Dräger

Dräger-Vapor® 19.n

Anaesthetic Vaporiser

Instructions for Use

A4

Influence of temperature

Vapor compensates for changes in temperature through the different thermal expansion characteristics of two different materials. The saturation concentration of the anaesthetic agent, which rises as temperature rises, is automatically balanced by routing a higher proportion of the gas flow through the vaporising chamber-bypass. This proportion is increased as temperature rises because the material which makes the gap has a lower thermal expansion than the material which surrounds it.

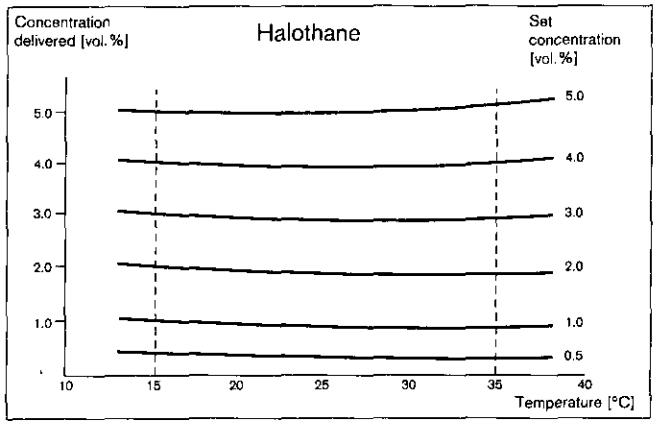
Temperature compensation changes the gap in a linear manner. This compensation does not exactly match the non-linear variation of the saturation concentration for the whole temperature range, so that the concentration delivered still remains slightly dependent on temperature. The deviations are within the accuracy specified between 15 ° and 35 °C. The diagrams show typical dependence. The deviations increase for temperatures outside this range, despite continuing compensation.

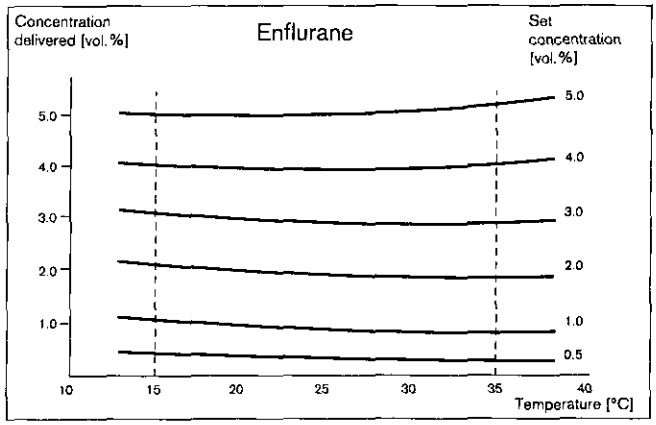
Under no circumstances must the temperature of the anaesthetic agent reach boiling point, as the concentration delivered will then become impossible to control. As altitude increases, boiling point falls:

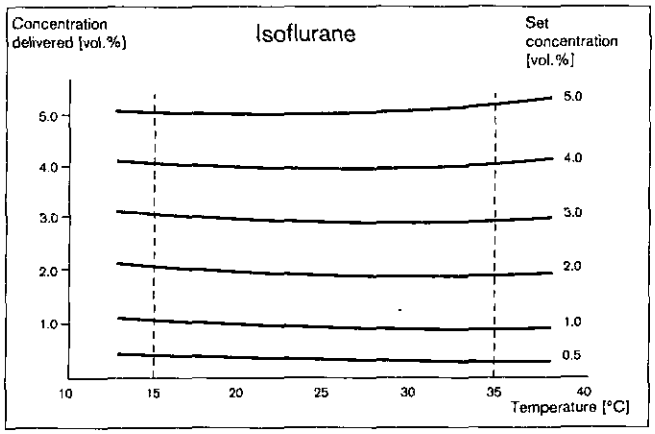
	Boiling point of anaesthetic agent °C			
Atmospheric pressure/ Altitude	1013 hPa 0 m	900 hPa 1000 m	800 hPa 2000 m	700 hPa 3000 m
Halothane	50.2	46.8	43.4	39.8
Enflurane	56.5	53.4	50.3	46.8
Isoflurane	48.5	45.4	42.2	38.9
Sevoflurane	58.6	53.4	52.1	48.7

