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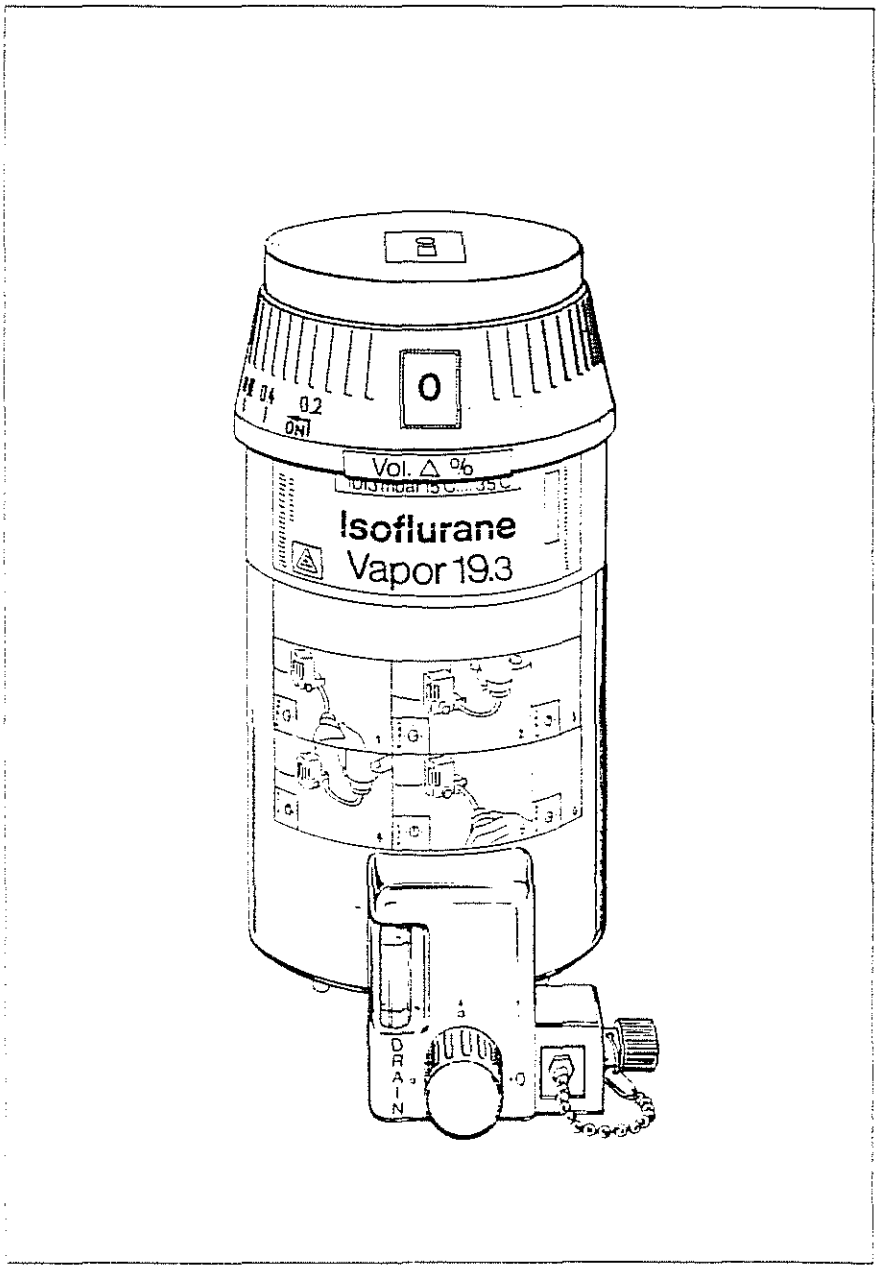
Vapor 19.n



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Physical principles

Vapour pressure curve

The Vapor 19.3 is an anaesthetic vaporizer which transforms liquid anaesthetics (halothane, enflurane or isoflurane) from their liquid state into a gaseous state and adds them to the fresh gas in a specified concentration. A characteristic feature of halothane, enflurane and isoflurane is that they exhibit a relatively high vapour pressure at room temperature.

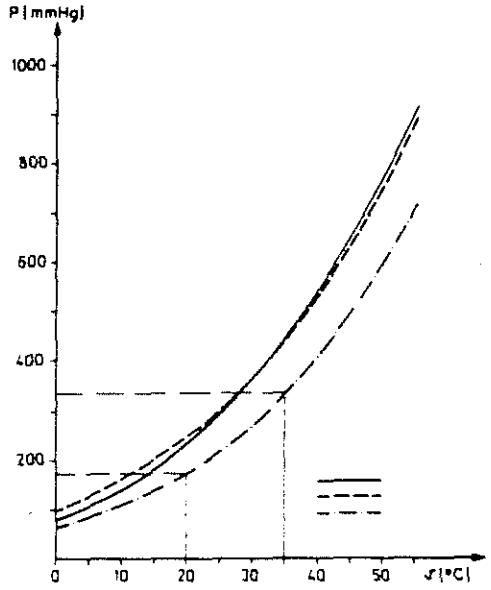

Fig. 1
(Vapour pressure curve of halothane, enflurane and isoflurane)

The concentration of the saturated vapour over the liquid can be calculated from the vapour pressure/air pressure ratio.

$$\text{Saturation concentration} = \frac{\text{Vapour pressure}}{\text{Air pressure}}$$

The figures are as follows at 20°C: 32 % for halothane, 22.6 % for enflurane and 30 % for isoflurane. In view of the fact that the vapour pressure is a function of the temperature, the saturation concentration is higher at higher temperatures.
As regards halothane, for example, the concentration of the saturated vapour increases from 32 % at 20°C to 58 % at 35°C.

Anaesthetic potency

When assessing anaesthetic potency, use is made of the MAC value. This refers to the Minimum Alveolar Concentration. It indicates the anaesthetic concentration in % at which 50 % of patients aged between 31 and 55 show no defensive reaction to irritation. This MAC value is a function of the gas composition. Given 100 % oxygen, the MAC value for halothane is 0.75 vol. %. With 70 % nitrous oxide and 30 % oxygen the halothane MAC value drops to 0.29 vol. %. If these values are compared to the concentration of saturated vapour of halothane for example at 20°C (32 %), it can be seen that the concentration of the saturated vapour is roughly 40 times higher than the MAC value with 100 % oxygen. It therefore follows that the anaesthetics cannot be directly inhaled and that they must be appropriately diluted before use.

MAC	Isoflurane	Enflurane	Halothane
MAC 100 % O_2	1,15 Vol.-%	1,68 Vol.-%	0,75 Vol.-%
MAC 70 % N_2O/30 % O_2	0,50 Vol.-%	0,57 Vol.-%	0,29 Vol.-%

Table 1
(Minimum alveolar concentration (MAC) for isoflurane, enflurane and halothane)

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Evaporator principle

The above-mentioned principles reveal that the essential task of the vaporizer is to split up the flow of fresh gas into two components, namely a vaporizer flow in which the gas is enriched with the anaesthetic and a flow which bypasses the vaporizer without anaesthetic. These two flows are then merged again.

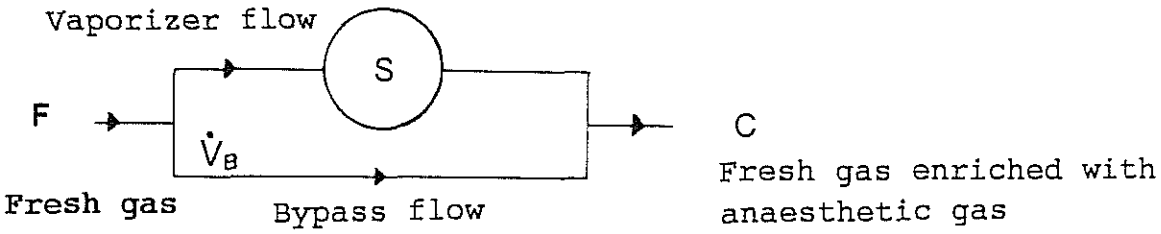


Fig. 2
(Principle of an anaesthetic vaporizer)

A simple estimate reveals the following:

$$\text{Concentration} \quad \text{Saturation concentration} \times \frac{\text{Vaporizer flow}}{\text{Fresh gas flow}}$$

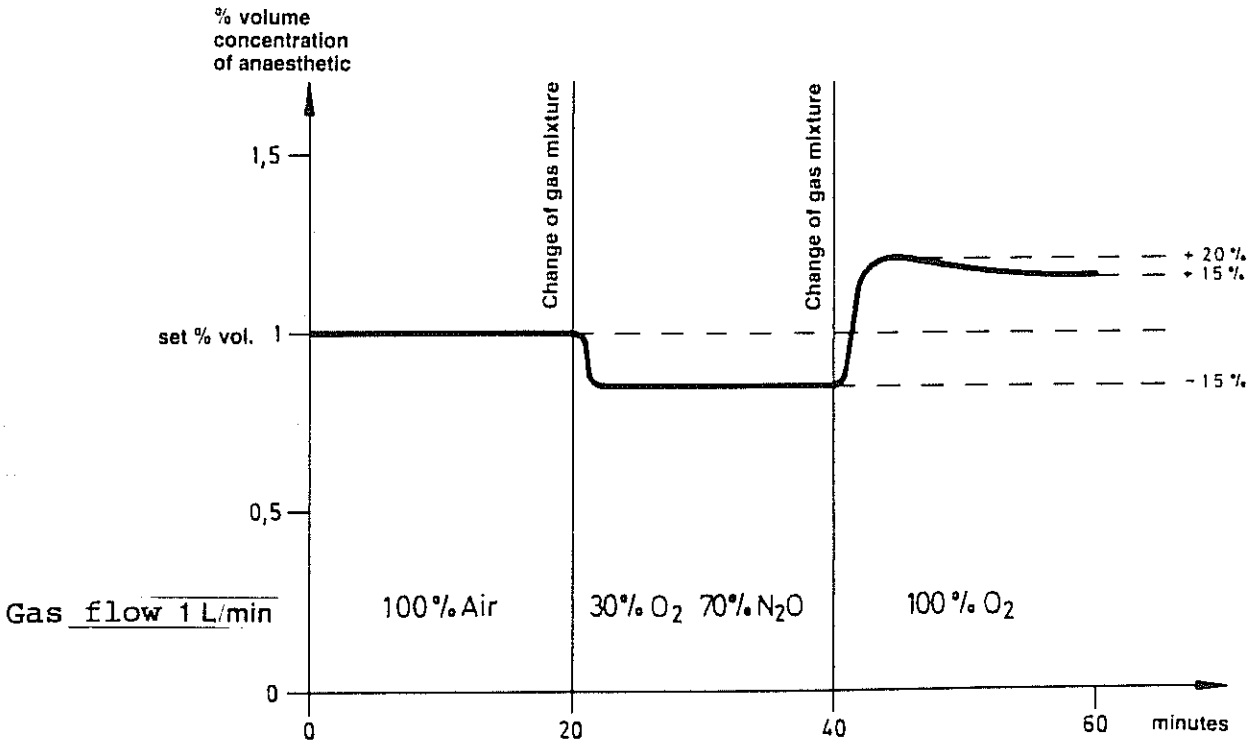
If 5 % of the fresh gas flows through the halothane vaporizer chamber at 20°C, this results in an anaesthetic concentration of 1.6 vol. % at the outlet of the vaporizer. If 10 % of the fresh gas flows through the vaporizer chamber, the resultant anaesthetic concentration is 3.2 vol. % always assuming that the gases are ideally mixed. If consideration is given in the same estimate to the flows through the vaporizer chamber under varying conditions, the following becomes apparent:
If a fresh gas flow of 0.5 L/min. is passed through an enflurane vaporizer and if the resultant concentration is 0.2 vol. %, then the flow through the vaporizer chamber is 4.4 mL/min. If, however, a fresh gas flow of 15 L/min. is used for the same anaesthetic and the resultant anaesthetic concentration is 5 vol. %, then the flow through the vaporizer chamber is 3319 mL/min.
These two examples indicate the extreme nature of the flows to be processed.
The conclusion to be drawn from these considerations is that

a vaporizer must be very precise and very stable in order to be able to cover this extremely broad range.
As mentioned, the vapour pressure of the anaesthetic changes with changes in temperature. This means that the anaesthetic concentration supplied would change given a change in temperature, if the anaesthetic vaporizer were to be purely constructed in line with the bypass principle. If, with such a vaporizer, a figure of 3.2 vol. % were to be taken at 20°C, and if the temperature were to increase to 35° under equilibrium conditions, then the concentration supplied would increase to 5.8 vol. %. The clinical requirement made of an anaesthetic vaporizer is however that the anaesthetic concentration provided is independent of temperature in the relevant temperature range. Compensation must thus be provided for the physical effect of the temperature dependence of vapour. The principle of temperature compensation used is based on reducing the vaporizer flow with increasing temperature, so as to offset the increase in saturation concentration. As temperatures increase, less gas is routed through the vaporizer chamber. The technical solution to this problem is based on utilization of the thermal expansion of materials.

