offer, using knob, and confirm. Password number is then shown below with asterisks (* * * *).
  If password has been entered correctly, menu for selecting default values appears.
- Display (example):



Adjusting pulse tone

0 = off

9 = maximum volume

- Select **pulse tone** with knob and confirm.
  The cursor jumps automatically to value selected previously (example, 5)
- Set value with knob and confirm.

Adjusting alarm sound

1 = minimum volume

9 = maximum volume

- Select **alarm sound** with knob and confirm.
  The cursor jumps automatically to the value selected previous (example, 4)
- Set value with knob and confirm.

Selecting mode

adult = adult mode

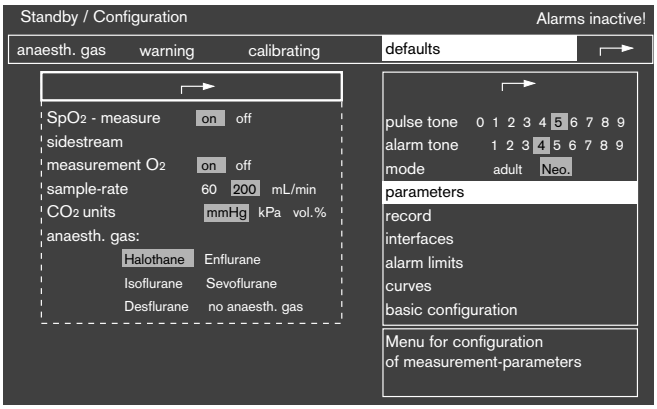
neo. = neonate mode

Scaling of volumeter and trend display are carried out at the same time.

- Select **mode** with knob and confirm.
- Select **adult** or **neo.** and confirm.

Selecting parameters

- Select **parameters** with knob and confirm.
  The **parameter** menu is opened
- Display (example):



Switching SpO_2 measurement (option) on/off:

- Select **SpO_2 measure** line with knob and confirm.
- Select **on/off** and confirm.

Switching sidestream O_2 measurement on/off:

- Select **sidestream O_2 measurement** line with knob and confirm.
- Select **on/off** and confirm.

Selecting sample flow:

- Select **sample flow** with knob and confirm.
- Select **60/200 mL/min** and confirm.

Selecting CO_2 units:

- Select **CO_2 units** line with knob and confirm.
  The measuring unit previously selected is shown on a grey background.
- Select measuring unit desired with knob and confirm.

Selecting anaesthetic gas:

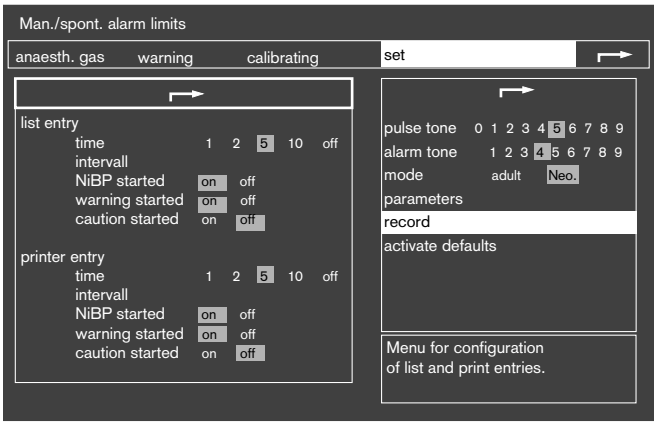
The anaesthetic gas selected in the menu under default values applies every time the machine is switched on and also during measurement after »call-up defaults«.

- Select **anaesth. gas** line with knob and confirm.
- Select anaesthetic gas desired and confirm.

Protocol

For stipulating which incidents will be automatically entered in the protocol list and printed out on the associated protocol printer.

- Select **protocol** with knob and confirm.
- Display (example):



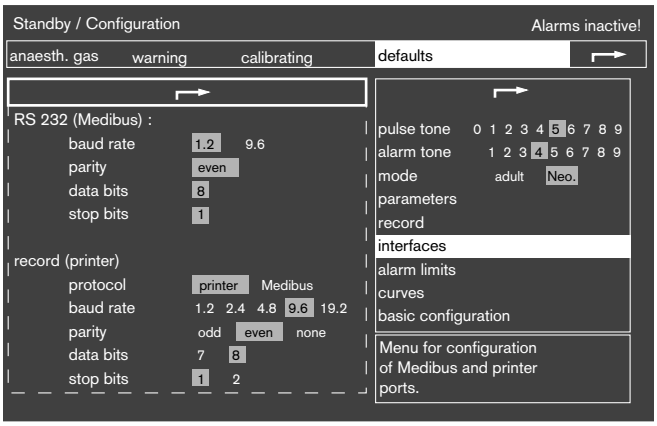
Time interval (min)	Fixed time interval in minutes between entries.
NiBP measured	Each NiBP measurement is entered with new measured values.
Alarm given	Entry made when an alarm is triggered.
Caution given	Entry made when a caution message is triggered.

- Select entry with knob and confirm.

Configuring interfaces

To configure Dräger RS 232 MEDIBUS interface and printer interface.

- Select **interfaces** with knob and confirm.
- Display (example):



Baud rate Data communication speed (can be changed, see Instructions for Use of machine connected).

Parity This display cannot be changed for MEDIBUS and is for information only.

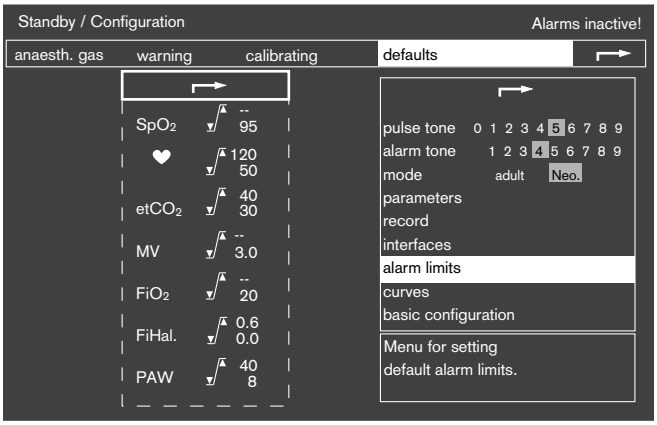
Data bits This display cannot be changed for MEDIBUS and is for information only.

Stop bits This display cannot be changed for MEDIBUS and is for information only.

Protocol selection The printer interface can also be used as a second MEDIBUS interface.

Selecting default alarm limits

- Select **alarm limits** desired with knob and confirm.
- Display (example):



- Select desired alarm limit with knob and confirm.
  The default alarm limit is displayed dark on a light background.
- Set value with knob and confirm.
  The value is displayed again in the normal way. The cursor jumps to the next default alarm limit.
- Set next default alarm limit, as described.

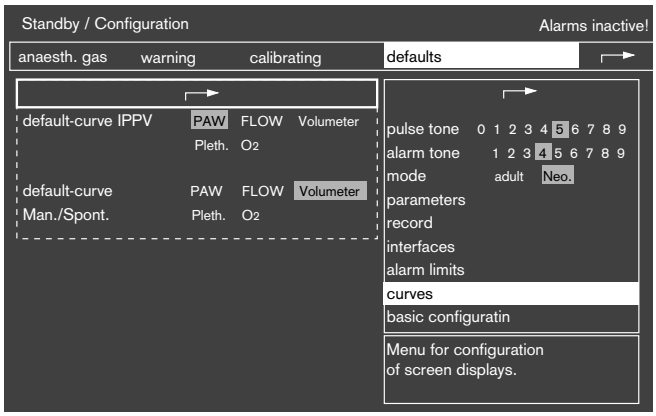
The new default alarm limits which have been set become effective only when machine is switched on again (cold start) or when »defaults« line is selected in »alarm limits« menu on »standby/configuration« page.

The hospital's own specific default settings should be entered in the table on page 89.

Configuring waveforms

To select a second default waveform.

