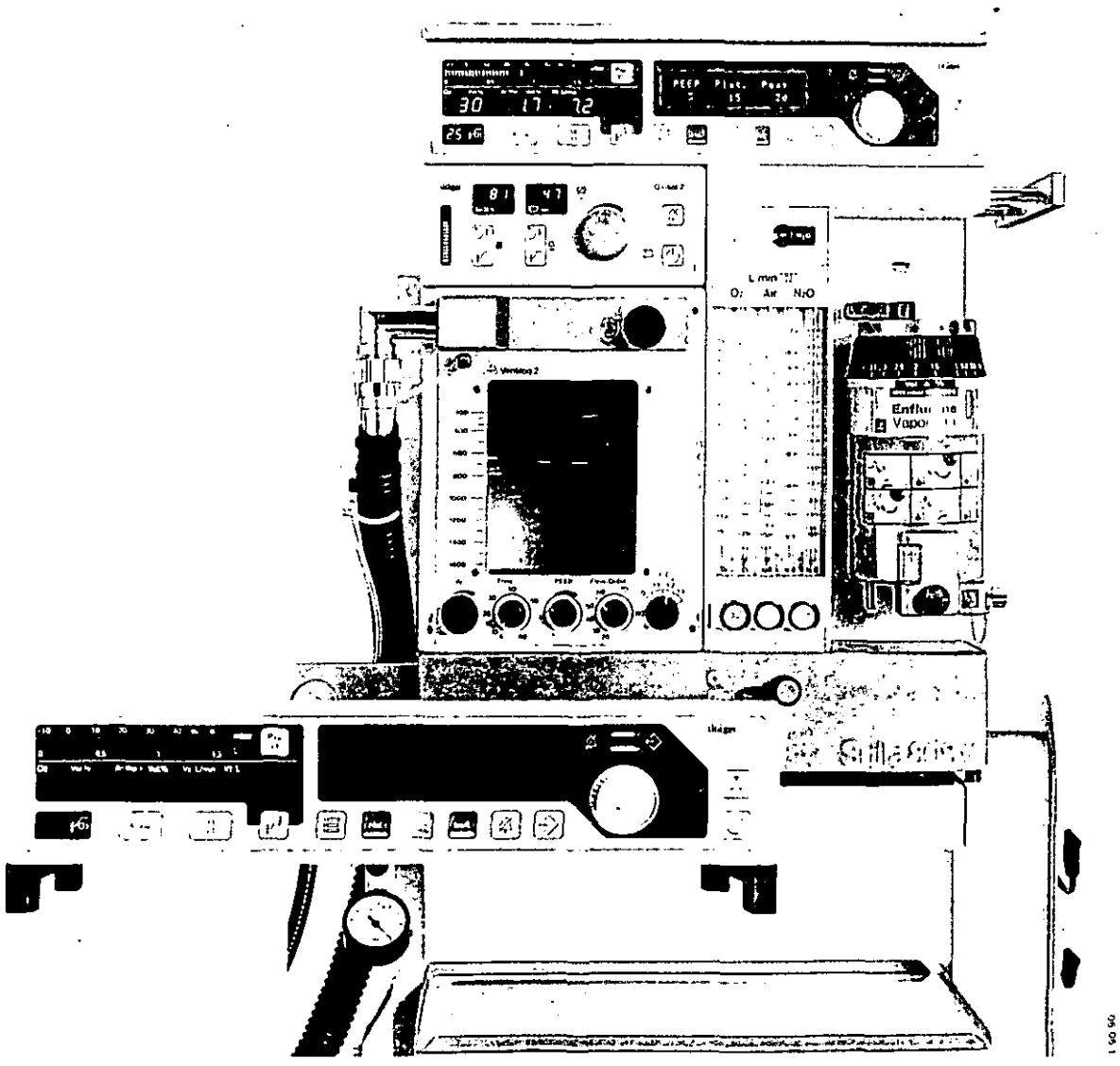
Dräger

PM 8030

Airway Monitor

Instructions for Use

- Software 6.n -



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Contents

For Your Safety and That of Your Patients

For correct and effective use of the apparatus and to avoid hazards it is essential to read the following recommendations and to act accordingly[1]:

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 by experts at regular 6 month intervals (and a record kept).
We recommend obtaining a service contract with DrägerService.
Repairs and general overhaul of the apparatus may only be carried out by DrägerService.
Only original Dräger spare parts may be used for maintenance.
Observe chapter "Maintenance Intervals".

Power connection

The apparatus is only to be used in rooms with mains power supply installations complying with national safety standards (such as in F. R. of Germany: VDE 0107). The requirements laid down in IEC 601/1 "Safety of Medical Electrical Equipment" are applicable for electrically powered equipment.

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.

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.

Drägerwerk Aktiengesellschaft 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 Drägerwerk Aktiengesellschaft are likewise not modified by the recommendations given above.

Drägerwerk Aktiengesellschaft

1) *Insofar as reference is made to laws, regulations or standards, these are based on the legal system of the Federal Republic of Germany.*

A4

Intended Use

Measuring and monitoring ventilation parameters and the concentration of anaesthetic agents during anaesthesia.

Measuring:

Airway pressure Paw, Peak, Plateau, PEEP, Pmean

expiratory minute volume $\dot{V}_E$, tidal volume V_T, breathing frequency,

inspiratory oxygen concentration FiO_2

inspiratory airway temperature

Concentration in fresh gas of halothane, enflurane, isoflurane

Monitoring:

Airway pressure Paw

Inspiratory oxygen concentration FiO_2

Expiratory minute volume $\dot{V}_E$

Inspiratory airway temperature

Concentration of anaesthetic agent in fresh gas

RS 232 C-Interface:

For exchanging data with the PM 8010 Patient Monitor (software 3.2) or the PM 8020 Data Manager or for transferring data to a PC or a printer.

Monitorbus-Interface:

To start measuring operations by PM 8030 or other monitors centrally from the Ventilog 2 anaesthetic ventilator.

Do not use with flammable gases or flammable anaesthetic agents.

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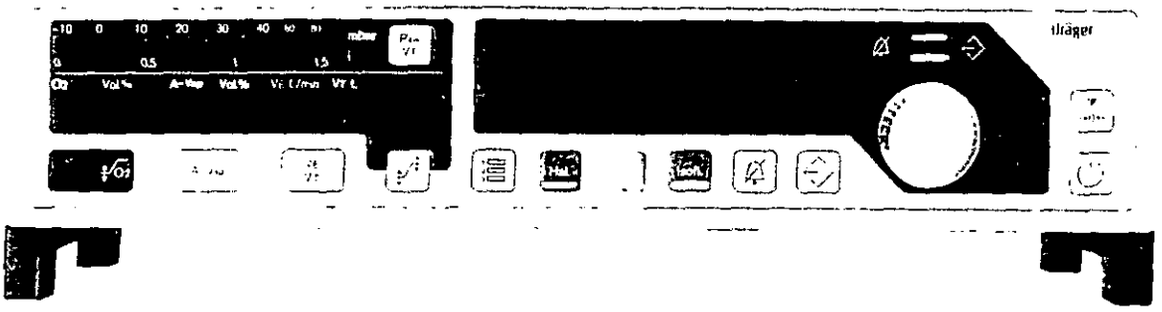
Brief description



The display fields for measured values are on the left:

- O_2 concentration
- Lower limit value O_2
- Anaesthetic agent concentration
- Minute volume or tidal volume, can be selected with button
- Airway pressure or tidal volume as strip display, can be selected with button

The right-hand display field shows the values:

- PEEP, Plateau, Peak
- or these can be selected with button
- Pmean, airway temperature, breathing frequency

The menu guide and the alarm displays are shown in the right-hand display field.
The menu content can be recalled using the menu buttons:

- select limit values
- calibrate sensors
- A-Vap select anaesthetic agent

With selector knob:

to select or to adjust = turn; confirm = press

menu contents are selected, limit values set and special warning messages confirmed.

Other function buttons:

- Change operating mode: measuring or standby mode
- suppress warning tone for 2 minutes
- display stored warning messages

Preparation

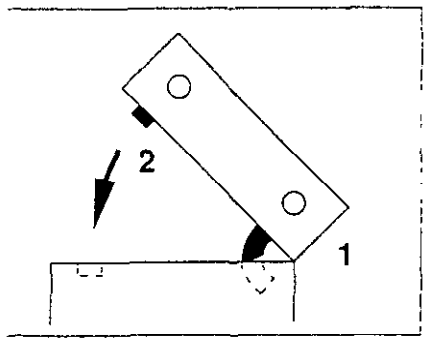
Attaching PM 8030

by latching mechanism to base for Dräger medical equipment

- Remove the two feet.

1 Tilt PM 8030 forward at an angle of 45°, insert front latches into the slots on the base.

2 Lower PM 8030, inserting the rear latches into the rear slots and secure at the back with knurled screws.



or:

- Place on an even surface such as a monitor rack.
- Fix PM 8030 securely.

Connecting sensor and pressure measuring line

- Use sterile or disinfected sensors.

At the back

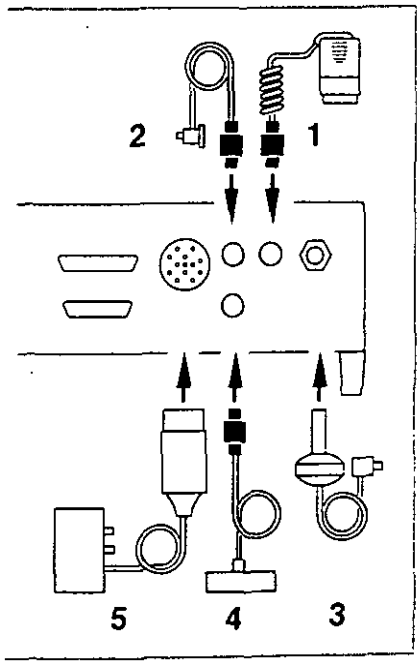
1 Connect O_2 sensor plug.