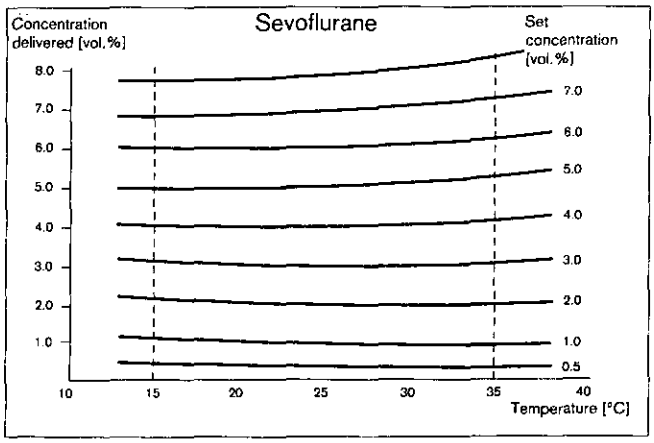
The operating range of Vapor with Dräger anaesthetic machines has been set in such a way that, in the most critical situation of 700 hPa, 35 °C and a maximum negative pressure of –100 mbar on the Vapor, the boiling point of the anaesthetic agent cannot be reached.

Temperature compensation is resistant to ageing and hysteresis, but is affected by a certain inertia: differences in temperature between Vapor and the room within the 15 to 35 °C range are compensated within the concentration accuracy specified.
However, if the temperature of the Vapor before use was outside 15 to 35 °C, a time of 15 min/°C has to be allowed for temperature adjustment if the concentration is to remain within the accuracy specified.







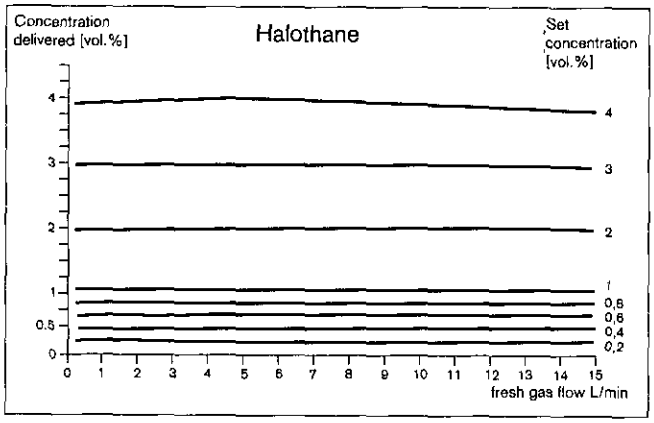


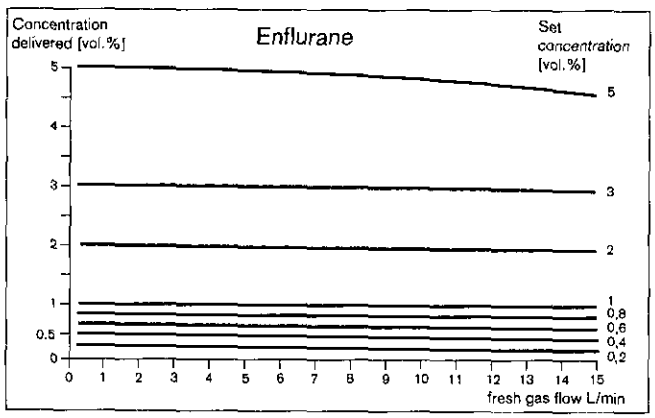
Influence of flow

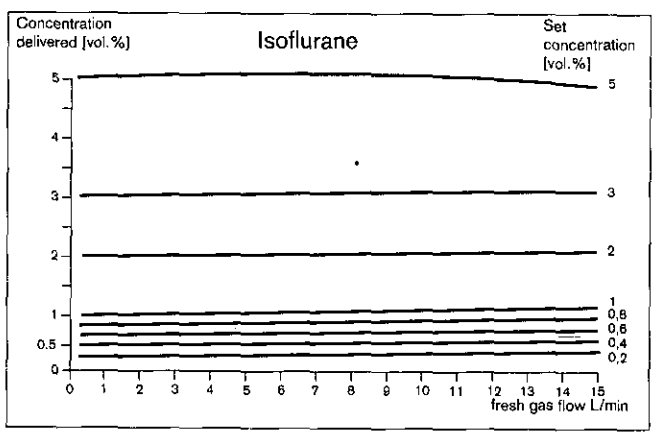
The concentration delivered by Vapor is virtually independent of fresh gas flow within the specified flow range.

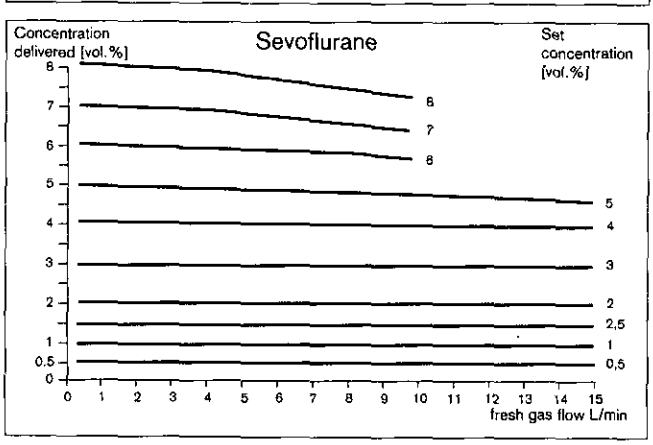
The concentration delivered is reduced slightly when high concentrations are set at the same time as a high fresh gas flow. Under such conditions full compensation is not made for the cooling of the anaesthetic agent due to evaporation. However, the concentration delivered will remain within the concentration accuracy specified.