- Select **waveforms** with knob and confirm.
- Display (example):



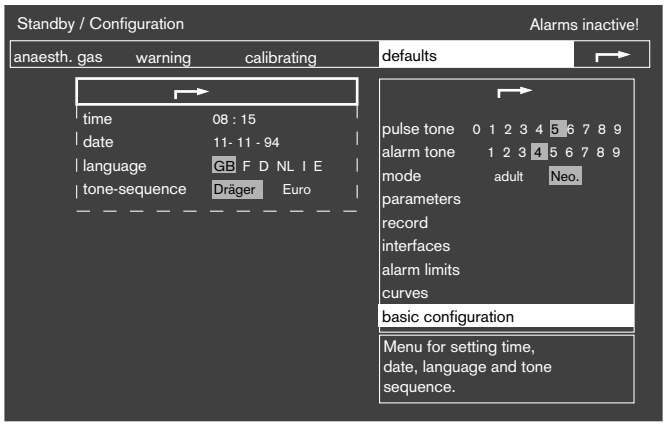
Selecting second default waveform

- Select **default waveform IPPV** or **default waveform Man./spont.** line with knob (as described for default alarm limits).
- The default waveforms previously selected are displayed on a grey background.
- Select new waveform with knob and confirm.
  The waveform selected only becomes effective when machine is switched on again (cold start) or when measuring after »call-up defaults«.

Carrying out basic configuration

for clock, date, language etc.

- Select **basic configuration** line with knob and confirm.
- Display:



Setting time/date

- Select **time** line with knob and confirm:
  cursor jumps to hour.
- Confirm with knob; the value is displayed light on a dark background and can now be changed with knob and confirmed.
  Set minutes in same way and confirm
- Set date and confirm – as described.

Setting language of display text:

The language which was set last time is displayed on a grey background.

Alternatives which may be selected:

English (**GB**)

French (**F**)

German (**D**)

Dutch (**NL**)

Italian (**I**)

Spanish (**E**)

Selecting another language:

- Select **language** line with knob and confirm.
- Select national initials for language with knob and confirm; texts in menu now appear in the new language.

Setting sound pattern:

- Select **sound pattern** line with knob and confirm.
- Select Dräger alarm sound pattern – or Eurostandard* alarm sound pattern – and confirm.

---

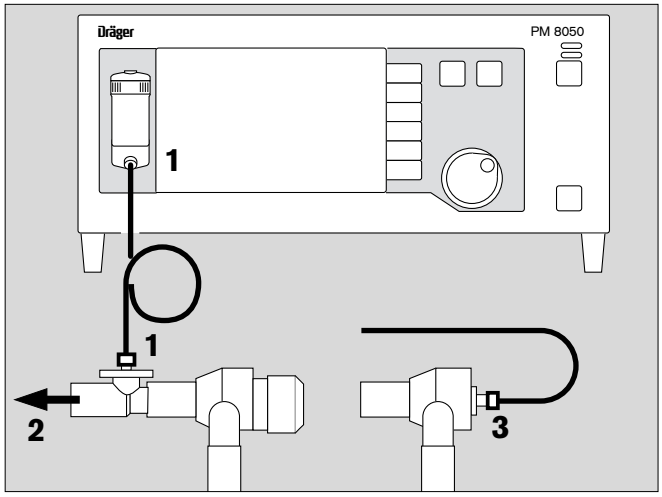
* Eurostandard EN 475

Care

Stripping down

The procedure for stripping down the sensors is illustrated for the Dräger Circle System 9 by way of example.

- Note the corresponding Instructions for Use when using other machines.



1 Unscrew filter and sampling line from water trap and T-piece. These are disposed of as household waste = disposable articles.

2 Remove T-piece from Y-piece

and

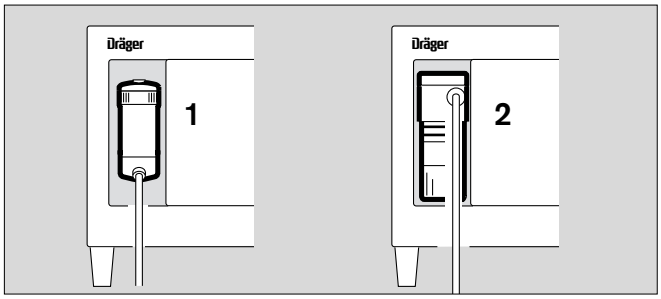
3 unscrew sampling line from Y-piece.

Emptying water trap

PM 8050 has two versions

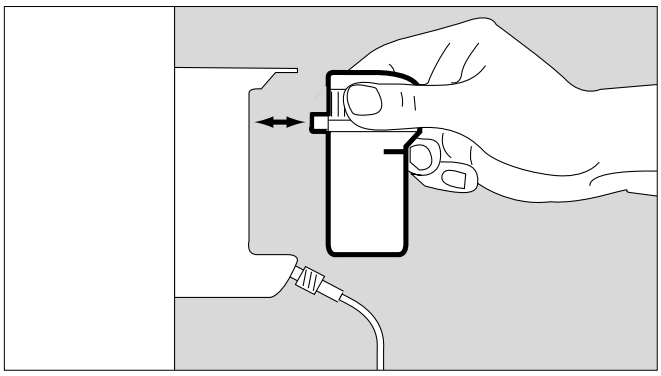
1 Waterlock

2 Water trap with separator



Using waterlock

- Hold the water trap by the knurled surface and pull it out.



Replace:

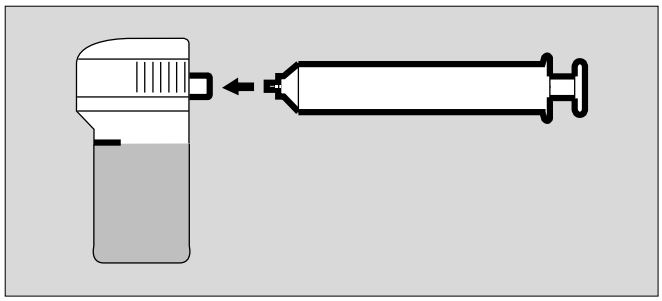
– when severely soiled and

– when used for more than the max. period of 4 weeks.

Emptying:

- Insert empty syringe without cannula, min. 20 mL, in connector.
- Extract water, remove syringe and dispose of full syringe as household refuse.
- Slide water trap back into holder – until you feel it engage.

- **Alcohol and cleaning agents/disinfectants must not be allowed to enter the water trap!**
- **The water trap must not be washed or sterilized otherwise it may be damaged!**



Disposal:

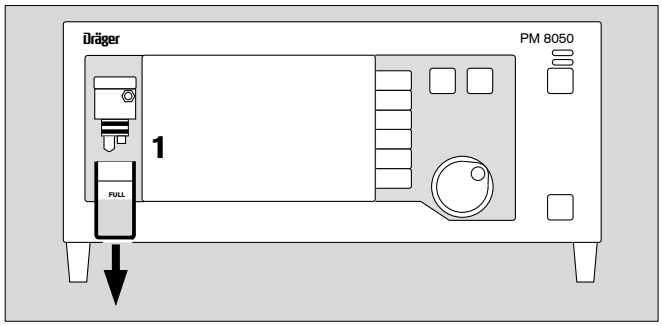
- Water traps which have been taken out of service can be disposed of as commercial waste similar to household waste.
  Key code 91101

Sampling in the sidestream may fail if the container overflows or if the water separator is faulty!

Emptying water trap with separator

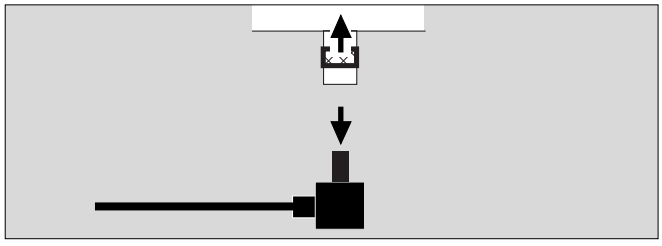
1 Pull water trap container downwards and empty it.
  Note the hospital hygiene regulations. Risk of infection!

- Prepare the container for sterilization.



Removing pressure measuring line

- Disconnect plug on pressure measuring line = slide ring on coupling back.
- Disconnect pressure measuring line and filter from back of machine and let condensate drain from measuring line.

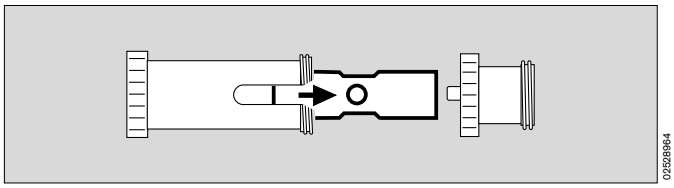


Removing flow sensor

- Disconnect lead from flow sensor.