With the Vapor 19.3 the anaesthetic concentration can be infinitely set in a range between 0.2 and 4 vol. % for halothane and 0.2 - 5 vol. % for enflurane and isoflurane. The anaesthetic concentration supplied is virtually independent of flow in the range between 0.5 and 15 L/min. The above-mentioned temperature compensation operates in the range between 15 and 35°C. The concentration supplied by any anaesthetic vaporizer is dependent on the composition of the fresh gas. The Vapor 19.3 is calibrated with air. When use is made of pure oxygen, the concentration supplied is roughly 5 - 10 % higher than for operation with air. Given operation with 30 % O_2 and 70 % N_2O, the figure is between

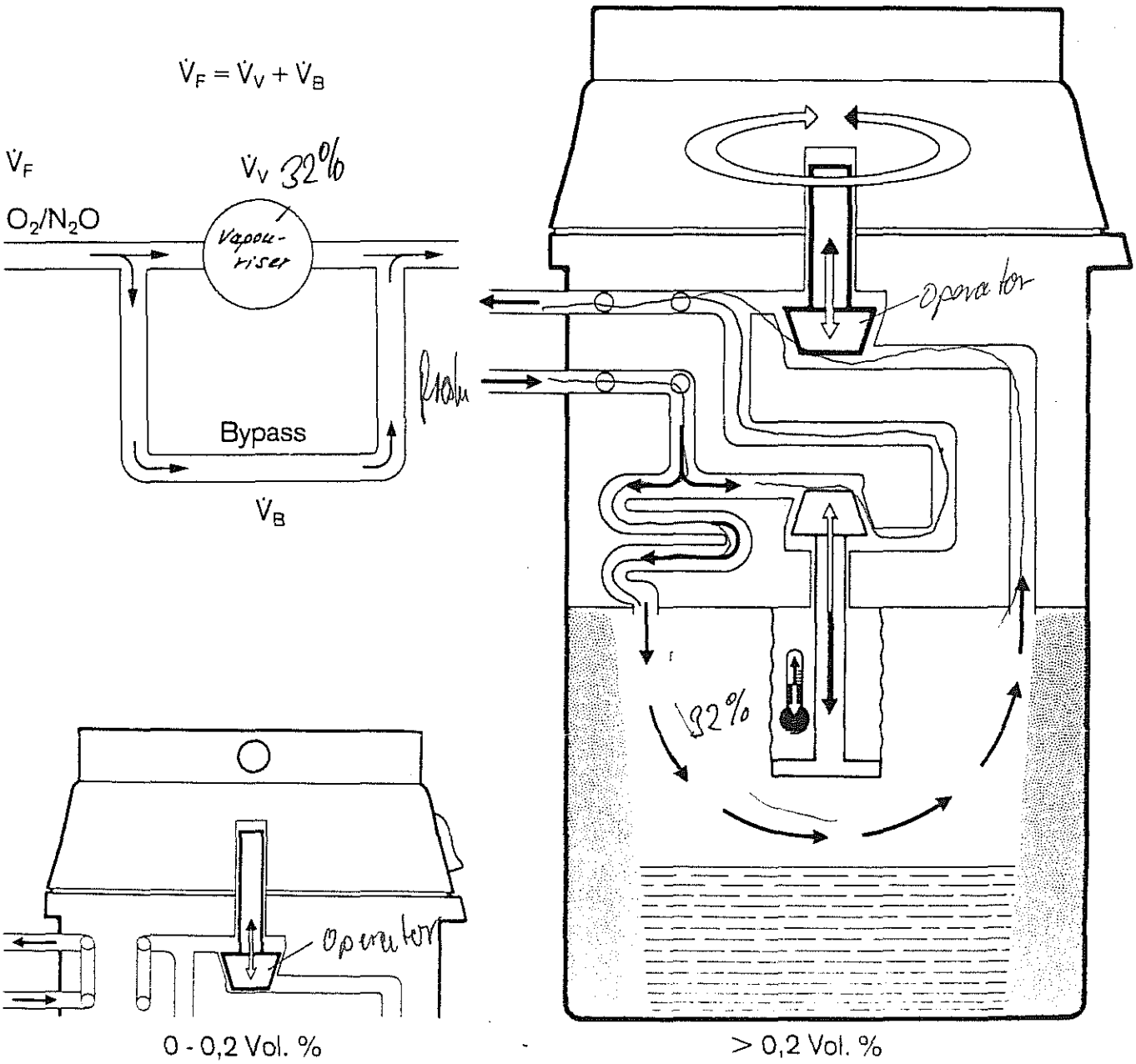
approx. 5 and 10 % lower. This can be attributed to the differing viscosity of the gases. A dynamic effect, which results in an additional concentration deviation with the same sign until the previous fresh gas has been flushed out, is superimposed on the above effect given a change in gas concentration. These deviations and their duration become more pronounced

- the smaller the fresh gas flow
- the smaller the amount of anaesthetic in the vaporizer
- the higher the set concentration and
- the more extreme the change in the type of gas becomes.



4.4.1 Fig. 4
(Influence of carrier-gas composition on anaesthetic concentration)

Vapor 19.n


$\dot{V}_F = \dot{V}_V + \dot{V}_B$
$\dot{V}_F$
$\dot{V}_V$ 32%
O_2/N_2O
Vapou-riser
Bypass
$\dot{V}_B$
operator
32%
operator
0 - 0,2 Vol. %
> 0,2 Vol. %

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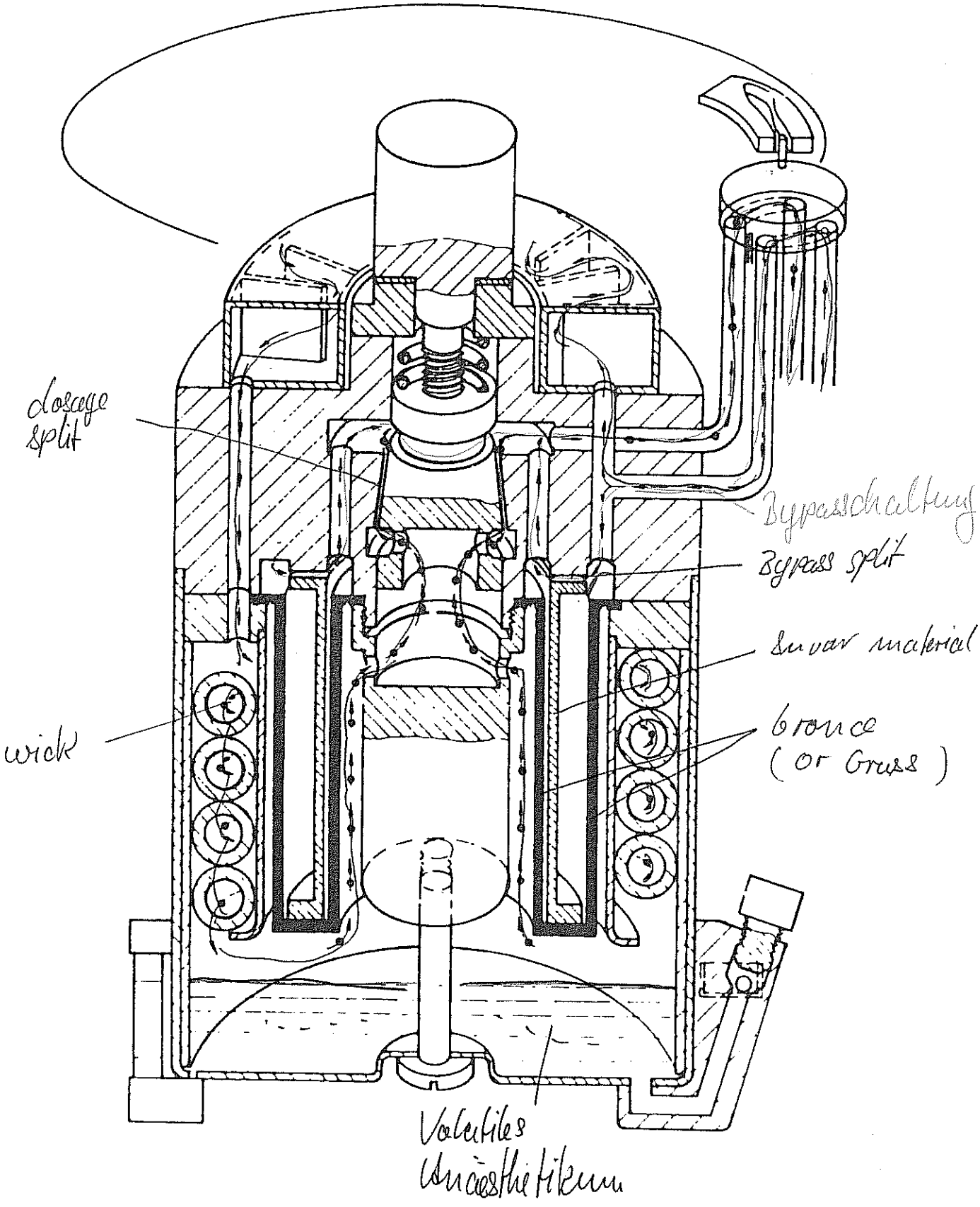
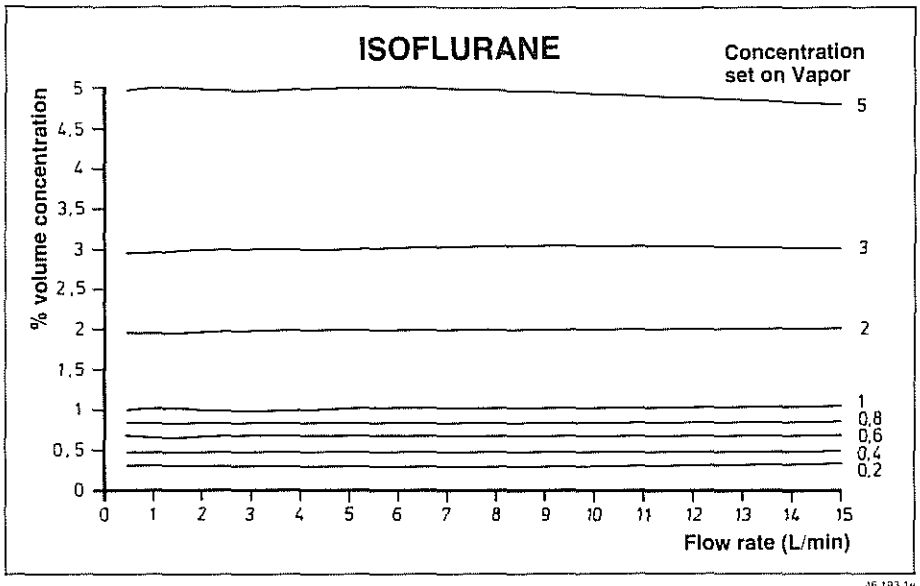
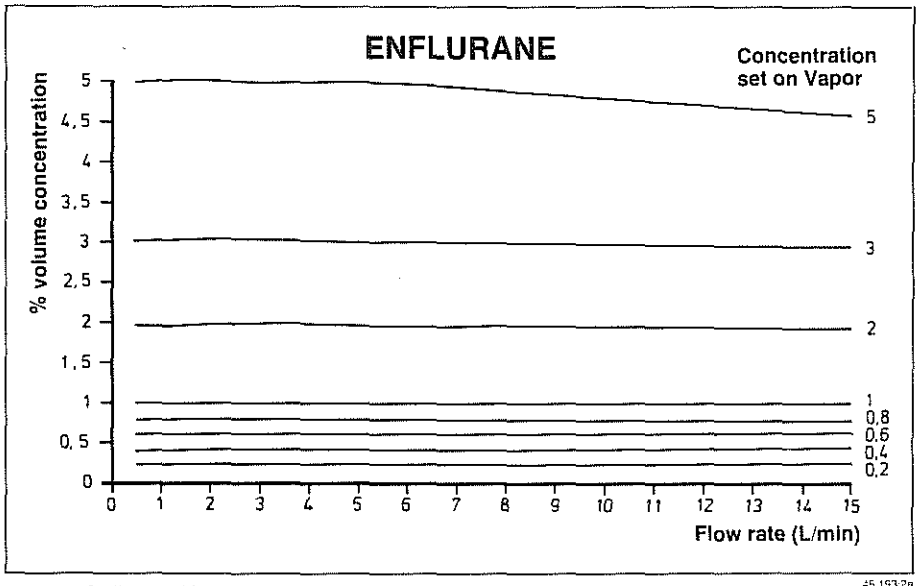
Vapor 19.n

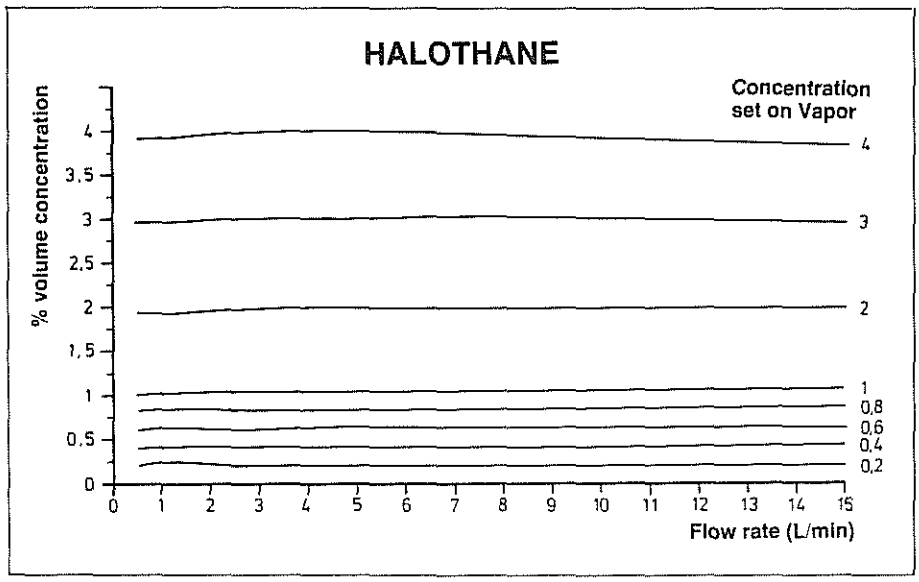




Isoflurane Vapor



Enflurane Vapor



Halothane Vapor

Boiling point of Isoflurane
48.5°C at 1013 mbar
Boiling point of Enflurane
56.5°C at 1013 mbar
Boiling point of Halothane
50.2°C at 1013 mbar

at a temperature of 22°C (standard atmospheric pressure 1013 mbar, operation with air).