The diagrams show typical dependence of the concentration delivered after 1 minute at 22 °C, 1013 hPa, during operation with Air (measured in accordance with ISO 5358).









Influence of gas composition

The concentration delivered is dependent on the composition of the fresh gas since the viscosity and density of the gas changes from one gas and composition to another. The Vapor is calibrated with Air because the concentration delivered is then in the middle of the range for available anaesthetic gas mixtures.

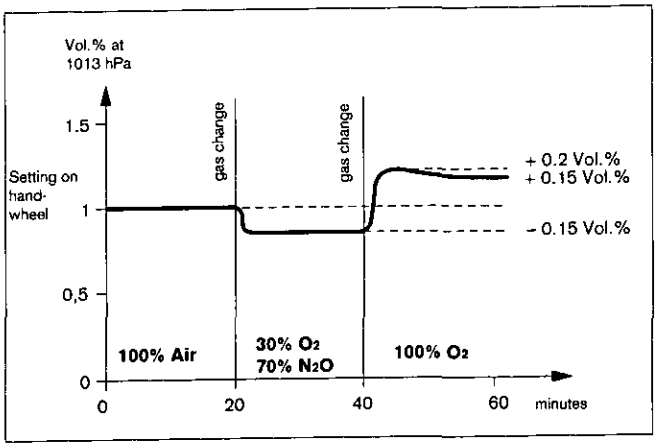
When 100 % O_2 is used the concentration delivered compared with Air rises by 15 % of the set value at most, up to a maximum of 0.3 vol.%
When 30 % O_2 and 70 % N_2O is used, it falls by 15 % of the set value at most, and by not more than 0.3 vol.%.

The effect of gas composition varies slightly for different anaesthetic agents and, for this reason, maximum effects are given here.

When changing from one gas mixture to another, an additional dynamic effect can occur which may result in a further deviation in concentration until the earlier fresh gas is flushed out of the vaporising chamber.

These deviations and their duration are all the greater,
– the lower the volume of anaesthetic agent in the Vapor
– the higher the concentration set and
– the more extreme the change of gas type.
The extent of this dynamic deviation increases as gas flow increases, though the duration of the deviation decreases.

The diagram shows the dependence of concentration delivered on the fresh gas composition at a 1 vol.% setting. Illustration of maximum measured deviations in the entire 0.25 to 15 L/min flow range at 1 vol.% (22 °C, atmospheric pressure 1013 hPa, Vapor 1/4 filled).



Influence of atmospheric pressure

The anaesthetic agent partial pressure delivered by Vapor (see calibration, page 32) is almost independent of atmospheric pressure, so that weather-based fluctuations do not need to be taken into account and altitude-based pressure changes in the range 700 to 1100 hPa will lead to only small deviations within the accuracy specified. For this reason, the physiological effect – the depth of anaesthesia – at a defined Vapor setting is independent of atmospheric pressure.

When measuring the concentration delivered by Vapor in partial pressure (e.g. with Dräger IRIS or PM 8030/35) there is no influence of ambient pressure.
When measuring in volume percent (e.g. with Dräger PM 8020 or PM 8050) the measured values do, however, change with atmospheric pressure and measured values rise, when atmospheric pressure falls below 1013 hPa.
The following formula for conversion applies:

$$\text{Concentration [\% partial pressure]} = \frac{\text{Measured value [vol.\%]} \cdot \text{atmospheric pressure [hPa]}}{1013\ \text{hPa}}$$

Example:
A concentration output of 4 % partial pressure, when measured in units of vol.% at an altitude of 1000 m (900 hPa) is 4.5 vol.% , and at 2000 m (795 hPa) it is 5.1 vol.%.

Under no circumstances must Vapor 19.n be used at atmospheric pressures and temperatures at which the anaesthetic agent could start to boil (see "Influence of temperature", page 33), as the concentration delivered rises and is impossible to control.

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Influence of fluctuations in pressure
during ventilation

When ventilation is being carried out without fresh gas de-coupling, pressure fluctuations on the anaesthetic vaporiser can cause a higher concentration to be delivered than is shown on the handwheel setting.