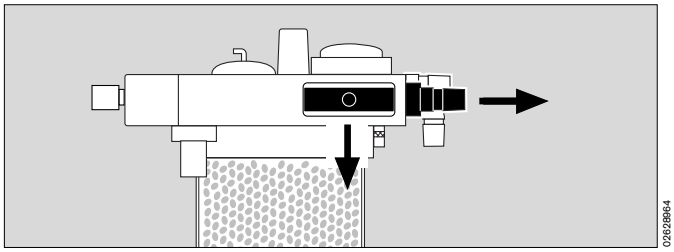
On Circle System 9:

- Remove and unscrew flow measuring connector with flow sensor, remove flow sensor.



On COSY:

- Unscrew expiration nozzle.
- Remove flow sensor.



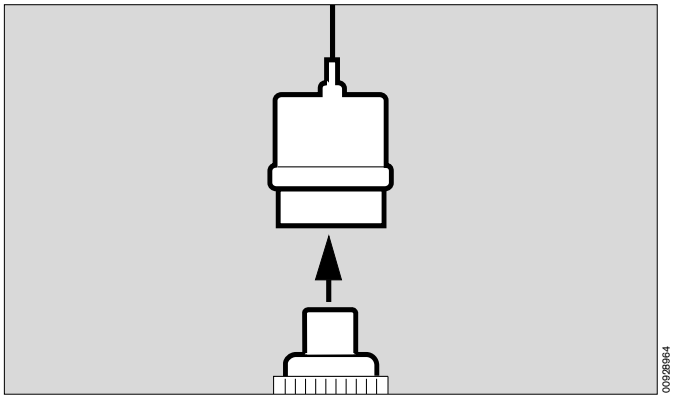
The flow sensor cannot be disinfected/cleaned in the washing machine, nor can it be sterilized with hot steam.

- Disinfect flow sensor for approx. 1 hour in 70% ethanol solution.
  Leave sensor to flash off in air for at least 30 minutes.
  The sensor may be destroyed by any residual alcohol during calibration.
- The flow sensor can be reused as long as it can be calibrated successfully.

Removing O_2 sensor

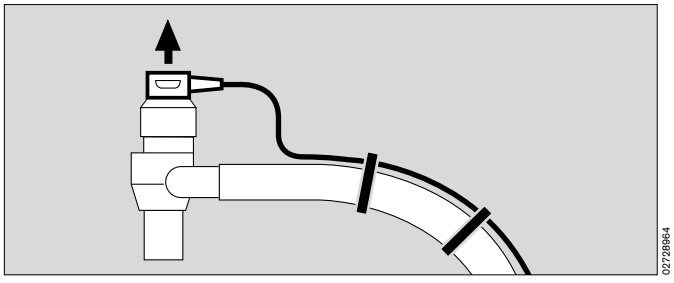
- Remove inspiratory O_2 sensor and unplug connector from back of machine.

  The O_2 sensor for sidestream measurement remains in the PM 8050.



Removing temperature sensor

- Pull temperature sensor out of Y-piece, pull Y-piece off ventilation hoses. Prise cable out of hose clips.
- Unplug temperature sensor connector from back of machine.



Cleaning/Disinfecting/Sterilizing

For disinfection purposes use preparations from the surface-disinfectant group. For reasons of material compatibility suitable preparations are those based on:

– aldehydes
– alcohols
– quarternary ammonium compounds.

Not suitable are:

– phenols
– halogen-releasing compounds
– strong organic acids
– oxygen-releasing compounds.

For users in the Federal Republic of Germany we recommend disinfectants contained in the latest DGHM list (DGHM: German Society for Hygiene and Microbiology).
The DGHM list also indicates the active substances on which each disinfectant is based.
For countries in which the DGHM list is not known, we recommend the above-mentioned substances.

Do not allow alcohol or alcohol-based agents to get into the sampling hose!
Alcohol distorts the results when concentration is being measured.

Inspiratory O_2 sensor

- **Do not disinfect in liquid or autoclave.**
- Wipe off any dirt on the housing or cable with a damp disposable cloth; wipe any dirt off the wire screen of the sensor capsule with a disposable cloth moistened with distilled water only.

Temperature sensor, pressure-measuring line and filter, combined measuring connector for flow sensor, water trap container, T-piece, Y-piece with Luer lock

- Wipe any dirt off with a damp disposable cloth.
- Sterilize in hot steam at 134 °C.

PM 8050 and flow sensor cable

- Wipe off any dirt with a damp disposable cloth.
- Wipe disinfection, for instance with Buraton 10 F (Schülke & Mayr, Norderstedt).
  Follow manufacturer's instructions.

Before re-use:

- To re-assemble the unit, see p. 10 – 16.
- To check before use, see p. 68.

Checking before use

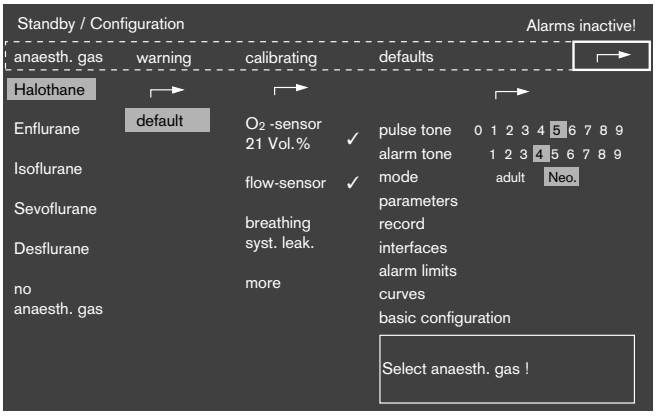
Following care procedures.

1 Push mains switch in at back – as far as it will go = ON.

- Test picture with software version should appear on screen:

- Machine carries out a self-test.
  All LEDs and display segments are lit for about 2 seconds; LED in ⏻ standby key remains lit.

  2 alarm sounds commence.
  Internal programme memories are tested.
- Self-test lasts about 1 minute.
- Screen display:



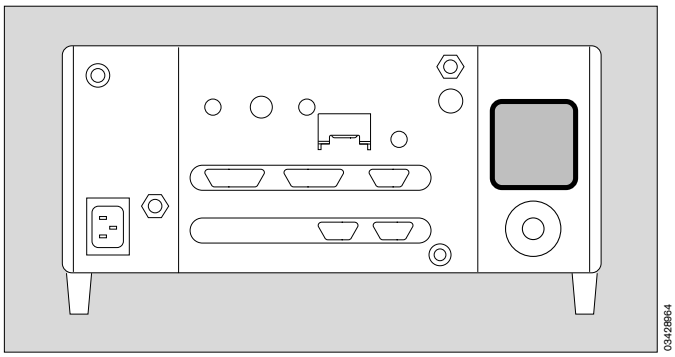
PM 8050 is ready for use.

Maintenance Intervals

Always clean and disinfect the apparatus or the relevant components before undertaking any maintenance work and also before returning to the manufacturer for repair!

Water separator	Replace when dirty or if the message **CO_2 line?!** is displayed (and the cause is not an open, uninstalled sampled line). Can be discarded as household waste.
O_2 sensor	Replace when no longer possible to calibrate or if the message **FiO_2 INOP** is displayed. For disposal, see page 71.
Bacterial filter of the measured gas return line	Replace every six months. Can be incinerated at over 800 °C with low pollutant emissions.
Cooling air filter	Every month, either clean and dry thoroughly or replace. Replace at the latest after 1 year. Can be discarded as household waste.
Optical measuring bank for measuring the anaesthetic gas concentration	Must be tested by specialists every 6 months.
Inspection and servicing	Every 6 months by trained service personnel.
Time Keeper RAMs and battery pack	Must be replaced by specialists after 3 years. Must be discarded in accordance with local waste disposal regulations.

Replacing cooling-air filter

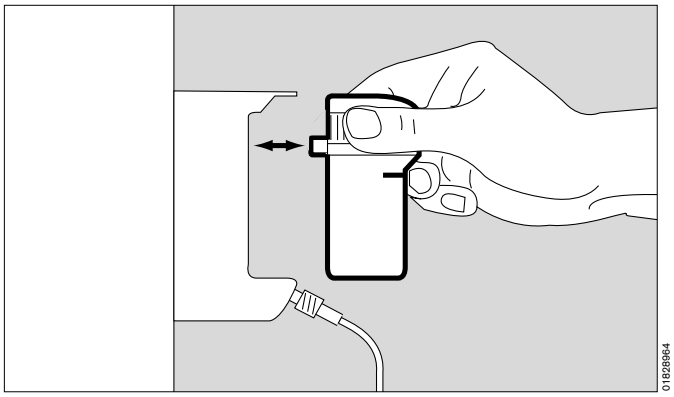


- Remove filter from holder.
- Renew, or clean in warm water containing detergent and dry thoroughly.
- Replace filter in holder making sure that there are no creases.