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Calculation of anaesthetic consumption

A direct conclusion as to the consumption of liquid anaesthetic (ml/h) cannot be drawn from the setting of the desired anaesthetic concentration on the vaporizer (vol. %).
The question as to how consumption can be calculated is frequently posed and an attempt to answer the question is given in the following.
The anaesthetic poured in liquid form into the vaporizer evaporates.
The amount of anaesthetic vapour produced from a certain amount of liquid depends amongst other things on the anaesthetic itself and on the temperature (given constant pressure).
(See Table 1).

	Halothane	Enflurane	Isoflurane
ml of vapour from 1 ml of liquid			
at 20°C	224	197	197
at 25°C	228	200	200

Table 1:
Vapour obtained from 1 ml of liquid (in ml)

Example: 3 ml of liquid isoflurane give 600 ml of isoflurane vapour (at 25°C)

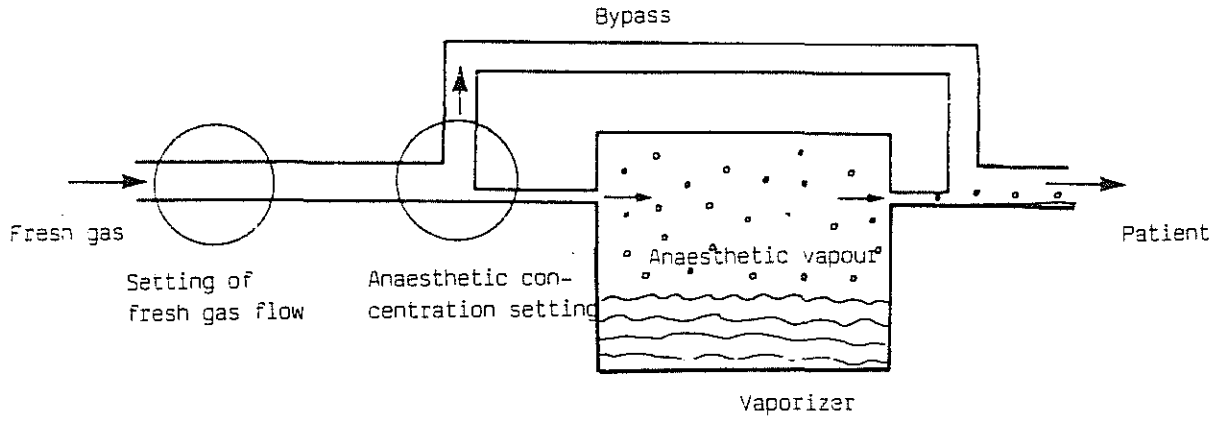


Fig. 1:
Operating principle of vaporizer

The anaesthetic vapour is passed to the patient along with the fresh gas (see Fig. 1) The amount of anaesthetic is dependent on two settable parameters:
- Anaesthetic concentration in vol. % (breakdown of fresh-gas flow)
- Fresh-gas flow in ml/min.

The equation for calculating consumption is as follows:

$$\text{Consumption} = \frac{\text{Fresh-gas flow (ml/min.) x anaes. concen. (vol. \%) x duration of anaes. (min).}}{\text{Amount of vapour per quantity of liquid (ml vapour/ml liquid}}$$

Example 1: *Fresh-gas flow: 4000 ml/min.* *Anaesthetic:* Isoflurane

Anaesthetic concentration: 1 vol. %

Duration of anaesthesia: 30 *minutes*

$$\text{Consumption: } \frac{4000 \text{ ml/min.} \times 0{,}01 \times 30 \text{ min.}}{200} = 6 \text{ ml}$$

The equation for calculating consumption per hour is as follows:

$$\text{Consumption/h} = \frac{\text{Fresh-gas flow (ml/min.) x anaes. concen. (vol. \%) x conversion factor 60 min./h}}{\text{Amount of vapour per quantity of liquid (ml vapour/ml liquid)}}$$

Example 2: Fresh-gas flow: 4000 ml/min. Anaesthetic: Isoflurane

Anaesthetic concentration: 1 vol. %

$$\text{Consumption/h} = \frac{4000 \text{ ml/min.} \times 0{,}01 \times 60 \text{ min/h}}{200} = 12 \text{ ml/h}$$

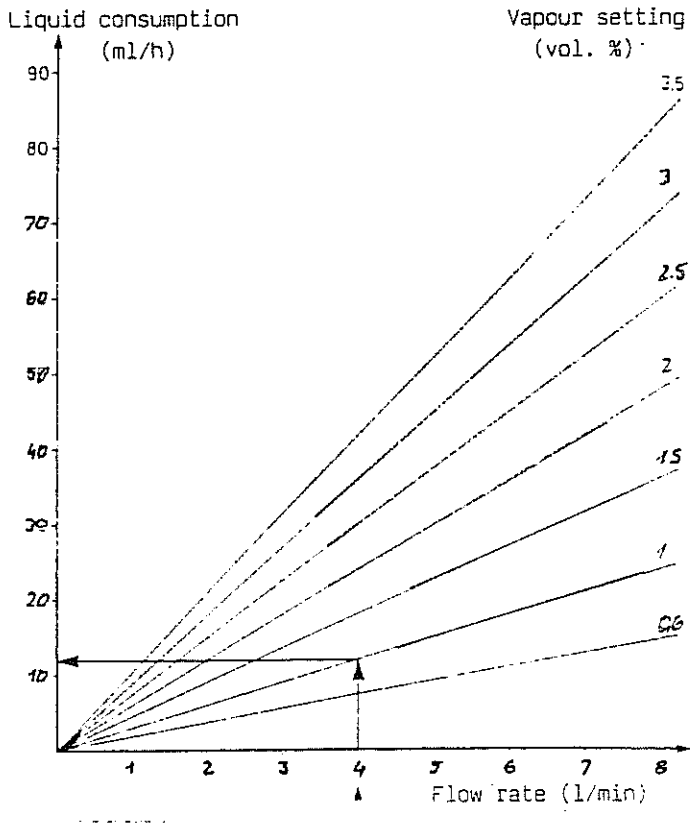
Example 3: Fresh-gas flow: 1000 ml/min. (low flow)

$$\text{Consumption/h} = \frac{1000 \text{ ml/min.} \times 0{,}01 \times 60 \text{ min./h}}{200} = 3 \text{ ml/h}$$

Example 4: Fresh-gas flow: 500 ml/min. (minimal flow)

$$\text{Consumption/h} = \frac{500 \text{ ml/min.} \times 0{,}01 \times 60 \text{ min./h}}{200} = 1{,}5 \text{ ml/h}$$

The consumptioncan also be taken as a rough value from the graph in Fig. 2. The Values apply to enflurane and isoflurane. In the case of halothane, the actual value is 14 % below the reading, since with halothane more vapour is obtained from the same amount of liquid than with the other anaesthetics.



Example 1

Fig. 2:
Anaesthetic consumption (enflurane, isoflurane) as a function of concentration and amount of fresh gas (at 20°C and 1013 mbar)
For halothane: Actual value = reading - 14 %.

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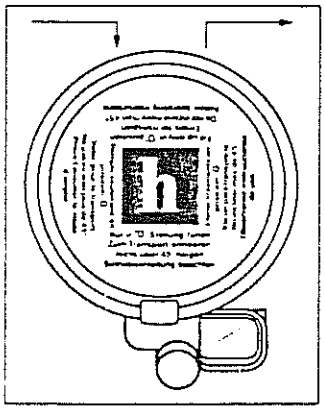
Marking for gas inlet of Vapor 19, 19.1, 19.2, 19.3

1. The gas inlet on the Vapor basic unit can be seen from the filter.

2. The gas flow through the Vapor is always from left to right, when observing the Vapor from the front.



Connection of Vapor to anaesthetic apparatus

The Vapor is always to be connected such that the fresh gas flows from left to right through the vaporizer.

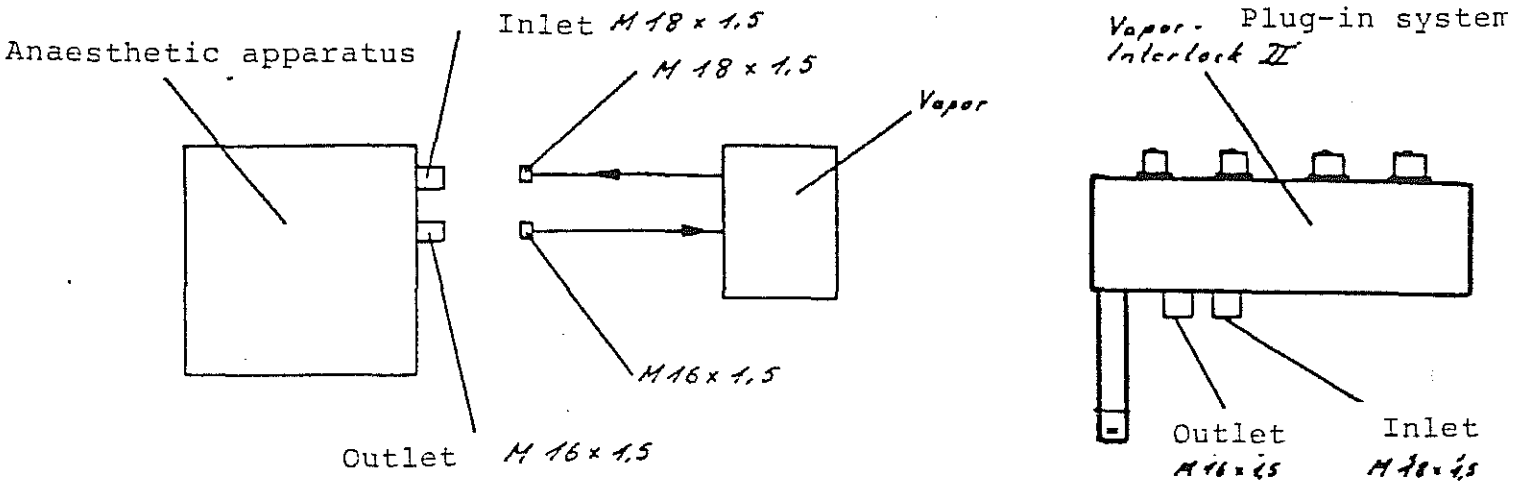
Connection of Vapor:
Schematic representation of fresh-gas inlet and outlet on Halothane Vapor 19.1

3. The German Industrial Standard DIN 13252, valid as of 01.06.84, defines threads for the gas inlet and gas outlet of vaporizers.

The following applies to DW devices:

Anaesthetic apparatus, switching units and interlock units have:

an M 18 x 1.5 thread as gas inlet;
an M 16 x 1.5 thread as gas outlet.



4. To guarantee reliable operation of the Vapor 19, inlets and outlets are to be correctly connected. Laboratory experiments have revealed that allowing the gas to flow in the wrong direction increases the concentration supplied:
The concentration assumed values $\leq$ + 20%, relatively referenced to the concentration set on the handwheel for the flow and concentration range specified for halothane in the Operating Manual.