The vapour in the vaporising chamber is compressed when pressure raises, and it expands when pressure falls. When this effect is strong enough it will pump small quantities of saturated vapour backwards through the inlet of the vaporising chamber into the fresh gas.
This pumping effect becomes greater,
- the higher the ventilation pressure and ventilation frequency,
- the more rapid the fall in pressure during expiration,
- the lower the fresh gas flow,
- the lower the concentration set,
- the smaller the quantity of anaesthetic agent in the vaporiser.

The ability of the Vapor to compensate for these effects will reduce them in practise so that the requirements of DIN 13252 and other Standards can easily be met.

When anaesthetic ventilators are being used, which provide a continuous supply of fresh gas to the breathing system (without a buffer for fresh gas de-coupling), and ventilation pressures are greater than 20 mbar and concentration set at <1 vol.% and/or a fresh gas flow at <1 L/min, the Vapor should be filled completely, so that deviations due to fluctuations in pressure can be kept as low as possible.

Influence of positive/negative pressure
relative to ambient and dynamic pressure

Vapor's application range is limited to between −100 and 200 hPa relative to the ambient atmospheric pressure at the Vapor outlet.

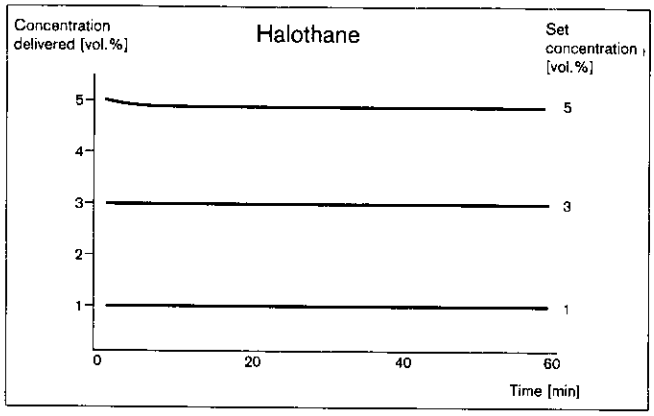
Pressure in the Vapor is a little higher than ambient atmospheric pressure, as the fresh gas flow builds up dynamic pressures of between 0.5 and 150 mbar in the flow control system.

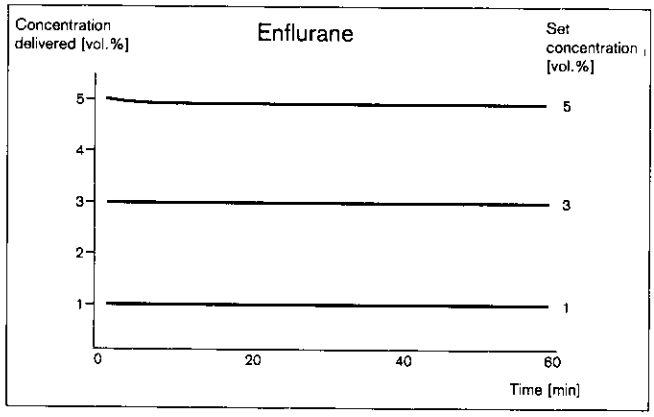
When O_2 flushing is activated on Dräger anaesthetic machines a negative pressure is produced at the Vapor outlet which may be up to 100 mbar, according to ISO 5358. 100 mbar negative pressure has the same effect as an increased altitude of 1000 m or a drop in boiling point of about 3.5 °C (see "Influence of temperature", page 33).