Replacing water trap/water separator

When soiled
or:
following the message **CO_2 LINE ? !** when the sampling line is clear.

Replacing waterlock

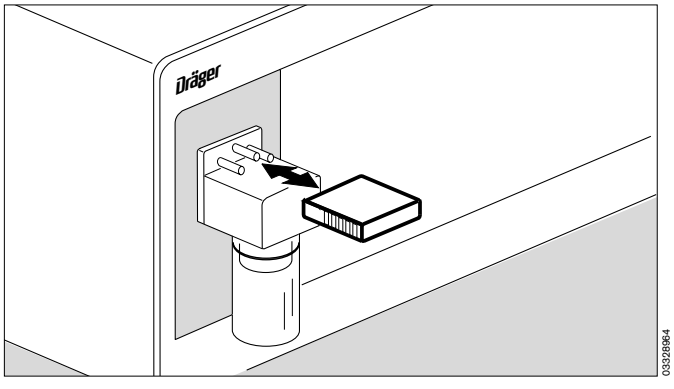


- Hold water trap by the knurled surface and pull it out.
- Remove new water trap from packaging.
- Note date in space provided on new water trap.
- Hold water trap by the knurled surface and push it into holder – until you feel it engage.

Disposal

- Water traps which have been taken out of service can be disposed of as commercial waste similar to household waste.
  Key code 91101

Replacing water separator



- Hold water separator by the sides and pull it out.
- Push new water separator into guide as far as it will go.
- Dispose of old water separator with household waste.

Sampling in the sidestream may fail if the water separator is faulty!

Disposal of used batteries and O_2 sensors

Batteries and O_2 sensors:

- must not be thrown in the fire: danger of explosion!
- must not be forced open: risk of chemical burning and corrosion!
- Batteries must not be recharged.

Batteries are special waste.

- Batteries must be disposed of in accordance with local waste disposal regulations.

Used O_2 sensors can be returned to Dräger.

Disposal of used apparatus

– At the end of its service life

The PM 8050 can be returned to Dräger for correct disposal.

Fault – Cause – Remedy

PM 8050 lists alarm messages in three priorities indicated by exclamation marks:

Warning = !!! Message with top priority
Caution = !! Message with middle priority
Advisory = ! Message with low priority

The following table lists some of the possible causes of an alarm to assist the operator in identifying and remedying the actual cause.

The messages are listed in alphabetical order.

Display	Cause	Remedy
AGT ERR **!**	Fault in anaesthetic gas measurement.	Call DrägerService.
AGT NOT SEL **!**	Anaesthetic gas not selected.	Check anaesthetic gas to be used on anaesthetic vaporiser and select.
APNEA CO2 **!!!**	Breathing/ventilation has stopped. No breaths for 30 seconds. (In alarm mode "Man./spont. alarm limits" no breaths for 60 seconds).	**Ventilate patient manually immediately.** Check patient's spontaneous breathing. Check anaesthetic ventilator.
APNEA PRES **!!!**	Ventilation has stopped. No change in pressure for 15 seconds.	**Ventilate patient manually immediately.**
	Not enough fresh gas.	Check fresh-gas setting on anaesthetic machine.
	Leak in hose system.	Check hose system.
APNEA VOL **!!!**	Ventilation has stopped. No expired tidal volume for 15 seconds.	**Ventilate patient manually immediately.** Check anaesthetic ventilator.
	Not enough fresh gas.	Check fresh-gas setting on anaesthetic machine.
	Kinked tube. Leak in hose system.	Check hose system.
AW-TEMP **!!!**	Inspiratory breathing gas temperature is higher than 40 °C.	Switch off breathing gas humidifier. When temperature has dropped to 37 °C, set lower heat level.
CO2/AGT ERR **!**	Fault in CO_2/anaesthetic gas measurement and therefore fault in sidestream O_2 measurement.	Switch to inspiratory O_2 measurement, or call DrägerService.
CO2 ERR **!**	Fault in CO_2 gas measurement.	Call DrägerService.
CO2 LINE BLK ? **!**	Sampling hose blocked.	Check sampling hose, filter in T-piece and filter in water trap; replace if necessary. Check hose to scavenging system for kinking.
COOLING 8050 ?	Temperature inside machine is too high.	Clean filter on back of machine. Call DrägerService.

Display	Cause	Remedy
ET CO2 ↗ !!	The upper alarm limit for endexpiratory CO_2 concentration has been exceeded for at least 2 breaths.	Check ventilation.
ET CO2 ↘ !!	The lower alarm limit for endexpiratory CO_2 concentration has been crossed for at least 2 breaths.	Check ventilation.
% HAL ↗ !!! % ISO ↗ !!! % ENF ↗ !!! % DES ↗ !!! % SEV ↗ !!!	The inspiratory concentration of each of these anaesthetic agents is above the upper alarm limit. The upper alarm limit has been exceeded for at least 2 breaths.	Check settings on anaesthetic agent vaporiser.
% HAL ↘ !! % ISO ↘ !! % ENF ↘ !! % DES ↘ !! % SEV ↘ !!	The inspiratory concentration of each of these anaesthetic agents is below the lower alarm limit. The lower alarm limit has been crossed for at least 2 breaths.	Check setting on anaesthetic vaporiser.
INSP CO2 ↗ !	Inspiratory CO_2 concentration is above upper alarm limit of 5 mmHg.	Replace soda lime in circle system of anaesthetic machine.
MIN VOL ↘ !!	Lower alarm limit for minute volume has been crossed.	Check anaesthetic machine.
	Tube blocked/kinked.	Check tube.
	Leak in breathing system.	Make breathing system leakproof.
	Loss in volume through pressure limitation. Lung compliance is reduced.	Correct pattern of ventilation.
	Flow sensor not calibrated or faulty.	Calibrate flow sensor, see p.23. Replace if necessary.
MIN VOL ↗ !!	Upper alarm limit for minute volume has been exceeded.	Correct tidal volume or breathing frequency.
N2O ERR !	Fault in N_2O gas measurement.	Call DrägerService.
NO SPO2 PULSE ? !!!	No pulse signal detected for about 10 seconds during SpO_2 measurement.	**Check patient condition.** Check SpO_2 sensor.
% O2 ↗ !!	The inspiratory O_2 concentration is higher than the upper alarm limit. O_2 flush used?	Check O_2 concentration in fresh-gas flow.
% O2 ↘ !!!	The inspiratory O_2 concentration is below the lower alarm limit.	Check O_2 supply. Check setting on O_2 flowmeter.
% O2 ERR !	O_2 sensor for sidestream measurement faulty.	Replace O_2 sensor for sidestream measurement, see p.14. Call DrägerService.

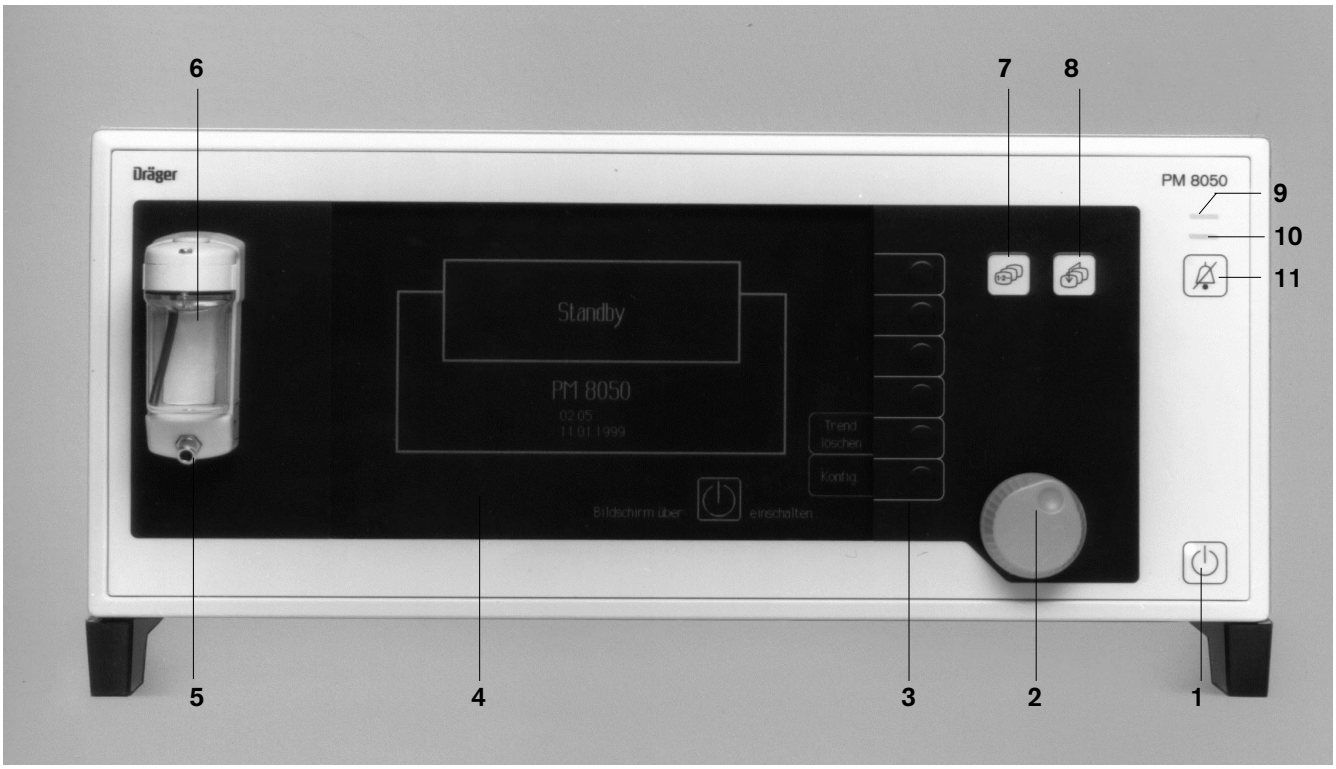
Caution messages

Display	Cause	Remedy
% O2 ERR ! CO2 ERR !	Sidestream measurement is faulty.	Switch to inspiratory O_2 measurement. Call DrägerService.
% O2 ERR !	Sensor for inspiratory O_2 measurement incorrectly calibrated.	Calibrate sensor, see p.22.
	Sensor has been changed and/or not calibrated.	Calibrate sensor.
	Sensor faulty. Sensor not fitted.	Replace sensor capsule, see p.11, and calibrate.
	Sensor cable faulty.	Replace O_2 sensor housing.
	Genuine Dräger sensor capsule not used.	Use Dräger sensor capsule.
PAW ⟋▲ !!!	Upper alarm limit for airway pressure has been exceeded, kinked ventilation hose, stenosis.	Check hose system on anaesthetic machine.
	Pressure limit set too high.	Correct pressure limit on anaesthetic machine.
PAW NEGATIVE !!!	Not enough fresh gas. Mean pressure (P_{mean}) lower than –2 mbar. Airway pressure (P_{aw}) lower than –7 mbar.	Set adequate fresh-gas supply on anaesthetic machine.
PM 8050 ERR !!!	Internal machine fault. Machine cannot be used.	Switch off machine and call DrägerService.
PRESS ERR !	Sensor faulty.	Call DrägerService.
PRESSURE LIMIT !	Ventilator operates with pressure limitation.	Check tube / filter.
	Lung compliance has changed. Tube is buckled. Inspiratory filter clogged.	Increase Pmax if necessary.
	Fault in expiration valve. Measured tidal volume may be too high.	Check expiration filter.
RS 232 COM ERR !	Communication via RS 232 interface interrupted.	Check plug connections on both PM 8050 and on machine which is connected.
SPEAKER FAIL !	No alarm sound. Loudspeaker faulty.	Call DrägerService.
SPO2 ERR !	Fault in SpO_2 measurement.	Call DrägerService.
SPO2 ⟋▲ !!	Oxygen saturation higher than upper alarm limit.	Check O_2 concentration in fresh-gas flow. Check ventilation.
SPO2 ▼⟋ !!!	Oxygen saturation is below the lower alarm limit.	Check ventilation. Check O_2 concentration of fresh gas.

Advisory messages

Display	Cause	Remedy
SPO2 PULSE ⌐▲ !!	Pulse rate is higher than the upper alarm limit set.	
SPO2 PULSE ▼⌐ !!!	Pulse rate has dropped below alarm limit set.	**Check patient condition.**
SPO2SEN DISC ? !	SpO_2 sensor not connected.	Check sensor connection.
VOL ERR !	Sensor incorrectly calibrated.	Calibrate sensor, see p. 23.
	Sensor not fitted.	Fit sensor correctly.
	Sensor faulty.	Replace sensor and calibrate.
	Cable faulty.	Replace cable and calibrate sensor.

What's What



Front view

1 Key for standby or measurement. Yellow LED is lit for standby.

2 Knob to select menu items = rotate and to confirm = press

3 Screen keys

4 Screen

5 Luer-lock connector for sampling hose

6 Water trap

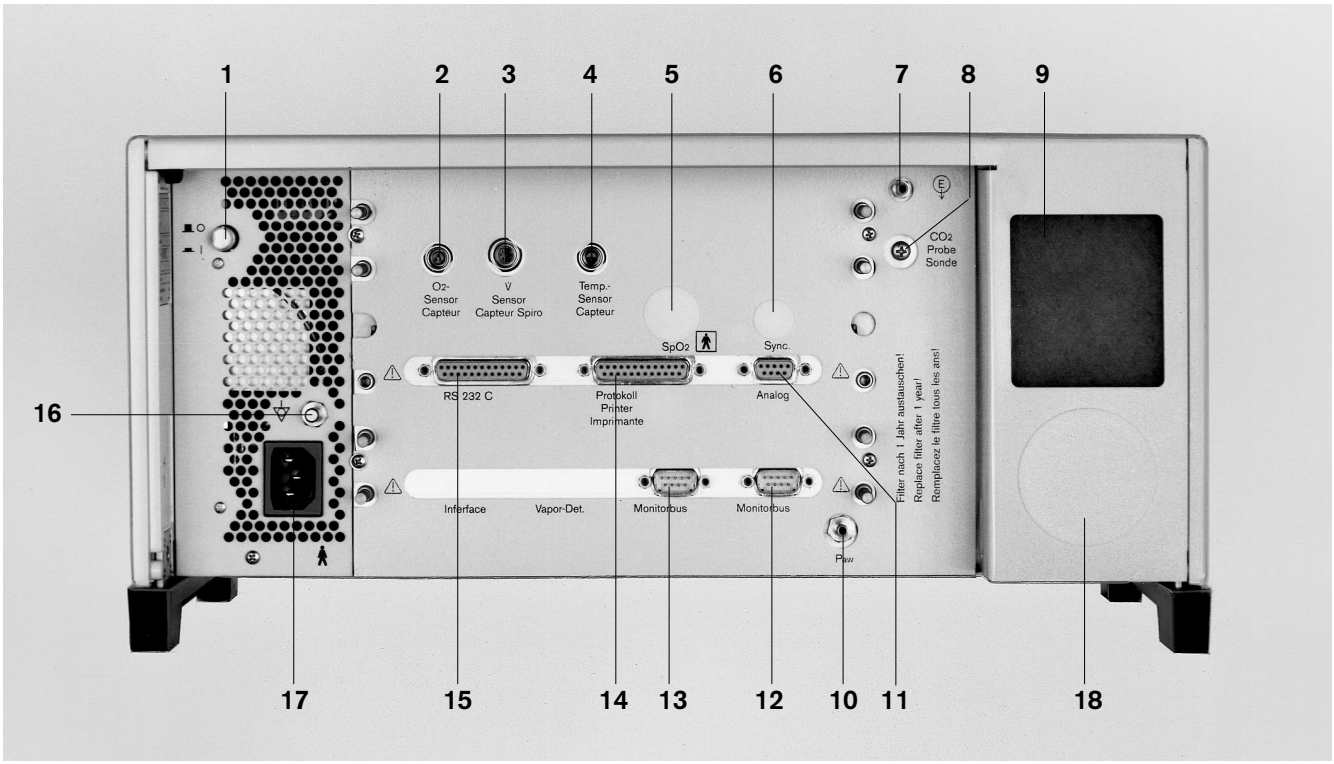
7 Key for requesting defaults page, data page and trend page in sequence