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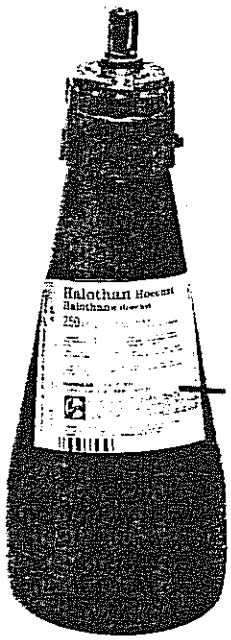
Index connection piece
(geometric and colour coding)
with filler and
vent holes

Handwheel for infinite
adjustment of volume concentration

Adapterhose



Narcotic-Bottle

Sight glass for
indicating level

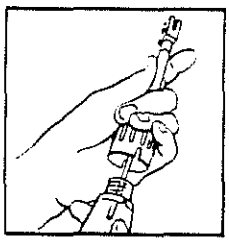
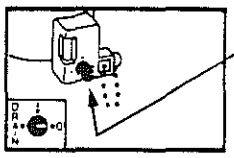
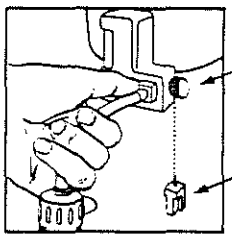
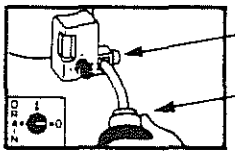
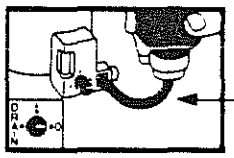
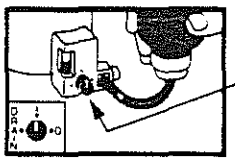
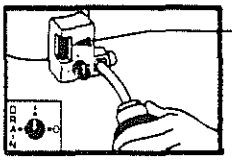
Screw for pressing shutter
against sealing plate

Rotary knob for
switching valve
for filling and
emptying Vapor

Shutter (geometric coding)

Fig. 5
(Concept of safety filling device)

Filling the Dräger-Vapor® with pin safety system

①		Switch off Vapor (handwheel to 0 vol.%). Screw adaptor hose **tightly** onto bottle.
②		Valve knob points to "0".
③		Unscrew the screw **as far as stop.** Pull out the plug. Insert adaptor hose; leave bottle suspended.
④		Tighten the screw. Bottle is suspended.
⑤		Raise the bottle **slowly**. Adaptor hose must **completely** be filled with liquid.
⑥		Turn valve knob to ↑. Filling process begins now, bubbles emerge in the bottle. If not: proceed according to ⑦, ⑧, ⑤, ⑥ or see in the operating instructions "Trouble Shooting".
⑦		Liquid level has reached the maximum mark: lower the bottle. Wait until liquid in the hose has drained back into bottle.
⑧		Turn valve knob to "0".
⑨		Unscrew the screw **as far as stop.** Pull out the adaptor hose. Insert the plug. Tighten the screw.

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Safety filling device

A Vapor 19.3 configured in accordance with DIN features a safety filling device. This device ensures that the anaesthetic can only get into the appropriate anaesthetic vaporizer. This is achieved by way of geometric encoding of anaesthetic bottle, filler hose and Vapor filler neck.

Mixing up an anaesthetic results - depending on anaesthetic and vaporizer - in up to 4 x overdosing or underdosing. The following example makes this clear:
If halothane has been inadvertently poured into an enflurane vaporizer and if the enflurane vaporizer has been set in the usual way to 2 vol. % in order to obtain an MAC of 1.2 for enflurane, then the vaporizer - since it contains halothane - will supply 3.2 vol. % corresponding to four times the MAC value of halothane. The safety filling device is fitted to avoid such circumstances.

Behaviour following tilting

If an anaesthetic-filled Vapor is tilted, liquid anaesthetic can get into the metering unit both when it is switched on and when it is switched off. This may lead to an increased concentration being supplied or to an inadequate concentration. If a filled Vapor has been accidentally tilted by more than 45°, flushing at a rate of 10 L/min. is required with maximum concentration setting prior to usage. A flushing time of 5 minutes is generally sufficient following brief tilting and immediate straightening up again. On the other hand, a flushing period of at least 20 minutes is required if a filled Vapor has assumed an impermissible horizontal position. In such cases it is recommended that the anaesthetic be drained from the vaporizer chamber.
Deviations in concentration do not occur up to an angle of tilt of 45°. The anaesthetic must be drained off for transportation involving an angle of tilt in excess of 45°.

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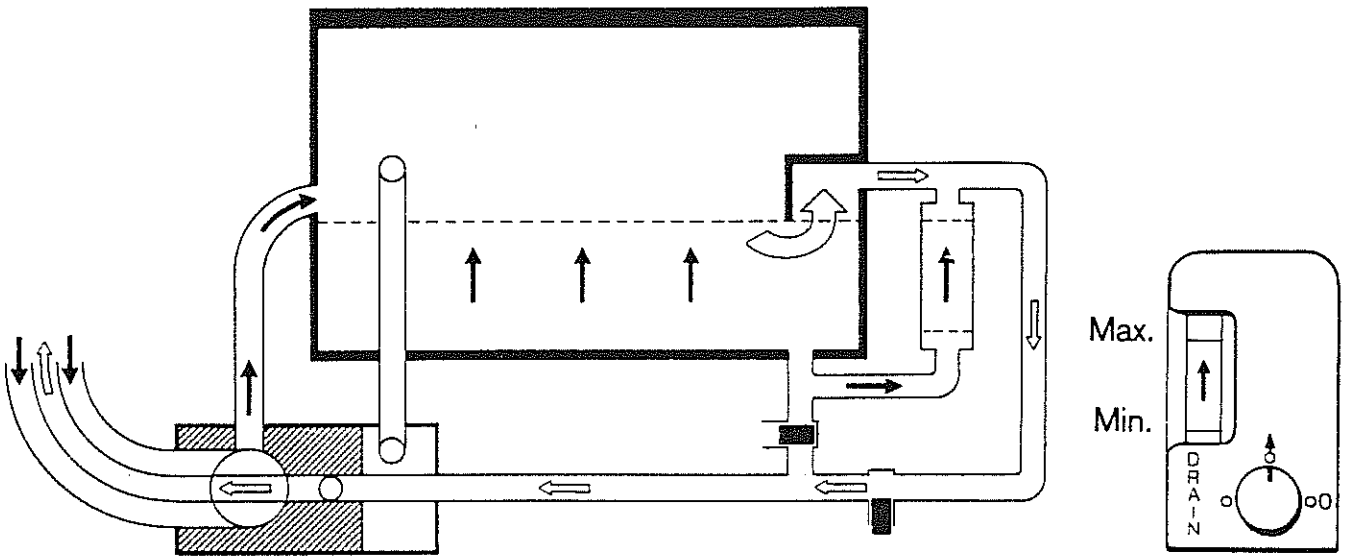
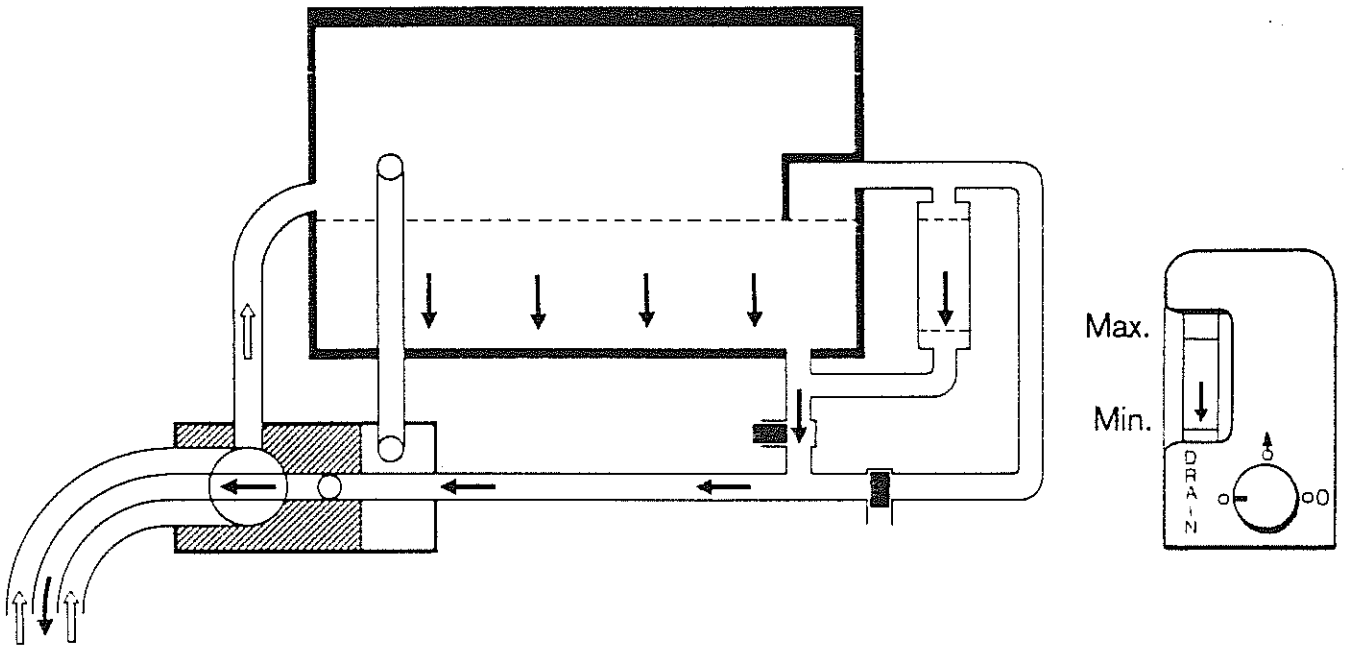
safety filling system Functional schematic