2 Connect temperature sensor plug.

3 Push hose of pressure measuring line firmly onto spigot.

4 Connect flow sensor plug.

5 Connect anaesthetic agent sensor plug.



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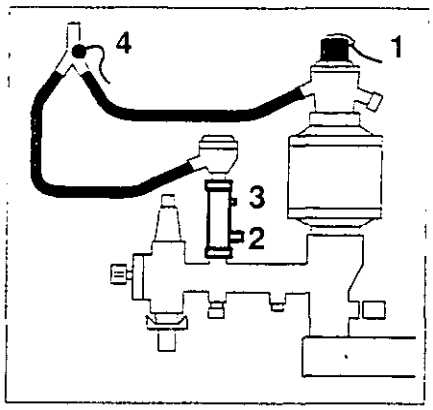
Connecting sensors to anaesthetic machine



In brief:

1 O_2 sensor

2 Coupling for pressure measuring line

3 Flow sensor

4 Temperature sensor

The anaesthetic agent sensor is permanently mounted in the fresh gas supply of the anaesthetic machine - which must only be done by DrägerService.

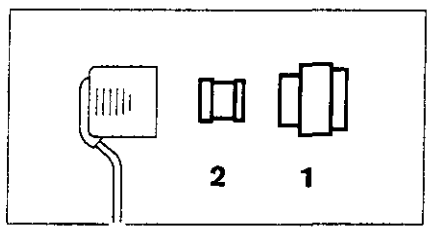
Connecting O_2 sensor capsule

1 Unscrew cap from sensor housing.

- Remove new sensor capsule from packaging, or use disinfected sensor capsule.

2 Place capsule in housing - ring-shaped conductor track onto contacts in housing.

1 Tighten screw cap by hand.



Connecting O_2 sensor

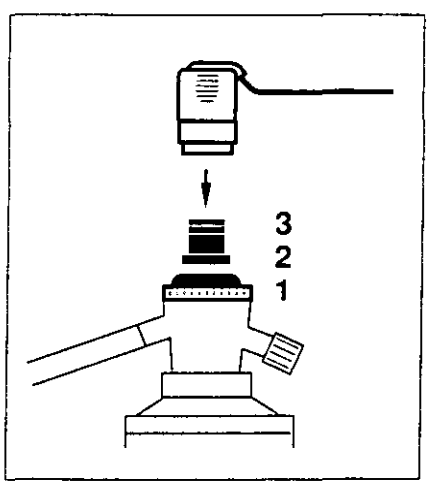
with cap	M 21 482
plug adapter	M 27 964
condenser, if a great deal of condensation is expected	M 27 668

1 Unscrew the nut on the inspiratory valve.

2 Replace the sight glass with cap. Re-fit the nut.

3 Firmly screw the lower part of plug-adapter into cap by hand.

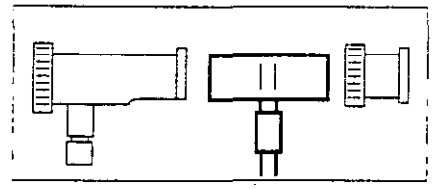
- Push O_2 sensor onto cap as far as it will go.



AB

Connecting flow sensor and pressure measuring line

with measuring connection M 28 833



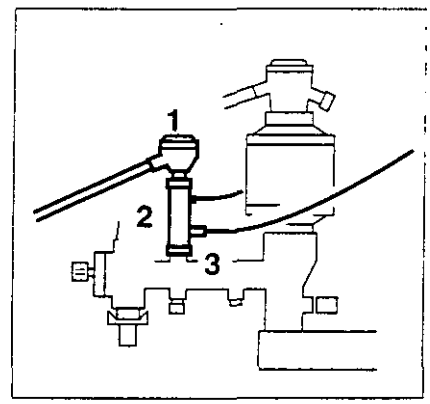
- Screw flow sensor into housing.

1 Unscrew expiratory valve.

2 Screw the measuring connection on with the flow sensor in place.

1 Screw expiratory valve back.

3 Push plug of pressure measuring line into coupling - as far as it will go. Tilt hose upwards so that condensate can flow downwards.



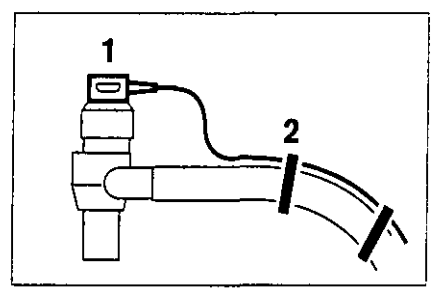
Connecting temperature sensor

Adapter and accessories:

Y-piece	M 30 543
Hose clip (set of 10)	84 04 047

1 Push temperature sensor into hole on the Y-piece as far as it will go.
After replacing the Y-piece, align sensor vertically so that condensate will not be able to get into it.

2 Attach sensor cable to inspiratory hose with hose clips.



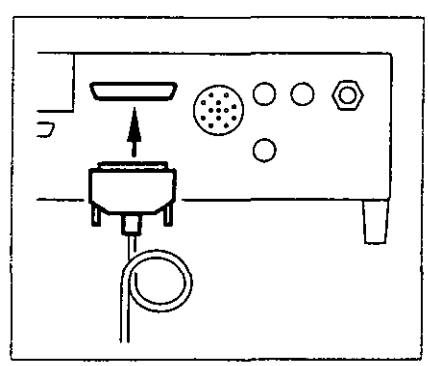
Connecting other machines

via RS 232 C-Interface

- PM 8010 Patient Monitor
  with data cable "PM 8010" 85 00 337
- PM 8020 Data Manager
  with data cable "PM 8020" 86 00 133

  or

- Printer e.g.:
  Desk Jet Printer (Hewlett Packard)
  Think Jet Printer (Hewlett Packard)
  PA 565 (NEC)
  with data cable 86 00 133



- Connect and secure plug to both machines.

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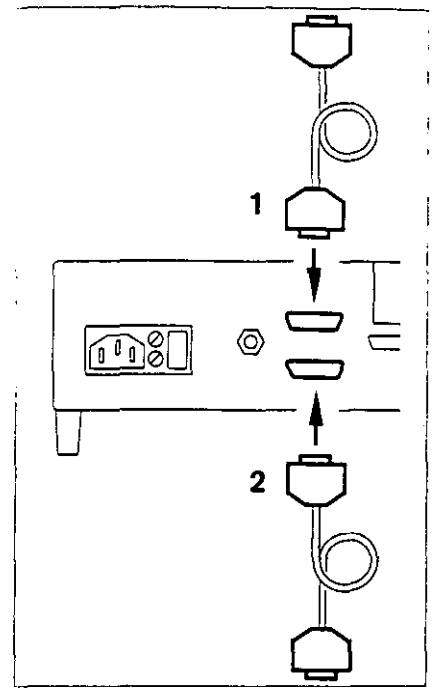
via Monitorbus-Interface

- E.g. for remote switching on of PM 8030 from Standby or switching on anaesthetic ventilator
  or
- for muting Dräger equipment.

with Monitorbus cable 0.45 m M 30 893



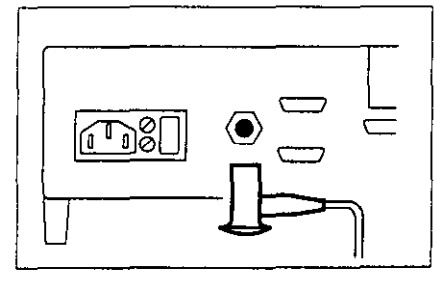
1 Connect plug to both machines and secure with screwdriver.

2 Another machine can be connected with the second connection.

Additional earth connection

e.g. for cardiac operations

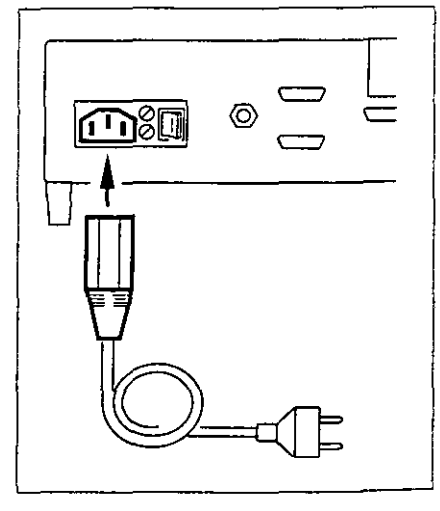
- Attach one end of the earth cable to the potential equalisation pin at the back of the machine.
- Connect the other end to a potential equalisation point in the room.



Connecting to power supply

PM 8030 can be operated on mains voltages from 100 V to 240 V.

- Connect monitor to mains power supply.



Checking mains failure alarm, carrying out self-test

before first operation and after long periods of storage.

1 Switch on mains power supply at the back.

After about 10 seconds:

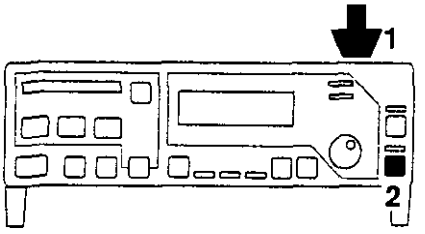
2 Press >Standby< button; green LED goes out = measuring mode.

1 Switch off mains:

- A continuous tone commences, volume remains constant for at least 10 seconds = mains failure alarm is functional.
  Otherwise: charge NiCd battery.

2 Press >Standby< button; the continuous tone ceases.

1 Switch mains power back on:



- The monitor now carries out a self-test.
  All LEDs and display elements are lit; a single tone sounds. Software and language versions are displayed.
  The internal program memories are tested.
  The alarms for monitoring are checked.

The self-test is completed in about 30 seconds.

Charging NiCd battery

If, when the mains failure alarm is being checked, the volume decreases after 10 seconds:

Leave machine connected to the mains power supply and switched on for 24 hours.

- Check mains failure alarm again.

A 11

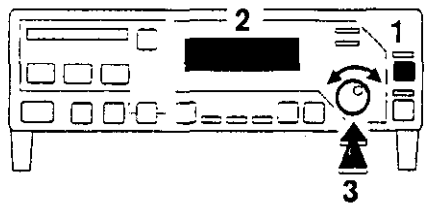
Calibration

On request by PM 8030

- after switching on
- message >sensor not ready to measure<

or

when calibrating during operation:



1 Press calibration button

2 Display:
Sensor calibration
O2 flow A-Vap

3 Select desired sensor = turn knob
and confirm = press knob.

For further information, refer to:

Calibrating O_2 sensor, see below

Calibrating flow sensor, page 13.

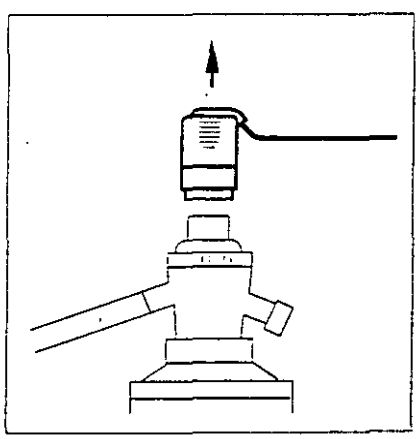
Calibrating anaesthetic agent sensor, page 15.

Calibrating O_2 sensor

- after sensor has been replaced (15 minutes warming-up time).
- after 24 hours.
- after 1 month carry out linearity check.

For use mainly with O_2 concentrations up to 60% by vol.: calibrate with air

For use with O_2 concentrations up to 100% by vol. and for linearity checks: calibrate with O_2

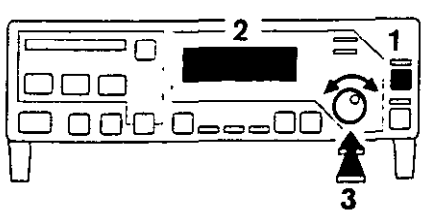


Calibration with air

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

When requested by machine after switch on

or



1 Press calibration button and select O_2 sensor.

2 Display:
Calib. O_2 sensor?
21% 100% no

With the O_2 sensor in ambient air

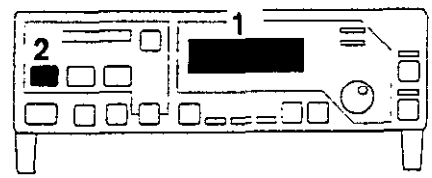
3 Select >21%< in menu and confirm.

A 12

Calibration

1 Display:
O_2 calibration
at 21 vol. %

2 Display for O_2 concentration:
CAL



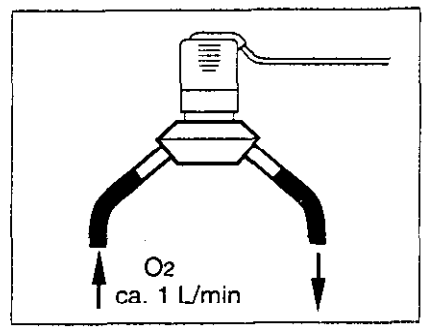
After about 30 seconds, but no longer than 3 1/2minutes:

1 Display:
O_2 sensor
calib. completed

- Replace O_2 sensor on cap.

Calibration with O_2

- Remove O_2 sensor and fit test adapter 68 01 349 to sensor.
- Flush the O_2 sensor with a flow of about 1 L/min for about 2 minutes.



When requested by the machine after switching on

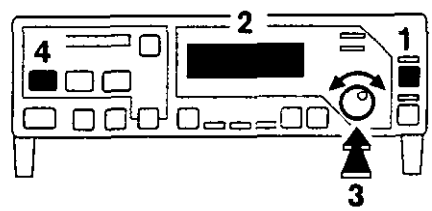
or

1 Press calibration button and select O_2 sensor.

2 Display:
Calib. O_2 sensor?
21% 100% no

- Continue flushing with O_2.

3 Select >100%< in menu and confirm.



2 Display:
O_2 calibration
at 100 vol. %

4 Display for O_2 concentration
CAL

After about 30 seconds but no longer than 3 1/2 minutes:

2 Display:
O_2 sensor
calib. completed

Calibration has been completed.

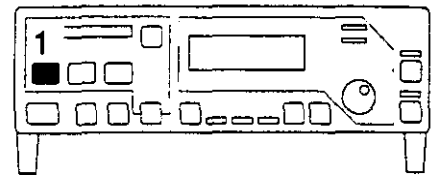
- Switch off O_2 flow, remove test adapter and replace O_2 sensor on cap.

A 13

Checking linearity

- to be carried out monthly

First calibration with O_2, page 12, then:



- Expose sensor to ambient air for about 2 minutes.

1 O_2 concentration display:
21 vol. % O_2 ± 3% by vol.

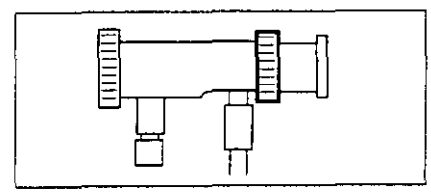
- Replace O_2 sensor on cap

If the display is outside the range 18 to 24% O_2 by vol., the sensor capsule is faulty.

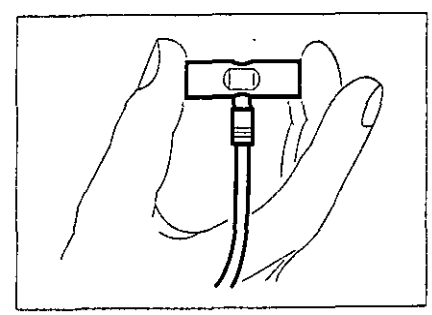
- Replace capsule, page 7 and calibrate, page 11.

Calibrating flow sensor

- when sensor has been replaced
- after 24 hours of operation



- Unscrew measuring connection and remove flow sensor.



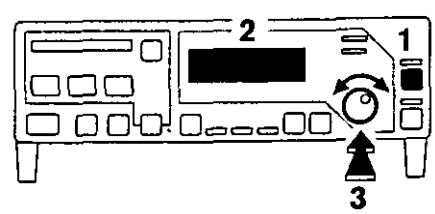
- With flow sensor in horizontal position - connector pointing downwards - seal both openings in the ambient air preferably using thumb and middle finger.

After a request by the monitor when switching on

or

1 Press calibration button and select flow sensor.

2 Display:
Calib. flow sensor?
yes no cleaning



With sealed sensor

3 Select >yes< and confirm

2 Display:
Flow sensor
calibration

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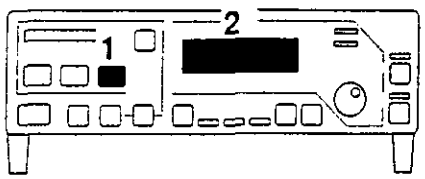
Calibration

1 Display for $\dot{V}E/VT$:
CAL



Calibration will be completed in about 8 seconds.

2 Display:
Flow sensor
Calib. completed

Re-insert the flow sensor in the anaesthetic machine.

Cleaning flow sensor

During prolonged anaesthesia, when there is a danger of contamination.

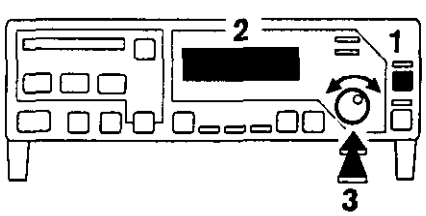
Only sensors which are ready for measurement can be cleaned by this method; the sensor remains connected.

During calibration, the sensor is automatically cleaned.

1 Press calibration button and select flow sensor.

2 Display
Calib. flow sensor?
yes no cleaning

3 Select >cleaning< and confirm.



2 Display:
Flow sensor
cleaning

After about 4 seconds:

2 Display:
Flow sensor
cleaning completed

B1

Calibrating anaesthetic agent sensor

- when sensor has been replaced
- every 24 hours

Allow 3 minutes warming-up time after switching on the machine.

On anaesthetic machine

- **Set anaesthetic vaporiser to 0 (zero point stop button engaged), otherwise faulty calibration will occur.**
  Set O_2 flow of about 10 L/min on flowmeter block or on blender.
- Flush anaesthetic agent sensor for at least 10 seconds.

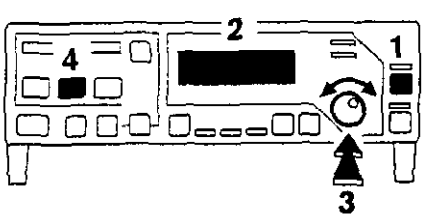
  Do not use O_2 flush for flushing.

After switching on and after request by machine

or

1 *Press calibration button and select A-Vap sensor.*

2 Display:
Calib. A-Vap sensor?
yes **no**



3 *Select >yes< and confirm.*

2 Display:
A-Vap sensor
flushed with O_2/air?

Continue with anaesthetic vaporiser at 0 and O_2 flow of about 10 L/min.

3 Confirm = press knob.

2 Display:
A-Vap sensor
calib.

4 A-Vap display
CAL

Calibration is completed in about 8 seconds.

2 Display:
A-Vap sensor
calib. completed

If there is a faulty sensor or cable:

2 Display:
A-Vap sensor
not ready to measure

B 2

Operation

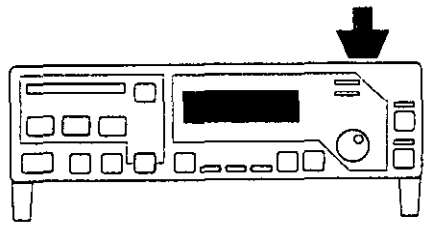
Carrying out function check

Immediately before daily use as described in the checklist on the anaesthetic machine.

Monitor self-test

- Switch on mains power supply at the back.

  The monitor carries out a self-test:
  The internal programme memories are tested.
  The software and language versions are displayed.
  All LEDs and display elements are lit; a single tone sounds.



- Display:
  Dräger PM 8030

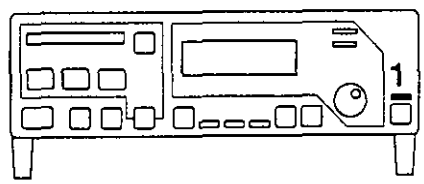
  The alarms for monitoring are tested.

  The self-test is completed after about 30 seconds.