8 Key to call up defaults page

9 Red alarm LED

10 Yellow caution/advisory LED

11 Key to suppress alarm sound for 2 minutes and to re-activate.



Back view

1 Mains power switch

2 Connector for O_2 sensor

3 Connector for flow sensor

4 Connector for temperature sensor

5 Connector for SpO_2 sensor cable (optional)

6 Connector for C-lock ECG synchronisation (optional)

7 Connector for anaesthetic agent return flow or scavenging

8 Additional connector for CO_2 sampling hose

9 Cooling-air filter

10 Nozzle for pressure-measuring line

11 Analogue outlet

12 Connector for Dräger Monitorbus

13 Connector for Dräger Monitorbus

14 RS 232 protocol interface (printer/MEDIBUS)

15 RS 232 C MEDIBUS interface

16 Pin for potential equalisation

17 Mains power supply connector

18 Under the cap:
Assembly for O_2 sensor for sidestream O_2 measurement

Technical Data

Ambient conditions

During operation:	
Temperature	10 to 40 °C
Atmospheric pressure	85 to 110 kPa
Rel. humidity	20 to 80% (no condensation)
During storage:	
Temperature	–20 to 70 °C
Atmospheric pressure	50 to 110 kPa
Rel. humidity	< 98% (no condensation)

Performance data

Pressure measurement

Airway pressure	–10 to 80 mbar
Resolution	1 mbar
Accuracy	better than ±4% of measured value, or at least 1 mbar, whichever is the greater.

O_2 measurement (inspiratory)

Range	5 to 105 vol.%
Resolution	1 vol.%
Accuracy	
calibrated with 21 vol.% O_2	better than ±3 vol.% in measuring range 6 to 18 vol.% better than ±1 vol.% in measuring range 18 to 30 vol.% better than ±3 vol.% in measuring range 30 to 50 vol.% better than ±5 vol.% in measuring range 50 to 60 vol.%
calibrated with 100 vol.% O_2	better than ±3 vol.% in measuring range 0 to 100 vol.%

O_2 measurement (sidestream, inspiratory and expiratory)

Sampling flow	60 mL/min or 200 mL/min
Range	5 to 105 vol.%
Resolution	1 vol.%
Accuracy	better than 5% of measured value or at least ±3 vol.%
Response time $t_{10...90}$	
at 200 mL/min	<500 ms (500 ms with PM 8050 NMR)
at 60 mL/min	<1 s (1.5 s with PM 8050 NMR)

Flow measurement

Tidal volume (V_T)	
Range	0.02 to 9.99 L
Resolution	0.01 L
Accuracy	better than ± 8% of measured value or 0.01 L whichever is the greater. (subject to calibration conditions and 1013 hPa)
Minute volume (MV)	
Range	0 to 99.9 L/min
Resolution	0.1 L/min
Accuracy	better than ± 8 % of measured value (subject to calibration conditions and 1013 hPa)
Breathing freqency (f)	
Range	0 to 60/min
Resolution	±1/min
Accuracy	±1/min

CO_2 measurement

Sampling flow	60 mL/min
(optional)	200 mL/min
Measuring range	0 to 9.9 kPa (0 to 80 mmHg) 0 to 9.9 vol.%
Accuracy	
0 to 5.3 kPa (0 to 40 mmHg)	better than ±0.2 kPa (±1.5 mmHg)
5.3 to 8.0 kPa (40 to 60 mmHg)	better than ±0.38 kPa (±2.5 mmHg)
8.0 to 9.9 kPa (60 to 80 mmHg)	better than ±0.53 kPa (±4.0 mmHg)
Resolution	0.1 kPa (1 mmHg) 0.1 vol.%
Response time $t_{10...90}$	
at 200 mL/min	300 ms (500 ms with PM 8050 NMR)
at 60 mL/min	1 s (1.5 with PM 8050 NMR)
Warm-up phase	8 min
Drift	
Zero point	Within the above accuracy without time limit

Anaesthetic gas measurement

Display range for N_2O	0 to 100 vol.%
Accuracy for	
0 to 40 %	better than ±2,5 vol.% absolute
41 to 100 %	better than ±6.0 vol.% absolute
Resolution	1 vol.% absolute

Display range for Halothane	0 to 7.5 vol.%
Accuracy for	
0 to 5 %	better than ± 0.2 vol.% absolute
5 to 7.5 %	better than ± 0.3 vol.% absolute
Resolution	0.1 vol.%
Display range for Enflurane and Isoflurane	0 to 7.5 vol.%
Accuracy for	
0 to 5 %	better than 0.2 vol.% absolute
5 to 7.5 %	better than 0.3 vol.% absolute
Resolution	0.1 vol.%
Display range for Desflurane	0 to 20 vol.%
Accuracy for	
0 to 10 %	better than ± 0.4 vol.% absolute
10 to 20 %	better than ± 0.8 vol.% absolute
Resolution	0.1 vol.%
Display range for Sevoflurane	0 to 9 vol.%
Accuracy for	
0 to 5 %	better than ± 0.2 vol.% absolute
5 to 9 %	better than ± 0.4 vol.% absolute
Resolution	0.1 vol.%
Response time $t_{10...90}$	
at 200 mL/min	450 ms (500 ms with PM 8050 NMR)
at 60 mL/min	1.2 s (1.5 with PM 8050 NMR)
Warming-up time	8 minutes
Drift	
zero point	within the given specifications

Measurement of functional oxygen saturation, SpO_2 measurement (optional)

Display range	0 to 100% SpO_2
Accuracy (adults)	
in range 70 to 100 % SpO_2	better than ±2 % SpO_2
in range 50 to 70 % SpO_2	better than ±3 % SpO_2
in range 0 to 50 % SpO_2	not specified
Resolution	1 % SpO_2
Accuracy (neonates)	
in range 70 to 95 % SpO_2	better than ±3 % SpO_2
in range 0 to 70 % SpO_2	not specified
in range 95 to 100 % SpO_2	not specified
Pulse rate	20 to 250/min
Accuracy	±2/min
Resolution	1/min

Sensors	
Type	compatible with Nellcor sensors Oxisensor, Oxiband and Durasensor
Wavelengths	660 nm (red) 920 nm (infra-red)
Audible pulse signal	A sound is given per perceptible pulse stroke at a pitch proportional to oxygen saturation.

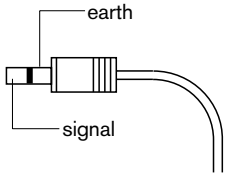
Temperature measurement (optional)

Breathing gas temperature	
Range	20 to 50 °C
Resolution	1 K
Accuracy	±0.5 K within measurement range 30 to 41 °C

Data communication

Data interface RS 232 C (MEDIBUS)	
Plug	25 pole, sub D
Pin layout	1 – screen 2 – TxD 3 – RxD 7 – GND
Isolation	1.5 kV
Protocol (printer)	
Plug	25 pole, sub D
Pin layout	1 – screen 2 – TxD 3 – RxD 7 – GND
Isolation	1.5 kV
Analogue output	
CO_2	0 to 10 kPa ≙ 0 to 10 V
Plug	9 pole, sub D
Pin layout	1 screen 3 + 4 –
Isolation	1.5 kV

C-Lock ECG synchronisation (optional)

Required for ECG synchronisation signal	pos. signal with voltage > 4.5 V > 10 hs duration to drive 2 mA.
Max. permissible delay of signal relating to actual QRS complex	40 ms
Socket for 2-pole latching earth plug Ø 3.5	
Layout of plug	
Isolation of signal against remaining electronics	
Voltage protection	4 kV

Operating data

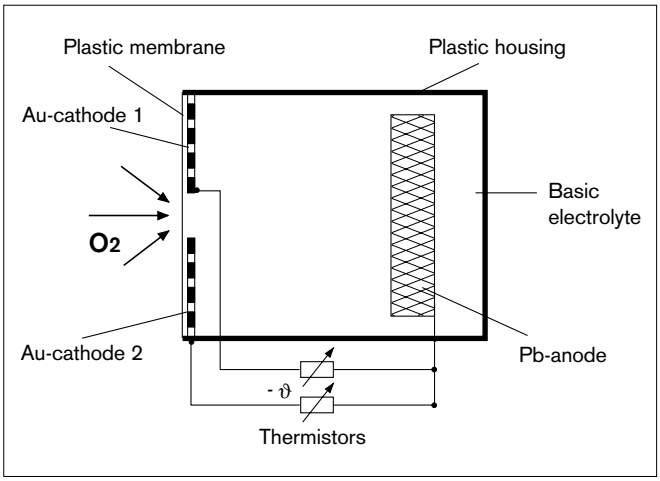
Mains power supply	85 to 140 V; 1A; 50/60 Hz can be switched to 195 to 265 V; 0.5 A; 50/60 Hz
Mains fuse	
110 V	T 4 A DIN 41662 (2x)
230 V	T 2 A DIN 41662 (2x)
Noise emmission (corresponds to free field measurement over reflecting surface)	max. 56 dB (A)
Dimensions W x H x D (with water trap)	425 x 176 x 346 mm
Weight	11.5 kg
Class	
Machine	I, Type B  according to DIN IEC 601/1
SpO_2 sensor	Type BF  isolated from protective conductor
Electromagnetic compatibility / EMC	tested to EN 60601-1-2
Classification as per EC Directive 93/42/EEC Annex IX	Class II b
UMDNS-Code Universal Medical Device Nomenclature System – Nomenclature for medical products	17-445

Description

O2 measurement

Measuring principle and signal processing

The O2 sensor functions according to the galvanic cell principle. Oxygen molecules from the gas mixture to be measured diffuse through a plastic membrane into an electro- chemical cell and are reduced at noble metal electrodes.



Simultaneously oxidation occurs at a base metal electrode, which is eroded as a result of the oxidation process and thus the life of the sensor is limited. The current flowing through the cell is proportional to the oxygen partial pressure in the gas mixture.

If the pressure and temperature of the gas mixture being measured is constant, the measured value is directly proportional to the oxygen partial pressure.

Particularly characteristic of the O2 sensor are the two electrically-separated cathodes which give two independent redundant measuring signals. Both measuring signals are evaluated electronically and the mean value of both individual signals is displayed.

Where the individual signals differ by more than the tolerance permitted, due to an external or internal malfunction, the display will switch off automatically, thus avoiding faulty displays and subsequent faulty interpretation.

Flow measurement

Measuring principle and signal processing

The sensor works according to the principle of constant temperature, hot wire anemometry. The breathing gas flows over a very thin, electrically- heated platinum wire in the sensor tube. The wire is heated to a temperature of 180 °C which is kept constant by a control circuit. When the gas flows over this wire, heat is conducted away. The greater the gas volume per unit time flowing over it, the more heat is conducted away.
The increased current required to keep the temperature of the wire constant is a measure of the gas flow.

Gas compensation

A second, heated platinum wire provides compensation for the effect of the different gases present in breathing gas.
During the phase without flow (for an expiratory sensor, during inspiration), the heat output of the 2nd wire depends on the composition of the resting "gas column" in the flowmeter.
The gas composition is calculated from the different specific thermal conductivities of the gases present in breathing gas.
Linearity is based on internal "calibration tables" for O2/N2O, air and 100 % O2 gas mixtures.

CO_2 and anaesthetic agent measurement

Measuring principle

CO_2 and anaesthetic agents absorb infra-red light. A pump draws a small amount of the breathing gas through a measuring cuvette. The measuring cuvette is irradiated with infra-red light. By using different filters a frequency band is selected which can absorb only one of the different gases at any one time. By rapidly changing the filters all gases can be measured almost continuously. Absorption is a measure of gas concentration in the cuvette. By simultaneously measuring temperature and absolute pressure in the cuvette the gas concentrations of the breathing gases can be calculated.

Cross-sensitivity of anaesthetic agent measurement: Vapours from organic substances (such as may be present in cleaning and disinfecting agents) in the ambient air, the sampling hose or the T-piece may result in faulty anaesthetic agent measurement. When the patient's breathing air contains alcohol, increased anaesthetic agent values are displayed, particularly during halothane anaesthesia.

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%	—

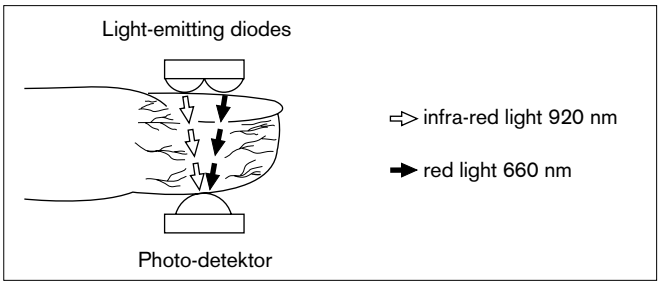
SpO2 measurement

Measuring principle

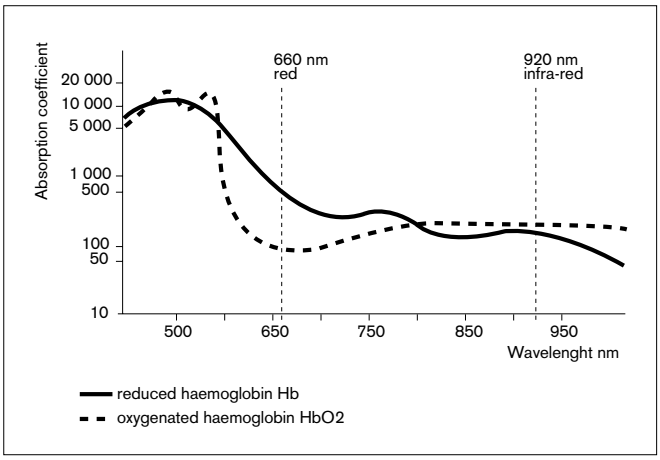
Principles of pulse oximetry:

Oxygenated, arterial blood (oxyhaemoglobin, HbO_2) has different light-absorption properties from unsaturated, venous blood (reduced haemoglobin, Hb). O_2 saturation is a logarithmic function of radiated light intensity (Lambert-Beer's law).
The influence of dyshaemoglobins, such as carbon monoxide haemoglobin (HbCO) and methaemoglobin (MetHb), may be ignored in normal cases.

The sensor consists of two light-emitting diodes which alternately emit infra-red light with a typical wavelength of 920nm and then with a typical wavelength of 660 nm. A photo-detector placed opposite them measures the intensity of radiation. The sensor is attached to a part of the body where arterial blood vessels can be radiated, e.g. finger, toe, bridge of the nose.



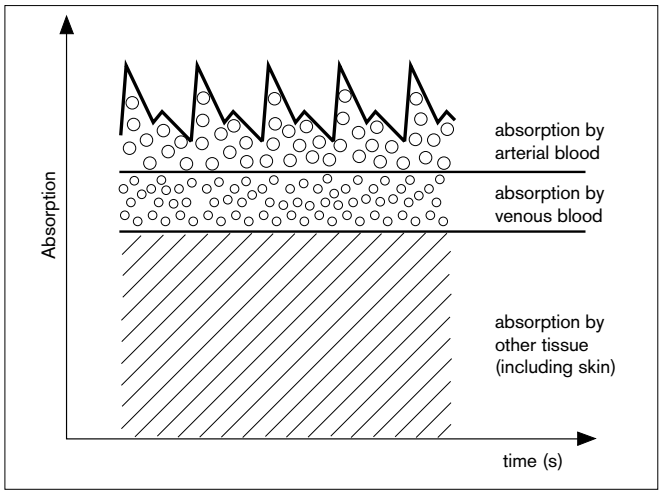
The 920 nm and 660 nm wavelengths were selected because useful absorption values can be achieved for the oxygenated and reduced blood, even with some slight perfusion, and because they differentiate well.



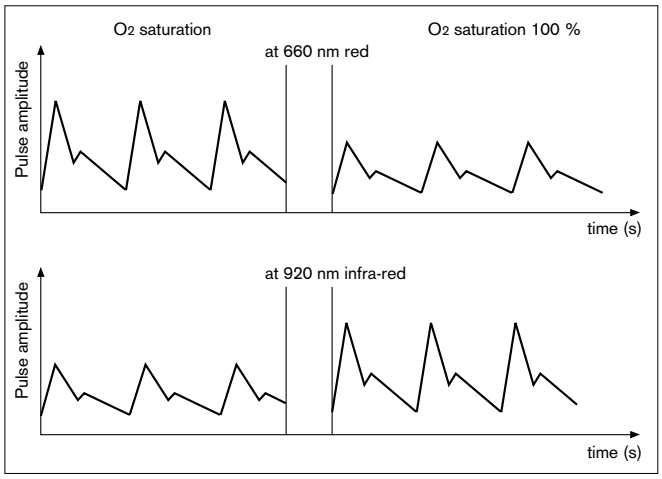
The total absorption of light emitted alternately by the diodes is caused by the pulsating arterial blood, the skin, finger nails, muscular tissue, bones, venous blood.

Except for the pulsating, arterial blood, the absorption by the other components during a defined period of time remains constant as far as volume and optical density are concerned.

However, the arterial blood pulsating with every heart beat causes a pulse-synchronised volume change in the radiated tissue, and consequently a pulse- synchronised change of absorption of the transmitted light.



First, light absorption is determined when no pulsating blood is present (during diastole). This measurement shows the light absorbed by the tissue and by non-pulsating blood.
Normally, this does not change during a pulse phase so it is a reference value for the pulsating part of absorption. The absorption is then measured after the next heart beat, when the pulsating blood enters the tissue. During this measurement, light absorption in both wavelengths is changed by the pulsating arterial blood.



The diagram shows an example of the way in which blood absorbs light at 660 nm (red) and 920 nm (infra-red). Whilst absorption, and consequently pulse amplitude, is reduced at 660 nm with increased O_2 saturation, it rises at 920 nm. Since the absorption coefficients of HbO_2 and Hb are known for the two wavelengths, PM 8050 is able to calculate how much of the two haemoglobin types there is.

The quotient of oxygenated haemoglobin (HbO2), divided by the reduced and oxygenated haemoglobin (Hb + NbO2), is called the functional saturation:

$$\%\ SpO_2\ (func) = 100 \times \frac{HbO_2}{HbO_2 + Hb}$$

This refers to the haemoglobin which is available to transport oxygen. The dyshaemoglobins, HbCO and MetHb, can be ignored in normal cases, but might, however, impair the accuracy of the measurements.

Temperature measurement

Measuring principle

Temperature-dependent resistance changes of a resistance with a negative temperature coefficient (NTC), with a linearisation switch.

Pressure measurement

Measuring principle

Piezo-resistant resistance change of a membrane.

Definition of PEEP and plateau pressure (Plat.)

PEEP (positive endexpiratory pressure) is the airway pressure at the end of expiration.

Plateau pressure is the airway pressure measured 16 milliseconds before the start of expiration.

Calculation of compliance

PM 8050 calculates the total compliance (C) from tidal volume (V_T) and plateau pressure (Plat.) as well as PEEP. The system compliance of the anaesthetic machine must be deducted to determine patient compliance (C_{pat}):

$C_{pat} = C - C_{System}$

The system compliance (C_{System}) is given in the Technical Data in the Instructions for Use.

Explanation of abbreviations and symbols used

adult	adult mode
AW temp	inspiratory breathing gas temperature
CAL	calibration carried out
C-lock	ECG-synchronisation during SpO_2 measurement
etCO_2	endexpiratory CO_2 concentration
FetDes.	endexpiratory Desflurane concentration
FetEnf.	endexpiratory Enflurane concentration
FetHal.	endexpiratory Halothane concentration
FetIso.	endexpiratory Isoflurane concentration
FetN_2O	endexpiratory N_2O concentration
FetSev.	endexpiratory Sevoflurane concentration
FiDes.	inspiratory Desflurane concentration
FiEnf.	inspiratory Enflurane concentration
FiHal.	inspiratory Halothane concentration
FiIso.	inspiratory Isoflurane concentration
FiN_2O	inspiratory N_2O concentration
FiO_2	inspiratory O_2 concentration
FiSev.	inspiratory Sevoflurane concentration
flow	expiratory flow
f	breathing frequency
HLM	monitoring mode for heart/lung machine
inCO_2	inspiratory CO_2 concentration
INOP	malfunction
IPPV	automatic ventilation mode: intermittent breathing with positive pressure
LED	light-emitting diode
Man./spont.	manual ventilation and spontaneous breathing
MV	expiratory minute volume
neo.	neonate mode
Paw	airway pressure
Peak	peak pressure
PEEP	positive endexpiratory pressure
Plat.	plateau pressure
Pleth.	plethysmogram
Pmean	mean pressure
SpO_2	functional O_2 saturation
V_T	tidal volume

?	request for calibration
✓	action carried out
!!!	warning message
!!	caution message
!	advisory message
– –	alarm limit switched off
	pulse rate
	lower alarm limit
	upper alarm limit
	alarm monitoring switched off
	menu cursor
	close menu, return to higher menu
	standby/measurement
	call up basic pages in sequence
	call up defaults page
	suppress alarm sound for 2 minutes
	observe Instructions for Use
	connection for potential equalisation
	mains power switch ON
	mains power switch OFF
	class type B (DIN IEC 601)
	class type BF (DIN IEC 601)

Order List

Name and Description	Part No.
PM 8050 basic unit	86 02 440
PM 8050 complete for Circle System 9	86 00 702
PM 8050 complete for Circle System 9 with SpO_2	86 00 703
PM 8050 complete for compact breathing system COSY	86 01 773
PM 8050 for Fabius Germany	86 01 794
Accessories designed for use with the basic unit	
Optional	
SpO_2 modification set with Durasensor	86 00 648
Monitor-on switch for Ventilog	M 30 891
Modification set for 110 V supply	86 00 836
Accessories for	
PM8050/Circle System 9	86 00 965
PM8050/ISO Circle System	86 00 472
Special accessories for measuring SpO_2	
Pre-amplifier cable	21 70 116
Sensor extension cable	82 01 015
Finger sensor, Dura DS-100A	82 01 001
Adhesive sensor, D-25 (24 off)	82 01 002
Adhesive sensor, D-25 (6 off)	82 01 035
Adhesive sensor, D-20 (24 off)	82 01 003
Adhesive sensor, D-20 (6 off)	82 01 036
Adhesive sensor, I-20 (24 off)	82 01 004
Adhesive sensor, I-20 (6 off)	82 01 037
Adhesive sensor, R-15 (12 off)	82 01 006
Adhesive sensor, R-15 (6 off)	82 01 039
Oxiband adhesive sensor complete	82 01 013
Oxiband adhesive strip (50 off)	82 01 012
Reflex sensor, RS-10 (1 off)	21 70 280
For sampling gas return flow	
Hose set	M 32 692
Filter	84 02 868
For measuring gas scavenging	
T-piece	82 90 287
Rubber sleeve	82 90 320
Hose	11 90 520
Hose set	M 32 692
Filter	84 02 868

Name and Description	Part No.
For temperature measurement	
Temperature sensor	84 05 371
Y-piece with seal for temperature sensor	M 30 543
Hose clip (10 off)	84 04 047
For data communication	
with Patient Monitor RS 232 cable	85 00 337
with PM 8060 Vitara, 2 m	86 01 585
with PC, 2 m	86 01 140
for printer connection	86 00 133
Monitor bus cable 45 cm	M 30 893
Consumables and spare parts destined for use with the basic unit	
For CO_2/anaesthetic gas measurement	
T-piece (plastic, can be autoclaved)	86 00 224
Filter	86 00 225
Sampling line (set of 10)	82 90 286
Waterlock (set of 12)	68 70 567
Water separator	86 00 570
Luer Lock Y-piece	M 33 278
For inspiratory O_2 measurement	
O_2 sensor housing	68 50 720
Plug-in adapter for O_2 sensor	M 27 964
O_2 sensor capsule	68 50 645
Cap for O_2 sensor	M 21 482
O_2 adaptor	84 05 807
Test adaptor	68 01 349
For sidestream O_2 measurement	
O_2 sensor	68 50 930
For pressure measurement	
Pressure measuring line	83 02 841
Pressure measuring connector	M 25 638
Combined measuring connector	M 28 833
Filter	84 02 868
For flow measurement	
Flow sensor (set of 5)	84 03 735
Flow measuring cable	83 01 795
Sensor connector (AV 1, CU 1)	84 07 390
Flow measuring connector	M 28 844

Default Alarm Limits

	Pre-set on delivery	Set in hospital	
SpO_2	– – 95	_____ _____	_____ _____
Pulse	120 50	_____ _____	_____ _____
$etCO_2$	50 (mmHg) – –	_____ _____	_____ _____
MV	3,0	_____	_____
FiO_2	– – 20	_____ _____	_____ _____
FiHal.	1,5 – –	_____ _____	_____ _____
FiIso.	2,3 – –	_____ _____	_____ _____
FiEnf.	3,4 – –	_____ _____	_____ _____
FiDes.	12,0 – –	_____ _____	_____ _____
FiSev.	3,4 – –	_____ _____	_____ _____
Paw	40 8	_____ _____	_____ _____

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These Instructions for Use apply only to
PM 8050 2.n
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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