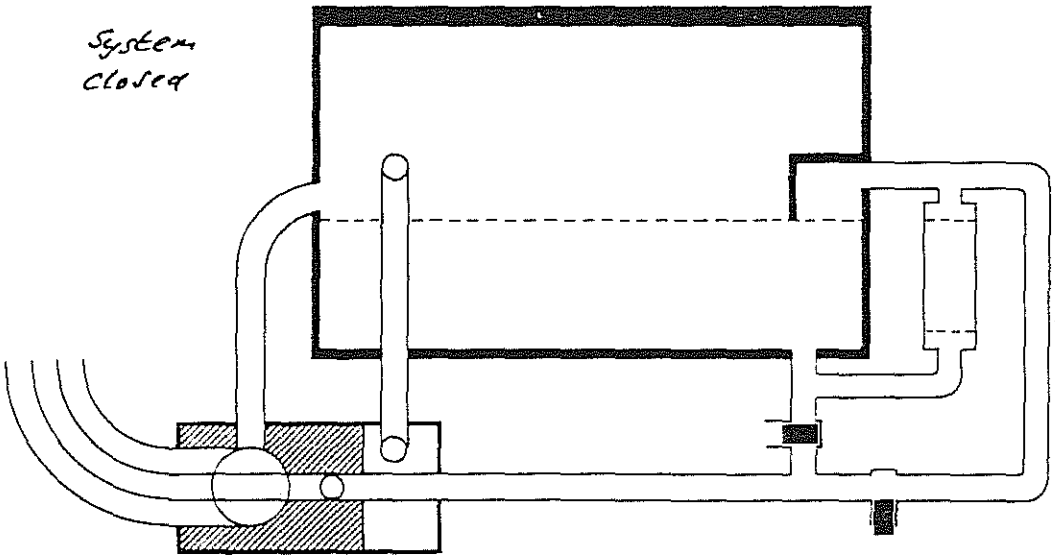
filling procedure

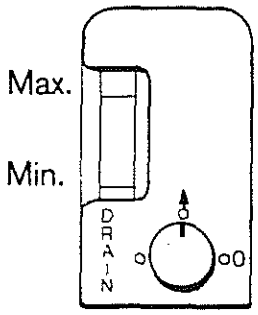


Draining

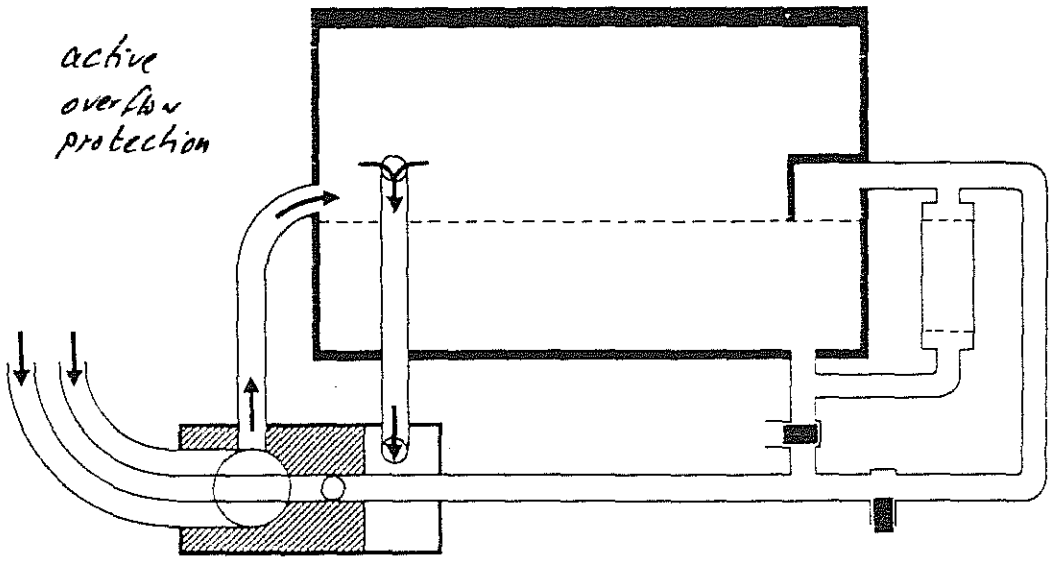


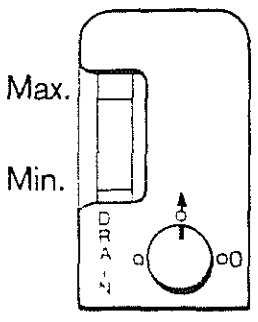
System closed





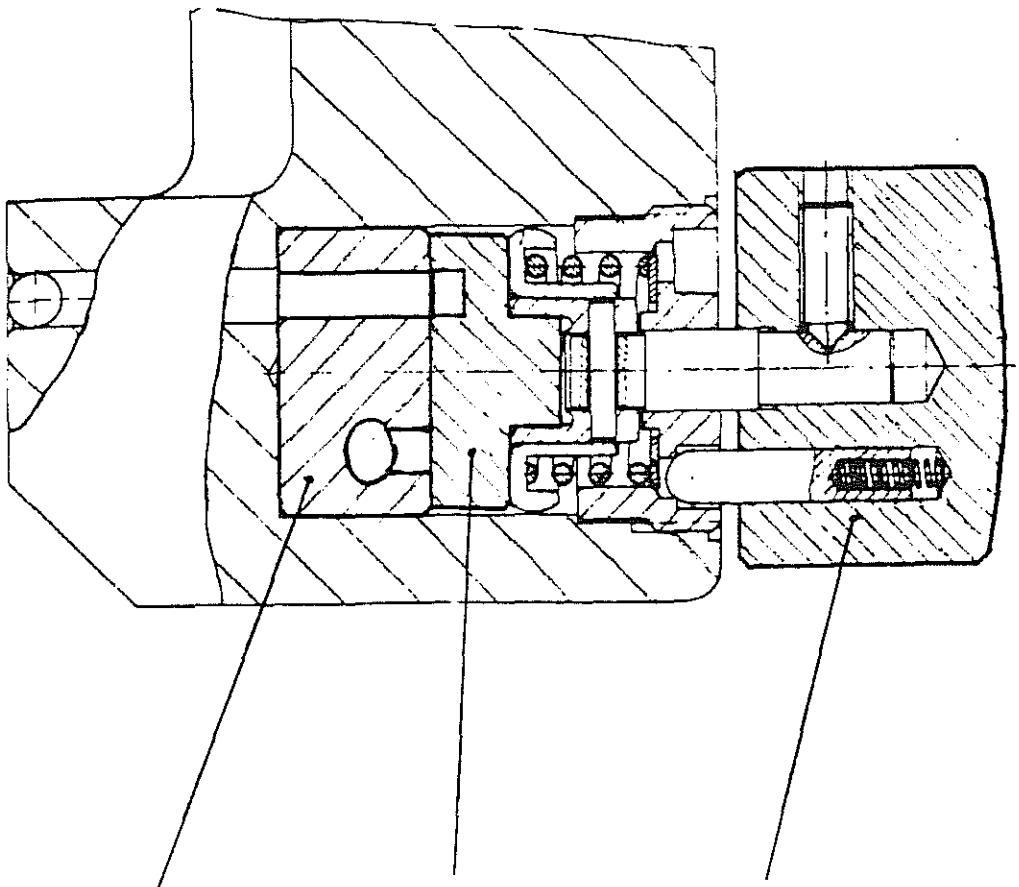
active overflow protection

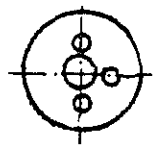
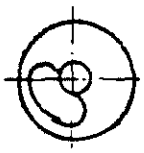
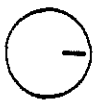
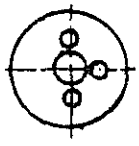
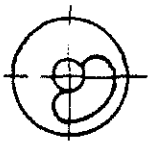
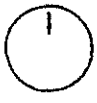
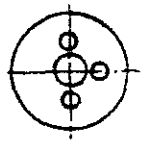
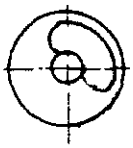
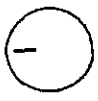




Safety filling system

1. Switch positions



Sealing seat	Slide	Rotary knob	Setting
		 ∘0	closed
			fill
		 DRAIN ∘	empty

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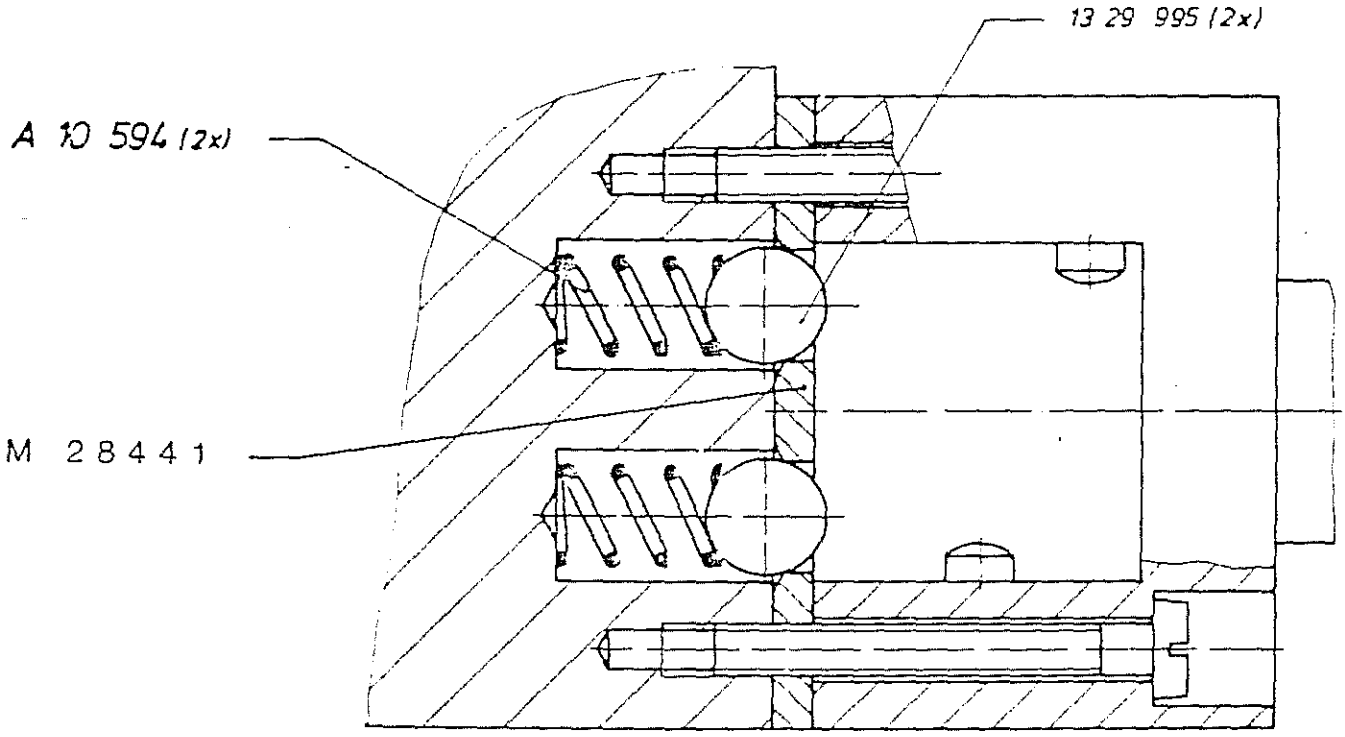
Product information

Replaces the product information of 06.87/
Medical technology news number 2/3, 2nd volume 1986
Vapor 19.2/19.3

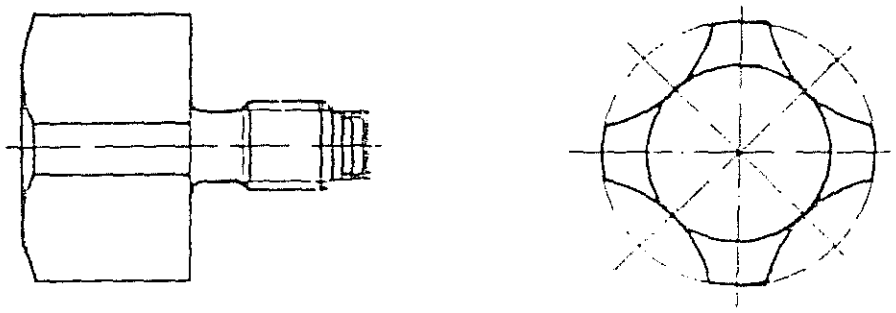
Following changes have been/will be performed with the Vapor:

1. Seal

As of Vapor no. 71902 (production as of Nov.'86) 2 spring-loaded balls have been fitted ahead of the 1st seal to protect the seal in the safety filler. When the filler neck is introduced into the safety filler this neck is pressed outwards by the spring-loaded balls. In order to be able to adequately press the filler neck/ shutter against the seal, the clamping screw has been enlarged and given a star shaped design.



Clamping screw M 28450



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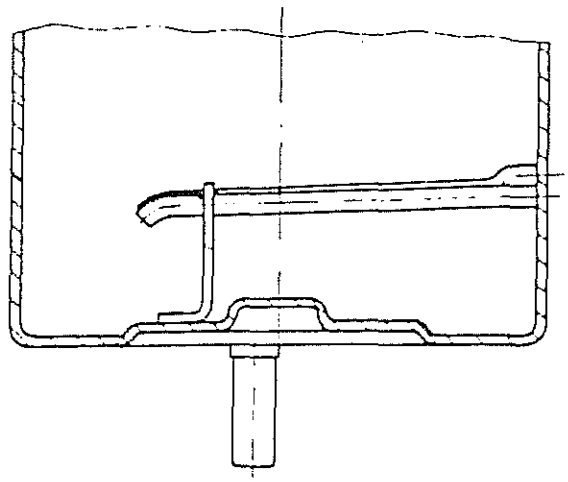
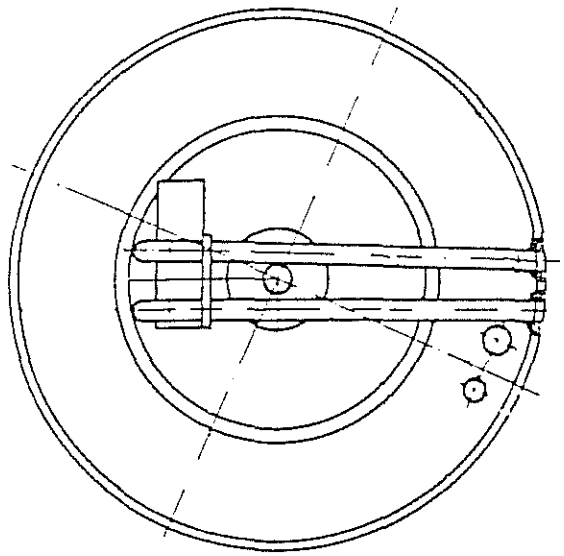
2. Overflow safeguard

Two lines will be fixed in the Vapor vessel probably as of april'87, see diagram, which prevent an overflow of the anaesthesia liquid into the overflow hole of the safety filler in transport.





Note: Vapors with a sealing protection which do not contain an overflow safeguard however, have been marked with a "K" (no overflow safeguard) at the bottom of the vessel.

A repair exchange of the Vapor vessel is not planned. Probably as of june '87 new Vapor vessels are available for customers who desire both changes (sealing protection and overflow safeguard).

Conversion kit Vapor h	M 28431
Conversion kit Vapor e	M 28432
Conversion kit Vapor i	M 28433

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Both changes, sealing protection and overflow safeguard, have led to new item nos.:

Comparison

Designation	Previous item no.	New item no.	Note/Change
* Conversion kit, vessel h	M 24386	M 28431	With sealing protection and overflow safeguard
* Conversion kit, vessel e	M 24391	M 28432	
* Conversion kit, vessel i	M 27682	M 28433	
Vessel h	M 26850	M 28435	Vapors with sealing protection, however without overflow safeguard are marked with a "K" at the bottom of the vessel
Vessel e	M 26851	M 28434	
Vessel i	M 26338	M 28436	
Safety filler	M 24385	M 28442	The old and new versions of the safety filler must not be mutually interchanged on account of the different design. Because of that not available as spare part.
Clamping screw	M 24376	M 28450	enlarged
Seal	M 24388	M 28441	was given additionally 2 holes for the balls Replaces the seal M 24388.
* Spring		A 10594	new
* Ball		1329995	new

* Item nos. are not listed in the S-list 8.82/4.86
The parts required for replacement of the vessel are contained in the conversion kit vessel:

O-ring	M 22714
O-ring	M 18238
Screw	M 22797
Sealing cap	M 22798

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Vapor-Maintenance

Permissible Maintenance Operations on Vapors 19 - 19.3 by DrägerService.

The maintenance of the Vapor 19 n. is divised in 4 service depths.