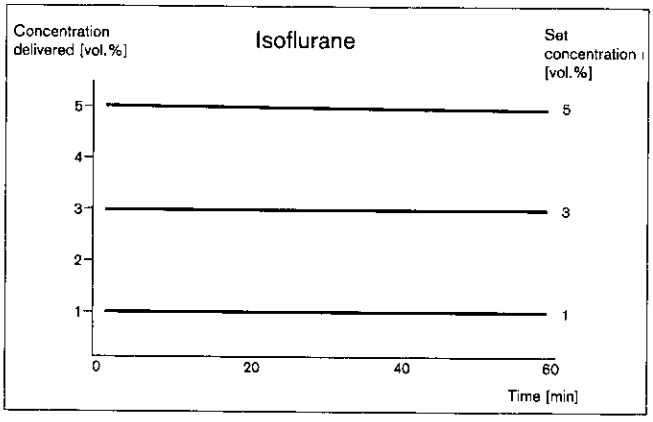
Influence of running time

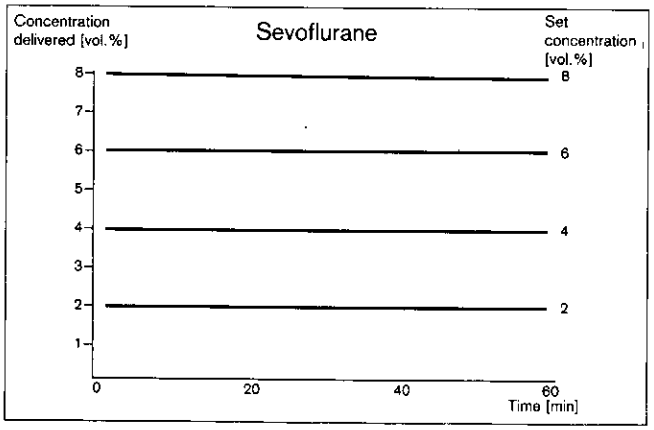
Evaporation of the anaesthetic agent during operation cools the Vapor. The temperature falls more rapidly the higher the concentration set and the higher the flow selected. Saturation concentration decreases as the temperature falls and so the concentration delivered also decreases.
Temperature compensation counters this and limits deviations in the concentration delivered. However, since the temperature at the evaporation point differs a little from the temperature of the temperature compensation mechanism depending on evaporation rate, the duration of operation has some effect on concentration. Since ambient heat is more effectively absorbed as a Vapor cools, a Vapor stabilises at a lower temperature and a slightly lower concentration after a certain time of operation.
All Vapors 19.n conform to DIN 13252, which stipulates that after 20 minutes, and at 8 L/min and 22 °C, no concentration may deviate from the set value by more than ±20 %.

The diagrams show typical concentration curves, taken at 22 °C and 4 L/min Air.









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Behaviour when tilted

A fixed screwed Vapor can be used at an angle of up to 45°.

For a Vapor with plug-in adaptor or on portable anaesthetic machines, there may be occasions when a filled Vapor is tilted by more than 45°. Liquid anaesthetic agent could then get into the flow control system and lead to an incorrect concentration output. If a filled Vapor has been tilted by more than 45°, the concentration being delivered must be checked before it is ready for operation (see "Checking concentration", page 24).

If the concentration delivered is not within the tolerance range specified during this test, drain Vapor and flush with 10 L/min at maximum concentration setting for about 5 to 20 minutes (depending on how long the Vapor has been tilted). Allow gas to flow into the scavenging system. Then check concentration again. Flushing will cool the Vapor markedly so wait for a further 2 to 3 hours before checking the concentration delivered.
If the specified accuracy for concentration is not reached after the Vapor has been flushed a second time, the Vapor must not be used.
Vapor must be checked by DrägerService.

For transportation where the angle of inclination may be greater than 45°, drain the anaesthetic agent (see page 19 and 21).

Mechanical stress

The Dräger-Vapor is a precise instrument – it must be handled with care and no force applied.

Vapor 19.n has been vibration-tested in fixed configuration for aeronautical conditions (MIL-STD 810 method 514, curve M) and has been passed for **transport** in helicopters.
Because of the vibration, Vapor must not be **operated** in helicopters unless it has vibration-free suspension.

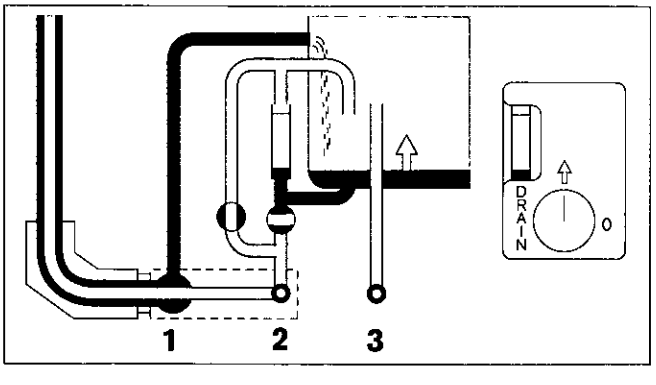
After 10,000 full revolutions of the handwheel, wear is so minimal that the deviation in concentration due to wear is within the accuracy specified.

Key-indexed filling system

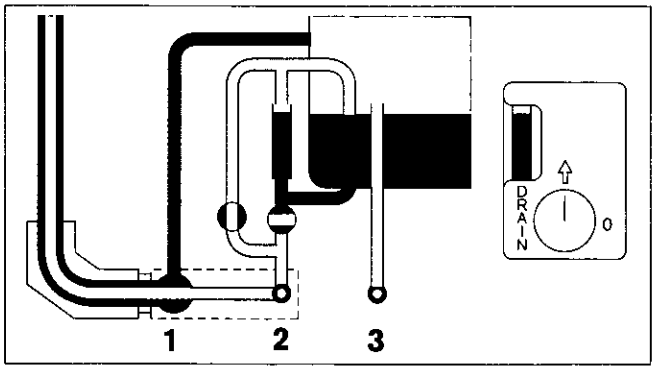
The key-indexed filling system consists of an anaesthetic-agent-specific filling device on the Vapor and an anaesthetic-agent-specific filling adaptor for connection to an anaesthetic agent bottle with an indexed collar. This system
- prevents filling with incorrect anaesthetic agent
- reduces the amount of anaesthetic vapour released during filling
- prevents any overfilling of Vapor.