For operation with Monitorbus

- Switch ventilator to IPPV:

1 The green LED goes out, PM 8030 is in measuring mode.



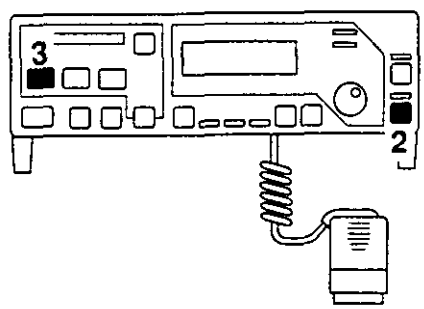
Checking O_2 measurement

2 Press >Standby< button, green LED goes out = measuring mode

- Remove O_2 sensor from cap and expose to ambient air for at least 2 minutes.

3 Display:
21 vol. % O_2

- Replace O_2 sensor on cap.



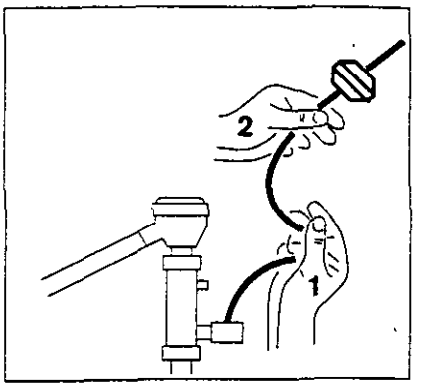
B 3

Checking pressure measurement

1 Kink pressure measurement hose near the coupling and

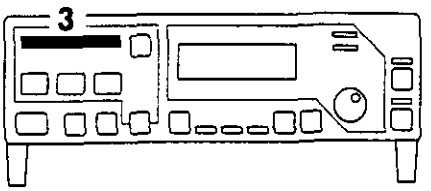
2 Squeeze hose to close it:

3 A value greater than 0 mbar is displayed.



- Release hose:

3 Value 0 mbar is displayed.



Checking flow measurement

On anaesthetic machine:

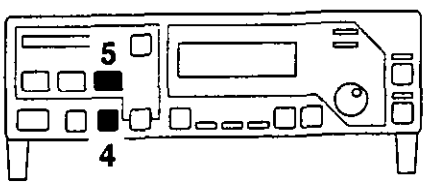
- Switch to spontaneous breathing/manual ventilation, keep Y-piece sealed and fill breathing bag with the O_2 flush.

On PM 8030:

4 Select V_T with >$\dot{V}_E/V_T$< button.

- Squeeze out breathing bag with Y-piece closed.

5 A value greater than 0 L is displayed.



PM 8030 is ready for use.

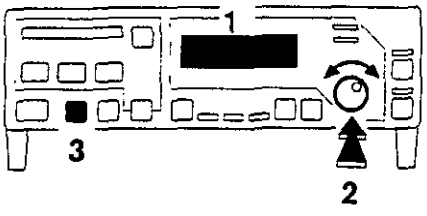
B4

Selecting anaesthetic agent

After switching on and after request by machine.

1 Display:
Select A-Vap
Hal. Enf. Iso. none

2 Select = turn knob and
confirm = press knob.



Selecting another anaesthetic agent:

3 Press >A-Vap< button:

1 Menu selection is indicated.

2 Select anaesthetic agent and confirm.

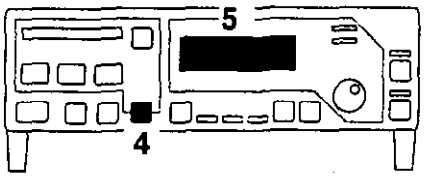
Setting limit values

for monitoring parameters

- Inspiratory O_2 concentration FiO_2 % by vol.
- Airway pressure Paw mbar
- Expiratory minute volume $\dot{V}_E$ L/min
- Anaesthetic agent concentration A-Vap % by vol.

4 Press >limit values< button.

5 The menu selection for limit values is displayed:
Limit values <IPPV>
MODE O_2 $\dot{V}_E$ Paw A-Vap



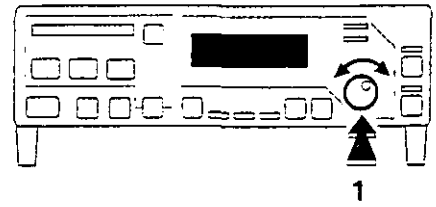
or

Limit values <MAN/SP>
MODE O_2 $\dot{V}_E$ Paw A-Vap

<IPPV> is the display for complete limit value monitoring

<MAN/SP> is the display for reduced limit value monitoring, page 22.

B5



Continue menu selection:

1 To select monitoring parameters = turn knob and confirm = press knob.

Display, e.g.:
FiO2 / vol. %
21 Exit ---

Lower limit value is on the left; upper limit value is on the right

1 Select limit value and confirm.

Example given:
lower limit value: 21% by vol.
upper limit value: --- = off

The dashes under limit value flash = request to set limit value.

then

1 Set limit value and confirm, the dashes under limit value cease flashing.

1 Exit menu: Select >Exit< and confirm.

The next parameter can now be selected.

- Press another button =
  Complete setting of limit values.

  or

- Wait for about 15 seconds = time out.

Setting ranges

	Factory Setting = Standard limit values		Setting range
	lower limit value	upper limit value	
FiO2	20	--	18 to 100
Paw	8	40	0 to 98
Min. vol. ($\dot{V}E$)	3	12	0 to 40
A-Vap/Hal	0	2	0 to 9
A-Vap/Enf	0	2	0 to 9
A-Vap/Iso	0	2	0 to 9
AW-Temp	--	40	fixed setting

The lower and upper limit values cannot overlap.

The upper limit value for FiO2 and the lower limit value for Paw can be switched off (-- to adjust).

For Paw the minimum separation between lower and upper limit value is 5 mbar.

Setting O_2 limit value

Recommendation:

For O_2 concentrations lower than 50% by vol.:
lower limit value 5% by vol. lower than the actual O_2 concentration.

Where air is applied post-operatively:
set lower limit value to 20% by vol.

For O_2 concentrations greater than 50% by vol.:
lower limit value 10 % by vol. lower than the actual O_2 concentration.

Depending on clinical indications, set or switch off upper limit value.

Setting Paw limit value

Set lower limit value about 8 mbar below plateau pressure.

Where there is no pleateau pressure, set at about 8 mbar below peak pressure.

The lower limit value may be switched off.

Set the upper limit value about 10 mbar above peak pressure.

Setting minute volume ($\dot{V}E$) limit values

Recommendation:

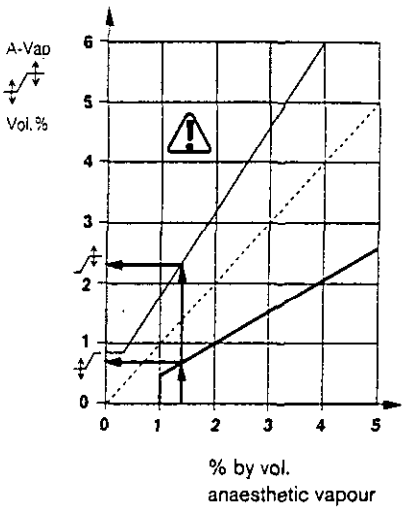
Set lower limit value 20% lower than minute volume

Set upper limit value about 20% higher than minute volume

B7

Setting A-Vap limit values

Using the graph, determine the limit values depending on the setting of the anaesthetic vaporiser. The upper limit values are based on the maximum permissible values which must not be exceeded.
The lower limit value may be set even lower when necessary for clinical reasons.



Vertical axis:

Setting of limit values (0 to 6% by vol.)

upper limit value

lower limit value

Horizontal axis:

Concentrations set on anaesthetic vaporiser (0 to 5% by vol.)

Example:

The anaesthetic vaporiser was set at 1.4% by vol.: the intersection with the lower line projected to the left shows the lower limit value :

about 0.7% by vol

The intersection with the upper line projected to the left shows the upper limit value :

about 2.1% by vol.

Rule of thumb:

lower limit value = set value - 50%

upper limit value = set value + 50%, max. 6% by vol.

B 8

Limit values - reduced monitoring

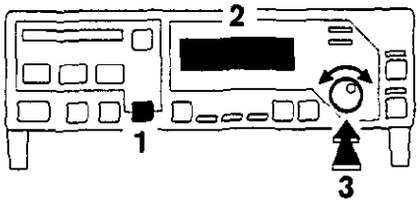
For operating conditions such as manual ventilation or spontaneous breathing, monitoring can be reduced to the parameters

A-Vap with upper limit value

O_2 with lower limit value

Paw with upper limit value

thus preventing alarms which are not required.



1 Press >limit values< button.

2 Display:
Limit values <IPPV>
Mode O_2 V_E Paw A-Vap

3 Select >Mode< and confirm.

2 Display:
MODE <IPPV>
MAN/SP IPPV default

3 Select >MAN/SP< and confirm.

2 Display:
Limit values
MAN/SP active
= reduced monitoring

Activating all limit values

Set, as described above, but

3 Select >IPPV< and confirm.

2 Display:
Limit values
IPPV active

All limit values are effective at the set values

Selecting default limit values

Set, as described above, but

3 Select >Default< and confirm.

2 Display:
Limit values
default active

These default limit values are set by the manufacturer and apply after each re-start (table, page 19).

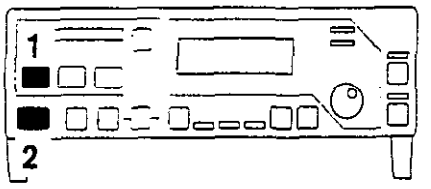
B 9

Displaying measured values

O_2 concentration:

1 Display:
XXX vol. %

2 Display of lower limit value:
XX

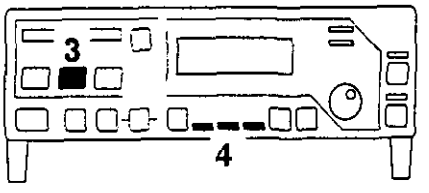


Anaesthetic agent concentration A-Vap:

3 Display:
X,X vol. %

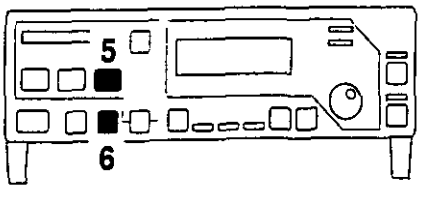
4 Anaesthetic agent selected is shown by the particular LED being lit.

After a cold start, allow a warming-up time of about 3 minutes. No calibration or measurement is possible during this period; dashes are shown in the measured value display, and monitoring is not taking place.



Tidal volume V_T or minute volume $\dot{V}_E$:

5 Display:
V_T X, XX L
or
$\dot{V}_E$ XX, X L/min



Selecting other measured values:

6 Press >$\dot{V}_E/V_T$< button.

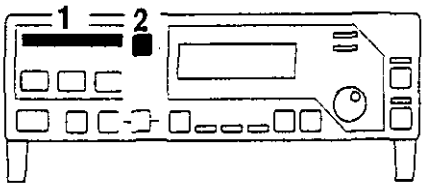
B 10

Analogue values Paw or tidal volume VT:

1 Strip display (Paw mbar)
The limit values are displayed brightly

or

Strip display (VT L)



Change display:

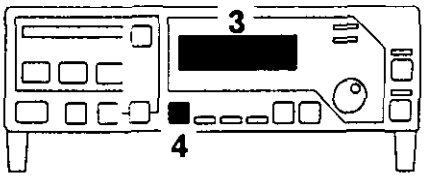
2 Press >Paw/VT< button.

Strip display can be used for leak test for anaesthetic machine or ventilation.

PEEP, Plat, Peak:

3 Display (mbar):
PEEP* Plat.* Peak
XX XX XX

or



Mean pressure, Insp. airway temperature, frequency:

3 Display (mbar, °C, bpm)
Pmean AW-Temp Freq.
XX XX XX

Change display:

4 Press selector button

If the fixed upper limit value is exceeded (40°C), the temperature measured value flashes.

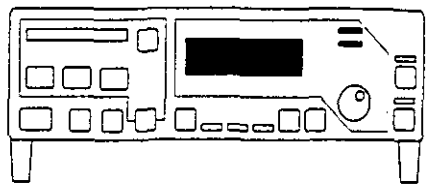
Where the temperature sensor has been disconnected, airway pressure Paw dependent on time is displayed, instead of temperature.

This display can also be used for leak testing.

* If dashes (--) appear below PEEP and Plat., the flow sensor is not ready for measurement.
If dashes appear below Plat. in the operating mode MAN/SPON, there is no plateau pressure.

B 11

Alarms



All alarms are coded according to their importance and priority and are distinguished optically/acoustically, and displayed accordingly.

Warning messages are given priority in the text display; the red (lower) LED flashes together with a sound sequence at 2.5 second intervals.

Caution messages: the yellow (upper) LED flashes together with a sound sequence at 30 second intervals.

Advisory messages: the yellow (upper) LED is lit together with a single tone.

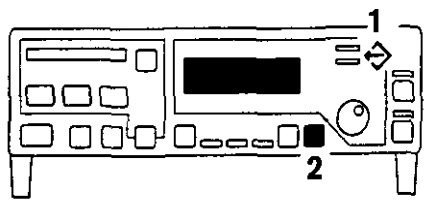
If there is an alarm, the appropriate warning or caution message is indicated in the upper line of the display. The lower line shows the appropriate measured value, the upper and lower limit values to the right and to the left respectively. Any limit value which has been exceeded can be changed directly with the selector knob (to set and to confirm).

During warning messages for O_2 concentration, anaesthetic agent concentration or expiratory minute volume $\dot{V}E$, the appropriate displays flash. During warning messages for airway pressure, the appropriate limit value segment flashes in the strip display.

Alarms, their causes and remedies are listed in the table on page 29.

Displaying the last warning message

The last warning message given is stored and can be displayed later for evaluating the alarm.
Messages without warning characteristics, such as advisory messages, are not stored.



1 If the symbol is lit, this indicates a warning message which has been stored but not yet displayed.

2 Press button; this last warning message is displayed.

Ending display of the last warning message:

2 Press button again, the symbol disappears.

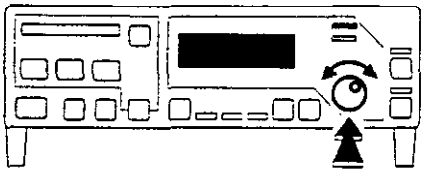
B 12

Acknowledging advisory messages

With advisory messages, such as for a faulty sensor, the display can be cleared for measured values:

- Confirm = the advisory message disappears; the yellow LED goes out.

If the error has not been rectified, the advisory message will re-appear after a set period.

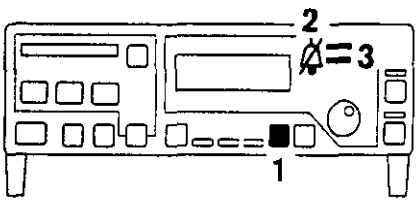


Suppressing alarm tone

1 Press button.

2 The symbol >🔕< is lit; the alarm tone is switched off for 2 minutes. During this period, any new alarms are indicated by a single tone sequence.

3 The red or yellow LED continues to flash; the text remains, as well as the flashing displays.



with connected Monitorbus:

- Other Dräger equipment which is connected is automatically muted. The sound can also be switched off on the Dräger equipment which is connected.

Switching on alarm tone again:

1 Press button again.

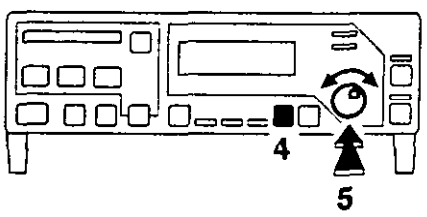
2 Symbol disappears.

Setting alarm tone volume

- only during Standby.

4 Keep button pressed; the alarm tone sequence sounds after about 2 seconds.

5 Turn rotary knob:
clockwise = louder
anti-clockwise = quieter
confirming set volume:
press knob.



After switching off and then on again, the normal volume will apply.

Communication by PM 8030 with other Dräger machines

With the Monitorbus

- e.g. remote switch is activated to switch PM 8030 on from Standby, after start of the anaesthetic ventilator or
- for muting the other Dräger machines.

With the RS-232 Interface

For the transfer of warning, caution and advisory messages, of measured values, for the combination of function "Switching on and 2 minute suppression of acoustic alarms" and for remote switching on of other Dräger machines.

- Communication with the PM 8010 Patient Monitor (software 3.2):
  measured values and warnings are transferred according to the MEDIBUS format (baudrate of 1200 bit/s)

- Communication with the PM 8020 Data Manager:
  measured values, warnings and real time curves of flow and pressure are transferred according to the MEDIBUS format (baudrate of 19200 bit/s)

- Communication with a serial printer:
  measured values and warnings are issued at pre-set time intervals as ASCII-code

  Printer setting:

  Paper format DIN A4/11"

  Page length 66 lines

  Page width 80 characters

  8 databits, 1 stopbit

  non parity, Baudrate

  optimum 9600 Bit/s

  (1200...19200 Bit/s)

Independent documentation

For the preparation of lists on a printer with serial interface.
By changing from Standby to operation, the documents may be printed out at pre-set time intervals. The first page has a protocol heading for the entry of patient data. When the anaesthetic agent is changed, a new page must be started.

Example of documentation on a printer:

PM 8030 Documentation

Date :_____ Page : 1

Name :_____ Prename :_____ Age :_____

Time	Peak mbar	PEEP mbar	Mean mbar	Plat mbar	Rate 1/ /min	Ve L/ /min	Vt L	FiO2 Vol%	AVap Vol%	Temp DegC
00:00	0		0		0					
00:01	0		0		0					
00:02	0		0		0					
00:03	0		0		0					
00:03	0		0		0					
00:04	0		0		0					

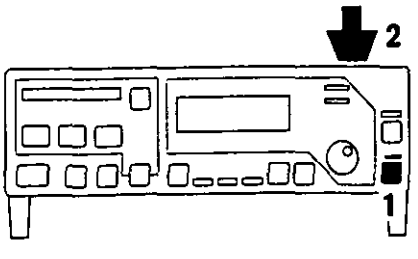
A maximum of three simultaneous warning messages can be printed out on one line, i.e. the three most important messages in order of priority. If a new warning is added or deleted, the new warning is printed out according to its priority. The print-out of this warning line is independent of the pre-set time and in addition triggers the print-out of a measured value line.
The procedure for caution messages is identical to that of warning messages.
Advisory messages are not logged.

Shut-Down

1 Press button, green LED lights.

2 Disconnect from mains power supply.

- Remove O_2 sensor from cap and expose to the ambient air.



C1

Fault - Cause - Remedy

Message	Cause	Remedy
Warning messages		
Paw negative (PAW NEGATIVE)*	Insufficient fresh gas supply Mean pressure Pmean smaller than -2 mbar Airway pressure Paw smaller than -7 mbar	Procure adequate fresh gas supply
Discon./Apnoea pressure (APNOEA PRESSURE)	Insufficient fresh gas supply Breathing or ventilation has stopped *Leak in hose system*	Procure adequate fresh gas supply *Check hose system*
Paw high (PAW ↗)	Upper limit value for airway pressure has been exceeded, Kink in ventilation hose, stenosis Pressure limit set too high Overpressure valve switched off	 Check hose system on anaesthetic machine Adjust pressure limit on anaesthetic machine Switch on pressure limit on anaesthetic machine
Apnoea volume (APNOEA VOL)	Breathing or ventilation has stopped. No volume expired during 15 seconds Insufficient fresh gas supply Tube blocked/kinked Leak in hose system	Check ventilator *Procure adequate fresh gas supply* Check hose system
FiO2 low (FIO_2 ↓)	The inspiratory O_2 concentration is below the lower limit value	Check O_2 supply, check setting of flowmeter on blender
Halothane high (VAP HAL ↗) Enflurane high (VAP ENF ↗) Isoflurane high (VAP ISO ↗)	The appropriate anaesthetic agent concentration in the fresh gas is higher than the upper limit value Incorrect anaesthetic agent has been selected	Check setting on anaesthetic vaporiser
PM 8030 fault XXXX (PM8030 INOP)	Internal hardware fault with error number Machine is not ready for operation	Call DrägerService, give error number

* Messages in parenthesis are displayed, or printed on the peripheral machines PM 8020 and PM 8010, or on a PC or on a printer.

C 2

Fault - Cause - Remedy

Message	Cause	Remedy
Caution messages		
Min. vol. low (AMV ↓/)	Lower limit value for minute volume has been crossed	
	Tube blocked/kinked	Check tube
	Leak in breathing system	Seal breathing system.
	Loss of volume through pressure limitation	Correct ventilation parameters
	Lung compliance has been reduced	
	Flow sensor not calibrated, or faulty	Calibrate flow sensor, page 13; replace if required
Halothane low (VAP HAL ↓/) Enflurane low (VAP ENF ↓/) Isoflurane low (VAP ISO ↓/)	The appropriate anaesthetic agent concentration in the fresh gas is lower than the lower limit value Incorrect anaesthetic agent has been selected	Check setting and filling level of anaesthetic vaporiser
FiO_2 high (FIO_2 /↑)	O_2-flush used, the inspiratory O_2 concentration is above the upper limit value	Check O_2 setting on the flowmeter block or on the blender
Min. vol. high (AMV /↑)	Upper limit value for the minute volume has been exceeded	
	Flow sensor not calibrated or faulty	Calibrate sensor, page 13 replace if required
AW-Temp. high (AW-Temp /↑)	The inspiratory breathing gas temperature is above 40°C	Switch off humidifier. When temperature has dropped to about 37°C set low heating level
Check RS 232	Fault in data connection or cable	Check cable
	Fault in connected machine	Check machine

C 3

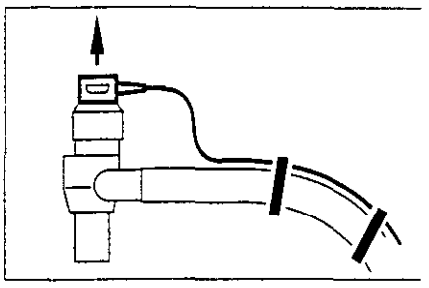
Message	Cause	Remedy
Advisory messages		
O_2 sensor not ready to measure (FiO_2 INOP)	Sensor calibrated incorrectly	Calibrate sensor, page 11
	Sensor has been replaced but not calibrated	Calibrate sensor
	Sensor's life exceeded	Replace sensor capsule, page 7, and calibrate
	Faulty sensor cable	Change housing of O_2 sensor
Flow sensor not ready to measure (FLOW INOP)	Sensor calibrated incorrectly	Calibrate sensor, page 13
	Faulty sensor	Replace sensor and calibrate, page 13
	Sensor replaced but not calibrated	Calibrate sensor
	Faulty cable	Replace cable and calibrate sensor
Pressure sensor not ready to measure (PRESSURE INOP)	Faulty sensor	Confirm = press knob, the advisory message disappears Call DrägerService
A-Vap sensor not fitted? (A-VAP INOP)	Sensor plug not connected	Connect plug at the back, confirm
A-Vap sensor warming up time (A-VAP INOP)	Sensor is still warming up	Await 3 minute warming-up time
A-Vap sensor not ready to measure (A-VAP INOP)	Sensor calibrated incorrectly	Calibrate sensor, page 15
AW-Temp. Sensor not ready to measure (AW-TEMP INOP)	Sensor or cable not connected, or faulty	Connect sensor or use new sensor
Settings lost	Internal battery for data storage is discharged	Calibrate all sensors, the machine is then ready for operation; call DrägerService without delay
Warm start: limit-values unchanged	Temporary voltage failure	
	Internal, automatic new start	Monitoring is re-activated after a few seconds

Additional advisory messages

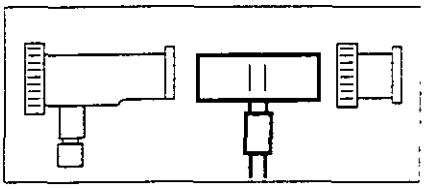
Message	Explanation
Calib. flow sensor? (CALIB FLOW?) Calib. O_2 sensor? (CALIB FIO_2?) Calib. A-Vap sensor? (CALIB A-VAP?)	Request to calibrate after switching on machine
Standby (PM8030 STBY)	Machine is ready for operation Monitoring is switched off
Limit values Default active	Default limit values selected
Limit values IPPV active	Limit values for automatic ventilation selected
Limit values MAN/SP active (MAN/SP ⏻ MODE)	Limit values for manual ventilation or spontaneous breathing selected lower limit value minute volume off upper limit value minute volume off lower limit value Paw off lower limit value A-Vap off upper limit value O_2 off

C 5

Stripping-down



- Detach temperature sensor from Y-piece; detach Y-piece from ventilation hoses; remove cable from hose clips.
- Disconnect plug at the back; do not pull on the cable.



- Unscrew the housing and remove flow sensor.

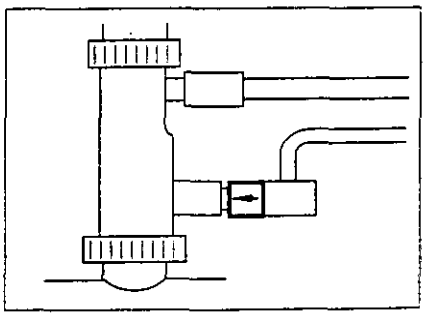
When contamination is likely:

- Remove flow sensor = disposable

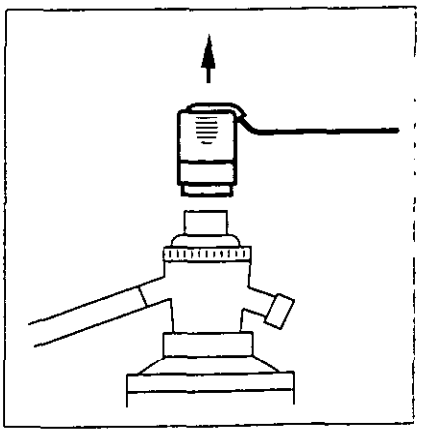
or

- Re-use flow sensor as long as it is possible to calibrate it.

The sensor cannot be autoclaved or disinfected.



- Loosen plug on pressure measuring line = push ring on coupling back.
- Remove pressure measuring line and filter from the back of the machine and drain condensate from the measuring line.



- Remove O_2 sensor and disconnect plug from the back of the machine; do not pull on the cable.

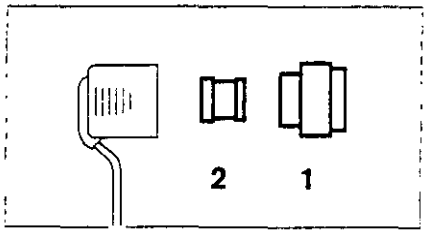
C 6

Detaching O_2 sensor capsule

1 Unscrew cap from sensor housing.

2 Take out sensor capsule.

The plug of the anaesthetic agent sensor remains connected.



Disinfecting/Cleaning/Sterilizing

Use surface disinfectants for disinfection. To ensure that materials are compatible, we recommend preparations based on

- aldehydes
- alcohols
- quaternary ammonium compounds.

Do not use

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

For users in the Federal Republic of Germany we recommend only disinfectants given in the current DGHM list (DGHM: German Society for Hygiene and Microbiology). For users in other countries, we also recommend the above preparations.

O_2 sensor

- Do not autoclave or disinfect in liquid
- Wipe any soiling off the housing or cable with a damp disposable cloth. Wipe any soiling off the wire screen of the sensor capsule with a disposable cloth lightly wetted with distilled water.
- *Sterilize in ethylene oxide at not more than* 50°C; follow the prescribed airing times

  or

- *Disinfect in Aseptor 9000 using the 45°C programme* - in accordance with the Aseptor Instructions for Use.

C 7

Temperature sensor, pressure measuring line with filter, measuring connection of flow sensor

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

PM 8030 and sensor cable from flow sensor

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

Alternatively

- Disinfect in Aseptor 9000 using the 45°C programme - in accordance with Instructions for Use. First wipe off any soiling with a damp disposable cloth.

Before re-use

- Re-assemble monitor, pages 6 to 8.
- Check function, page 36.
- Immediately before use on patient, carry out check of monitor function, page 16.

C 8

Checking Function

- after assembly, at least every 2 weeks.

Self-test of machine

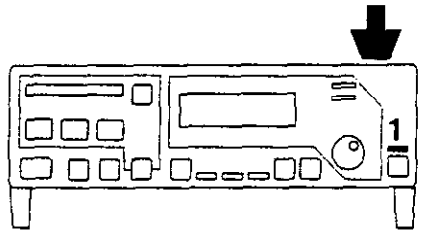
- Switch on mains power:

  The monitor carries out a self-test:
  The internal programme memory is tested.
  The software and language versions are displayed.
  All LEDs and display elements are lit; a single tone sounds.

  Display:
  Dräger PM 8030

  The alarms for monitoring are tested.

  The self-test is completed in about 30 seconds.



For operation with Monitorbus:

- Set ventilator to IPPV.

1 The green LED goes out, the PM 8030 is in measuring mode.

- Calibrate flow sensor, page 13.
- Calibrate O_2 sensor, page 11.
- Calibrate anaesthetic agent sensor, page 15.
- Check pressure measurement, page 17.
- Check temperature measurement, see below.

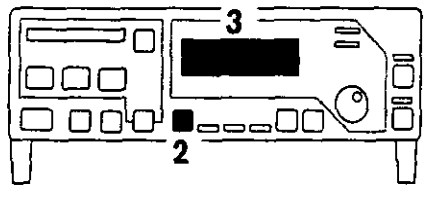
Checking temperature measurement

- Remove temperature sensor from Y-piece and expose to ambient air.

2 Select the display for airway temperature:
Pmean AW-Temp Freq
XX

3 After about 1 minute, room temperature is displayed.

- Re-insert temperature sensor in Y-piece.



C 9

Maintenance intervals

In accordance with DIN 31 051:

Inspection	= determining actual condition
Service	= measures to maintain specified condition
Repair	= measures to re-establish specified condition
Maintenance	= inspection, service, and, if necessary, repair

Clean and disinfect monitor and monitor components before maintenace · and also before dispatch for repair.