	Service depths	Note to operations which can be executed by DS.
1	Inspection (Statement of the actual state)	Check-up in accordance with Test Certificate 5327
2	Maintenance without operation or modification on neither handwheel nor metering unit	- Operation on Vapor vessel - Operation on filter funnel and safety filling system - Replacement of wick - Conversion of the Vapors 19.2 or 19.3 (Interlocksystem) - Replacement of the cover plate (= seal) on handwheel or interlock washer - Replacement of the seal at the Vapor vessel It is absolutely necessary to document these operations. The replacement of the seal has to be recorded and a complete check-up of the Vapor in question has to be executed subsequently in accordance with the Test Certificate.
3	Maintenance exceeding 2 with operation or modification of the position of the handwheel in relation to those parts moved by the handwheel.	The DS is not permitted to execute any maintenance operations demanding the disassembly of the handwheel. - As an exception Vapor 19 with zero-point-block can be retrofitted if the specific tolerances are observed.
4	Maintenance exceeding 3 with operation on the metering unit	Operations on the metering unit must not be executed by DS.

Summary: Except for check-ups according to Test Certificate 5327 and operations indicated under "R" on the micro-fiche DS does not execute any further maintenance works. Operations exceeding those indicated on the Test Certificate are only performed at Drägerwerk AG, Lübeck.

Die Dochte sind mit Handschuhen zu wechseln (Schweiß schädlich)

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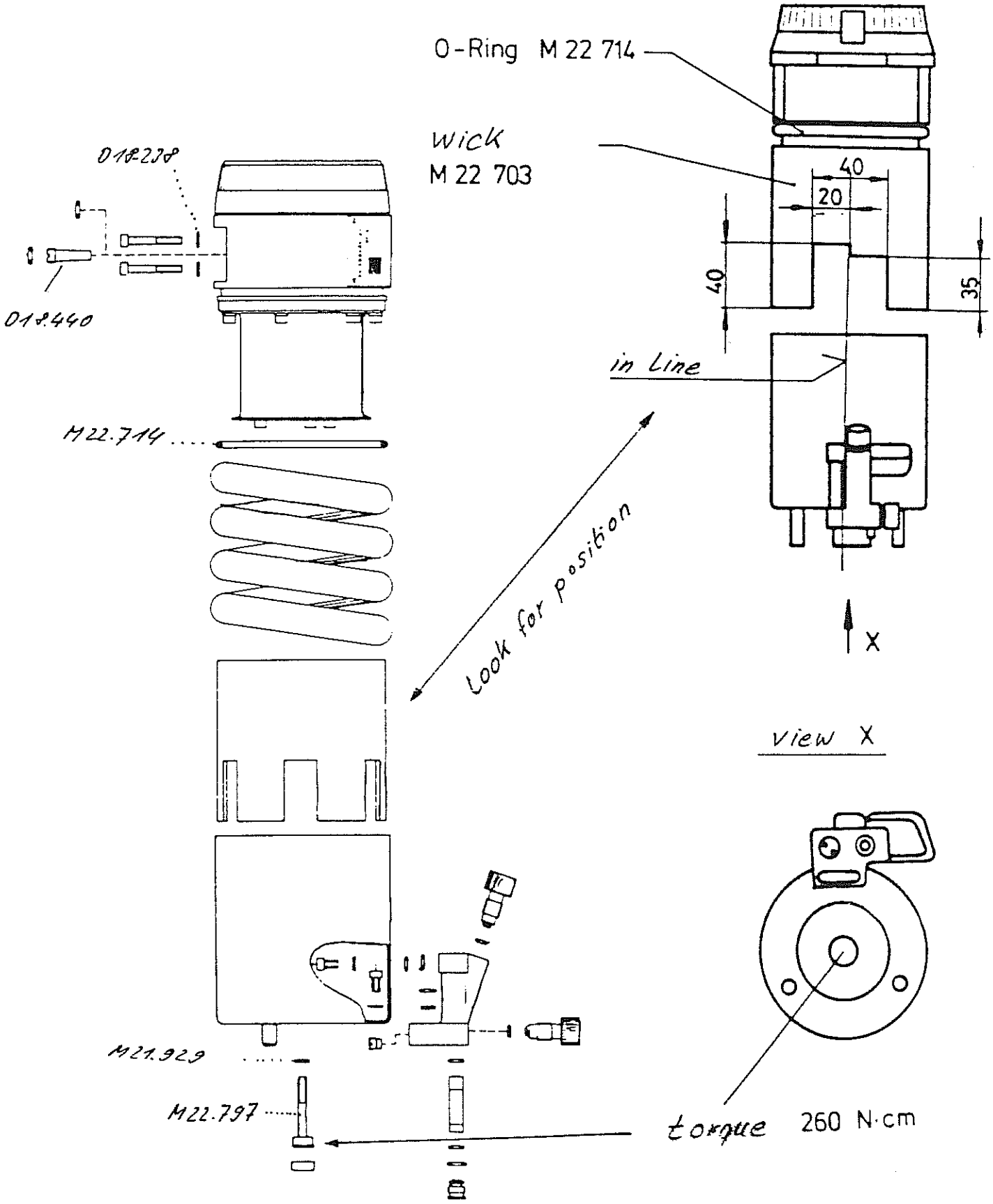

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Repair work on Vapors with safety filling system:

When installing Vapor housings with safety filling systems, care is to taken to ensure the following:

Only housings H for halothane on Halothane Vapors 19 - 19.3,
Only housings E for enflurane on Enflurane Vapors 19 - 19.3,
Only housings I for isoflurane on Isoflurane Vapors 19.1.

To avoid mix-ups, the housings are provided with a 13 x 100 mm wide adhesive label.

Housing H (halothane) M 24386 Colour: bright red

Housing E (enflurane) M 24391 Colour: bright red-orange

Housing I (isoflurane) Colour: violet

When performing repair work on the safety filling system itself (e.g. replacement of lateral seal M 24388), care is to be taken to ensure that the connection pieces, which are used for anaesthetic-specific coding, do not become mixed up (tip: only take apart one safety filler at a time).

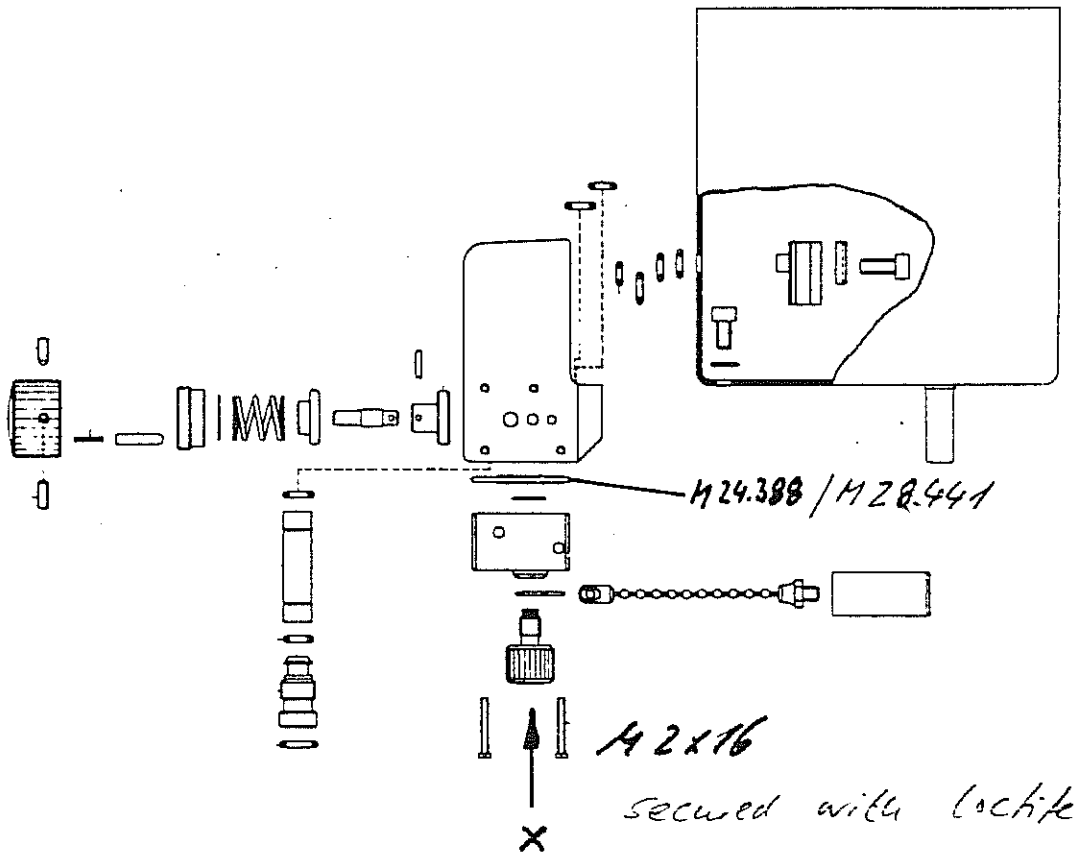
To preclude mix-ups, the connection pieces are marked on the underside with the initial letters of the respective anaesthetic:

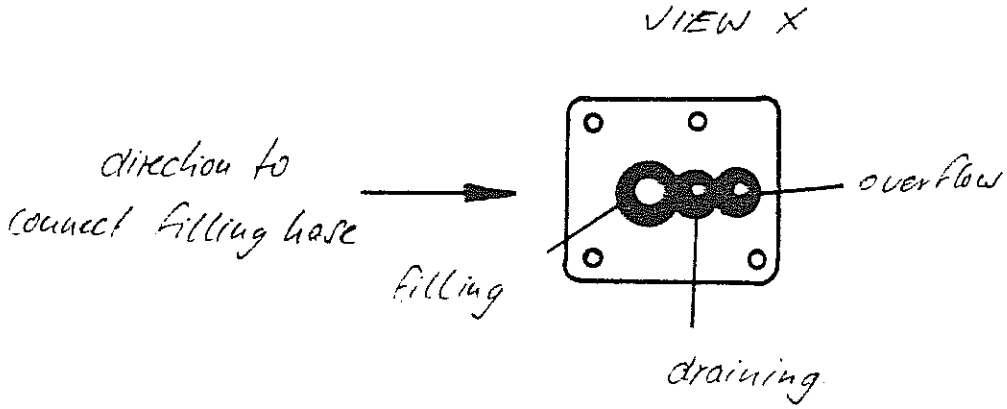
Connection piece h M 24377 or M 27328:
Marked with letter h (or H for older connection pieces)

Connection piece e M 24389 or M 27330:
Marked with e (or E with older connection pieces)

Connection piece i M 26995:
Marked with letter i

Note: On assembly, the 4 slotted screws 1333763 are again to be provided with Loctite 221 (11 95727)!


M 24.388 / M 28.441
M 2x16
secured with Loctite 221
X


VIEW X
direction to
connect filling hose
overflow
filling
draining

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Mappen-Nr. File no.:

5327.0

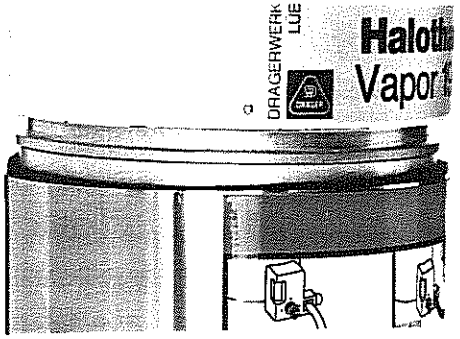
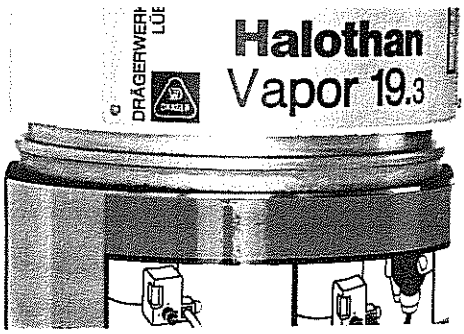
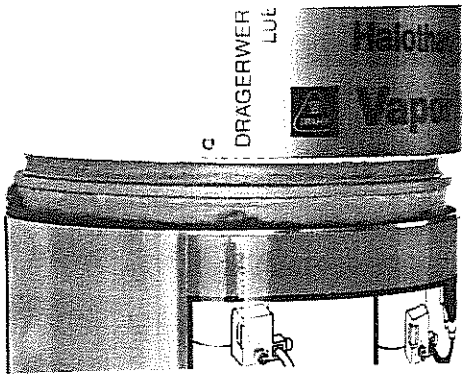
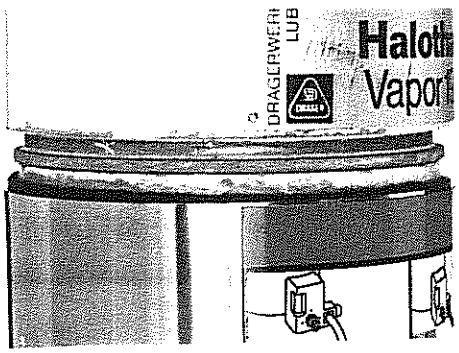
Judgement pattern for Halothane-Vapors 19 and 19.n

Ausgabe Edition:

06.88

DrägerService
Medizintechnik
Medical Systems

Item no. 790148

	Condition	Advisory
	brass-coloured surface	Vapor ok Soil degree 0
	slight reddish colour	Vapor ok The slight reddi colour has no influence on the functioning. Soil degree 0
	red colour	Return of the Vapor for basic overhaul. Soil degree 1
	white deposits	Return of the Vapor for basic overhaul. Soil degree 1

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Test Certificate
Isoflurane Vapor 19 and 19.n

File No: 5327.3
Edition: 07.91

DrägerService

Explanation of symbols

—	OK	C = Check condition
|	Defect	O = Check function
◯	Spare parts used	L = Check for leakage
/	Report	V = Enter test value

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Location of apparatus: _____

_____

_____

Serial No.: _____

Date of delivery Startup: _____

Invoice No. or delivery No: _____

Others: _____

---

1. General

1.1 The Vapor 19.n is to be tested prior to checking of the corresponding anaesthetic apparatus.

1.2 The following applies to on-loan/used and demonstration Vapor 19.n's: Checking in accordance with the Vapor 19.n test card is to be carried out prior to renewed delivery to a customer. A record of the check is to be kept. If on-loan/used and demonstration Vapor 19.n's are sold to customers, a prior prerequisite is that the Vapor 19.n's must have been subjected to a thorough overhaul.