The key-indexed filling device has three holes: for filling, venting and draining the Vapor and for overflow. The rotary fill/drain valve switches the function of hole **2**.

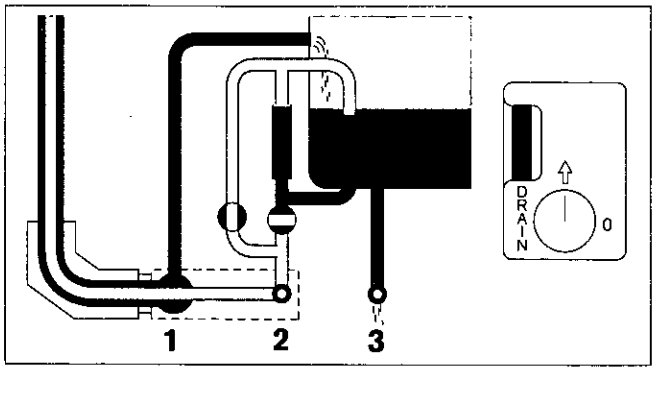
Filling:
The filling adaptor covers holes **1** and **2**. After the bottle has been swung into the upside down position, the filling hose has to fill with anaesthetic agent first. After switching to " ⇧ " the anaesthetic agent flows into the Vapor via hole **1**. At the same time, the saturated vapour displaced by the inflowing anaesthetic agent is routed out of the Vapor via hole **2** and the inner tube into the bottle.



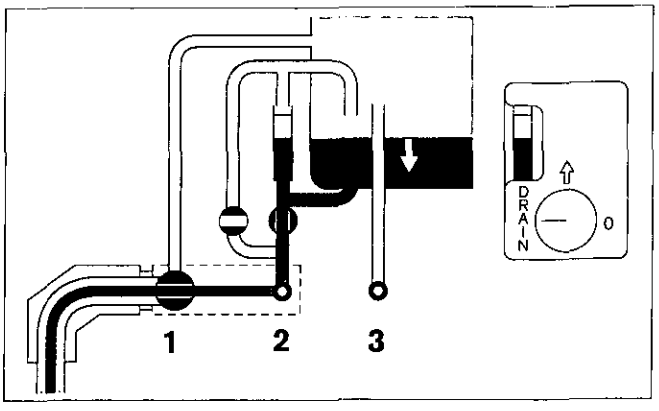
Overflow safety mechanism:
When the filling level reaches the bleed hole and covers it, the supply ceases as gas can no longer be exchanged between Vapor and bottle.



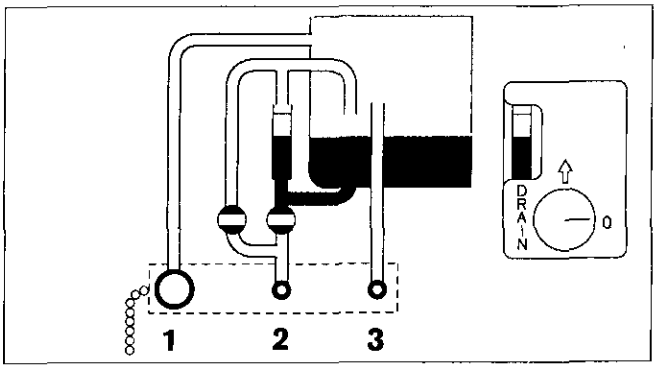
If the bottle and filling adaptor are incorrectly connected to the bottle thread or the seal on the filling system is not tight, the overfilling safety mechanism will no longer function. An overflow **3** is provided so that the anaesthetic agent may overflow to the outside if overfilling continues.



Draining:
With the switch at "DRAIN", hole **2** is connected to the drainage hole in the base of the Vapor. The anaesthetic agent from the Vapor flows through hole **2** and through the inner tube of the filling adaptor into the bottle. Saturated vapour from the bottle is routed into the Vapor through hole **1**.



Operation:
The valve is switched to »0« and the sealing block on the filling device is replaced to seal the three holes **1**, **2** and **3** when Vapor is to operate.



List of models/options for connection

Vapor and the connections suitable for different Dräger anaesthetic machines are described in brochure "Options for connecting Dräger-Vapors" (SD 5327.20).