O_2 sensor	replace, when calibration is no longer possible
Bacterial filter in pressure measuring line	replace after 1 year
Pressure measuring line (silicone rubber hose and socket)	replace if damaged, or after 1 year at the latest
NiCd battery for mains failure alarm	replace after 2 years by trained serviceman
Digital component lithium battery for data protection	replace after 3 years by trained serviceman
Inspection and service	every six months by trained serviceman

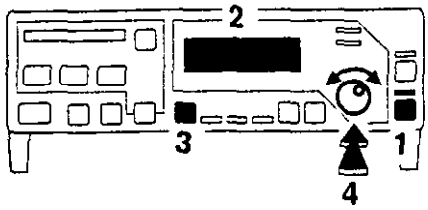
C 10

Configuration

Setting language of display texts

PM 8030 is supplied by the manufacturer with German display texts.

Optional alternatives are available in English, French, Spanish, Italian and Dutch.



1 Switch PM 8030 to Standby, green *LED is lit.*

2 Display:
Standby

3 Keep button pressed for at least 3 seconds:

2 Display:
configuration
language RS 232 sens.

4 Select >language< = *turn knob and* confirm = press knob

2 Display:
language <D>
GB F D E I NL

GB = English

F = French

D = German

E = Spanish

I = Italian

NL = Dutch

The actual language used is indicated by < > on the right in the top line.

4 Select the desired language and confirm.

3 *Press* button repeatedly, until:

2 Display:
Standby

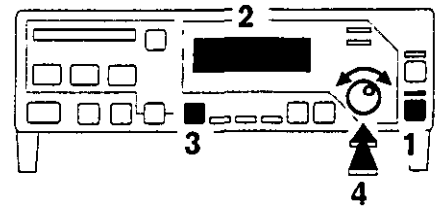
or

- Wait 30 seconds (time out).

C 11

Interface protocol for PM 8010 or PM 8020

PM 8030 prints out measured values and warnings according to the MEDIBUS format in real time via the RS 232-interface.



1 Switch PM 8030 to Standby; green LED is lit.

2 Display:
Standby

3 Keep button pressed for at least 3 seconds:

2 Display:
configuration
<u>language</u> RS232 sens.

4 Select >RS 232< = turn knob and confirm = press knob.

2 Display:
RS 232 <printer>
<u>MEDIBUS</u> printer rate

4 Select >rate< and confirm.

2 Display:
rate/100 baud <96>
0 12 24 48 <u>96</u> 192

The actual setting is indicated by < > on the right in the top line.

4 Select desired baudrate and confirm
for PM 8010 1200 baud **<12>**
for PM 8020 19200 baud **<192>**

3 Press button:

2 Display:
RS 232 <MEDIBUS>
<u>MEDIBUS</u> printer rate

4 Select >MEDIBUS< and confirm.

3 Press button repeatedly until:

2 Display:
Standby

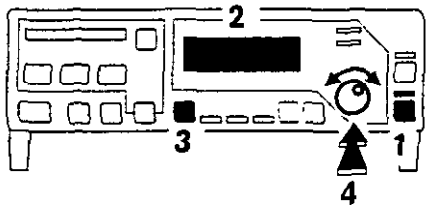
or

- Wait 30 seconds (time out)

Interface protocol for printer

PM 8030 is preset by the manufacturer for the connection of a printer:

Transfer rate	*9600 baud*
Interval time for measured value	5 minutes
Output of warning messages	"Warning" on
No output of caution messages	"Caution" off



1 Switch PM 8030 to Standby; green LED is lit.

2 Display:
Standby

3 Keep button pressed for at least 3 seconds:

2 Display:
configuration
language RS 232 sensor

4 Select >RS 232< = turn knob and confirm = press knob

2 Display
RS 232 <printer>
MEDIBUS printer rate

4 Select >rate< and confirm.

2 Display:
rate/100 baud <96>
0 12 24 48 96 192

The actual setting is indicated by < > on the right in the top line.

4 *Select desired baudrate and confirm.*

3 Press button briefly.

2 Display
RS 232 <printer>
MEDIBUS printer rate

4 Select >printer< and confirm.

2 Display:
printer <5>
data warning caution

4 *Select >data< and confirm.*

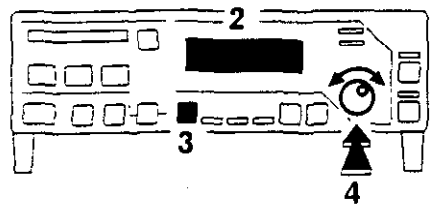
2 Display:
data/min <5>
1 2 5 10 off

4 Select desired interval time for measured value printout and confirm.

3 Press button and select "Warning".

2 Display:
warning <on>
on off
Warning <on> = warning messages are given
Warning <off> = warning messages are not given.

C13



4 Select desired configuration and confirm.

3 Press button and select caution.

2 Display:
caution <on>
<u>on</u> ***off***
Caution <on> = caution messages are given
Caution <off> = caution messages are not given

4 Select desired configuration and confirm.

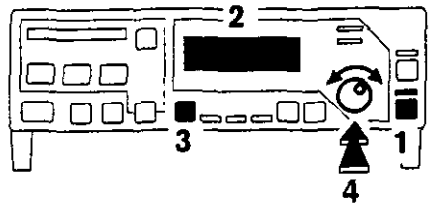
3 Press button repeatedly until:

2 Display:
Standby
or

- Wait 30 seconds (time out).

Switching off/on A-Vap/AW-Temp. sensors

When PM 8030 is used without anaesthetic agent measurement and/or without temperature measurement, such as for long-term ventilation:



1 Switch PM 8030 to Standby; green LED is lit.

2 Display:
Standby

3 Keep button pressed for at least 3 seconds:

2 Display:
configuration
<u>language</u> RS 232 sensor

4 Select >sensor< = turn knob and confirm = press knob.

2 Display:
sensors <on>
<u>A-Vap</u> AW-Temp.

4 Select sensor and confirm.

2 Display (example: A-Vap):
A-Vap <on>
<u>on</u> **off**

4 Select status >off< or >on< and confirm.

3 Press button briefly and continue for the other sensor.

If the sensor is connected, the measurement function cannot be switched off.

3 Press button repeatedly until

2 Display:
Standby
or:

- Wait 30 seconds (time out).

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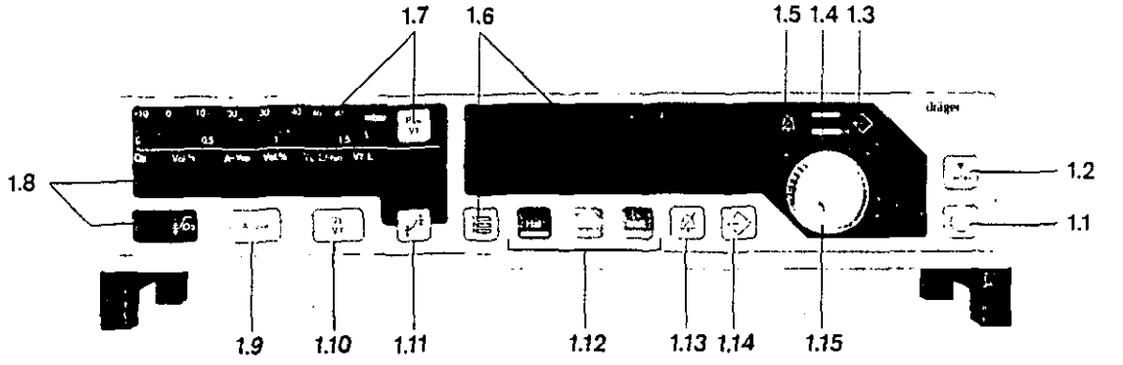
What's What

Front



1.1 Button for operating mode.
Switches between measuring mode and standby mode
green LED is lit in standby mode

1.2 *Button to select sensor calibration*
green LED flashes during selection and is lit continuously during calibration

1.3 Light to indicate stored warning message

1.4 Red warning LED below, yellow caution LED above

1.5 *Display "Alarm tone switched off for 2 minutes"*

1.6 Dialogue and display window with selector button to change display, or for selection of language and interface

1.7 Strip display for ventilation pressure Paw or tidal volume V_T with selector button

1.8 *Display for the O_2 measured value and display for lower limit value for O_2*

1.9 Display for anaesthetic agent concentration in fresh gas with selector button for anaesthetic agent

1.10 Display for expiratory minute volume $\dot{V}_E$ or tidal volume V_T with selector button

1.11 Selector button for limit values

1.12 LEDs to indicate selected anaesthetic agent

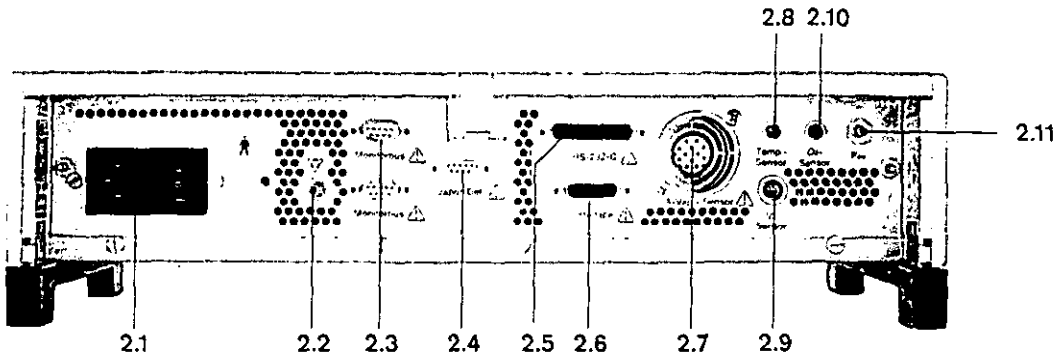
1.13 Button to switch off alarm tone for 2 minutes and to set volume of alarm tone