1.3 Following vessel disassembly, use is to be made of a new screw M 22797 or M 30820, new O-rings D 18238 and alternatively M 22714, as well as, a new lead seal M 22798 (S-set M 29792). The vessel fastening screw is to be tightened to a torque of 260 N x cm (26 dN x m).

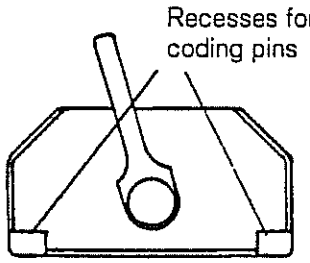
1.4 Extraneous liquids
Thorough overhaul is necessary if water or liquids other than Isoflurane is/are established in the vaporizer chamber.

1.5 Lead seal M 22798 beneath Vapor 19.n vessel in untouched condition.
(Otherwise: note under Item 11 „Report") C

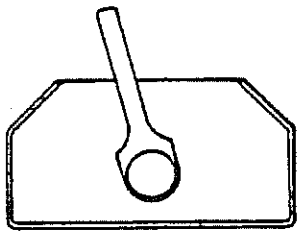
2.	Test item not applicable (Applies only to Halothane Vapor 19.n's)	
3.	Check on apparatus labelling and equipment functions Empty Vapor 19.n beforehand	
3.1	I-Vapor 19 - 19.1 - 19.2 - 19.3	C
3.1.1	Interlock disk tightly positioned on handwheel	C
3.2	I-anaesthetic distinguishing features	
3.2.1	Adjustment handwheel The plate on the handwheel must be in perfect condition and the German labelling must be legible from the front in the „0 position". (Otherwise: note under Item 11 „Report")	C
3.2.2	Sticker The colour coding of the sticker must tally with the anaesthetic-specific code letter on the cover plate of the handwheel and with the anaesthetic designation on the rating plate. Code colour: violet	C
3.3	Check the handwheel adjustablility	C O
3.3.1	Zero detent	C O
3.3.2	Check freedom of movement of stem by turning handwheel	
3.3.2.1	Range: 0...0.2 vol. %(on/off switch)	O
3.3.2.2	Range: 0.2 ... vol. % full scale value	O
3.4	Filling spout	C
3.4.1	Inspection window M 22691	C
3.4.2	Sealing screw (2x) M 23127 (old) M 26420 (new)	C
3.4.2.1	O-ring M 23178 for sealing screw M 23127 (if applicable, make use of new sealing screw M 26420)	C
3.5	Safety filling device	C O
3.5.1	Inspection window M 22691	C
3.5.2	Freedom of movement of switching valve	C O

3.5.3	Blocking slide	C O
3.5.4	Seal (M 28441) (replace if necessary)	C L
3.5.5	Seal gaurd (2 spring-loaded balls) - if provided	C O
3.6	Filler hose i M 26993	C O
3.6.1	Index connection piece (chamfer present)	C
3.7	Filling adapter i M 30290	C O

3.8 Plug-in system

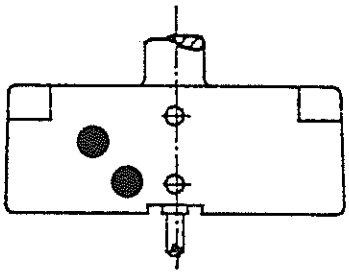


Plug-in system - Vapor 19.n section
M 27070 (only for Vapor 19.3)
Top view

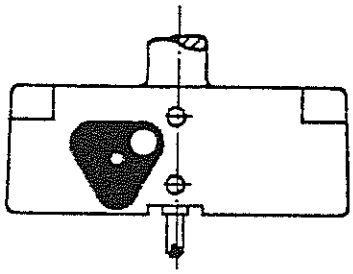


Plug-in system - Vapor 19.n section
M 25140
Top view

Coded I-type plug-in system,
Vapor 19.n section



M 30980



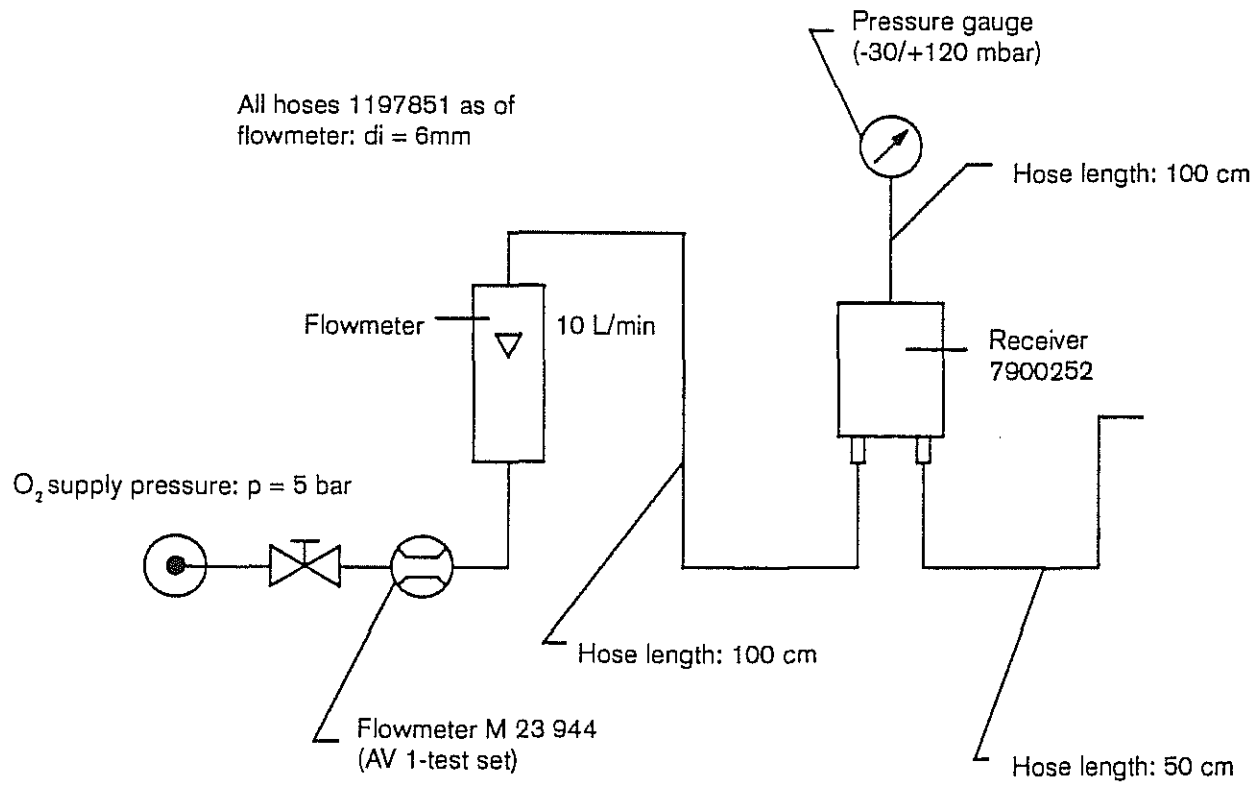
M 30980

3.8.1 I-Vapor 19/19.1 with plug-in system
M 25140
Caution: The Vapors 19 and 19.1
are not to be fitted with a
plug-in system M 27070 or
plug-in system code with
recesses for interlock II
coding pin.

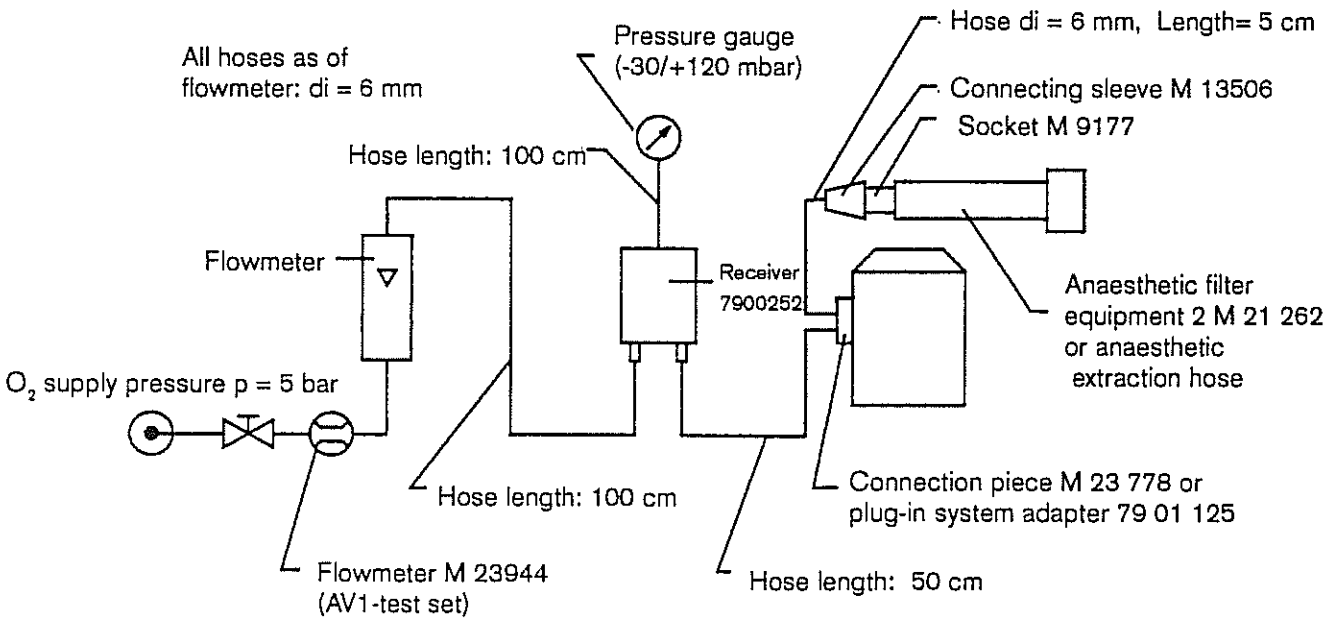
3.8.2	I-Vapor 19.3 with plug-in system M 27070 or M 25140	C O
3.8.3	I-Vapor 19.3 with I-type plug-in system/code M 30980	C O

3.8.3.1		Identification letter or code colour strip	
3.8.4		Locking lever for plug-in system must automatically return (with Vapor 19.n detached from anaesthetic apparatus)	O
3.9		Interlock system I for permanently attached Vapors 19.2	C
3.9.1		Interlock, alternating function Only 1 Vapor 19.n can be switched on in each case	O
3.9.2		Mount for coding pin 12 50 345 (with Vapor 19.2 removed)	C O
3.10		Interlock system II (for plug-type Vapors 19.3)	C
3.10.1		Interlock, alternating function with attached Vapors 19.3 Only 1 Vapor 19.n can be switched on in each case. (Switch Vapor 19.n's round and repeat test)	O
3.10.2	*	Renew O-ring U 04314 on housing section of plug-in system once a year.	C
4.		Leak test	
4.1		Sealing ring M 21929 (2x) (Testing of sealing rings M 21929 does not apply to Vapor 19.n's with plug-in system)	C
4.2	*	Renew filter element D 18440 in Vapor 19.n inlet every 2 years.	C
4.3		Test set-up for Item 4.3.1 - 4.3.3.1 Vapor 19.n with no hoses: Connection piece M 23778 or plug-in system adapter 79 01 125 Connect up Vapor 19.n inlet to gas supply. Connect up Vapor 19.n outlet to pressure gauge.	
4.3.1		Set handwheel to position > „0.2 Vol.%“ and build up p = 200 mbar.	
4.3.1.1		Test value: Pressure drop to p = 188 mbar permitted in 90 seconds.	L V
4.3.2		Handwheel in setting „0“	

4.3.2.1	A hissing noise must be audible on closing handwheel between 0.2 and 0 Vol.%.	O
4.3.3	Vapor 19.n switched off (Handwheel in position „0“) Build up p = 200 mbar.	
4.3.3.1	Test value: Pressure drop to p = 170 mbar permitted in 90 seconds.	L V
5.	Resistance measurement at ambient temperature of: t = 21 - 25 °C	V
	Vapor 19.n's, the resistance value(s) of which is/are outside the restricted tolerances at t = 21 - 25 °C, must be temperature regulated and measured again at one of the temperatures (18 - 26 °C) in accordance with Item 6.	
	The test is considered to have been passed if the resistance values are then within the tolerances applying to the respective temperature.	
5.1	Test set-up:	



Set a flow rate of $\dot{V}$ = 10.0 L/min
with discharge to atmosphere.
(Vapor 19.n not connected up).
Resistance due to test set-up
$p \leq 3$ mbar.
Flow setting is then not to be
subjected to further change.
Set pressure gauge to 0 mbar.
Connect up Vapor 19.n.