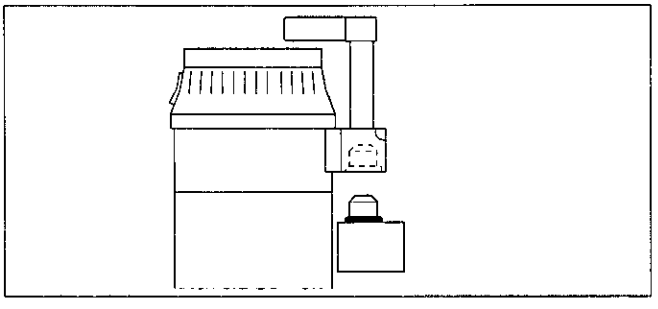
Plug-in adaptor, coded

Vapor 19.3 with plug-in adaptor

Plug-in adapter
with anaesthetic-agent-specific coding

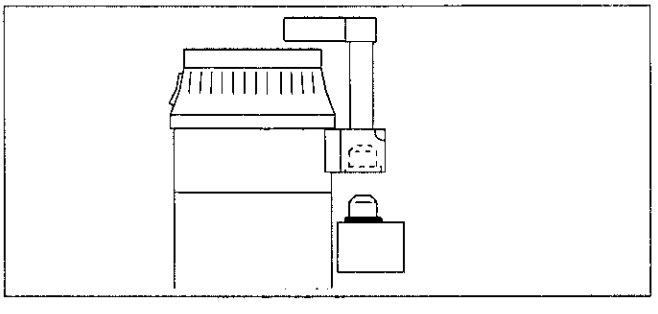
for Halothane	M 30 978
for Enflurane	M 30 979
for Isoflurane	M 30 980
for Sevoflurane	M 32 380

Coded plugs must not be interchanged.



Plug-in adaptor, uncoded

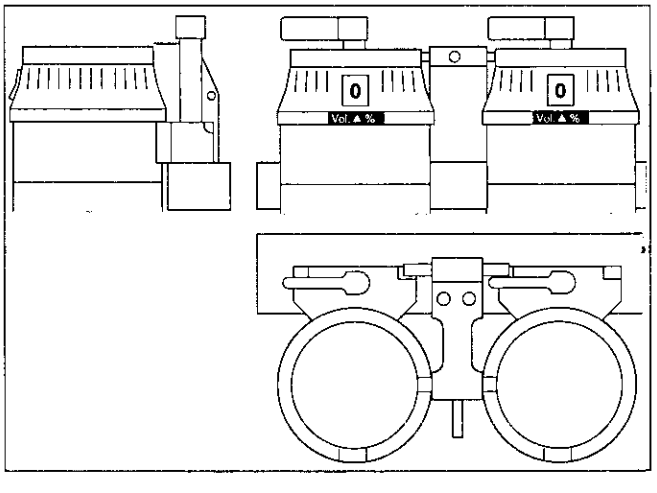
For Vapor 19.1 with M 25 140 plug-in adaptor without milled corners.
For Vapor 19.3 with M 27 070 plug-in adaptor with milled corners or
M 25 140 plug-in adaptor without milled corners.



Plug-in adaptor + Interlock 2

Plug-in system with Interlock 2 for Vapor 19.3 only.

Vapor 19.1 can be modified to Interlock 2 by DrägerService.

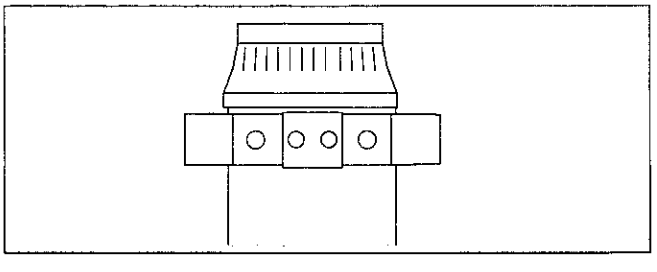


Permanent connection + 23 mm ISO cones

Vapor ISO connector connecting a Vapor 19.3 (or 19.1) permanently.

(Basic model, permanent connection + M 27 425)

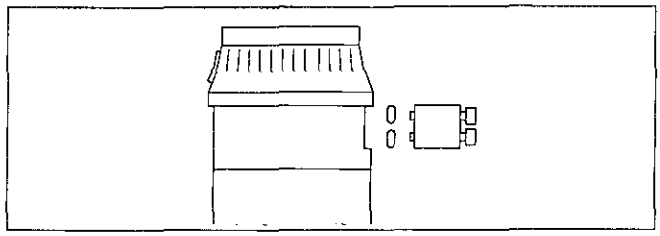
Vapors must not be switched on in series.



D3

Permanent connection

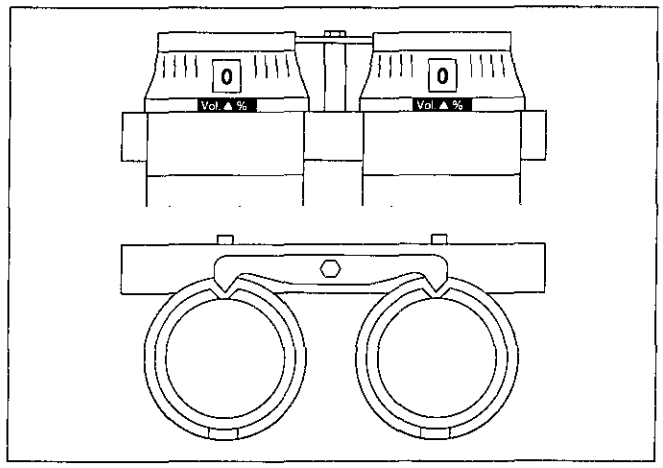
For Vapor 19.3 and 19.1



Permanent connection + Interlock 1

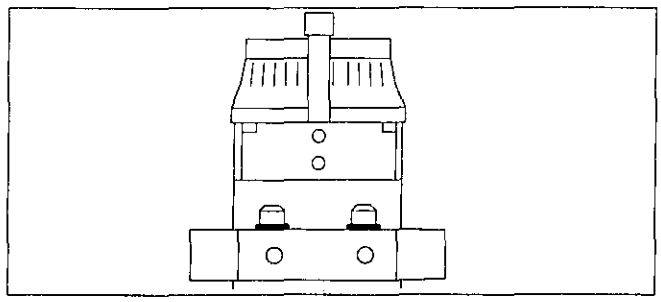
With permanent connection for Vapor 19.2 only.

Vapor 19.1 can be modified to Interlock 1 by DrägerService.

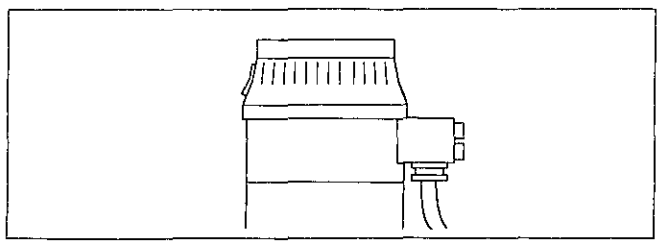


Plug-in adaptor + 23 mm ISO cones

Vapor ISO connector plug-in system for connecting Vapor 19.3 (or 19.1) to plug-in adaptor
(Basic model plug-in adaptor + M 27730)



Hose systems for Vapor 19.3 (19.1)



Vapor connecting systems

Name and Description	Order No.
Interlock system 1 0.5/0.5 for permanently connecting two Vapors 19.2	M 27 097
Interlock system 2 0.5/0.5 for connecting two Vapors 19.3 with plug-in adaptor	M 27 723
Vapor switching block plug-in system for connecting two Vapors 19.3 (or 19.1) with plug-in adaptors	M 26 615
Vapor switching block for permanently connecting two Vapors 19.3 (or 19.1)	M 25 226
Vapor plug-in system for AV 1 for connecting two Vapors 19.3 (or 19.1) with plug-in adaptor	84 06 715
Vapor plug-in system with pin for connecting one Vapor 19.3 (or 19.1) with plug-in adaptor	M 26 588
Vapor plug-in system, rail for connecting one Vapor 19.3 (or 19.1) with plug-in adaptors, mounting for wall rail	M 26 848
Hose connector 160 mm / 120 mm (inlet/outlet) for one Vapor 19.3 (or 19.1)	M 23 805
Hose connector *600 mm / 600 mm (inlet/outlet) for one Vapor 19.3 (or 19.1)*	M 22 407
Vapor ISO connector for permanently connecting one Vapor 19.3 (or 19.1)	M 27 425
Vapor ISO connector, plug-in system for connecting one Vapor 19.3 (or 19.1) with plug-in adaptor	M 27 730

Order List

Name and Description		Order No.
Accessories for key-indexed filling system		
Filling adaptor s for Sevoflurane		M 31 930
Filling adaptor i for Isoflurane		M 30 290
Filling adaptor e for Enflurane		M 30 289
Filling adaptor h for Halothane suitable for Hoechst or ICI Halothane bottles		M 30 288
Parking holder		
Holder for parking position (rail) for mounting to a wall rail, to hold 2 Vapors with plug-in adaptors		M 26 966
Holder for parking position (wall) for permanent attachment to wall, to hold 2 Vapors with plug-in adaptors		M 26 374
For all Vapor 19.n models: O-ring		M 21 929
For filling spout: Sealing screw		M 26 420
For plug-in system: O-ring		U 04 314
Instructions for Use	German	DB 01050
	English	DB 01171
	French	DB 01172
	Spanish	DB 01173
	Italien	DB 01182
	Dutch	DB 01183
	Swedish	DB 01184
	Finnish	DB 01185
	Danish	DB 01186

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