1.14 Button to display stored warning messages

1.15 Selector knob
to select or adjust = turn
to confirm = press

D 1

Rear



2.1 Mains connection with mains fuse (2x) and mains switch

2.2 Potential equalisation pin to connect an additional earth line

2.3 Connection for Dräger Monitorbus

2.4 Connection for identification of anaesthetic vaporiser (optional)

2.5 RS 232-C interface to connect PM 8010 Patient Monitor or PM 8020 Data Manager or a printer

2.6 Connection for additional digital interface (optional)

2.7 Connection for anaesthetic agent sensor

2.8 Connection for temperature sensor

2.9 Connection for flow sensor

2.10 Connection for O_2 sensor

2.11 Spigot for pressure measuring line

≙ DIN IEC 601, para 19, table 4:
max. permissible earth leakage current 0.5 mA

Technical Data

Ambient conditions

During operation:	
Temperature	15 to 40°C
Atmospheric pressure	900 to 1100 hPa
Rel. humidity	10 to 90% (below dewpoint)
During storage:	
Temperature	- 20 to 60°C
Atmospheric pressure	500 to 1100 hPa
Rel. humidity	< 98% (below dewpoint)

Displays

For measuring and limit values as well as text displays	LED displays together with a two-line vacuum fluorescence display (VF display)
For Paw(t) and V_T(t)	40-stage LED strip display
Pressure displays	
Airway pressure Paw	LED strip display
Range	-10 to 80 mbar Limit values brighter
PEEP Plat. Peak Pmean	numerical display VF display, 2 digit
Range PEEP	-2 to 20 mbar
Plat. Peak Mean	-10 to 98 mbar
Resolution	1 mbar
Accuracy	± 4% of measured value, at least > 1 mbar
O_2 display	7-segment LED, 3 digit
Range	5 to 105 vol. %
Resolution	1 vol.%
Accuracy	
Calibrated with 21% O_2 by vol.	± 3% by vol. in measuring range 6 to 18% by vol. ± 1 vol.% in measuring range 18 to 30% by vol. ± 3 vol.% in measuring range 30 to 50% by vol. ± 5 vol.% in measuring range 50 to 60% by vol.
Calibrated with 100% O_2 by vol.	< 3% by vol. in measuring range 0 to 100% by vol.
Tidal volume V_T	LED strip display
Range	0 to 1.5 L
Tidal volume V_T	numerical 7-segment display, 3 digit
Range	0.02 to 9.99 L
Resolution	0.01 L
Accuracy	± 8% of measured value, at least > 0.01 L (subject to calibration conditions and 1013 hPa)
Minute volume $\dot{V}_E$	numerical 7-segment display, 3 digit
Range	0 to 99.9 L/min
Resolution	0.1 L/min
Accuracy	± 8% of measured value (subject to calibration conditions and 1013 hPa)
Frequency	numerical display, VF display, 2 digit
Range	0 to 60/min
Resolution	± 1/min
Accuracy	± 1/min

D 3

Inspiration gas temperature	numerical display, VF display, 2 digit
Range	20 to 50°C
Resolution	1°C
Accuracy	± 0.5°C in measuring range 30 to 41°C
Anaesthetic agent concentration	numerical 7-segment display, 2 digit
Range	0 to 9.9% by vol.
Resolution	0.1% by vol.
Accuracy	± 10 % of measured value, at least > 0.1% by vol.
Data interface (not for the control of the anaesthetic or intensive care ventilator) RS 232-C	
Plug	25 pole Sub D
Pin plates	1 - screening 2 - TxD 3 - RxD 7 - GND
Galvanic separation	1.5 kV

Operating Data:

Voltage	*100 to 240 V 50/60 Hz*
Current	max. 0.4 A
Mains fuse	T 2 A DIN 41662 (2x)
Dimensions W x H x D	425 x 88 x 300 mm
Weight	3.3 kg
Classification	I, type B conforming to DIN IEC 601/1 para. 19, table 4 max. permissible earth leakage current 0.5 mA Temperature and flow sensor, galvanic, separated from protective conductor type BF permissible patient current 0.1 mA

Manufacturer's certificate for radio suppression

The manufacturers certify that PM 8030 is radio-suppressed to conform to the guidelines contained in Regulations 1046 of the German Federal Post.

Order List

Basic Unit PM 8030 with accessories:	82 01 414
Mains cable 2m Measuring connection Pressure measuring line Flow measuring cable Flow sensors (5 off) O_2 sensor housing Plug adaptor for O_2 sensor housing O_2 sensor capsule Cap for O_2 sensor	

Accessories required

For anaesthetic agent measurement sensor required:	
Sensor universal for connection to Dräger anaesthetic machines and those of other manufacturers	82 90 033
or	
Sensor Sulla/Trajan	82 90 032
for connection to Dräger Sulla 808, Trajan 808 anaesthetic machines	
or	
Sensor Titus A for connection to Dräger Titus A anaesthetic machine	*82 90 328*
or	
Sensor NS 656, AV 1	82 90 030
for connection to Dräger NS 656 Anaesthetic Spiromat *and AV 1 Anaesthetic Ventilator* (Vapor mounted on the right-hand side)	
or	
Sensor AV 1 for connection to Dräger AV 1 Anaesthetic Ventilator (Vapor mounted on the left-hand side)	82 90 031
Test adapter	68 01 349

Special accessories

for temperature measurement:	
Temperature sensor	84 05 371
Y-piece with connection for temperature sensor	M 30 543
Hose clips (set of 10)	84 04 047
for data communication:	
with PM 8020 data cable "PM 8020"	*86 00 133*
with PM 8010 data cable "PM 8010"	85 00 337
for printer connection	86 00 133
Monitorbus cable 45 cm	M 30 893

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Order List

Spare parts

Flow sensor (5 off)	84 03 735
Flow measuring cable	83 01 795
O_2 sensor capsule	68 50 645
O_2 sensor housing	68 50 720
Caps for O_2 sensor (5 off)	M 21 482
Pressure measuring line (socket, filter, hose, plug)	83 02 841
Measuring connection	M 28 833
Temperature sensor	84 05 371
Y-piece with connection to temperature sensor	M 30 543
Mains cable 2 m	18 07 323

Appendix

Flow Measurement -

Measuring principle and signal processing

The sensor works on the principle of a constant temperature hot-wire anemometer. The breathing gas flows through a tube which contains two platinum wires. One of the wires is heated while the other compensates for gas temperature.

The transfer of energy from the wire to the breathing gas is dependent on mass flow. As a result the measurement of volume is influenced by ambient air pressure.

If ambient air pressure changes by 20mbar the measurement accuracy changes by 2% (relative to normal pressure 1013 hPa)

Gas compensation

PM 8030 automatically corrects the influence of breathing gases of different compositions (O_2/N_2O mixture) on flow measurement. During inspiration (no gas flow to sensor) the gas composition is identified.
Linearisation is carried out using different calibration tables for gas mixtures of O_2/N_2O or of air and O_2.

Classification of breathing models

The calibration of the sensor applies to defined flow conditions. Artefacts, arising from fluctuations of the gas column in the hoses or pressure surges during the closing or opening of valves are eliminated by using a specific model of the breathing process. This process is based on the physiological expiration flow model where there is a steep increase in flow at the beginning of expiration. A minimum flow and a minimum volume must be achieved to establish a valid breathing model:

$\dot{V}_E$ minute volume L/min	Minimum volume mL
$\dot{V}_E < 2$	15
$2 < \dot{V}_E < 4$	30
$4 < \dot{V}_E < 6$	50
$\dot{V}_E > 6$	90

Determination of $\dot{V}_E$

$\dot{V}_E$ measurement is independent of the breathing model. The measured value $\dot{V}_E$ is integrated from the flow for a 30 second time period.

Definition of PEEP and Plateau pressure

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.

This definition of PEEP and Plateau pressure is related to the breathing model described above.

D.4

O2 Measurement

Measuring principle and signal processing

The O2 sensor functions according to the galvanic cell principle. Oxygen molecules from the gas mixture for measurement 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.

At a constant pressure and temperature of the gas mixture being measured, 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 beyond a permissible tolerance due to external or internal malfunction, the display will switch off automatically. This prevents faulty displays and subsequent faulty interpretation.

Anaesthetic agent measurement

Measuring principle

The anaesthetic agent measurement works with the Dräger Iris sensor (IRIS = InfraRed Inhalation Sensor). The anaesthetic agents halothane, enflurane and isoflurane absorb a pulsed light beam inside the measuring chamber. At a constant pressure, the reduction of light intensity (compared to a calibration point) can be described approximately as the sum of two exponential functions.

In the selected wavelength ranges changes in the composition of the gas mixture (N_2O etc.) give no measurable cross sensitivity at the required accuracy.

PM 8030 is calibrated by the manufacturer at a temperature of 22°C, normal pressure of 1013 hPa.

Since measurement depends on gas density, the measured value must be corrected when there is any significant deviation from normal pressure (1013 hPa) and temperature (22°C):

$$C_{korr.} = C \cdot \frac{po}{p} \cdot \frac{273 + T}{295}$$

$C_{corr.}$ =correct measured value
C = measured value
po = normal pressure 1013 hPa
p = actual atmospheric pressure hPa
T = actual temperature °C

No correction for pressure is required for comparing the concentration set on the Dräger anaesthetic agent vaporiser Vapor 19.n and the display value on PM 8030.

See Dräger Vapor 19.n Instructions for Use.

Explanation of terms used

Abbreviation	Explanation	
A-Vap	Anaesthetic agent concentration in fresh gas	% by vol.
AW-Temp	Inspiratory gas temperature in the airway	°C
Enf	Anaesthetic agent enflurane	
Freq.	Ventilation or breathing frequency	bpm
FiO_2	Inspiratory oxygen concentration	% by vol.
Hal	Anaesthetic agent halothane	
Iso	Anaesthetic agent isoflurane	
MODE	Operating mode: monitoring during automatic ventilation <IPPV> (display for complete alarm monitoring) or during manual ventilation or spontaneous breathing <MAN/SP> (display for reduced alarm monitoring)	
Paw	Airway pressure	mbar
Peak	Peak pressure	mbar
PEEP	Positive endexpiratory pressure	mbar
Plat.	Plateau pressure	mbar
Pmean	Mean pressure	mbar
Default	Pre-programmed default values	
$\dot{V}_E$	Expiratory minute volume	L/min
V_T	Tidal volume	L

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