5.2	Isoflurane Vapor 19.n (0 ... 5 Vol.%)	
5.2.1	Handwheel setting : „0 Vol.%"	
5.2.1.1	Test value: $p \leq 25.0$ mbar	V
5.2.2	Handwheel setting: „0.2 Vol.%" Subtract the following pressure values: p = p at 0.2 Vol.% minus p at 0 Vol.%	
5.2.2.1	Resulting test value: 22.5 - 33.0 mbar	V
5.2.3	Handwheel setting „4.0 Vol.%" Subtract the following pressure values: p = p at 4.0 Vol.% minus p at 0 Vol.%	
5.2.3.1	Resulting test value: 22.5 - 33.0 mbar	V

6. Listed in the following are the test tolerances for Vapor 19.n's, the resistance value(s) of which is/are outside the restricted tolerances at t = 21 - 25 °C.

The Vapor 19.n to be tested in accordance with the following tolerances must have been temperature regulated to a defined temperature (18 - 26 °C)

If there is a deviation in the Vapor 19.n and/or ambient temperature, take the temperature-regulation times from the repair documentation (R).

6.1 Isoflurane Vapor 19.n (0 ... 5 Vol.%)

6.1.1 Handwheel setting: „0 Vol.%"

6.1.1.1 Test value: p <= 25.0 mbar V

6.1.2 Handwheel setting: „0.2 Vol.%"
Subtract the following pressure values:
p = p at 0.2 Vol.% minus
p at 0 Vol.%

6.1.2.1 Use one of the following resulting test values (dependent on ambient temperature):

Ambient temperaturem	Test value	
18 °C	27.5 - 43.5 mbar	V
19 °C	26.0 - 42.0 mbar	V
20 °C	24.0 - 40.0 mbar	V
21 °C	22.5 - 38.5 mbar	V
22 °C	21.0 - 37.0 mbar	V
23 °C	20.0 - 36.0 mbar	V
24 °C	18.5 - 34.5 mbar	V
25 °C	17.5 - 33.5 mbar	V
26 °C	16.0 - 32.0 mbar	V

6.1.3 Handwheel setting: „4.0 Vol.%"
Subtract the following pressure values:
p = p at 4.0 Vol.% minus
p at 0 Vol.%

6.1.3.1 Use of the following resulting test values (dependent on ambient temperature):

Ambient temperature	Test value	
18 °C	27.0 - 43.0 mbar	V
19 °C	25.5 - 41.5 mbar	V

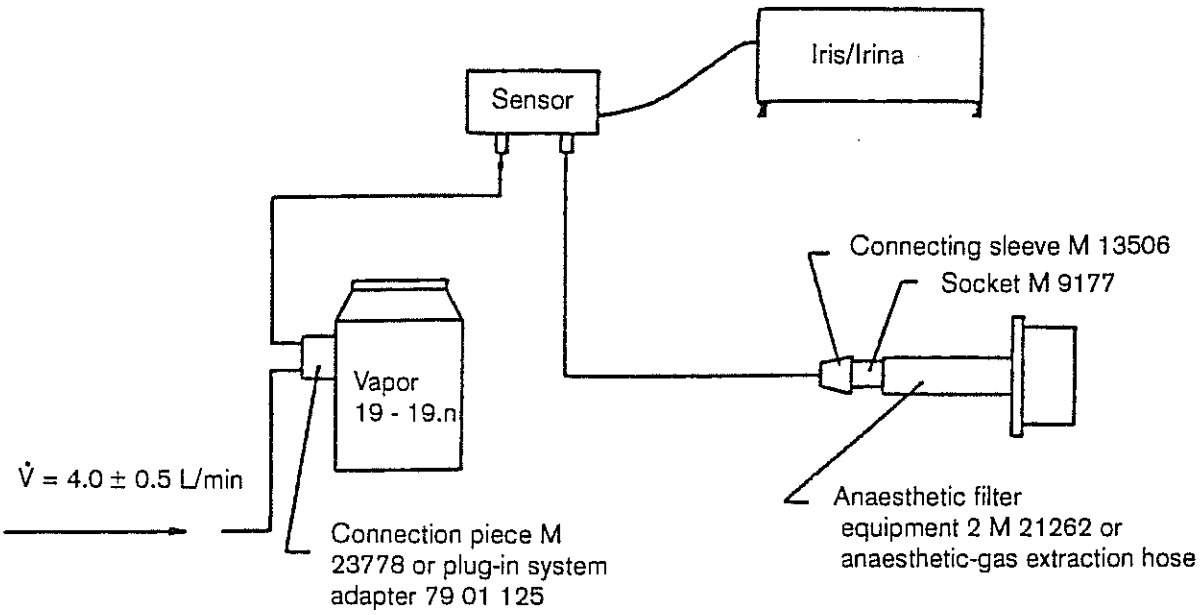
20 °C	24.0 - 40.0 mbar	V
21 °C	22.5 - 38.5 mbar	V
22 °C	21.0 - 37.0 mbar	V
23 °C	19.0 - 36.0 mbar	V
24 °C	18.5 - 34.5 mbar	V
25 °C	17.5 - 33.5 mbar	V
26 °C	16.0 - 32.0 mbar	V

7. Testing of concentration with „Iris" or „Irina".

7.1 Measurement prerequisite:
Flush Iris/Irina sensor and test hose with O_2 or AIR ($\dot{V}$ = 4 L/min) for 1 minute.
The Vapor 19.n is not connected up in this process.
Carry out zero balancing at Iris/Irina.
Connect up Iris/Irina sensor to Vapor 19.n.
Anaesthetic level in Vapor 19.n:
at least half full. Ambient and Vapor 19.n temperaturet t = 20 - 24 °C.
If there is a deviation in the Vapor 19.n and/or ambient temperature, take the temperature-regulation times from the repair documentation (R).

The concentration supplied at the Iris/Irina is to be read 2 ± 1 min. following adjustment of concentration on Vapor 19.n handwheel.

Test set-up:



7.2 Test values with carrier gas „AIR"
Anaesthetic measuring instrument:
Iris/Irina
(delete instrument which is not applicable)

Vapor 19.n handwheel setting	Concentration	
0 Vol.%	0 Vol.%	
1 Vol.%	0.7 - 1.3 Vol.%	V
2 Vol.%	1.6 - 2.4 Vol.%	V
3 Vol.%	2.6 - 3.4 Vol.%	V
4 Vol.%	3.5 - 4.5 Vol.%	V

7.3 Test values with carrier gas „O_2"
Anaesthetic measuring instrument:
Iris/Irina
(delete instrument which is not applicable)

Vapor 19.n handwheel setting	Concentration	
0 Vol.%	0 Vol.%	V
1 Vol.%	0.8 - 1.4 Vol.%	V
2 Vol.%	1.8 - 2.6 Vol.%	V
3 Vol.%	2.9 - 3.7 Vol.%	V
4 Vol.%	3.8 - 4.8 Vol.%	V

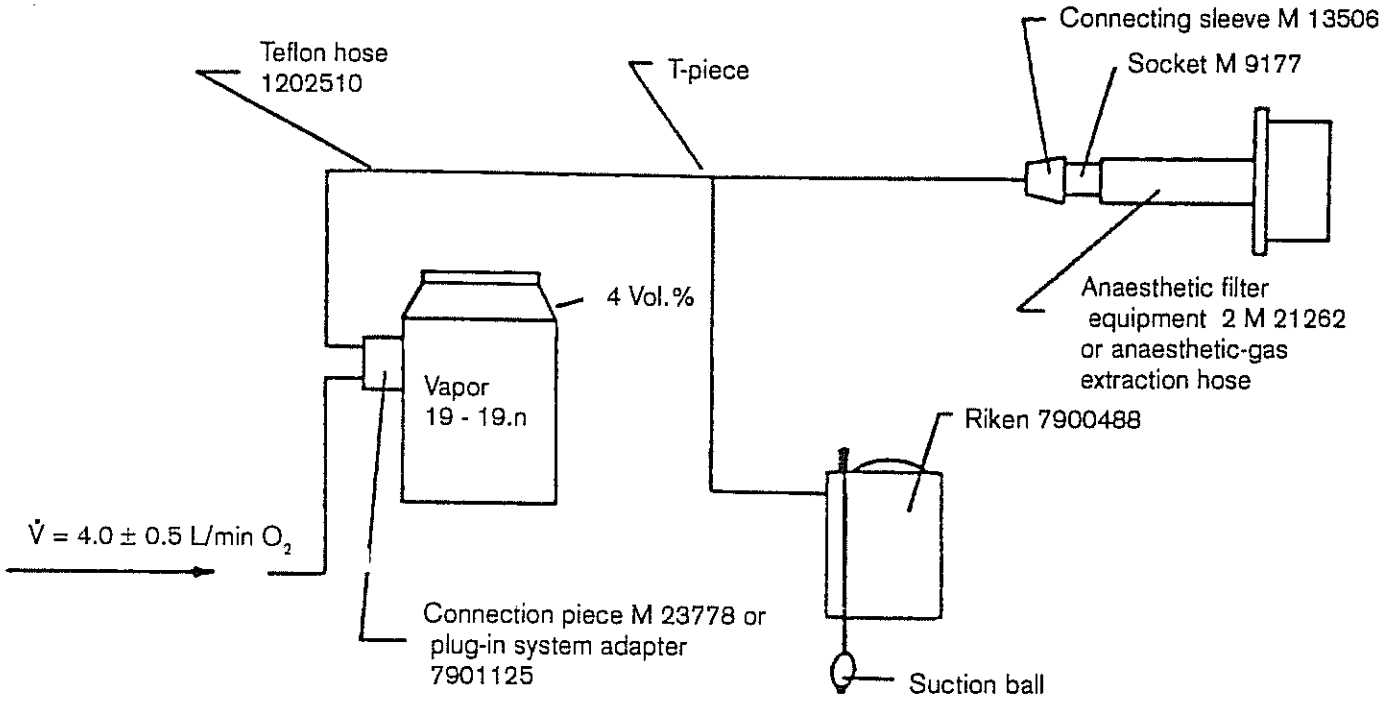
8. Testing of concentration with Riken gas analyzer

8.1 Measurement prerequisite:
Calibrate the Riken gas analyzer with the O_2 carrier gas.
Set the right-hand one of the two black index strips to position „0". The Vapor 19.n is not connected up in this process.
Connect up Riken gas analyzer to Vapor 19.n. Measurement hose must be made of teflon and and connected to the back of the Vapor 19.n. The hoses should be kept as short as possible, with the exception of the end hose from the T-piece to the anaesthetic filter - this must be long enough to prevent extraneous air being drawn in. Anaesthetic level in Vapor 19.n: at least half full.

Ambient and Vapor 19.n temperature
t = 20 - 24 °C.
If there is a deviation in the Vapor 19.n and/or ambient temperature, take temperature-regulation times from repair documentation (R).

Measurement of the concentration supplied - number of intake strokes for inputing gas into Riken - is effected 2 ± 1 min. following concentration adjustment on Vapor 19.n handwheel.

Test set-up:



Implement 5 strokes with suction ball, then shut off flow.

Implement 5 strokes with suction ball in each handwheel setting, before shutting off the flow and reading the scale value.
The flow is to be shut off after the measurement strokes, so as to preclude the possibility of biased measurements.

8.2 Test values with carrier gas „O_2"

Isoflurane

Vapor handwheel setting	Scale-value reading	
0 Vol.%	0	V
2 Vol.%	1.7 - 2.4	V
3 Vol.%	2.7 - 3.6	V
4 Vol.%	3.6 - 4.5	V

Note: The Riken gas analyzer is calibrated for Halothane in oxygen. In order to be able to calculate the concentration values in Vol.%, the scale value read must be multiplied by a factor.

Multiplication factor:
- Isoflurane = 1.07

8.3 Set Vapor 19.n to „0" following completion of measurement.
Flush test set-up for 1 minute with carrier gas O_2.
Set precision adjustment scale of Riken gas analyzer to „0".
Implement 5 strokes with suction ball.
Shut off O_2 flow.
The right-hand one of the two black index strips indicates „0". O

9. Concluding test

9.1 Check hose length
(in the case of hose system) C O

9.2 Check proper connection of hoses „inlet" - „outlet". C

9.3 Sealing rings of the connecting hoses C

9.4 Make unit available to the user in a ready-to-operate condition. C O

10. Confirmation of test:

Name:

Date:

* Expenditure on such work is classed as repair services and not included in the Inspection Service price.

11. Report: